From:	Noreen Walsh
To:	Cynthia Martinez; Jim Kurth; Steve Guertin; Betsy Hildebrandt; Dan Ashe
Cc:	Matt Hogan
Subject:	Missoulian on NBR
Date:	Monday, February 08, 2016 8:40:52 PM

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http://missoulian.com/news/local/fws-will-consider-transferring-national-bison-range-to-indian-tribes/article_b2533abc-91f4-5555-9be2-14a991550f05.html

Shared via the Google app

Apologies for any duplication

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

From:	Cynthia Martinez
To:	D M Ashe; Noreen Walsh; Jim Kurth; stephen_guertin@fws.gov
Subject:	Fwd: Briefing on NBR for AWCP
Date:	Thursday, February 11, 2016 9:35:14 AM

FYI, I let Susan know that we would attend. Happy to have a conversation about who might be the best to attend.

Thanks
Cynthia

Begin forwarded message:

> **From:** "Recce, Susan" <SRecce@nrahq.org>
> **Date:** February 10, 2016 at 4:21:47 PM EST
> **To:** "'cynthia_martinez@fws.gov'" <cynthia_martinez@fws.gov>
> **Cc:** Len Vallender <lvallen491@aol.com>
> **Subject: Briefing on NBR for AWCP**
>
> Hi Cynthia,
>
> The American Wildlife Conservation Partners is having a one-day meeting Tuesday, March 15th in Pittsburgh during the North American Conference. It has been suggested that we add the National Bison Range issue to the agenda given that it is on the front burner with many asking questions being asked about it within our community. I am copying Len Vallender on this email because he, representing Campfire Club of America, is the 2016 chair of AWCP. We would like to see if you are available to give AWCP a briefing on this topic. If you are not available, would you have someone on your staff who could?
>
> Thanks so much,
> Susan

From:	Noreen Walsh
To:	Cynthia Martinez; Dan Ashe; Jim Kurth; Stephen Guertin
Subject:	RE: Briefing on NBR for AWCP
Date:	Thursday, February 11, 2016 11:36:26 AM

Happy to help however I can.

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

From: Cynthia Martinez [mailto:cynthia_martinez@fws.gov]
Sent: Thursday, February 11, 2016 7:29 AM
To: D M Ashe; Noreen Walsh; Jim Kurth; stephen_guertin@fws.gov
Subject: Fwd: Briefing on NBR for AWCP

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>
> Thanks so much,

Susan

From:	Bulletin Intelligence
To:	Interior@BulletinIntelligence.com
Subject:	U.S. Department of the Interior News Briefing for Tuesday, February 16, 2016
Date:	Tuesday, February 16, 2016 7:03:13 AM

U.S. DEPARTMENT OF THE INTERIOR NEWS BRIEFING

Mobile version and searchable archives available at interior.bulletinintelligence.com. Please contact Public Affairs with subscription requests, questions or comments.

DATE: TUESDAY, FEBRUARY 16, 2016 7:00 AM EST

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DOI in the News:

OBAMA DESIGNATES THREE NEW NATIONAL MONUMENTS IN SOUTHERN CALIFORNIA. The White House announced on Friday that President Obama designated three new national monuments in the California desert. According to an information sheet, the White House says the new monuments will encompass "nearly 1.8 million acres of America's public lands," and will "nearly double the number of acres of public lands previously protected as national monuments by President Obama – demonstrating the Administration's strong commitment to aggressive action to protect the environment for future generations." The new monuments will "link already protected lands, including Joshua Tree National Park, Mojave National Preserve, and fifteen congressionally-designated Wilderness areas, permanently protecting key wildlife corridors and providing plants and animals with the space and elevation range that they will need in order to adapt to the impacts of climate change." The new monuments are Mojave Trails National Monument, Sand to Snow National Monument and Castle Mountains National Monument.

The Washington Post (2/12, Eilperin, 8.98M) reported the monuments create "the world's second-largest desert preserve" and nearly double "the amount of land [Obama] has unilaterally protected while in office," giving rise to opposition to Obama's use of executive powers. House Natural Resources Committee Chairman Rob Bishop (R-UT) called it "presidential bullying." On the other side, Agriculture Secretary Tom Vilsack said, "Sand to Snow's peaks and valleys have long provided physical and spiritual sustenance to native people," adding, "they are also an inspiration and recreational beacon to millions."

The AP (2/16, Rogers) pointed out the "Mojave Trails National Monument, at 1.6 million acres, is by far the largest of the three new ones." The article described the lands. US News & World Report (2/12, 853K) also carried the AP report. The Hill (2/16, Cama, 862K) cited Sen. Dianne Feinstein's (D-CA) support for the monument designations. The BLM, the NPS, and the Forest Service will manage the lands, which were "already owned by the federal government."

McClatchy (2/15, Doyle, 22K) quotes Interior Secretary Sally Jewell's statement that "the California desert is a cherished and irreplaceable resource for the people of Southern California." Jewell also said "valid existing" uses of the affected lands will continue, including those of the US military. Reuters (2/12, Bernstein) reported similarly, and its report was also carried by Philly (PA) (2/12, Bernstein, 822K) and Yahoo! News (2/12, Bernstein, 6.31M).

Greenwire (2/12, Jacobs, Subscription Publication) explained the monument designation "shields the land from any new mining and other industrial activities, including solar and wind farms." Jewell reportedly "applauded the designations in San Bernardino and Riverside counties." Jewell said in a statement, "Today's designation by the President furthers the longstanding work of public land managers and local communities to ensure these areas will remain preserved and accessible to the public for future generations."

The Sierra (CA) Sun Times (2/15) carries the press release from the Interior Department. Additional coverage was provided by My News LA (CA) (2/12, Sklar), Tech Times (2/14, Pascual, 173K), and The Guardian (UK) (2/12, Milman, 3.71M).

Western Lawmakers Concerned By "Federal Overreach" In Obama's National Monument Strategy. The Christian Science Monitor (2/13, Jonsson, 442K) discussed how President Obama's Friday decision to establish three new national monuments, the Mojave Trails, Sand to Snow, and Castle Mountains, in California "smacks of federal overreach" to critics. The article said "the reaction to Obama's use of executive powers to protect these natural resources highlights the shifts in thinking around public lands

and the impact of federal policy on Americans who live and work in the West."

JEWELL DISCUSSES NATIONAL MONUMENTS AT ALASKA WILDERNESS LEAGUE EVENT. The Seattle Post-Intelligencer (2/15, Connelly, 663K) reports that US Interior Secretary Sally Jewell was "honored Saturday night by the Alaska Wilderness League" following the creation of three new national monuments, but that the group proceeded to pitch "designation of a new national monument on land in Alaska's Arctic National Wildlife Refuge that is coveted by Big Oil." Jewell "joked" in responding, "Everybody is coming to me with their wish list." Jewell added, "The fact is you do not see the land of man," but also said "There's a lot of oil under there." The article describes how in recent months, Jewell "has lately been at work on everything from monuments to the role of indigenous people in protecing lands, to a global anti-poaching initiative which has taken her to Africa and Southeast Asia." At the event Jewell said of Obama, "He does not have the outdoor affinity that I do except for Hawaii. He is a creature of the beach."

PHILANTHROPIST DONATES $18.5 MILLION TO RENOVATE LINCOLN MEMORIAL. The AP (2/15, Barakat) reports that on Monday the NPS announced philanthropist billionaire David Rubenstein donated $18.5 million to refurbish the Lincoln Memorial and other icons, with the money slated to "be used to fix the memorial's roof, clean Lincoln's statue, repair marble panels and improve accessibility by adding a second elevator." The NPS "also plans to create 15,000 square feet of visitor space in the cavernous space below the memorial for education." NPS Director Jonathan Jarvis said the memorial is "pretty stout, and...has held up quite well for a structure of its age," but added, "you can't build a 100-year roof." The Washington Times (2/15, Barakat, 285K), the Washington (DC) Post (2/15, Barakat, 8.98M), the Christian Science Monitor (2/15, Barakat, 442K), the Houston (TX) Chronicle (2/15, Barakat, 1.99M), the Chicago (IL) Tribune (2/15, Services, 2.17M), Philly (PA) (2/15, Barakat, 822K), also carry this story.

The Washington Post (2/15, Ruane, 8.98M) says the planned repairs will likely be "the biggest overhaul of the building since the structure was dedicated in 1922," according to officials. Rubenstein said in an interview last week, "the idea was to take the basic Lincoln Memorial and reshape it a bit, make it more modern, scrub it up a bit," and to add an education center about Lincoln. National Mall and Memorial Parks superintendent Gay Vietzke said the memorial "has become symbolic of so much more." Jarvis said last week, "When we build the new exhibit and visitor-use space, it will...give the public an opportunity to actually see underneath the memorial," adding that he "feel[s] great" about the renovations.

The Chicago Sun-Times (2/15, Merda, 764K) quotes US Secretary of the Interior Sally Jewell's statement: "His act of 'patriotic philanthropy' will not only safeguard one of our most visited and recognizable memorials for future generations, but will also help preserve Lincoln's legacy to this country." UPI (2/15, Ware) further quotes Jewell as saying, "This generous donation by David Rubenstein, his fourth to benefit national parks, comes at a perfect time as our national parks usher in a new century of service to this nation."

The Washington Times (2/15, Mcdermott, 285K) cites Rubenstein saying his donation aims to "help people better understand Lincoln's leadership during a trying time." The article adds that the NPS "is expected to spend about $6 million of its own money" toward the project, and paraphrases Jewell as saying the NPS "is in desperate need of donation." Jewell said "From my office I've watched the roof of the Jefferson Memorial get browner and browner."

Reuters (2/16) reports similarly, and is also carried by Yahoo! News (2/16, 6.31M), Philly (PA) (2/15, 822K), and the website of AOL (2/15, 6.15M). WTOP-FM Washington (DC) Washington (2/18, 255K) and the Minneapolis (MN) Star Tribune (2/15, 1.25M) provide photographic coverage online. TIME (2/15, Reilly, 18.01M) also covers this story.

IN FASTEST-EVER SPECIES RECOVERY, FWS RECOMMENDS DELISTING CALIFORNIA FOXES. The AP (2/12) reported in its "The Latest" brief that on Friday the FWS said "years of work to monitor" the population of three island fox subspecies native to California's Channel Islands, to vaccinate them against diseases and to "relocate non-native predators have resulted in the historic recovery" of the subspecies that "were once on the brink of extinction." The FWS also recommended foxes on Santa Catalina Island "be reclassified from endangered to threatened, saying the potential for disease outbreak is a remaining

threat" to that subspecies. The FWS "says it's the fastest successful recovery of any mammal listed" under the ESA. This report was also carried by the Washington (DC) Post (2/12, 8.98M) and the Houston (TX) Chronicle (2/12, 1.99M).

In lengthier coverage, the Los Angeles Times (2/12, Sahagun, 4.1M) said a "remarkably successful recovery effort" by the FWS led to the delisting recommendation for subspecies. The Times explained the population of Santa Catalina Island foxes "crashed to roughly 100 in 1999 because of a canine distemper epidemic." The San Miguel, Santa Rosa and Santa Cruz Island foxes "were classified as endangered in 2004 after suffering catastrophic declines primarily because of predation by Golden eagles." FWS Director Dan Ashe said, "The speed at which these subspecies have recovered points to the strength of the endangered species act in focusing conservation attention and catalyzing recovery actions, and demonstrates what we can achieve together."

National Parks Traveler (2/14, 989) paraphrased the FWS press release as stating the "best available scientific data now suggests that populations of these island fox subspecies have recovered to self-sustaining levels." Ashe is further quoted as saying, "The remarkable recovery efforts of land managers and conservation partners over the past two decades on behalf of the Channel Island fox is the reason for this historic recovery success." Ashe added, "We look forward to continuing our collaborations with land managers and conservation partners on Santa Cruz, Santa Rosa, San Miguel and Santa Catalina Islands. ... Together, we will continue to monitor island fox populations to ensure their long-term survival in the wild."

E&E Publishing (2/12, Hiar, Subscription Publication, 705) added that "the only species that have recovered faster or as fast are Eggert's sunflowers, with an eight-year recovery, and Lake Erie water snakes, which took 12 years." Additional coverage was provided by the Santa Barbara (CA) Noozhawk (2/15, Potthoff, 210), Nature World News (2/14) and Solo News (ITA) (2/15).

THREATENED BAT SPECIES UNLIKELY TO DISRUPT CASINO CONSTRUCTION IN INDIANA. The AP (2/14) reported "a less restrictive rule taking effect this month" will allow the Pokagon Band of Potawatomi Indians to construct an 18-story casino in South Bend, IN despite a rule proposed by the FWS in April that would've prohibited development on potential northern long-eared bat habitat. The threatened species now only receives protection "on sites known to contain rooting trees." The AP paraphrased FWS field supervisor Scott Pruitt's statement to the South Bend (IN) Tribune (2/5, Parrott, 184K) that "the database for Indiana contains no records of roosting trees on the 165-acre site in South Bend where the tribe wants to build its development."

The AP story is also carried by the Times of Northwest Indiana (2/14, 283K), the Houston (TX) Chronicle (2/14, 1.99M), and the Washington (DC) Times (2/14, 285K).

Groups To Sue FWS Over Possible Bat Habitat Destruction. Greenwire (2/12, Skibell, Subscription Publication) reported four environmental groups said on Friday they plan to sue the FWS for permitting "logging and habitat destruction" for the northern long-eared bats. Despite disease causing the bat's decline, the groups claimed "habitat loss is also a contributing factor...because the animals require large, uninterrupted swaths of forest for foraging, migrating and roosting." The FWS' new rule would allow "logging, coal mining, pesticide use, oil and gas projects, and pipeline construction in the areas where the bats live."

ENVIRONMENTALISTS PERMITTED TO INTERVENE IN SAGE GROUSE LITIGATION. The AP (2/14, Sonner) reported that late last month US District Judge Miranda Du permitted three national conservation groups to intervene in Idaho Gov. C.L. "Butch" Otter's (R) lawsuit against the Obama Administration that contends "land use planning amendments impose unnecessary restrictions on activities in or near grouse habitat." Neither the Governor nor the Administration objected to the intervention, but other parties opposed the introduction of new elements "in an already complicated case expected to drag well into the summer in Reno." Du decided the conservation groups should be allowed to intervene "because of their more narrowed focus (on) environmental protections in contrast to the agencies' broader land management interests."

This story was also carried by the Houston (TX) Chronicle (2/14, Sonner, 1.99M), the Denver (CO) Post (2/14, 881K), the Washington (DC) Times (2/14, Sonner, 285K), the Elko (NV) Daily Free Press (2/15, 22K), Montana Kaimin (2/15, 11K), and on the website of KTNV-TV Las Vegas (NV) Las Vegas (2/15, 27K).

IMAX FILM "NATIONAL PARKS ADVENTURE" RECEIVES POSITIVE REVIEWS. The AP (2/14, Harpaz) continued coverage of the new IMAX movie, "National Parks Adventure," which debuted Friday, celebrating "the beauty and thrills of America's parks." The Clark County (WA) Columbian (2/13, 94K) and the Paducah (KY) Sun (2/13, 61K) also carried the AP story. Greenwire (2/12, Subscription Publication) quoted MacGillivray Freeman Films Director Greg MacGillivray as praising the 3-D movie medium, saying, "When something spectacular happens in an Imax film, audiences remember it like it's a firsthand experience." The movie "follows three adventurers led by elite climber Conrad Anker through some of the country's most famous landscapes." MacGillivray said the film "fills you with a reverence for what nature can do."

Skift (2/14) said the movie, narrated by Robert Redford, stars "geysers, red rock canyons, mountaintops and redwood forests." According to Skift, "the emphasis on adventure and not just beauty and history is a way of furthering the National Park Service's efforts to attract millennials." The article quoted NPS Director Jon Jarvis' statement that the service aims to "connect with the next generation of park visitors, supporters and advocates."

The Los Angeles Times (2/12, King, 4.1M) highlighted the "eye-popping footage" in its review of the movie. MacGillivray expressed gratitude for the production team's "incredible access to the parks," saying "the people in Washington, D.C., were able to help us a lot as far as navigating and working with each park to get the best possible shots."

In its review of the film, the Miami Herald (2/15, Granfield, 803K) calls the soundtrack "superb," as it "adds to the upbeat momentum of rushing waterfalls, towering canyons and other sweeping scenes." The Herald also praises the NPS' use of the IMAX medium. However, in assessing content the Herald concludes, "Though the film highlights threats that happened before the National Park's formation, such as the near extinction of redwoods for lumber, it falls short of engaging the audience with ongoing threats and controversial practices within and around the parks." NPS Ranger Gary Bremen said, "The centennial is a great opportunity for people to get out and experience the beauty of national parks. ... No matter what your interest is, there'll be something for you."

Additional coverage is provided by the website of KSTU-TV Salt Lake City (2/14, 165K) and the Uniontown (PA) Herald-Standard (2/15, 44K).

Empowering Native American Communities:

GOOGLE CULTURAL INSTITUTE TO OFFER NPS ARTIFACTS IN ONLINE MUSEUM. Indian Republic (2/15, Nehru) reports Secretary Jewell "was in Tuskegee Thursday to make a big announcement involving a public-private partnership with Google." The Google Cultural Institute will be putting many artifacts from the National Park Service in its online museum.

BIA, FBI INVESTIGATING STABBING DEATH ON UTE MOUNTAIN UTE RESERVATION. The Denver Post (2/16, 881K) reports on the investigation into the stabbing death of Keisha Meya Colorow at the Ute Mountain Ute reservation on Monday. The US Attorney's spokesman Jeff Dorschner said that "no arrests have been made," but that both the Bureau of Indian Affairs and FBI "are investigating."

Tackling America's Water Challenges:

SANTA CLARA VALLEY WATER DISTRICT URGED TO SUPPORT TWIN TUNNELS. Derrick Seaver of the San Jose Silicon Valley Chamber of Commerce and Josué García of the Santa Clara & San Benito Counties Building and Construction Trades Council write in an op-ed for the San Jose (CA) Mercury News (2/15, Seaver, García, 648K) that the Santa Clara Valley Water District should support the

California Water Fix. “It is absolutely vital to ensure reliable, secure water for our region and to protect the health of the failing Delta.” They note that Bay Area water districts supply “Lawrence Livermore National Laboratory, Oracle, AT&T, and many biotech and medical research firms.”

BUDGET WOULD BOOST FUNDS FOR LAND AND WATER CONSERVATION, IMPOSE FEE ON HARDROCK MINING. The Durango (CO) Herald (2/12, Graham, 31K) reports the Administration’s budget “would invest hundreds of millions of dollars in environmental causes to the benefit of Colorado and other Western states.” That includes funding for “land and water conservation...water sustainability efforts and...fees on hardrock mining.” It would spend $900 million for the Land and Water Conservation Fund. It would also impose a fee on hardrock mining, the revenue to be used for “remediating abandoned mine sites.” It would also include “$98.6 million for WaterSMART programs, with $61.5 million for water sustainability efforts through (the Bureau of) Reclamation.”

JUDGE REJECTS EFFORT TO FORCE BUREAU OF RECLAMATION TO RELEASE WATER TO IRRIGATORS ASSOCIATION. The Salem (OR) Capital Press (2/15, Jenkins, 113K) reports U.S. District Judge Rosanna Malouf Peterson ruled against the Columbia-Snake River Irrigators Association in its effort to secure “water to irrigate 14,000 acres in Eastern Washington.” The group sued “to push the U.S. Bureau of Reclamation toward providing” the water, but Judge Peterson “said she wasn’t going to second-guess” the agency.

SUIT SEEKS CHANGE IN MANAGEMENT OF DESCHUTES RIVER. The Bend (OR) Bulletin (2/15, 98K) reports on management of the Deschutes River as the Center for Biological Diversity and WaterWatch of Oregon are seeking a preliminary injunction to force “the Bureau of Reclamation and five irrigation districts in Central Oregon [to] manage the river’s water differently.” The groups are seeking to change water management in order to ensure water for “the Oregon spotted frog and other river animals.” The Deschutes Basin Board of Control objects that any change ordered by the court may result in “abrupt and severe restrictions” on water usage. The frog is listed as threatened by the US Fish and Wildlife Service.

COMPROMISE SOUGHT ON WATER USAGE AROUND QUIVIRA NATIONAL WILDLIFE REFUGE. The AP (2/12) reports on the effort to come to an agreement on “competing water needs of south-central Kansas irrigators” and the Quivira National Wildlife Refuge, “which has senior rights to water that has long been used by hundreds of surrounding irrigators with junior rights.” The US Fish and Wildlife Service has requested Kansas “to address the issue, but the state has so far refused.” A report last year from the Kansas Division of Water Resources found that “the refuge had been denied more than 3,000 acre-feet in 18 of the 34 years reviewed,” and that “a solution would likely include ‘long term cuts in groundwater pumping.’” Refuge manager Mike Oldham said the refuge needs water “to maintain the 7,000 acres of internationally recognized wetlands.” The various authorities and interests are “working to devise a compromise.”

FLORIDA RELEASING WATER FROM OKEECHOBEE TO EVERGLADES. USA Today (2/15, Gillis, 5.56M) reports that Florida is “releasing water from Lake Okeechobee to Everglades National Park” to reduce flooding. The release is attributed to Gov. Rick Scott’s insistence, and “the U.S. Army Corps of Engineers, National Park Service, U.S. Fish and Wildlife Service, the Florida Department of Environmental Protection, the South Florida Water Management District and others agreed to speed up a project aimed at restoring historic flows.” In addition, affected area landowners agreed not to sue, and the Miccosukee Tribe of Indians of Florida, facing flooding, also agreed.

Securing America’s Energy Future:

Renewable Energy:

FORMER EPA OFFICIAL CALLS FOR INVESTMENT IN NATURAL GAS PRODUCTION, INFRASTRUCTURE. Former EPA Assistant Administrator J. Winston Porter, in a letter to the editor of the Wall Street Journal (2/15, Subscription Publication, 6.74M), takes issues with Fred Krupp’s op-ed on methane leaks. While Porter agrees that methane leakage should be reduced, he argues Krupp doesn’t

credit the progress the industry is already occurring in this area. Porter disagrees with Krupp's call for additional regulation and instead calls for investment in natural-gas production and infrastructure.

Methane Leaks Said To Undermine Clean Power Plan Targets. Elena Krieger at PSE Healthy Energy and Zeke Hausfather at UC Berkeley write for The Hill (2/16, Krieger, Hausfather, 862K) that "according to a study by PSE Healthy Energy released in January, methane leakage from natural gas wells and pipelines could severely undermine the climate objectives of the Clean Power Plan." As a result of methane's "outsized impact on near-term climate change," the "real climate benefit of natural gas is much lower than the EPA suggests," they write. If methane leaks are not addressed, they could "severely undermine the EPA's aim to slash greenhouse gas emissions from the power sector, especially if states shift from coal to natural gas, rather than to renewable energy."

Additional coverage is provided by the Houston (TX) Chronicle (2/12, 1.99M), the Albuquerque (NM) Journal (2/15, 290K), the Oklahoman (2/15, Moss, 421K), the Durango (CO) Herald (2/14, 31K), a separate article in the Durango (CO) Herald (2/13, Graham, 31K), the Cortez (CO) Journal (2/15, Romeo, 4K), and the Santa Fe New Mexican (2/15, 67K).

CLEAN POWER PLAN IN LIMBO WITH JUSTICE SCALIA'S DEATH. NPR (2/14, Elving, 1.81M) reports that following the death of Supreme Court Justice Antonin Scalia, "any case in which his vote would have been decisive will be left in stalemate, and the last ruling by a lower court will remain in force." President Obama has vowed to submit a nominee to replace Justice Scalia, but key Senate Republicans have said that a nominee should be chosen by the next president. NPR says, "Scalia's vote to freeze enforcement of President Obama's orders reducing greenhouse gas emissions from power plants, announced on Feb. 9, will stand because that 5-4 order had already been issued." However, a "short-handed court in the months ahead could elevate the importance of the decision on that issue by the D.C. Circuit Court of Appeals, which is expected to rule before summer."

The Guardian (UK) (2/14, Redden, 3.71M) says that such a scenario would favor the Administration as "the DC panel is made up of mostly Democratic appointees, and is likely to dismiss the states' argument that the clean power plan is illegal and represents federal government overreach." Were that to occur, the Supreme Court "would still have to overturn its stay – which would be problematic if Scalia's seat remains empty." The stay has left the EPA "unable to enforce any part of the bill until the litigation is over – marking a significant victory for opponents of regulation to restrict greenhouse gas emissions."

In a column for The Atlantic (2/14, 2.95M), Robinson Meyer speculates that "the opening of a new slot on the Supreme Court makes the Clean Power Plan's survival much likelier – if a Democrat wins the White House in November," while "the Plan might also enter force if a Court with a vacant seat hears its case."

Wisconsin Gov. Walker Orders Agencies Not To Prepare For Clean Power Plan. The Milwaukee Journal Sentinel (2/15, 743K) reports that citing last week's decision by the US Supreme Court to stay the Clean Power Plan, "Wisconsin Gov. Scott Walker on Monday ordered state agencies not to do any work to prepare for federal climate change regulations." Walker in a statement said, "The stay granted last week by the Supreme Court validates our concerns about this rule. The Executive Order we issued today protects our taxpayers from an unnecessary cost of up to $13 billion as we continue to act in the best interests of Wisconsin citizens."

McCarthy: Court Stay Slows But Does Not Stop Carbon Cutting. E&E Publishing (2/15, Subscription Publication, 705) reports that despite a Supreme Court ruling putting the Clean Power Plan on hold, state officials "signaled interest" in continuing planning for power-sector carbon reductions when EPA Administrator Gina McCarthy spoke before the National Association of Regulatory Utility Commissioners (NARUC), National Association of State Energy Officials and National Association of Clean Air Agencies. McCarthy said EPA "remains fully confident in the legal merits of this rule," adding, "One decision to stay doesn't mean that the CPP isn't alive or isn't going to survive."

GEOENGINEERING SEEN AS TOO RISKY TO REDUCE GLOBAL EMISSIONS. Bloomberg News (2/15, Hirtenstein, 2.92M) reports that Phil Williamson, a scientist at Britain's University of East Anglia, "examined the ecological effect of a number of proposed methods known as geoengineering and

concluded in a paper that none would work at a large scale without huge risks for the planet." Williamson said in a phone interview, "We could cool the world in all sorts of weird and wacky ways that seem like they could be technically possible, but whether they will actually work on a large scale is a big question, and what kind of disruptions they would cause is another."

NEVADA COMMISSION UPHOLDS RATE INCREASE FOR ROOFTOP SOLAR CUSTOMER. The Las Vegas Review-Journal (2/15, Whaley, Corey, 479K) reports that on Friday the Nevada Public Utilities Commission voted to keep a Jan 1 2016 phased in rate increase to rooftop-solar customers in effect and rejected proposals to grandfather in existing customers under original net metering rates. The Commission also reduced the credits to solar-users for their excess energy back to the grid. "I think this proposal creates a seamless transition to cost-based rates," Commission Chairman Paul Thomsen said. The Review-Journal says "Gov. Brian Sandoval expressed disappointment at the decision, saying it did not go far enough to protect existing rooftop-solar customers." Hundreds of protesters gathered outside of the Las Vegas PUC offices in support of solar customers.

Additional coverage of this story was provided by Reuters (2/16) which reports that all three members of Nevada's Public Utilities Commission voted unanimously to keep the increased rates.

In its "Ballot Box" blog The Hill (2/13, Neidig, 862K) reports that on Saturday at a campaign stop in Reno Nevada, Bernie Sanders called on Warren Buffett to hear from Nevada constituents on the solar decision, saying "this is a terrible decision" and "the ruling went exactly the wrong way."

Nevada Public Utilities Union Denies Request To Resume Energy Efficiency Programs. The Las Vegas Sun (2/12, Rothberg, 196K) reports that on Friday, Nevada's Public Utilities Union denied NV Energy's request "to bring back two popular energy efficiency programs in Southern Nevada." One program "lowered the cost of residential LED lights and another helped cover the cost of energy-efficient pool pumps." NV Energy claimed that "it would be able to reinstate the programs under the budget the commission approved in December for the utility's energy efficiency programs." However, "The commission denied NV Energy's argument on the foundation that NV Energy had not met its burden for an appeal before the quasi-judicial panel," and also said that the utility "did not submit any new information to warrant a change."

NEW YORK RANKS FOURTH IN US FOR SOLAR ENERGY JOBS. The AP (2/15) reports a census by the Solar Foundation "shows New York ranks fourth in the nation in solar technology jobs." The nonprofit group "reports in its 2015 census that 208,859 Americans now work in the solar energy sector, including 8,250 in New York." The Solar Foundation "says it's the third consecutive year that solar jobs nationwide have grown by 20 percent or more."

Onshore Energy Development:

LAWMAKERS PUSH CONGRESS TO CUT EU SODA ASH TAX. E&E Daily (2/12, Brown, Subscription Publication) reported Wyoming's congressional delegation asserted in a letter, "U.S. trade negotiators shouldn't come home from trans-Atlantic trade negotiations until they've persuaded the European Union to drop its tax on soda ash," as part of a push for "Congress to reduce soda ash royalty rates at home to offset the impacts of what they see as foreign subsidies." The article cited the Interior Department as indicating "Wyoming and California are home to many of the 78 soda ash mining leases on 99,000 acres of public lands, while Oregon's Port of Portland is a major shipping point."

NATIONAL GRID POISED TO SHIFT COSTS TO CUSTOMERS. Newsday (NY) (2/15, Harrington, 1.23M) reports, "National Grid is proposing to shift its $356,000 annual electricity bill onto its gas customers following LIPA's decision to end its longtime practice of providing electricity to the company for free." Newsday says, "Most of the free electric service went to support National Grid's operation of the LIPA electric grid, company spokeswoman Wendy Ladd said." However, "That changed in the aftermath of superstorm Sandy, and in 2014 LIPA handed the contract to operate the electric system to PSEG Long Island" and "National Grid was forced to split off the gas and electric parts of its business." Ladd said that National Grid "is now responsible for electric charges for the portion of these facilities supporting the gas business."

NORTH DAKOTA PSC HAD HUNDREDS OF CONSUMER CONTACTS LAST YEAR. The AP (2/15) reports the Public Service Commission in North Dakota "says it received hundreds of consumer contacts in the last year that included complaints against regulated entities." The commission "says it received a total of 905 consumer contacts in 2015" but the commission "says more than a third of them called for increased crude oil conditioning, which didn't fall under the agency's jurisdiction." The PSC "regulates coal mining, land reclamation, pipelines, electric and gas utilities, grain elevators, telecommunications and auctioneers."

COUNCIL SAYS NORTHWEST'S POWER NEEDS CAN BE MET WITH CONSERVATION. The AP (2/15, Geranios) reports the Northwest Power and Conservation Council is predicting that "the electricity needs of Northwest states can be met in the next 20 years mostly through conservation efforts, with little need to construct new power plants." The NPCC "recently issued its 20-year plan for meeting the energy needs of Oregon, Washington, Idaho and Montana." In a statement last week Council Chairman Henry Lorenzen said, "By investing in energy efficiency at the levels recommended in the plan, we'll be able to grow without initiating an aggressive program to build new generating resources, and we'll keep Northwest electricity rates low."

CONNECTICUT TO CLOSE LAST COAL-POWERED PLANT. The Hartford (CT) Courant (2/11, Hladky, 518K) reports that officials from PSEG have announced they will close down Connecticut's last coal-fired power plant, Bridgeport Harbor Station, by 2021 and replace it with a natural-gas-powered plant to begin operating in 2019. The Courant reports that Gov. Dannel P. Malloy and Bridgeport Mayor Joe Ganim "praised the announcement as a major step toward reducing pollution and retaining employment within the community."

NYTIMES CRITICIZES MOUNTAINTOP REMOVAL. The New York Times (2/16, Subscription Publication, 12.03M), in an editorial, denounces "mountaintop removal" mining for "leaving behind...a grossly disfigured landscape." It cites a report from Duke University researchers on the effects of the practice, and points out that the Interior Department is "working on a stronger Stream Protection Rule." The Times concludes by quoting Chief Judge Charles Haden II of United States District Court, "No effect on related environmental values is more adverse than obliteration."

FRACKING BECOMES FLASH POINT IN PENNSYLVANIA'S DEMOCRATIC SENATE PRIMARY. The AP (2/13, Levy) reports that in recent days, a divide over fracking has emerged in the Democratic primary battle to challenge Republican Sen. Pat Toomey in November as "two of the three candidates declared their support for a halt to hydraulic fracturing on both public and private lands." Mayor John Fetterman and former Congressman Joe Sestak "both support a halt to fracking, at least until there is stronger regulation," while a third candidate, Katie McGinty, "a former top-level environmental adviser in Washington and Harrisburg, also supports stronger regulation, but not a broad moratorium." G. Terry Madonna, a pollster at Franklin and Marshall College, "said it's not clear that the stance will help Fetterman or Sestak," but "it is likely to be part of their campaign to highlight where McGinty may not be as liberal and help Sestak and Fetterman even the playing field with a candidate who has considerable support from the party establishment."

Pennsylvania Democrats "Squabbling" Over State's Fracking Future. E&E Publishing (2/15, Subscription Publication, 705) reported that Pennsylvania Democrats vying in an April 26 primary are "squabbling" over fracking's future in the state as well as "taking aim at each other over campaign contributions tied to the energy industry." Former White House Council on Environmental Quality Chairwoman Katie McGinty "has called fracking the state's 'secret sauce' for job growth," while former Rep. Joe Sestak "has long supported a moratorium on drilling the oil-and-gas-rich Marcellus Shale." Meanwhile, Braddock Mayor John Fetterman is "in the middle" and "has endorsed significantly stricter environmental regulations on the process and endorsed taxing natural gas drilling."

The AP (2/13, Levy) reported that Fetterman and Sestak both support a "halt to fracking" while McGinty supports stronger regulation, "but not a broad moratorium." Fetterman's campaign attacked McGinty on the issue, sending out an online video that accused McGinty of taking campaign contributions from the oil and gas industry, while McGinty's supporters deny the charge.

LENDING LIMIT REVIEW COULD CAUSE SHAKEOUT IN OIL, NATURAL GAS PRODUCERS. USA Today (2/14, Loveless, 5.56M) reports Standard & Poor's Rating Services predicts that 45 speculative-grade US oil and natural gas producers will have their "borrowing bases" drop "by an average 20%-30% when banks take a fresh look" at credit lines in April, "making it difficult for some companies to stay in business." S&P lowered its credit ratings for 25 of the producers; previously the company "lowered credit ratings and outlooks for 13 large, investment-grade producers, including Chevron."

OIL DOWNTURN COULD HIT PIPELINE COMPANIES. The Houston Chronicle (2/16, Grattan, 1.99M) reported that US pipeline companies that move and process crude oil are likely to be impacted by an impending wave of oil company bankruptcies. Smaller pipeline companies face the most pressing fallout as their customers can be fewer and riskier. Williams Cos. and Energy Transfer Equity, which are in the process of merging, recently saw their stocks take a hit on rumors that major Williams' customer Chesapeake Energy was considering bankruptcy.

Jakab: Investors Should Cautious On MLPs. In his "Heard on the Street" column for the Wall Street Journal (2/12, Subscription Publication, 6.74M), Spencer Jakab wrote that while the energy MLP sector appears to offer good performance, he advises investors to be cautious. Jakab says that MLP's customers are struggling, with some filing for bankruptcy, and long-term contracts between MLPs and producers could be thrown out, meaning uncertain cashflow and spooked investors.

SPECULATORS BETTING ON OIL PRICE REBOUND. Bloomberg News (2/15, Shenk, 2.92M) reports speculators are betting oil prices will rebound, with long positions in West Texas Intermediate crude up "to the highest since June as oil sank toward a 12-year low, according to U.S. Commodity Futures Trading Commission data." Bloomberg notes Chevron Corp and other companies "have said they will reduce outlays to maintain cash." Meanwhile, Phil Flynn, senior market analyst at Price Futures Group in Chicago, said, "There's a growing realization after all the announcements of cuts in capital expenditures that we're going to see a drop in production."

Offshore Energy Development:

FIRST STUDY OF OFFSHORE HYDRAULIC FRACTURE IS UNDERWAY. The Los Angeles Daily News (2/13, Mazza, 301K) reports on "the first federal study of offshore hydraulic fracturing," due to a suit filed by the Center for Biological Diversity against the US Department of Interior's Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement. The suit alleged that "the environmental and human health dangers that could arise from fracking" had not been sufficiently studied as required by the Coastal Zone Management Act, the National Environmental Policy Act, and the Outer Continental Shelf Lands Act.

SCIENTISTS EXAMINE WAYS TO HARNESS ENERGY OF GULF STREAM. The Hampton Roads (VA) Virginian-Pilot (2/15, Hampton, 312K) reports on research into "harnessing energy from the Gulf Stream off Cape Hatteras, N.C.," which may offer "more potential than offshore wind." That's because the ocean current offers energy that is "about 800 times more dense" than wind. The Gulf Stream current is "about 60 miles wide and 3,000 feet deep in places," moving more water "than all the world's rivers put together."

CONTINUING COVERAGE OF KEEP IT IN THE GROUND ACT. In continuing coverage, the San Francisco Chronicle (2/13, Lochhead, 3.37M) reported on the Keep It in the Ground Act, which seeks "to halt new fossil fuel development on all federally controlled public lands, which is where most of the nation's coal, oil and natural gas is found." Besides blocking "leases for coal, oil, gas, oil shale and tar sands on public land," there would be a moratorium on new leases for offshore drilling and leases not producing fuel would be ended. Furthermore offshore drilling in the Arctic and the Atlantic seaboard would be banned. This is "an aggressive escalation by the Democratic left on the issue." The Contra Costa (CA) Times (2/12, Halstead, 251K) and the Billings (MT) Gazette (2/13, Pfister, 131K) also covered this story.

SHELL COMPLETES BG TAKEOVER, BECOMING WORLD'S TOP LNG COMPANY. Reuters (2/15, Bousso) reports that Royal Dutch Shell's $53 billion takeover of BG Group became effective Monday, creating the world's top liquefied natural gas company. Said Shell CEO Ben van Beurden, "We will now

be able to shape a simpler, leaner, more competitive company, focusing on our core expertise in deep water and LNG." The deal will define van Beurden's legacy, reports Reuters, as he seeks to transform the company. According to Shell's statement, BG shareholders opted largely for shares as opposed to cash in the deal. BG will now be a wholly-owned subsidiary of Shell headed by Huibert Vigeveno.

USA Today (2/15, Bomey, 5.56M) added that after completing the acquisition, Shell is now the world's second largest energy company behind Exxon Mobil. "This is an important moment for Shell," van Beurden said. "It significantly boosts our reserves and production and will bring a large injection to our cash flow." KPRC-TV Houston (2/15, 5:07 p.m. CST, 87K) broadcast that "with the improvement, Shell is expecting to improve their revenue by $3.5 billion," while International Business Times (2/15, McHugh, 693K) reported that "the transition will be a difficult one, according to industry experts, because of an ongoing oil glut."

Merger To Boost Shell's Position In Brazil. Bloomberg News (2/15, Valle, 2.92M) reported that following the merger, Shell "has made Brazil one of its top three countries" and "sees the South American nation's deep-water fields remaining competitive for years to come." Reuters (2/16, Blount, Nogueira) reports separately that speaking in Brazil, van Beurden said, "We believe in the strong fundamentals of Brazil and the fundamentals of its geology. ... We will be looking at a substantial part of our production from Brazil." According to van Beurden, Shell is hoping to quadruple oil and gas output in Brazil by 2020. Brazil will be key for Shell as the company focuses on LNG and deepwater oil production, thanks in part to BG's portfolio of Brazilian assets and Shell's 2013 purchase of 20% of the Libra offshore project.

The Wall Street Journal (2/15, Connors, Kent, Subscription Publication, 6.74M) reported that by speaking from Brazil, van Beurden highlighted the importance of Brazil's oil and gas market. While the acquisition makes Shell the largest foreign oil company in Brazil, Brazil's political climate and the scandal surrounding Petróleo Brasileiro SA will create challenges. The Houston Chronicle (2/15, 1.99M) reported in a brief that van Beurden said Monday that Brazil "will remain a key destination country for us for investment dollars for at least another decade."

Reuters (2/15, Schaps) reported in a third article that van Beurden said on Monday that oil price volatility could stabilize later in 2016, with prices possibly rebounding after that, with the Financial Times (2/15, Leahy, Adams, Subscription Publication, 1.36M) adding that van Beurden predicts prices will rebound to levels in 2016 that will allow production in Brazil's pre-salt deepwater fields to break even. Equilibrio Informativo (VEN) (2/15, Ojeda) likewise reported that while van Beurden "said there are 'a lot of challenges' in Brazil, he expects oil prices to 're-balance' this year and for the region to remain competitive."

Shell CEO: Merger "Creates A Company Of Extraordinary Strengths." The Times (UK) (2/16, Van Beurden, Subscription Publication, 3K) carried an op-ed by Shell CEO Ben van Beurden, who wrote that the "joining together of Shell and BG creates a company of extraordinary strengths – a combination greater than the sum of our parts." Over time, van Beurden "expect[s] the fundamentals of energy supply and demand to reassert themselves and the strategic and economic benefits of the deal to fully deliver for shareholders." He praises assets Shell is inheriting in the North Sea, Brazil, Australia, the Caribbean and Asia, and names "other clear benefits" including "BG's strong position in trading and shipping, which will bolster Shell's capabilities, volumes and relationships in these core areas for the future development of the global gas market." Mr. van Beurden concludes that with the merger, "we have truly changed course and are going full speed ahead."

Analysts: Following Merger, Shell Will Struggle To Spin-Off Assets At Prices It Expected. The Telegraph (UK) (2/13, Ambrose, 898K) reported that as Shell completes its takeover of BG Group, the company faces "a fresh battle to dispose of $30bn of assets in the next three years" as low oil prices continue to weigh on the market. Analysts "say Shell will struggle to spin-off assets at the price it once expected to" as low oil prices cut value across the energy sector. Once a "key prize of the merger," BG Group's deepwater Brazilian gasfields "now raise investor concerns after allegations of corruption against project partner Petrobras emerged last year."

Additional Coverage. The story is also covered by the Express and Star (UK) (2/15), the Norfolk (UK)

Eastern Daily Press (2/15, Woods, 218), and the trade publications of Offshore Energy Today (2/15), Offshore Post (2/15), Offshore Technology (2/15), Argus Media (2/15), LNG World News (2/15), Maritime Executive (2/15, 21), Energy Voice (UK) (2/15), Natural Gas Europe (2/15) and LNG Industry (UK) (2/15).

LOUISIANA GOVERNOR ASKS OBAMA TO HALT ATTEMPT TO REPEAL OFFSHORE REVENUE-SHARING. The AP (2/12) reported that Louisiana governor John Bel Edwards has asked President Obama to drop an attempt in his 2017 budget proposal to repeal a 2006 budget provision establishing a revenue-sharing formula for offshore drilling in the Gulf of Mexico. Edwards in a Friday letter to Obama "said the budget proposal would strip Louisiana of the only consistent source of federal funds the state has for coastal restoration projects."

TEXAS-BASED PARAGON OFFSHORE DRILLING COMPANY FILES FOR BANKRUPTCY. The New York Times (2/15, Corkery, Subscription Publication, 12.03M) reports Houston-based oil drilling company Paragon Offshore filed for Chapter 11 bankruptcy protection Sunday, becoming roughly the 60th company in the sector to file for bankruptcy in the last 16 months. Paragon completed a prepackaged bankruptcy agreement last week that cut its $2.7 billion of debt "by about $1.1 billion" so it can keep operating. The Times says the swift drop in oil prices could lead "to a series of drawn-out and messy bankruptcies," and analysts say as much as a third of the US oil and gas industry "could be consolidated as a result of the downturn."

USA Today (2/15, Bomey, 5.56M) reported that the bankruptcy "reflects what analysts say is the latest in a string of energy bankruptcies," with drillers "particularly susceptible as oil companies cut back considerably on production" with a worldwide oversupply. The Wall Street Journal (2/14, Brickley, Subscription Publication, 6.74M) reported that the low oil prices are taking their toll as companies compete for increasingly scarce business, with Paragon's big customers Petróleos Mexicanos and Petróleo Brasileiro SA both moving to cut back contracts.

LITTLE OPTIMISM FOR INDUSTRY AT INTERNATIONAL PETROLEUM WEEK CONFERENCE. Bloomberg News (2/12, Hoffman, Smith, Blas, Rascouet, 2.92M) reports that attendees at last week's International Petroleum Week conference had seemed to repeat the same underlying message: "There are few reasons for optimism. The world is awash with oil. The market is overwhelmingly bearish." Bloomberg says, "Prices will stay low for up to a decade as Chinese economic growth slows and the U.S. shale industry acts as a cap on any rally, according to Ian Taylor, chief executive officer of Vitol Group." Jeff Currie, head of commodities research at Goldman Sachs, echoed that sentiment, saying, "I wouldn't be surprised if this market goes into the teens." Land-based oil storage is running out, "and the contango is getting so steep that it's becoming profitable to hire supertankers, fill them with crude and anchor them offshore."

TRUMP DISCUSSES OFFSHORE OIL DRILLING. The Miami Herald (2/16, Smith, 803K) reported on comments by Donald Trump on Cuba, oil drilling and opposing candidate Marco Rubio. When asked about current Congressional proposals that would expand offshore drilling and allow it closer to Florida's coast, Trump said, "They've already got plenty in the Gulf. ... It would be a little bit of a shame [to expand drilling closer to Florida], because there's so much fracking and there's so much oil that we have now that we never thought possible. That's an issue I'd absolutely study and do the right thing."

Despite Price Rally, Oil Demand Set To Decline With Winter's End. Bloomberg News (2/15, Smith, 2.92M) reported "one reason to withhold faith in oil's recovery" is that despite oil prices' recent rally, once winter ends fuel demand will decline until summer. David Hufton with PVM Group said, "Given the seasonality of oil demand, traditionally there is a supply surplus in the first half of the year," with unconsumed oil now "coming on top of the mountain of oil that built up in 2014 and 2015."

America's Great Outdoors:

Bureau of Land Management:

FBI ENDED OCCUPATION AT WILDLIFE REFUGE PEACEFULLY WITH HELP. In a 2,250-word

article, the Washington Post (2/13, Sullivan, Berman, 8.98M) chronicled the final days of the occupation at the Malheur National Wildlife Refuge in Oregon. The Post described the "key" roles Nevada Assemblywoman Michele Fiore and the Rev. Franklin Graham played in convincing the four holdouts "to surrender" peacefully. In another article, the Washington Post (2/13, Sullivan, Berman, 8.98M) reported that Graham and Fiore – "a celebrity among anti-government activists" – kept the occupiers calm by assuring them that the FBI would allow them to meet Graham and Fiore after they turned themselves in.

WPost: FBI Deserves Credit For Approach To Oregon Occupation. In an editorial, the Washington Post (2/13, 8.98M) gave "credit to federal law enforcement authorities" for negotiating a "peaceful denouement" to the 41-day occupation of the Malheur National Wildlife Refuge. The Post praised the FBI for having "showed restraint in sitting out the armed activists" and for refusing to "waver on the need to bring to account those who so willfully and flagrantly broke the law." According to the Post, the FBI "clearly had learned lessons from the bloody sieges" of the 1990s and its "patient approach in letting the Oregon siege play out and burn out proved far more effective than a SWAT team assault."

FBI: No Booby Traps Found At Wildlife Refuge. The AP (2/12, Boone, Dubois) reported that the FBI said Friday that investigators had not found any booby traps or rigged explosives at the Malheur National Wildlife Refuge. FBI Portland Assistant Special Agent in Charge Larry Karl said agents were concluding their safety sweep of the refuge and were hoping to begin processing evidence soon. According to Karl, some hazardous materials were stored at the refuge prior to the takeover, and the FBI had information that the armed occupiers may have brought additional materials with them. Karl, the AP (2/13, Boone) reported, said that collecting evidence from the wildlife refuge could take several weeks. "Then the U.S. Fish and Wildlife Service will be tasked with cleaning up the site, including garbage or debris left by the people who occupied the refuge during the standoff," the AP added.

Oregon Authorities Look To Feds, Occupiers To Cover Occupation Costs. Reuters (2/16, Urquhart) reports that Oregon officials have indicated that they hope to have the federal government – and the militants themselves – pay the bulk of the expenses caused by the wildlife refuge occupation. Oregon Governor Kate Brown is seeking up to $1 million from state lawmakers to offset the costs to cities and towns. She will seek to reimburse the state from federal funds. Harney County judge and county commissioner Steven Grasty said the county plans to seek reimbursement directly from the armed occupiers, and is prepared to take them to court. Federal prosecutors, a source said, are looking into whether the US will join the county in pursuing reimbursement from the occupiers. Though the exact cost of the occupation is unknown, it is estimated in the millions of dollars, Reuters says. The New York Times (2/13, Subscription Publication, 12.03M) also reports Reuters' coverage on its website.

Twenty-Three Charged So Far In Occupation. The Guardian (UK) (2/15, Levin, 3.71M) reports that 23 people allegedly involved with the occupation all face a single federal charge of conspiring to impede federal officials via "force, intimidation and threats." The suspects "hail from 10 states across the US and have a wide range of prior involvement in conservative activism and criminal activity," The Guardian said. Despite the long list of individuals charged, the newspaper says, some observes have noted that many involved with the occupation have so far, avoided arrest and prosecution. "Notably, many of the most high-profile women of the militia...are...not listed in the charges," the Guardian says.

Experts: Cliven Bundy Case Is Complex. The AP (2/15, Ritter) reports that according to experts the case against Cliven Bundy in the 2014 armed standoff with federal authorities in Nevada will be a complex one. Bundy was arrested Wednesday and charged with "conspiracy, assault on a federal officer, obstruction, weapon use and possession, extortion to interfere with commerce, and aiding and abetting" in the 2014 case, the AP says. "They've probably been working up to this by talking to a lot of people who showed up as followers, and making deals and trying to get cooperating witnesses," said former US Attorney Richard Pocker said. "It's really hard to get folks in these movements to cooperate with a grand jury."

The Los Angeles Times (2/12, Pearce, 4.1M), the Washington Post (2/12, 8.98M), and the Oregonian (2/15, Brosseau, 864K) also report on the aftermath of the Oregon occupation.

BLM PROPOSES RULE TO UPDATE RESOURCE MANAGEMENT PROCESS. The Oil and Gas

Journal (2/15, Snow, 1K) reports BLM has "proposed a rule aimed at improving its resource management process" as part of its Planning 2.0 initiative. The proposal "will make changes to regulations that are guided by the 1976 Federal Land Policy and Management Act" including the creation of "several new opportunities for early public involvement during the planning process" and requiring the "development of a planning assessment before work could begin on putting together a land use plan."

Politico Pro (2/12) quoted BLM's announcement that the reforms support the agency's "shift to science-based, landscape-scale approaches to resource management while increasing opportunities for early engagement by state and local government, tribes, partner agencies, stakeholders, and the public." Politico explained the plans entail the overhaul of Resource Management Plans, which are "the systems that the Interior Department unit uses to coordinate collective priorities for public lands, from fossil-fuel development to recreation to wildlife protection."

TEXAS CITIES ASK BLM TO HALT PLANS FOR GAS DRILLING LEASES BELOW LEWISVILLE LAKE. The AP (2/13) reported that some North Texas cities as well as environmental groups have asked the Bureau of Land Management to halt plans to allow gas drilling below Lewisville Lake, where as many as 259 acres are up for auction for leases. The lake is "a drinking water source for millions and has a dam cited by the U.S. Army Corps of Engineers as being in hazardous condition," and "nearby residents fear possible drinking water contamination and earthquakes that could further threaten stability." This story was also carried by the Washington (DC) Times (2/13, 285K) and the Houston (TX) Chronicle (2/13).

The Dallas Morning News (2/12, Mosier, 1.24M) added that Dallas and Highland Village are among those opposing the drilling. Additional coverage is provided by Fuel Fix (TX) (2/15, 28K), the Cross Timbers (TX) Gazette (2/15, Pry, 429) and on the website of WFAA-TV Dallas (2/15, 367K).

BLM, UTAH AGENCY SETTLE SUIT OVER WILD HORSE AND BURRO MANAGEMENT. KSL-TV Salt Lake City (2/15, O'Donoghue, 404K) reports on its website that a lawsuit against BLM brought by the Utah Schools and Institutional Trust Lands Administration "alleging mismanagement of wild horse and burro populations on school trust lands in Utah was dismissed after the parties reached a cooperative agreement this month." The agreement calls for "identification of priority removal areas, population surveys and enhanced monitoring of rangeland conditions." The Salt Lake (UT) Tribune (2/15, Maffly, 388K) reports that "in a news release announcing the settlement last week, BLM vowed to do the things the agency...has long claimed it already does, namely collaborate with local stakeholders and protect resources."

BLM TO HOLD FARMINGTON, NM PUBLIC FORUM ON PROPOSED RULE CHANGE. The Farmington (NM) Daily Times (2/14, Fenton, 44K) reports that BLM will hold a public forum at San Juan College in Farmington, New Mexico on Tuesday "to hear comment on the agency's proposed rule on oil and gas industry venting and flaring." The proposed rule "targets the escape of methane gas from venting and flaring, processes used in oil and gas production, and from gas leaks during drilling operations and from well sites. The proposed update to a current rule is designed to cut in half the industry's methane emissions from operations on federal land."

CHICAGO TRIBUNE FEATURE ON DEATH VALLEY NATIONAL PARK CITES BLM. The Chicago Tribune (2/15, Williams, 2.17M) has a feature on Death Valley National Park, writing that "it is astonishing that the land in Death Valley remains as pristine as it is, with its history of mining. In 1994, Congress expanded the area's protection beyond its status as a national monument to that of a national park." The Tribune piece highlights "the Trona Pinnacles, jagged peaks formed underwater up to 100,000 years ago in the now dry Searles Lake, according to the Bureau of Land Management."

LAND PARCELS IN SAN JUAN NATIONAL FOREST TO BE UP FOR LEASE IN BLM SALE. The Durango (CO) Herald (2/14, 31K) reports, "The first land parcels in 15 years within the San Juan National Forest will be available for lease this spring through the Bureau of Land Management's quarterly oil and gas lease sale." Four parcels in the forest are among six that will be up for competitive bid on May 12.

Fish and Wildlife Service:

DOMINION PROPOSES NEW ACP ROUTE. The AP (2/12, Szkotak) reported that Dominion proposed a new route for the Atlantic Coast Pipeline (ACP) in response to a previous permit rejection from the US Forest Service, which "cited a 1994 conservation agreement with the Fish and Wildlife Service aimed at shielding the salamander from actions that would place it under the Endangered Species Act." The new proposal would have a 30 percent smaller footprint in the Monongahela and George Washington national forests, but adds 30 miles to the project, involving an additional 249 landowners.

This story was also carried by the Daily Mail (2/12, 4.92M), the Washington (DC) Post (2/12, Szkotak), the Houston (TX) Chronicle (2/12, Szkotak, 1.99M), and Philly (PA) (2/12, Szkotak, 822K).

Residents Ask County Board To Oppose ACP. The Fayetteville (NC) Observer (2/15, Banks, 148K) reports that several residents spoke to the Cumberland County Board of Commissioners on Monday, asking them to oppose the Atlantic Coast Pipeline that they believe will devalue their property and bring fracked gas to their community. "I'm pleading with the county commissioners to not approve. We can't afford to fight them, personally, because we don't have the money to fight them," said Fayetteville resident Rodney Simmons. Dominion senior policy advisor Bruce McKay was scheduled to address the Board, but did not attend and "his absence came as a surprise to the commissioners."

Letter: Pipeline Resistance Overdone. In a letter to the editor of the Washington (DC) Post (2/15, 8.98M), Woodbridge resident Jeff Hazle rejects the premise of a previous letter from Lewis Freeman of the Allegheny-Blue Ridge Alliance, arguing that resistance to the Atlantic Coast Pipeline "seems oversold and more consistent with a generalized opposition to hydrocarbons than any genuinely significant risks." He questions how the project could result in damage to the water supply.

MILITARY BASES RECEIVE $17.5M IN CONSERVATION GRANTS. The AP (2/12, Bynum) reported that on Friday Agriculture Secretary Tom Vilsack announced "$17.5 million in conservation funding to protect longleaf pine forests used for training troops while assisting the recovery of threatened species." The awards to bases in Georgia, Mississippi and North Carolina were among 84 grants totaling $720 million. FWS Fort Stewart branch chief Tim Beatty said, "Fortunately the Army is pretty good at starting fires. ... If we have an urban development at the edge of Fort Stewart, it would be awfully tough to continue to do burning the way we do now." This story was also carried by the Washington (DC) Post (2/12, Bynum, 8.98M) and the Houston (TX) Chronicle (2/12, Bynum, 1.99M).

WHALE BONES FOUND IN LUGGAGE AT BALTIMORE AIRPORT. The AP (2/12) reported that on Friday the US CBP said agents found possible whale bones while inspecting baggage from Iceland at BWI Airport on Feb. 7. The traveler carrying the luggage also "claimed they were whale bones," but "Customs officials kept the bones to determine their origin." Border agents said the FWS regulates whale bones. This story was also carried by the Washington Post (2/12, 8.98M), the Baltimore (MD) Sun (2/12, 712K), and the Houston (TX) Chronicle (2/12, 1.99M).

US FISH AND WILDLIFE SERVICE PROPOSES TRANSFERRING BISON RANGE TO SALISH AND KOOTENAI TRIBES. The Missoulian (MT) (2/15, Devlin, 78K) reports on a "surprise" proposal by the US Fish and Wildlife Service to support legislation to transfer the National Bison Range to the Confederated Salish and Kootenai Tribes. The proposal would "place the refuge's 18,766 acres in trust for the tribes, and leave it to them to manage and operate" with no continuing role for the Fish and Wildlife Service, and the range would no longer be part of the National Wildlife Refuge System. There are some remaining questions regarding the "costs of managing and maintaining the Bison Range." Indian Country Today Media Network (2/15, 48K) reports the tribes "have worked to become more involved with management of the bison range since the 1994 Self Governance Act made that a possibility."

Missoulian Favors Plan. The Missoulian (MT) (2/15, 78K) in an editorial says the Fish and Wildlife Service "showed signs it is finally coming to its senses" in making the proposal. The paper says the tribes ought to hold "the bison range in trust for the people of the United States – including its original inhabitants."

USDA AGENCY SPECIALIZES IN KILLING PREDATORS. Rachael Bale writes in National Geographic (2/15, Bale, 30.99M) about Wildlife Services, an agency under the US Department of Agriculture that

"specializes in killing wild animals that threaten livestock," though it also provides "bird control nationwide at airports to prevent crashes and feral pig control in the South." Bale cites an article by Christopher Ketcham in Harper's Magazine titled "The Rogue Agency: A USDA program that tortures dogs and kills endangered species." The article describes Ketcham's indictment of the agency.

National Park Service:

INTERIOR DEPARTMENT VALENTINE'S VIDEO DISTRIBUTED. EHS Today (2/15, 3K) reports the Interior Department "created a video showcasing couples who committed to one another while celebrating their love of planet Earth." The agency said, "America's public lands are wonderful places to love and be in love." On its website, the Miami Herald (2/14, 803K) hosted the Interior Department's video that celebrates the thousands who get engaged and married in national parks ever year.

Spending Valentine's Day In A National Park Recommended. On its website, CNN (2/14, 3.96M) summarized ways to spend Valentine's Day, describing how lovers could "celebrate nature and the centennial of the National Park Service by visiting Yosemite or Yellowstone National Parks or one of the nation's park sites in your state." CNN wrote that lovers "can be awed by the same beauty and power that inspired President Abraham Lincoln (who protected Yosemite in the middle of the Civil War), Sierra Club founder John Muir and President Theodore Roosevelt."

HOUSE NATURAL RESOURCES SUBCOMMITTEE HEARS TESTIMONY ON HISTORICAL SITE CONVERSATION BILLS. E&E Daily (2/12, Kessler, Subscription Publication) reported on testimony before the House Natural Resources subcommittee regarding "four bills aimed at promoting the conservation of historical sites." A bill "from Rep. Marsha Blackburn, H.R. 87, would modify the boundaries of Shiloh National Military Park in southern Tennessee" to permit the NPS "to preserve more than 21,000 additional acres to include Fallen Timber Battlefield, Russell House Battlefield and Davis Bridge Battlefield." Chairman Tom McClintock (R-CA) rebutted an economic argument for the historical preservation of the sites.

INTERIOR, GOOGLE LAUNCH ONLINE EXHIBIT OF PARKS' HISTORY. National Parks Traveler (2/15, 989) reports the Department of the Interior said it "is partnering with the Google Cultural Institute to photograph and share historically important material with global audiences and digitally preserve them for future generations." The institute's Centennial One Object Exhibit contains "more than 3,800 works of art, artifacts, and records [that] can be viewed as part of an online exhibition just launched to honor the National Park Service's centennial." Secretary of the Interior Sally Jewell said in a statement last week, "This marriage of technology and history means that anyone, anywhere can see artifacts and sites that provide a taste of the rich and diverse story of America," adding, "Our hope is that this partnership will not only illustrate and elevate our nation's history and culture, but inspire more people to visit the wonderfully diverse places that the National Park Service protects and preserves for current and future generations."

NPS EXTENDS COMMENT PERIOD ON BISON QUARANTINE PLAN. The AP (2/15) reports that the National Park Service "has extended the public comment period" two weeks to February 29 on its plan to "quarantine some Yellowstone National Park bison on the Fort Peck Indian Reservation in Montana."

YELLOWSTONE BISON CULL CRITICIZED. Christopher Ketcham, a fellow at M.I.T.'s Knight Science Journalism Program, writes in the New York Times (2/15, Subscription Publication, 12.03M) on the bison cull at Yellowstone National Park, which "is done largely outside of public view" in order to protect "the safety of the public and staff" according to the park service, though Ketcham says it is because "the brutality of the cull would be revealed." Ketcham says the cull has been justified by fears that cattle could be infected with brucellosis from the bison, but "not a single instance of transmission has ever been documented." He argues that instead of the cull, the bison should be allowed to roam, like other wild animals and controlled "with seasonal hunting." Ketcham praises Montana Gov. Steve Bullock's proposal to allow the "Yellowstone bison to roam in certain areas beyond the park's boundaries throughout the year," but laments "the park service...helping to slaughter a native animal so iconic that it is emblazoned on the park service's own logo."

DEATH VALLEY PARK RANGER HOPES FOR "SUPER BLOOM" THIS YEAR. The Washington Post

(2/12, Starrs, 8.98M) reports on Death Valley, where National Park Service Park Ranger Alan Van Valkenburg said that he hopes there will be a “super bloom” this year. He explains that such events “are quite rare, maybe once a decade or so,” the last one having been in 2005. But, he also points out that they “are near-impossible to predict and very short-lived.” There is a bloom at present that is “beginning to spread beyond the southeastern part of the park.”

PARK SERVICE ACCEPTING COMMENTS ON YELLOWSTONE ROAD PROPOSAL UNTIL MARCH 15. The AP (2/14) report the National Park Service is accepting public comments until March 15 on its proposal for a “road repair project on the east side of Yellowstone National Park.” The proposal includes reconstructing “a segment of the East Entrance Road from Fishing Bridge to Indian Pond.”

MAINE GOVERNOR OPPOSES PROPOSAL FOR NEW NATIONAL PARK IN MAINE. The AP (2/14) reports that Maine Gov. Paul LePage opposes the proposal for a new national park in Maine, “especially when there’s a $12 billion backlog of maintenance.” The idea comes from “Burt’s Bees founder and conservationist Roxanne Quimby [who] proposed donating land east of Baxter State Park for a new national park in 2011.” LePage says the idea “defies logic” given the maintenance backlog.

NATIONAL PARK FOUNDATION PRESIDENT URGES SUPPORT FOR CENTENNIAL CAMPAIGN. Will Shafroth, President of the National Park Foundation, writes at Huffington Post (2/15, Shafroth, 518K) on the centennial of the National Park Service. He writes that the “national parks and their future are dependent on vibrant and robust public-private partnerships.” That’s because “federal appropriations only sustain basic operations,” and there are “$11.9 billion in deferred maintenance projects.” That means the parks “rely on other sources of funding,” namely, the National Park Foundation. The foundation is conducting “the largest comprehensive fundraising campaign in its history, the Centennial Campaign for America’s National Parks” with a goal of $350 million.

MONTANA EXPECTED TO SEE MORE NATIONAL PARK VISITS THIS YEAR. The AP (2/14) reports Norma Nickerson, director of the Institution for Tourism and Recreation Research, is projecting “another big year for national park visitation and ski resorts” in Montana, due “to the National Park Service’s centennial and an increase in advertising.”

ADDITIONAL COVERAGE: INTERIOR ASKED TO DO MORE TO PROTECT GRAND CANYON EMPLOYEES. CBS5 Arizona (2/15) continued coverage in reporting on its website “Arizona’s congressional delegation says the National Park Service must do more to protect Grand Canyon employees who participate on the agency’s river rafting trips.” The article notes that “a report released last month by a federal watchdog found that Park Service workers have preyed on their female colleagues, demanding sex and retaliating against women who refused.” The NPS “banned alcohol on the trips and required pre-trip briefings while the Interior Department’s Office of the Inspector General looked into allegations of sexual harassment,” but “Arizona’s congressional delegation says those reforms are insufficient.”

US Geological Survey:

BUDGET PROPOSES $8 MILLION FOR “SHAKEALERT” SYSTEM. McClatchy (2/15, Hotakainen, 22K) reports the President’s budget proposes $8 million for “an early earthquake warning system,” known as the “ShakeAlert” system, that would include “a network of sensors on the ocean floor” over the Cascadia Subduction Zone. The system is being developed with the assistance of the University of Washington, the California Institute of Technology, the University of California, Berkeley, the University of Oregon, and the U.S. Geological Survey. Secretary Jewell has also urged support for the system.

APP TO USE CELLPHONES TO HELP DETECT EARTHQUAKES. The Los Angeles Times (2/12, Xia, Lin, 4.1M) reports on an app to test an idea to use “cellphones to detect earthquakes as soon as they start.” The app “uses smartphone sensors to detect movement caused by an earthquake,” and sends that data “to a central server.” The app works on the idea that if 300 phones in an area are “sending warnings” that means there is an earthquake. It may also be used to support a system to “provide early warnings before the worst shaking from an earthquake arrives,” which is based on “the U.S. Geological Survey’s ShakeAlert prototype.” The phone app could not be a replacement because the phone sensors are not

“as effective as hundreds of sophisticated earthquake sensor stations installed underground,” but it might provide an alternative where there are few or no earthquake sensors.

USGS: OKLAHOMA HIT BY STATE’S THIRD-STRONGEST EARTHQUAKE EVER. Reuters (2/16) reports that according to the US Geological Survey, Oklahoma this weekend was hit by the third-strongest quake to ever be recorded in the state, a magnitude 5.1 quake that struck at around 11 am Saturday morning. Seismologists say Oklahoma’s frequent earthquakes could be linked to the oil and gas industry’s injection disposal wells. CBS News (2/16, Villarreal, 3.97M) reports on its website that the quake hit near Fairview, which “is quickly gaining a big reputation for large quakes.”

This story was also covered by the Daily Mail (2/15, 4.92M), the Washington (DC) Post (2/13, 8.98M), the New York Daily News (2/15, 3.7M), the Houston (TX) Chronicle (2/13, Miller, Press, 1.99M), Philly (PA) (2/13, 822K), and the website of ABC News (2/15, 4M).

Top National News:

WHITE HOUSE COULD ANNOUNCE HIGH COURT NOMINEE NEXT WEEK. The coming battle over the successor to late Supreme Court Justice Antonin Scalia received 19 minutes of coverage between the three broadcast networks, with CBS and NBC opening with the story. The White House is indicating that President Obama may offer a nominee as soon as next week, but most of the television coverage deals with the difficulty any nominee will have in advancing, and on the role the vacancy will play in the presidential race. Those political considerations are also part of the print and online coverage, but these sources also look at prospective candidates, with Attorney General Lynch and District of Columbia Circuit Court of Appeals Judge Sri Srinivasan mentioned as top contenders.

The CBS Evening News (2/15, lead story, 3:00, Pelley, 5.08M) reported that the “quiet memorial” to Scalia outside the Supreme Court is “in sharp contrast to the coming political battle over his successor.” CBS (Crawford) added, “When the justices return to the bench next week, it will be the first time for all eight to serve without Justice Scalia. ... They will have a term of controversial case, regulation of abortion clinics, another challenge to Obamacare, affirmative action and college admissions and presidential power on immigration.” Without Scalia, it will be “a court on pause. Many of those cases will end up in a 4-4 tie, keeping the lower court rulings in place and setting no nationwide precedents.”

NBC Nightly News (2/15, lead story, 2:35, Holt, 7.86M) opened by saying, “In an election year already fraught with improbable plot twists and drama, now this: The ideological balance of the US Supreme Court suddenly in limbo...as lines are drawn for an epic battle between Democrats and Senate Republicans who are determined to leave the choice up to the next president. Tonight, the current president is suggesting Republicans are full of bluster.” On ABC World News (2/15, story 5, 2:50, Muir, 5.84M), Jonathan Karl reported, “The flag is at half staff today at a snowy and peaceful Supreme Court, but the epic political battle is just beginning. ... Within an hour” of Scalia’s death, Senate Majority Leader McConnell “drew the battle lines, declaring, ‘This vacancy should not be filled until we have a new president.’ Then, President Obama weighed in, paying tribute to Scalia, but making it clear, he’s ready to fight to replace him.”

Reuters (2/16, Mason, Rampton) reports the White House said the President had started discussions with his advisers about selecting a nominee. USA Today (2/15, Korte, 5.56M) reports deputy press secretary Eric Schultz said a nominee could come “as soon as next week.” Schultz said, “As soon as the Senate returns, the President was very clear that he is going to fulfill his constitutional responsibility to nominate a successor to Justice Scalia. ... There are no caveats. The Constitution does not include exemptions for election years, or for the president’s last term in office. There’s no exemption for when a nomination would tip the balance of the court.”

The Washington Times (2/15, Boyer, 285K) says the Senate “is in the middle of a 10-day recess until Monday, giving Mr. Obama a chance to bypass Congress and install a successor quickly” via recess appointment. But The Hill (2/15, Balluck, 862K) and the NPR (2/15, 1.81M) website report that Obama has ruled that out.

In a 2,100-word assessment, Tom Goldstein of SCOTUSblog (2/15, 2K) writes that Obama "has two priorities. First, fill the Scalia seat by getting a nominee confirmed," and "second, gain as much political benefit as possible and exact as heavy a political toll as possible on Republicans, particularly in the presidential election." Goldstein says a nominee "may in fact receive a vote" in the Senate, and "if Republicans can come up with even a slender substantive thread on which to base an objection to the nominee, they will seize on it and vote the nominee down on the merits." Politically, the best candidate "would probably be Hispanic," but Obama "personally will be very tempted to appoint a black Justice." California Attorney General Kamala Harris would be the best choice, Goldstein writes, but as "the prohibitive favorite" in the California Senate race, she probably does not want it. So Lynch "is a very serious possibility." AOL (2/15, 6.15M) and Mediaite (2/15, Griswold, 277K) also report on Goldstein's assessment.

However, Edward-Isaac Dovere of Politico (2/15, 1.07M) writes that while Lynch is "suddenly lighting up chatter as a potential dark horse," Srinivasan is Obama's "likeliest Supreme Court choice." He would be "a historic first" as an immigrant from India and won unanimous Senate approval to the appeals bench. On the CBS Evening News (2/15, story 2, 1:45, Pelley, 5.08M), Margaret Brennan said Obama "could choose a candidate who has already won Senate approval," such as Srinivasan, "or he could make a bold choice" like Lynch, "who had to wait more than 160 days before she was confirmed for her current position."

The Wall Street Journal (2/15, Hughes, Subscription Publication, 6.74M) reports that whomever Obama nominates, the candidate will face a polarized Senate Judiciary Committee. Chairman Charles Grassley, who has said he supports McConnell's plan to block any Obama nominee, would be presiding over his first Supreme Court confirmation hearings. Karen Tumulty of the Washington Post (2/15, 8.98M) says the "rancorous debate...reflects in many ways a growing public skepticism toward the US Supreme Court itself, as its image has evolved from impartial arbiter of the laws to yet another politicized institution."

The Washington Post (2/15, 8.98M) editorializes, "This one shouldn't be complicated. The fourth year of President Obama's four-year term has just begun. Senators are elected to six-year terms, and all of them have at least 11 months still to serve." Scalia's death "has created a vacancy on the nine-member Supreme Court. The Constitution tells the president to nominate justices and senators to confirm or reject those nominees." Dana Milbank writes in his Washington Post (2/15, 8.98M) column that the Senate should "force Obama's nominee to prove that he, or she, is in the mainstream. But unless the Senate wants to return to antebellum divisions, don't deny that nominee consideration."

But the Wall Street Journal (2/16, Subscription Publication, 6.74M) says in an editorial that it is liberals who have politicized the Court, so it is reasonable that Republicans would prefer to wait for a new president before confirming a nominee. In a second editorial, the Wall Street Journal (2/16, Subscription Publication, 6.74M) quotes Sen. Charles Schumer from a 2007 speech, 18 months before President Bush left office, saying that should a vacancy arise, he would recommend to his colleagues "that we should not confirm any Bush nominee to the Supreme Court except in extraordinary circumstances." The CBS Evening News (2/15, story 3, 2:05, Pelley, 5.08M) also included Schumer's 2007 remarks in a report.

Four Republican Senators In Tight Races Backing McConnell. The New York Times (2/15, Shear, Steinhauer, Subscription Publication, 12.03M) reports that several Republican senators facing tough re-election races this year are now saying they will back McConnell in blocking a nominee. New Hampshire Sen. Kelly Ayotte, "who faces a primary threat from the right wing of her party, said over the weekend that she supported" McConnell. In addition, Ohio Sen. Rob Portman said Monday, "It is common practice for the Senate to stop acting on lifetime appointments during the last year of a presidential term, and it's been nearly 80 years since any president was permitted to immediately fill a vacancy that arose in a presidential election year." Politico (2/15, Everett, 1.07M) reports that Pennsylvania Sen. Pat Toomey and Wisconsin Sen. Ron Johnson are also backing McConnell.

The Washington Post (2/15, Mufson, Eilperin, 8.98M) writes that "one consideration that may force Republicans to recalibrate their strategy is the prospect of political damage" to some of these incumbents. The Chicago Tribune (2/15, Pearson, 2.17M) reports that Illinois Sen. Mark Kirk, "perhaps the most

vulnerable of Republican senators seeking re-election this year," is "offering no clue on whether he will side with" McConnell.

The New York Times (2/15, Savage, Subscription Publication, 12.03M) says "the clash is less a new front against the White House than an escalation of a battle that had begun at the appeals court level." Since Republicans gained the Senate majority 13 months ago, "the process that would enable Mr. Obama to fill vacancies on the 12 regional federal courts of appeal has essentially been halted."

Cruz, Trump Make Issue Of Vacancy. Bloomberg Politics (2/15, Kapur, 289K) reports that "within hours" of Scalia's death, Republican presidential candidates "began using the battle to tear each other apart" ahead of Saturday's pivotal South Carolina primary. Sen. Ted Cruz is airing an ad "attacking Republican front-runner Donald Trump as untrustworthy when it comes to picking justices," while Trump is blasting Cruz for supporting the 2005 nomination of John Roberts as chief justice. Politico (2/15, Glueck, 1.07M) reports that Cruz also criticized Trump for suggesting last year that his sister Maryanne Trump Barry, a federal appeals court judge, would be his pick. Trump said he was joking, but on Monday, Cruz called Barry "a Bill Clinton-appointed federal appellate judge who's a radical pro-abortion extremist."

NBC Nightly News (2/15, story 2, 2:15, Holt, 7.86M) reported, "No matter who it is the President picks, the Republican leader in the Senate and many of the leading GOP candidates say no one should get a vote and the seat should remain empty until the next president nominates a successor. That could leave this battle raging for well over a year." The New York Times (2/15, Hulse, Subscription Publication, 12.03M) says "the unexpected vacancy...immediately made the Supreme Court a dominant issue in the presidential campaign. The court, usually cast in the role of deciding issues that elections cannot, now may be the issue that decides the election."

Scalia Left Suggestions On Successor In Passage From 2015 Dissent. The New York Times (2/15, Liptak, Subscription Publication, 12.03M) writes that "we know more than you might think" about what sort of successor Scalia might have preferred. In a "largely overlooked passage in his dissent from the court's decision in June establishing a constitutional right to same-sex marriage, he left detailed suggestions," such as finding "someone who did not go to law school at Harvard or Yale," or "a candidate from the Southwest" or an evangelical Christian. He "was criticizing the lack of diversity of the court he sat on, and he did not exclude himself." ABC World News (2/15, story 6, 2:30, Muir, 5.84M) and the CBS Evening News (2/15, story 11, 2:05, Pelley, 5.08M) both broadcast remembrances of Scalia's life and career.

Scalia's Death Sparks Conspiracy Theories. The Washington Post (2/15, Sun, Horwitz, 8.98M) reports on the "conspiracy theories" arising in the wake of Scalia's sudden death, particularly since no autopsy was ordered. The AP (2/15, Hananel, Warren) reports that Presidio County Judge Cinderela Guevara, "who decided no autopsy was needed," said she spoke to Scalia's doctor on the day he was found dead and was told that Scalia "had a history of heart trouble, high blood pressure and was considered too weak to undergo surgery for a recent shoulder injury."

Writer Wonders If Obama Could Sue Senate Over Obstruction. Writing at the Huffington Post (2/15, 518K), television writer Michael Russnow asks, "Why can't Obama sue the Senate?" Last September, "a court determined that the House of Representatives could sue the Executive Branch over funding of the Affordable Care Act." He argues that "a Senate led by an obstructionist" may be overstepping constitutional boundaries.

SURGEON GENERAL SAYS "TRUSTED VOICES" NEED TO GET INVOLVED IN FLINT. The Detroit Free Press (2/15, Allen, 989K) reports Surgeon General Murthy said in Flint, Michigan on Monday night that "most Flint kids exposed to toxic lead in the city's tap water should be OK, but 'trusted voices' need to impart critical nutrition and education." Murthy said, "The problem is, we don't know which kids are going to develop complications going forward. And that's why what we have to do is make sure that we are providing as much support to these kids and their families as possible."

HOUSE FETAL TISSUE INVESTIGATION SUBPOENAS MORE THAN 30 GROUPS. The Washington Post (2/15, DeBonis, 8.98M) reports the special House committee formed amid the Planned Parenthood fetal tissue controversy "has begun a broad investigation of the matter, issuing document requests to

more than 30 agencies and organizations, including a closely scrutinized abortion clinic and some of the nation's most prominent research institutions." Subpoenas were sent to "StemExpress, a California firm that prepares human specimens for researchers; Southwestern Women's Options, an Albuquerque abortion clinic; and the University of New Mexico, whose Health Sciences Center conducts medical research using fetal tissue." Critics have expressed concern about "the privacy implications of the wide-ranging requests."

Editorial Wrap-Up:

NEW YORK TIMES. ***"A College Education For Prisoners."*** The New York Times (2/16, Subscription Publication, 12.03M), in an editorial, says "the most effective way to keep people out of prison once they leave is to give them jobs skills," and that "means restarting prison education programs." The Times says that those inmates "who attend privately financed college classes" have much lower recidivism rates, with a Bard College program showing a "recidivism rate of 4 percent" for participants and "2.5 percent" for graduates. The Times urges New York to provide public funding for college education for prison inmates.

"The Chirp Heard Across The Universe." A New York Times (2/16, Subscription Publication, 12.03M) editorial

"How The Coal Industry Flattened The Mountains Of Appalachia." The New York Times (2/16, Subscription Publication, 12.03M), in an editorial, denounces "mountaintop removal" mining for "leaving behind...a grossly disfigured landscape." It cites a report from Duke University researchers on the effects of the practice, and points out that the Interior Department is "working on a stronger Stream Protection Rule." The Times concludes by quoting Chief Judge Charles Haden II of United States District Court, "No effect on related environmental values is more adverse than obliteration."

WASHINGTON POST. ***"Ukraine Should Heed Its Economy Minister's Warning On Corruption."*** The Washington Post (2/15, 8.98M) in an editorial says that Ukraine must "build a strong and prosperous nation" if it is going to remain independent of Russia, but has so far "remained mired in a system in which billionaires gobble up state assets and siphon off the revenue streams." The Post says the problem goes "all the way to the top" of Ukraine's government, and that if Ukraine is to "survive" it must be rid of this system.

"Senators, Do Your Job And Vote On The Next Supreme Court Nominee." The Washington Post (2/15, 8.98M) editorializes, "This one shouldn't be complicated. The fourth year of President Obama's four-year term has just begun. Senators are elected to six-year terms, and all of them have at least 11 months still to serve." Scalia's death "has created a vacancy on the nine-member Supreme Court. The Constitution tells the president to nominate justices and senators to confirm or reject those nominees."

"Gun Safety Advocates Are Wrong To Rebuff Gov. McAuliffe's Gun Control Victory." The Washington Post (2/15, 8.98M) says it's a "shame" that gun safety advocates have "vilified" Virginia Gov. Terry McAuliffe for scrapping the state's attorney general's order ending recognition of concealed-carry permits from 25 states "with lax standards" in return for "a concession from the pro-gun lobby" that will allow the state to criminalize gun possession of almost 5,000 domestic abusers hit with protective orders annually. While the deal "isn't perfect," a "cold-eyed assessment suggests that Mr. McAuliffe got the better bargain."

WALL STREET JOURNAL. ***"The Supreme Court After Scalia."*** The Wall Street Journal (2/16, Subscription Publication, 6.74M) says in an editorial that it is liberals who have politicized the Court, so it is reasonable that Republicans would prefer to wait for a new president before confirming a nominee.

"The Schumer Precedent." The Wall Street Journal (2/16, Subscription Publication, 6.74M) quotes Sen. Charles Schumer from a 2007 speech, 18 months before President Bush left office, saying that should a vacancy arise, he would recommend to his colleagues "that we should not confirm any Bush nominee to the Supreme Court except in extraordinary circumstances."

"Donald Trump's MoveOn.org Moment." The Wall Street Journal (2/16, Subscription Publication, 6.74M) blasts Donald Trump's claim during Saturday's GOP debate that the Administration of President George W. Bush deliberately "lied" about the existence of weapons of mass destruction in Iraq, noting that there is no evidence to support the claim. The Journal says touting false conspiracy theories should disqualify a presidential candidate because it undermines public trust in democracy and argues Trump's willingness to entertain the theory demonstrates the risk the GOP would be taking by making him the party's presidential nominee.

Big Picture:

HEADLINES FROM TODAY'S FRONT PAGES.

Wall Street Journal:
Scalia's Death Sets Up Collision
Millennial Wave Unsettles Presidential Race
Senate Girds For A Pivotal Battle On Court Nominee
Stocks Rise As Banking Shares Rally

New York Times:
Before Scalia's Death, A Clash Between GOP And Obama Over Appellate Judges
What Would Scalia Want In His Successor? A Dissent Offers Clues
South Carolina Church Bridges Racial Gap, But Not Political Divide
Bush Brothers Swipe At Donald Trump
Tasked With Combating Opium, Afghan Officials Profit From It
Cornell's Plan To Merge Hotel School Gets An Icy Reception
Kendrick Lamar Sweeps Rap Field At Grammys; Taylor Swift Wins Best Album

Washington Post:
In Nev, Sanders Is Challenging Clinton's "Firewall"
"My Demons Won Today": Ohio Activist's Suicide Spotlights Depression Among Black Lives Matter Leaders
Court Fight Hits Senate Races
Venezuela Lacks Tools To Battle Zika Virus
In A Fearful Europe, Racial Profiling Becomes More Common

Financial Times:
Russia-Turkey Tensions In Syria Hit Peak
Criminals' "Currency Of Choice" For Chop

Washington Times:
Special Forces Face Challenges As Integration Of Women Loom
Lawmakers Hope To Stop Pressure On Child Brides In Virginia
Ex-President Makes Return To Campaign For Jeb Bush
Obama Starts With Cautious Approach To Fill Scalia's Seat
Kiosk Carnage Raises Questions On Moscow's Business Climate
Palestinians Admit To Working With Israel To Foil Local Attacks

Story Lineup From Last Night's Network News:
ABC: Severe Weather; Weather Forecast; 2016 Politics-Republicans; 2016 Politics-Democrats; Supreme Court Nomination Debate; Supreme Court Justice Scalia Death; Syria-Hospital Bombed; Virgin Atlantic Flight-Laser Scare; Heartburn Medication Warning; Peyton Manning-University Of Tennessee Allegations; Pope Francis-Mexico Visit; Westminster Dog Show.
CBS: Supreme Court Justice Scalia Death; Supreme Court Nomination Debate; Supreme Court Nomination Process; 2016 Politics-Republicans; Syria-Hospital Bombed; Pope Francis-Mexico Visit; Central America-Migration Crisis; Severe Weather; Alaska Flight-Smoke; Lincoln Memorial Restoration; Justice Scalia-Record.

NBC: Supreme Court Nomination Debate; Supreme Court Nomination Process; 2016 Politics-Republicans; 2016 Politics-Democrats; Severe Weather; Syria-Hospital Bombed; Pope Francis-Mexico Visit; Heartburn Medication-Warning; Virgin Atlantic Flight-Laser Scare; 2015 Airline Safety; Jimmy Carter-Grammy.

Network TV At A Glance:
Supreme Court Justice Scalia Death – 19 minutes, 05 seconds
2016 Politics – 12 minutes, 50 seconds
Severe Weather – 6 minutes, 25 seconds
Syria-Hospital Bombed – 4 minutes, 35 seconds
Pope Francis-Mexico Visit – 0 minutes, 45 seconds

Story Lineup From This Morning's Radio News Broadcasts:
ABC: Supreme Court Nomination Debate; Severe Weather-Snow Storms; 2016 Politics-Republican Campaign Trail; Financial Markets.
CBS: Supreme Court Nomination Debate; 2016 Politics-Jeb Bush Campaign; Severe Weather-Damages; Grammy Awards; Oregon Legislation-Coal Reduction; Gas Price Decrease.
NPR: Supreme Court Nomination Debate; 2016 Politics-Jeb Bush Campaign; 2016 Politics-Republicans; US-ASEAN Summit; Severe Weather-Damage; Indian University-Student Protests; Bahrain-US Journalists Detained.
FOX: Supreme Court Nomination Debate; Syria Hospital Bombed-France Condemnation; US-ASEAN Summit; Severe Weather Damage.

Washington Schedule:

TODAY'S EVENTS IN WASHINGTON.
White House:

PRESIDENT OBAMA — Hosts day two of the US-ASEAN Summit in California.

VICE PRESIDENT BIDEN — No public scheduled events.
US Senate: Senate on recess from 12 Feb – 22 Feb
US House: House of Representatives on recess from 12 Feb – 22 Feb
Other: 9:30 AM Public Citizen Goes to Court Seeking to Uncover Misconduct by Immigration Judges – Public Citizen will argue before the U.S. Court of Appeals for the D.C. Circuit that the government should be required to disclose information about immigration judges who have been accused of misconduct. In 2013, Public Citizen and the American Immigration Council, acting as counsel for the American Immigration Lawyers Association (AILA), sued the U.S. Executive Office for Immigration Review (EOIR) under the Freedom of Information Act. The lawsuit challenged EOIR's refusal to disclose complaints against immigration judges and to make public records that would reveal agency investigations of and resolutions to those complaints. After filing the lawsuit, EOIR released nearly 16,000 pages of complaint and complaint resolution documents. However, key sections of many documents were blacked out. And none of the documents contained the names of the immigration judges who had been the subject of complaints, even though these judges are high-ranking public officials who make life-or-death decisions for the immigrant Location: Courtroom 31, U.S. Court of Appeals for the D.C. Circuit, 333 Constitution Ave., NW http://www.citizen.org/Page.aspx?pid=2281 https://twitter.com/public_citizen

8:30 AM National Academies workshop on the Zika virus – National Academies of Science, Engineering, and Medicine convene workshop – at the request of the Department of Health and Human Services – to identify basic research priorities that could be implemented in real time to help minimize the likelihood of local Zika virus transmission in the U.S. and inform public health responses. Experts and stakeholders discuss topics including clinical management, public health resources, and guidance that may be needed to inform prevention, mitigation, detection, and treatment efforts; current research efforts to better understand the virus and research gaps; specific risk factors for the babies of pregnant women who have been infected with the Zika virus and periods of particularly increased risk during pregnancy; burdens associated with microcephaly and other neurological disorders in babies and the resources need to care

for them and other affected individuals; and risk factors for developing Guillain-Barre syndrome after Zika infection and appropriate medical care Location: NAS, 2101 Constitution Ave NW, Washington, DC www.nas.edu/ https://twitter.com/NASciences #ZikaResearch

10:00 AM GOP Rep. Luke Messer speaks at NPC – House Republican Policy Chair Luke Messer discusses governing in the 2016 election year via NPC Newsmaker news conference Location: National Press Club, 529 14th St NW, Washington, DC http://press.org/ https://twitter.com/PressClubDC

10:00 AM Deputy Secretary of State Blinken in conversation at Brookings – 'New frameworks for countering terrorism and violent extremism: A conversation with Deputy Secretary of State Antony Blinken' hosted by Brookings Institution Foreign Policy program, on U.S. civilian-led initiatives to counter the spread of the Islamic State group and other violent extremist groups. He charts the path forward and outlines the challenges that lie ahead Location: Brookings Institution, 1775 Massachusetts Ave NW, Washington, DC http://www.brookings.edu https://twitter.com/BrookingsInst #CVE

1:00 PM Washington FPC briefed on new U.S. assistance for the Syrian crisis – Washington Foreign Press Center On-The-Record Briefing on 'New U.S. Assistance to Respond to Syria Crisis', featuring Assistant Secretary of State for Population, Refugees, and Migration Anne Richard, and USAID Acting Assistant Administrator for Democracy, Conflict and Humanitarian Assistance Thomas Staal Location: National Press Bldg, 529 14th St NW, Washington, DC www.fpc.state.gov https://twitter.com/ForeignPressCtr

Last Laughs:

LATE NIGHT POLITICAL HUMOR.

Jimmy Fallon: "In addition to the [Los Angeles] marathon, I also saw that President Obama just visited LA. Or as Donald Trump put it, 'The state is being taken over by Kenyans.'"

Jimmy Fallon: "Actually, while he was in Los Angeles last week, President Obama met privately with Will Smith. Not to be outdone, Joe Biden spent the day learning how to do the Carlton."

Jimmy Fallon: "Here's the latest on the election. Donald Trump just promised that he will no longer use foul language on the campaign trail. Now, when people ask him his policy on ISIS, he just says, 'I'm gonna bomb the shy diddly doodles out of them.'"

Jimmy Fallon: "And during a recent rally in Louisiana, Donald Trump actually autographed someone's baby. Even crazier, when he handed the baby back to the parents, he said, 'Congratulations, your baby is worth three times as much now.'"

Jimmy Fallon: "Meanwhile, Ted Cruz's campaign pulled a recent attack ad after it came out that one of the actresses in the ad had also appeared in some softcore porn films. I feel so bad for that actress who now has to explain to her parents what she was doing in a Ted Cruz ad."

Seth Meyers: "Republicans and Democrats are fighting over whether President Obama should be able to appoint Justice Scalia's successor. Democrats say that he should, whereas the Constitution says that he shall."

Seth Meyers: "The Ted Cruz campaign has pulled a new ad after it was revealed that the actress in it has appeared in softcore porn. And now Jeb has hired her to teach him how to act like he's enjoying something."

Jimmy Kimmel: "Donald Trump spent his President's Day getting ready by photoshopping his head onto a million-dollar bill."

Jimmy Kimmel: "Meanwhile, in a very different kind of race in LA: the LA marathon, the 31st annual

marathon. Between the marathon and Obama's visit, it was a big week for Kenyans screwing up LA traffic."

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From: Dan Ashe
To: Noreen Walsh
Subject: Re: National Bison Range transfer
Date: Thursday, February 18, 2016 10:33:20 PM

Please do!

Dan Ashe
Director, U.S. Fish and Wildlife Service

> On Feb 18, 2016, at 10:11 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>
> No, I don't mind, but I was going to call him. OK if I do that first?
>
> Sent from my iPhone
>
>> On Feb 18, 2016, at 8:04 PM, Dan Ashe <d_m_ashe@fws.gov> wrote:
>>
>> I've received none, actually. I know Dave well, and if you don't mind,
>> I'll send him a reply.
>>
>> Dan Ashe
>> Director, U.S. Fish and Wildlife Service
>>
>>
>>
>>> On Feb 18, 2016, at 9:31 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>>
>>> FYI
>>> I suspect you are hearing from a lot of retirees.
>>>
>>>
>>>
>>>
>>> Noreen Walsh
>>> Regional Director
>>> Mountain-Prairie Region
>>> U. S. Fish and Wildlife Service
>>> 303 236 7920
>>>
>>>
>>> -----Original Message-----
>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>> Sent: Thursday, February 18, 2016 11:48 AM
>>> To: noreen_walsh@fws.gov
>>> Subject: National Bison Range transfer
>>>
>>> Hi Noreen. We worked together briefly in Atlanta before I transferred to
>>> Denver-Refuges in 2000 and subsequently retired in 2003. My wife Catherine
>>> and I still reside near Conifer just off of Hwy. 285. I was glad when you
>>> were selected the RD for Region 6 as your reputation is a good one. I
>>> received a copy of your all-employees memo (not shocking in this day, is
>>> it :) concerning the issue of simply transferring the National Bison Range

>>> to local CSK tribes since previous efforts to "co-manage" were
>>> ineffective. I have no doubt you are very familiar with that whole issue,
>>> and I for one do not envy you the position you find yourself in. Careers
>>> have been greatly impacted in several cases over this issue, and
>>> unfortunately politics seems to oftentimes rule instead of good sound
>>> science as well as the future of the Refuge System itself. I'm sure you
>>> are aware that I and many others in my situation would be much opposed to
>>> the idea of transferring the Bison Range, or any other unit of the NWRS,
>>> unless it made sound biological and scientific sense, and would make the
>>> Refuge System stronger in the long run. As I said, I do not envy you the
>>> position you are in, these are potentially dangerous waters. I would
>>> simply encourage you to continue doing what YOU believe is the right thing
>>> to do on the part of our resources, and then do your best to take each day
>>> as it unfolds. Thanks for listening, I wish you all the best in your
>>> position, and pray to the Good Lord that He blesses you with good and
>>> honest advisers. Sincerely, Dave Heffernan (retired after 35 years of
>>> service with the Refuge System :)
>>>
>>> Sent from my iPad

From: Noreen Walsh
To: Dan Ashe
Subject: FW: National Bison Range transfer
Date: Thursday, February 18, 2016 9:31:22 PM

FYI
I suspect you are hearing from a lot of retirees.

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

-----Original Message-----
From: Dave Heffernan [mailto:deheffer248@yahoo.com]
Sent: Thursday, February 18, 2016 11:48 AM
To: noreen_walsh@fws.gov
Subject: National Bison Range transfer

Hi Noreen. We worked together briefly in Atlanta before I transferred to Denver-Refuges in 2000 and subsequently retired in 2003. My wife Catherine and I still reside near Conifer just off of Hwy. 285. I was glad when you were selected the RD for Region 6 as your reputation is a good one. I received a copy of your all-employees memo (not shocking in this day, is it :) concerning the issue of simply transferring the National Bison Range to local CSK tribes since previous efforts to "co-manage" were ineffective. I have no doubt you are very familiar with that whole issue, and I for one do not envy you the position you find yourself in. Careers have been greatly impacted in several cases over this issue, and unfortunately politics seems to oftentimes rule instead of good sound science as well as the future of the Refuge System itself. I'm sure you are aware that I and many others in my situation would be much opposed to the idea of transferring the Bison Range, or any other unit of the NWRS, unless it made sound biological and scientific sense, and would make the Refuge System stronger in the long run. As I said, I do not envy you the position you are in, these are potentially dangerous waters. I would simply encourage you to continue doing what YOU believe is the right thing to do on the part of our resources, and then do your best to take each day as it unfolds. Thanks for listening, I wish you all the best in your position, and pray to the Good Lord that He blesses you with good and honest advisers. Sincerely, Dave Heffernan (retired after 35 years of service with the Refuge System :)

Sent from my iPad

From: Jeff King
To: Will Meeks; Mike Blenden
Subject: Re: NBR meeting w staff
Date: Wednesday, February 24, 2016 10:50:59 AM

Use to following call in info.

nonresponsive
nonresponsive

Thanks,

jk
Sent from my iPad

> On Feb 23, 2016, at 7:32 AM, Will Meeks <will_meeks@fws.gov> wrote:
>
> Jeff,
>
> I would like to keep the time. It's only an update (not much new, but
> want the chance to talk to staff).
>
> Will Meeks
> U.S. Fish and Wildlife Service
> Mountain-Prairie Region
> Assistant Regional Director
> National Wildlife Refuge System
> 303-236-4303 (w)
> 720-541-0310 (c)
>
>> On Feb 22, 2016, at 1:32 PM, Jeff King <jeff_king@fws.gov> wrote:
>>
>> Will. We have some conflicts with a few staff. Amy will be at the WS
>> mtg in Missoula but could try to call in from there. Mike K and Dean
>> will be at a Flathead Advisory board meeting and won't be able to
>> participate. I think the rest are available. What do you want to do?
>>
>> Thanks
>>
>> jk
>>
>> Sent from my iPhone
>>
>>> On Feb 22, 2016, at 10:32 AM, Will Meeks <will_meeks@fws.gov> wrote:
>>>
>>> Yep
>>>
>>> Will Meeks
>>> U.S. Fish and Wildlife Service
>>> Mountain-Prairie Region
>>> Assistant Regional Director
>>> National Wildlife Refuge System
>>> 303-236-4303(w)
>>> 720-541-0310 (c)
>>>

>>>> On Feb 22, 2016, at 12:19 PM, Jeff King <jeff_king@fws.gov> wrote:
>>>>
>>>> On the 24th?
>>>>
>>>> Thanks
>>>>
>>>> jk
>>>>
>>>> Sent from my iPhone
>>>>
>>>>> On Feb 22, 2016, at 10:18 AM, Will Meeks <will_meeks@fws.gov> wrote:
>>>>>
>>>>> Yes, sorry for the moving target. 11:00 Mountain, 1:00 EST.
>>>>>
>>>>> Will Meeks
>>>>> U.S. Fish and Wildlife Service
>>>>> Mountain-Prairie Region
>>>>> Assistant Regional Director
>>>>> National Wildlife Refuge System
>>>>> 303-236-4303(w)
>>>>> 720-541-0310 (c)
>>>>>
>>>>>> On Feb 22, 2016, at 12:15 PM, Jeff King <jeff_king@fws.gov> wrote:
>>>>>>
>>>>>> Will. I'm confused on the final date and time you'd like to talk to
>>>>>> nbr staff. I need to know soon so I can make sure I can have as many
>>>>>> as possible available.
>>>>>>
>>>>>> Thanks
>>>>>>
>>>>>> jk
>>>>>>
>>>>>> Sent from my iPhone

From:	Will Meeks
To:	Jeff King
Subject:	Fwd: joint statement
Date:	Thursday, February 25, 2016 10:37:56 AM

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

From: Dan Ashe <d_m_ashe@fws.gov>
Date: February 18, 2016 at 9:10:39 PM EST
To: Vernon Finley <vernonf@cskt.org>
Cc: Brian Upton <brianu@cskt.org>, Noreen Walsh <Noreen_walsh@fws.gov>, cynthia_martinez@fws.gov, Betsy Hildebrandt <Betsy_Hildebrandt@fws.gov>, will_meeks@fws.gov
Subject: Re: joint statement

Hello Vernon and thank you for your kind note. I am very happy to hear that the CSKT Council is supportive, and we are anxious to begin working together. Our National Wildlife Refuge System Chief, Cynthia Martinez, has been meeting with the Montana delegation staff, and as you described from your visits, she is getting supportive responses.

We met today, with our DOI team, and the DOI Solicitor (Hilary Tomkins) is ready to begin work to draft legislation. Cynthia Martinez will be our point of contact on this effort and stands ready to work with Brian Upton and Hilary. I hope we can have a good draft by the end of next week, as I'm anticipating that the delegation may ask us for assistance in drafting legislation.

We also discussed convening the "Transition Team" that we agreed would be helpful. Our lead on this effort is Will Meeks (in Denver), and by copying him with this note, I'm asking him to take steps to convene this team, working with Brian Upton, and with Cynthia Martinez. As we discussed, we will need to involve BIA, and others from DOI. If you would like others to participate, from the tribal side, please let me know.

On the issue of a joint statement, we stand ready to do that. However, my communications team is suggesting that we hold off, for now, and work on a statement to issue when we have some news, like introduction

of legislation. That makes sense to me, but if you feel differently, please let me know.

Thanks again. We are proud to be working with you on this, and look forward to progress and success!

Dan.

Dan Ashe
Director, U.S. Fish and Wildlife Service

> On Feb 17, 2016, at 7:34 PM, Vernon Finley <vernonf@cskt.org> wrote:
>
> Good day Dan:
>
> It was great meeting with you on our recent trip to DC. The news that you shared with Brian Upton and myself concerning the Bison Range couldn't have been greater appreciated by myself and the Council. I shared the meeting as well as the emails that went out to FWS staff with the rest of tribal council and they were all ecstatic as well. I also wanted to thank you for the phone call and agreement to provide a joint statement about the willingness and cooperation between the FWS and CSKT on the transfer. That statement will be useful when the time is appropriate.
>
> Again thank you for your hospitality and we are looking forward to working with FWS staff to pull the legislation together and presented to Congress.
>
> later,
>
> vernon

From: Stephen Torbit
To: Anna Munoz; Will Meeks
Subject: RE: More Bison inquiries
Date: Monday, February 29, 2016 9:31:00 AM

I have a bison call from 10 – Noon and am free after that. Or could chat before 10.

Stephen C. Torbit
Assistant Regional Director
Science Applications
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, Colorado 80228
303-236-4602 – Office
720-626-7504 – Cell

From: Anna Munoz [mailto:anna_munoz@fws.gov]
Sent: Monday, February 29, 2016 9:29 AM
To: will_meeks@fws.gov; stephen_torbit@fws.gov
Subject: Fwd: More Bison inquiries

Can we discuss ASAP?

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, CO 80228
Office: 303-236-4510
Cell: 720-648-2542

Begin forwarded message:

> **From:** William Reffalt <w.c.reffalt@comcast.net>
> **Date:** February 29, 2016 at 9:24:32 AM MST
> **To:** "'Jones, Lee'" <lee_c_jones@fws.gov>
> **Cc:** <anna_munoz@fws.gov>
> **Subject: More Bison inquiries**
>
> Hello, again: I have also been reading the DOI Bison Report – 2014, and The Ecological Future of the North American Bison: Conceiving Long-Term, Large-Scale Conservation of Wildlife (by Eric Sanderson, et al in 2008). I find the herd by herd write-ups in the DOI Report very enlightening. However, I find contradictions between the DOI Team write-up for the National Bison Range (pp. 36-38), Natalie Halbert and James Derr's article: A Comprehensive Evaluation of Cattle Introgression into US Federal Bison

Herds, and the material presented on the NBR website under “Wildlife and Habitat”, then “Bison,” and, finally the Statements by Regional Director Noreen Walsh and NWRS Chief Cynthia Martinez regarding the current status of the Bison in North America and the notion that the NBR has been so successful that FWS believes it can move on to other matters.

Without putting either of you on the spot, doesn’t the larger picture and longer view strongly indicate that the NBR habitats and the NBR Bison herd, within its ecological context, remain an extremely important component to the full conservation and restoration of the N.A. plains bison? Forgive me, but it seems that the right-hand, left-hand concept is at play here.
Bill

From: Munoz, Anna
To: Stephen Torbit
Cc: Will Meeks
Subject: Re: More Bison inquiries
Date: Monday, February 29, 2016 10:01:02 AM

Let's plan on chatting around 12:30?

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

On Mon, Feb 29, 2016 at 9:31 AM, Stephen Torbit <Stephen_Torbit@fws.gov> wrote:

> I have a bison call from 10 – Noon and am free after that. Or could chat before 10.
>
> Stephen C. Torbit
>
> Assistant Regional Director
>
> Science Applications
>
> U.S. Fish and Wildlife Service
>
> 134 Union Blvd.
>
> Lakewood, Colorado 80228
>
> 303-236-4602 – Office
>
> 720-626-7504 – Cell
>
> ---
>
> **From:** Anna Munoz [mailto:anna_munoz@fws.gov]
> **Sent:** Monday, February 29, 2016 9:29 AM
> **To:** will_meeks@fws.gov; stephen_torbit@fws.gov
> **Subject:** Fwd: More Bison inquiries
>
> Can we discuss ASAP?
>
> Anna

Anna Muñoz

Assistant Regional Director - External Affairs

U.S. Fish and Wildlife Service

134 Union Blvd.

Lakewood, CO 80228

Office: 303-236-4510

Cell: 720-648-2542

Begin forwarded message:

From: William Reffalt <w.c.reffalt@comcast.net>
Date: February 29, 2016 at 9:24:32 AM MST
To: "'Jones, Lee'" <lee_c_jones@fws.gov>
Cc: <anna_munoz@fws.gov>
Subject: More Bison inquiries

Hello, again: I have also been reading the DOI Bison Report – 2014, and The Ecological Future of the North American Bison: Conceiving Long-Term, Large-Scale Conservation of Wildlife (by Eric Sanderson, et al in 2008). I find the herd by herd write-ups in the DOI Report very enlightening. However, I find contradictions between the DOI Team write-up for the National Bison Range (pp. 36-38), Natalie Halbert and James Derr's article: A Comprehensive Evaluation of Cattle Introgression into US Federal Bison Herds, and the material presented on the NBR website under "Wildlife and Habitat", then "Bison," and, finally the Statements by Regional Director Noreen Walsh and NWRS Chief Cynthia Martinez regarding the current status of the Bison in North America and the notion that the NBR has been so successful that FWS believes it can move on to other matters.

Without putting either of you on the spot, doesn't the larger picture and longer view strongly indicate that the NBR habitats and the NBR Bison herd, within its ecological context, remain an extremely important component to the full conservation and restoration of the N.A. plains bison? Forgive me, but it seems that the right-hand, left-hand concept is at play here.

Bill

From:	Munoz, Anna
To:	Stephen Torbit
Subject:	Fwd: Beginning questions
Date:	Monday, February 29, 2016 12:38:01 PM

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

---------- Forwarded message ----------
From: **William Reffalt** <w.c.reffalt@comcast.net>
Date: Mon, Feb 29, 2016 at 8:53 AM
Subject: RE: Beginning questions
To: "Jones, Lee" <lee_c_jones@fws.gov>
Cc: anna_munoz@fws.gov

Lee: Thanks, very much. I obviously have a lot of reading, and hopefully "learning" to do. I continue to have a problem understanding just how one goes about "reducing or ridding" a bison population that has introgression by cattle genes from that condition? Would "drift" amount to a natural way for a population to achieve increased "purity"? If metapopulations tend to reduce drift, does that not also reduce the efforts to lower the level of cattle introgression? Is culling the only method available to increase "purity" in a population known to have introgression? In populations of less than 50 animals (or even 100?) would total testing and culling result in definite and measurable movement toward "purity"? I have read the Bison Conservation Initiative – Bison Conservation Genetics Workshop – 2012/257 report and its section on "Resolving Introgression" but I fail to see a solution in the columns. Rather, it seems to be interim steps of testing, evaluation, and essentially trial and error research at this point. Am I incorrect? It would seem that if you have a herd testing positive for cattle introgression, and at the same time that herd is known to contain unique and valuable alleles, it raises a difficult paradox for management that requires complete testing and development of techniques designed to remove specific animals from breeding or even their elimination. Is that incorrect?

Bill

P.S. Anna: I don't know you or where you are stationed or your job title. Would you please enlighten me a bit? Thanks!

From: Jones, Lee [mailto:lee_c_jones@fws.gov]
Sent: Monday, February 29, 2016 6:42 AM
To: William Reffalt <w.c.reffalt@comcast.net>
Cc: Anna Munoz <anna_munoz@fws.gov>

Subject: Re: Beginning questions

Hi Bill,

Thank you for your patience for my reply, as I've been in and out of the office and am currently back in the field this week. As I explained over the phone, I'm happy to provide answers to your general genetics questions about NWRS bison conservation, but I've cc'd Anna Munoz on this message, as Anna is the person who can help you with any questions you may have regarding the National Bison Range.

FWS bison have been managed as a metapopulation since 2007. If FWS bison were not managed as a metapopulation with specific efforts to conserve genetic diversity, you would be correct about the size of the individual herd being very important in reducing genetic loss through drift. However, by managing the individual FWS herds as a metapopulation, we have essentially increased the "herd" size to around 1400 bison including all FWS herds, such that the loss due to drift is decreased. Several publications are available that support bison management through a metapopulation, including Gates et al. 2010, Hedrick 2009 and Dratch and Gogan 2010, and this concept is widely accepted for conservation of wildlife.

Management within herd to conserve diversity is yet another step we take against loss through drift, and a recent publication demonstrates that using genetic markers to manage for low mean kinship conserves diversity better than random removal or rare allele conservation (Giglio et al. 2016). This within herd diversity management provides additional protection against loss due to genetic drift in small herds.

I've attached publications for you here. Please let me know if you have any questions about these documents and thanks again for your patience. Lee

Lee C. Jones

USFWS-Wildlife Health office

10 E. Babcock, Rm 105

Bozeman, MT 59715

Office: 406.587.2169

Cell: 406.600.8405

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On Wed, Feb 17, 2016 at 3:54 PM, William Reffalt <w.c.reffalt@comcast.net> wrote:

> Lee: Good to talk with you. I am still working on questions, but have a couple of starting questions. I hope you will excuse the total lack of knowledge on my part for genetic concepts and jargon.
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>
> Bill

From:	Munoz, Anna
To:	Stephen Torbit
Subject:	Fwd: Beginning questions
Date:	Monday, February 29, 2016 12:38:10 PM
Attachments:	Giglio_et_al-2016-Animal_Conservation.pdf Bison Genetics Report _FINAL_DratchGogan2010.pdf Gates et al 2010_IUCNbisonconserveguide.pdf Hedrick_conservgeneticsbison_JH2009.pdf

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Cell: 720-648-2542

---------- Forwarded message ----------
From: **Jones, Lee** <lee_c_jones@fws.gov>
Date: Mon, Feb 29, 2016 at 6:42 AM
Subject: Re: Beginning questions
To: William Reffalt <w.c.reffalt@comcast.net>
Cc: Anna Munoz <anna_munoz@fws.gov>

Hi Bill,

Thank you for your patience for my reply, as I've been in and out of the office and am currently back in the field this week. As I explained over the phone, I'm happy to provide answers to your general genetics questions about NWRS bison conservation, but I've cc'd Anna Munoz on this message, as Anna is the person who can help you with any questions you may have regarding the National Bison Range.

FWS bison have been managed as a metapopulation since 2007. If FWS bison were not managed as a metapopulation with specific efforts to conserve genetic diversity, you would be correct about the size of the individual herd being very important in reducing genetic loss through drift. However, by managing the individual FWS herds as a metapopulation, we have essentially increased the "herd" size to around 1400 bison including all FWS herds, such that the loss due to drift is decreased. Several publications are available that support bison management through a metapopulation, including Gates et al. 2010, Hedrick 2009 and Dratch and Gogan 2010, and this concept is widely accepted for conservation of wildlife.

Management within herd to conserve diversity is yet another step we take against loss through drift, and a recent publication demonstrates that using genetic markers to manage for low mean kinship conserves diversity better than random removal or rare allele conservation (Giglio et al. 2016). This within herd diversity management provides additional protection against loss due to genetic drift in small herds.

I've attached publications for you here. Please let me know if you have any questions about these documents and thanks again for your patience. Lee

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Evaluation of alternative management strategies for maintenance of genetic variation in wildlife populations

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Keywords
bison; wildlife management; pedigree; modeling; culling; genetic variation; genetic diversity.

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Abstract

Wildlife management strategies are often designed around a population's demographic goals, but such strategies also can inadvertently impact genetic variation. For species like bison *Bison bison*, where management includes the regular removal of individuals to maintain restricted population sizes on constrained landscapes, management actions can be tailored to address genetic diversity retention in addition to simply maintaining a target population size. In this study, we provide an assessment of alternative culling strategies for maintenance of genetic variation in managed wildlife populations. Our primary goal was to compare the long-term retention of genetic variation and accumulation of inbreeding among three types of culling strategies, including one that considered genetic variation directly by measuring variation at a suite of variable loci [mean allele frequency (MAF) strategy], one that used genome-wide measures of variation [mean kinship (MK) strategy] and one that relied solely on demographic information (sex and age; RANDOM). To achieve this goal, we built an individual-based model, parameterized in accordance with bison biology, to project levels of genetic variation and inbreeding over time under each of the three management strategies. Our results suggest wildlife management strategies that incorporate goals for retaining genetic variation (MAF and MK strategies) are better suited to preserving the evolutionary potential of wildlife populations than those that focus solely on a target size and demographic stability (RANDOM). In particular, the MK culling strategy performed the best at maximizing the retention of genome-wide variation. These results extend previous work demonstrating the utility of pedigree-based mate selection strategies in captive population management, and show that such strategies maximize the retention of genome-wide variation under culling practices as well. These models will aid in the long-term management of bison, and can be adapted to other managed wildlife species.

Introduction

Wildlife management is an old practice, with Egyptian hunting records dating as far back as 2500 BCE (Leopold, 1933; Gilbert & Dodds, 2001). Today, wildlife management programs aim to maintain self-sustaining populations that are viable over the long term. Historically, this goal has been met by focusing on actions to maintain demographic stability, mainly by enforcing hunting and trapping restrictions such as bag limits or closed harvest seasons. As habitats are increasingly altered and wildlife populations are more heavily impacted by human activities, the intensity of wildlife management has increased, with more species dependent on regular monitoring and intervention to ensure their persistence. Management practices such as moratoria, anti-poaching efforts, predator removal, culling, health care and disease management are often undertaken at the scale of the individual animal, especially for small populations.

Small, isolated populations are not only less demographically stable than large populations, but they are also more susceptible to erosion of genetic variation by genetic drift (Wright, 1931). In the absence of gene flow, the loss of genetic variation through drift is not mitigated. A lack of genetic variation not only makes a population more susceptible to inbreeding depression (Ralls, Brugger & Ballou, 1979; Crnokrak & Roff, 1999; Keller & Waller, 2002), but also less able to adapt to changing environmental conditions (Falconer, 1981; Keller *et al.*, 1994; Willi, Van Buskirk & Hoffmann, 2006; Markert *et al.*, 2010). Preserving genetic variation has become a priority for management, particularly

for small and isolated populations, in order to maintain long term viability (McNeely *et al.*, 1990; Lacy, 1997).

A number of different strategies exist to maintain genetic variation in small, isolated populations. Indirect methods aim to maximize the exchange of genetic variation from generation to generation, and include maintaining balanced sex ratios (Komers & Curman, 2000; Harris, Wall & Allendorf, 2002; Peek *et al.*, 2002; Wedekind, 2002), avoiding fluctuations in population size over time (Caballero & Toro, 2000) and extending mean generation length (Foose & Ballou, 1988). For example, removal or contraception of young animals results in a greater proportion of offspring born to older females, an increase in generation time and higher retention of genetic variation (Gross, 2000; Gross & Wang, 2005; Hailer *et al.*, 2006). These indirect approaches are typically straightforward to implement because they do not require genetic data to be obtained for individuals.

Management strategies can also be designed to manage genetic variation directly. If genetic data are available for individual animals, strategies designed to maximize the retention of alleles could maintain variation in small and isolated populations (Wayne *et al.*, 1986). When rare alleles are found in individuals with underrepresented ancestry, an allele retention strategy could preserve rare and potentially important variation in a population (Hedrick & Miller, 1994). In contrast, if rare variants are deleterious, selective retention of such alleles could reduce the population's fitness (Hedrick *et al.*, 1986; Lacy, 2000). Additionally, strategies to retain specific rare alleles might result in loss of genetic variation across the remainder of the genome (Haig, Ballou & Derrickson, 1990; Vrijenhoek & Leberg, 1991; Miller, 1995). Rare allele retention strategies have been shown to be ineffective at retaining overall genetic variation when selecting breeding pairs for captive population management (Haig *et al.*, 1990; Miller, 1995). Nevertheless, such strategies could be effective in a population-based management approach in which individuals with rare alleles are preferentially retained in the population, but may or may not actually produce offspring because breeding is not managed.

The most effective genetic management strategies for captive population management have been those that consider genome-wide variation, rather than variation at a suite of target loci. Specifically, a management strategy that minimizes the average kinship (i.e. coancestry) in a population is an effective way to retain genetic diversity and limit the accumulation of inbreeding (Ballou & Lacy, 1995; Fernández & Toro, 1999; Sonesson & Meuwissen, 2001). A population's average kinship can be managed through breeding genetically valuable individuals (i.e. those with few relatives in the population and low mean kinships (MKs); Ballou & Lacy, 1995). However, it is impossible to dictate breeding pairs in free-ranging populations. In order to minimize average kinship in wild or semi-wild populations in which breeding pair selection is not possible, individuals with high MKs could be removed from populations. For example, removing individuals with high MK values and replacing them with unrelated individuals is outlined in the conservation plan for island populations of the endangered takahe in New Zealand (Grueber *et al.*, 2010). The concept has also been evaluated as a possible option for controlling the population size of wild horses on Assateague Island, while still maintaining genetic variation (Eggert *et al.*, 2010). Although MK-based strategies require genetic data for individual animals and established pedigrees, they could offer a distinct advantage for conserving genetic variation in intensively managed wild populations when such data are available.

Just 200 years ago, plains bison *Bison bison bison* numbered 30–50 million in herds of up to 10 000 animals (Redford & Fearn, 2007). By the late 1800s, massive overhunting and land use change reduced the population to roughly 1000 individuals, <1% of the historical population size. Efforts to establish managed herds led to an increase in the number of bison to over 500 000 individuals in North America (WCS, 2015). The successful recovery of bison is limited by the fact that the majority of extant herds are descendants of fewer than 100 bison from five private herds and a remnant population from the Yellowstone National Park (Coder, 1975). Additionally, <4% of the contemporary North American bison population (~19 000 animals) is currently maintained in conservation herds; the rest are maintained in privately owned or commercial herds. These 19 000 bison are divided into 54 conservation herds, where they are independently managed to maintain the long-term viability of the species (Gates & Aune, 2008).

Though bison have made a remarkable demographic recovery, a number of obstacles remain to ensure genetic viability over the long term. First, conservation herds were established with small numbers of individuals that remained after the severe bottleneck (Halbert, 2003; Halbert & Derr, 2008). Surplus animals from these conservation herds were often used to establish new herds, potentially exacerbating the loss of genetic variation. Second, gene flow between herds has been sporadic during the past century, often limited by concerns about disease introduction (Williams & Barker, 2001). Third, conservation herds are typically maintained at small population sizes to avoid permanent habitat damage and accommodate multiple-use goals on small, isolated reserves (Boyd, 2003; Boyd *et al.*, 2010). To maintain consistent population sizes, individuals are typically removed from populations each year. These obstacles make it critical that management of conservation herds focuses on retaining as much existing variation as possible. The annual removal of individuals is a key stage at which management actions could be designed to maximize the retention of genetic variation over time.

In this study, we provide an assessment of alternative culling strategies for maintenance of genetic variation in managed wildlife populations. Our primary goal was to compare the long-term retention of genetic variation and accumulation of inbreeding among three types of culling strategies, including one that considered genetic variation directly by measuring variation at a suite of variable loci, one that used genome-wide measures of variation and one that relied solely on demographic information (sex and age). To achieve this goal, we built an individual-based simulation, parameterized in accordance with bison biology, to project levels of genetic

variation and inbreeding over time by each of the three management strategies. Such individual-based, forward-in-time models are useful to predict the long-term genetic impact of management actions in small, potentially vulnerable populations (Haig *et al.*, 1990; Bruford *et al.*, 2010; Hoban, Bertorelle & Gaggiotti, 2012) or in populations of long-lived species (Tracy *et al.*, 2011) for which it would take many decades to observe effects of management actions.

Materials and methods

An individual-based computer simulation was constructed using the Visual Studio development environment (v10.0) to test the genetic impacts of three alternative culling strategies for wildlife management (Supporting Information Fig. S1). All culling strategies maintained balanced sex ratios in the population and preferentially culled yearlings.

Overview of culling strategies

MAF strategy

The MAF culling strategy was intended to maximize the retention of genetic variation by using a target set of microsatellite loci to guide culling decisions. Alleles at each target locus were ranked in priority based on their frequencies, and then individuals were selected for cull based on an absence of rare alleles. The overall rarity of an individual's alleles was quantified as MAF, calculated as the frequency of an individual's alleles averaged across all target loci:

$$\mathrm{MAF} = \frac{\sum_{n=1}^{N}(P_{n1} + P_{n2})}{2N},$$

where N represented the number of loci and P_{n1} and P_{n2} represented the population frequencies of the first and second alleles at the nth locus in a given individual. An individual's MAF ranged from a value >0.0 to 1.0, with lower values representing individuals with more rare alleles. Yearlings with the highest MAF values were iteratively selected for cull one at a time until the cull quota was reached, with MAF values being recalculated after each individual cull.

Pedigree-based strategy

The goal of the pedigree-based strategy (MK) was to minimize kinship across the population, thereby maximizing the retention of genome-wide variation. For this strategy, yearlings were chosen for cull based on how well represented their genomes were in the rest of the population. Animals with high representation (i.e. those with many relatives) were chosen for culling, while those with low representation (i.e. those with few relatives) were retained. The kinship (f) of a pair of individuals is the probability that two alleles at a given locus, one randomly drawn from each individual, are identical by descent from a common ancestor (Falconer, 1981). An individual's MK is then the average of pairwise fs between that individual and all living individuals in the population, including itself (Ballou & Lacy, 1995). MKs range from 0.0 to 1.0 and provide a measure of the representation of an individual's genome within a population; individuals with lower MKs have fewer relatives and, on average, carry rarer alleles than individuals with higher MKs. Yearlings with the highest MK values were iteratively selected for cull, one at a time, until the cull quota was reached, with MK values being recalculated after each individual cull.

Random removal strategy

As its name suggests, the random removal culling strategy (RANDOM) randomly removed yearlings from the population until the target size, with an even sex ratio, was reached. The strategy represented an important comparison to the two previously described, data-driven strategies because a random removal represented the least costly culling strategy to implement, both financially and with regard to required personnel, as it would require no genetic or demographic data other than sex and age.

Bison parameters

The simulation was parameterized in accordance with bison biology, using genetic and demographic information from the bison herd managed by the US Fish and Wildlife Service at the Fort Niobrara National Wildlife Refuge (FTN) in north-central Nebraska (Table 1). The FTN herd is managed annually with a population objective of 350 bison to remain in balance with the habitat and needs of other species. Extensive demographic data, complete genotypes for 55 microsatellite loci, and a nearly complete pedigree exist for this herd as of 2004. Data from 2004 to 2010 were used to parameterize the simulation.

Based on an annual 'adult' mortality rate of 3% for females and 5% for males and an annual 'juvenile' mortality rate of 5% for both sexes (Meagher, 1986), a mortality function was defined to accurately reflect age-specific mortality (see General Simulation Overview, for additional details) (Supporting Information Fig. S2). A maximum age of 24 years was specified to model a realistic lifespan (Meagher, 1986). We used the FTN pedigree to generate age-specific fecundity values (M_x; the number of same-sex offspring produced by an individual during an age class) with the PM_x software program (Fig. 1; Ballou, Lacy & Pollak, 2011). From the M_x distributions, we derived that reproduction generally occurs between ages 4 and 16 for males and between ages 3 and 21 for females. Although calving rates vary considerably between bison herds (Shaw & Carter, 1989), in concordance with recent research (Borgreen, 2010) we specified that 82% of breeding-age female bison in the FTN herd annually produce offspring. The yearly percentage of sexually mature males assigned as breeders was set at 46% based on the average proportion of males in a given year that sired offspring within the FTN herd (data from 2004 to 2010). Male breeders were further categorized as either subordinate

Table 1 Parameters used for the model, based on bison biology and data from the bison herd at the Fort Niobrara National Wildlife Refuge

Input file parameters	
Founder total	259
Target microsat total	55
Non-target microsat total	55
Loop parameters	
Target size (*T*)	350
Number of years to run	100, 200, and 500
Iterations	1,000
Breeding parameters	
Age range females will breed	2–21
Age range males will breed	4–16
Offspring produced by each breeding female	1
Proportion of males that will breed	0.46
Proportion of females that will breed	0.82
Dominant male breeding parameters	
Proportion of breeders that are dominant	0.21
Age range dominant males breed	8–12
Proportion of offspring produced by dominant males	0.40
Number of years males are dominant	1
Mortality parameters	
Female adult mortality	0.03×1.15^{AGE}
Male adult mortality	0.05×1.16^{AGE}

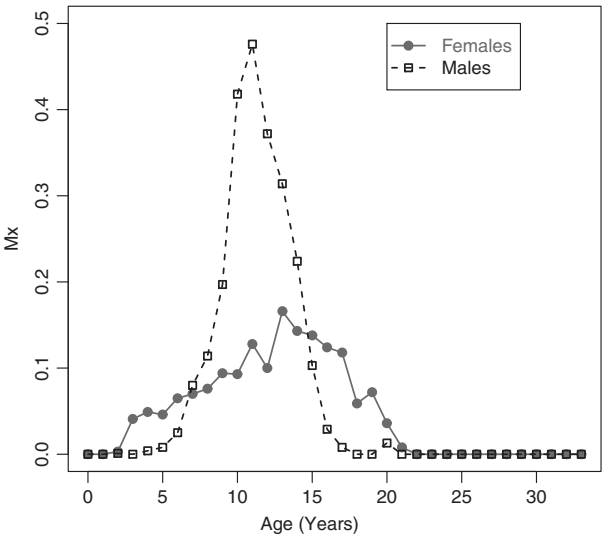


Figure 1 M_x values for males and females from the Fort Niobrara National Wildlife Refuge bison herd generated from known pedigree. M_x = the number of same-sex offspring produced by an individual during an age class.

or dominant. Using the number of offspring annually sired by each male in the FTN herd, we defined dominant males as those for which the number of sired offspring exceeded the third quartile (>3 offspring) and found that these dominant males fell between 8 and 12 years of age (Fig. 1). The yearly percentage of dominant males was then specified as 21% of all breeding males, which was the average yearly percent of dominant males calculated for the FTN herd. Finally, we specified that 40% of offspring were sired by dominant males, which was the average for the FTN herd (Fig. 1).

We used the breeders from the 2004 FTN bison herd (100 male, 159 female) as the initial starting population for our simulation. Year of birth, sex and microsatellite genotypes at 55 loci were specified from available records. For individuals lacking genotype data for a particular locus, a custom R script (R Development Core Team, 2014) was used to generate missing data by randomly drawing alleles based on their frequencies within the starting population. Because the full FTN pedigree started in 2004, all individuals within the starting population were assumed to be equally related to establish a baseline from which to measure future loss of gene diversity (*GD*) and inbreeding (all pairwise kinships assumed to be 0.0; kinship to self assumed to be 0.5). The target size of the simulated population was specified as 350 bison, in concordance with the population objective for the FTN herd.

To determine the effects of genetic-based culling strategies on non-target microsatellite loci, we created an additional panel of 55 loci that was tracked and evaluated, but not used to guide culling. At the beginning of our simulation, population-level allele frequencies for each non-target locus were determined by randomly selecting a frequency distribution from among the target set of microsatellite loci. Two alleles for each non-target locus were then assigned to each individual based on that locus' selected frequency distribution. This resulted in two different sets of loci with similar starting measures of heterozygosity and allelic richness. Data from both sets of loci were summarized for all tested culling strategies, but only the initial set of empirically generated data was used to inform culling for the MAF strategy.

General simulation overview

1 An initial starting population was loaded into the simulation. The following information was specified for each individual: sex, birth year, and the two panels of microsatellite genotypes (target and non-target). Pairwise kinships also were specified between all starting individuals.
2 Breeding individuals were identified. Potential breeders were first identified as those individuals that fell within specified reproductive age ranges. The specified percentage of potential breeders was then randomly selected to produce offspring. To allow for a polygynous mating system, a specified percentage of males selected to produce offspring was randomly flagged as dominant breeders.
3 Offspring were produced. Each breeding female produced one offspring, which was randomly assigned, with equal probabilities, a sex of male or female. The sire of each offspring was determined to be a dominant or subordinate breeding male based on the specified probability. After the dominant or subordinate designation was selected, the specific sire was randomly selected from among those two

breeding groups. Mendelian inheritance was used to generate the multi-locus genotypes of each offspring by randomly assigning one sire and one dam allele to each locus. Pairwise kinships (f) between each newly created offspring and all other individuals living in the population were calculated as $f_{xy} = 0.5(f_{xs} + f_{xd})$, where subscripts s and d referred to the sire and dam of each y offspring (Falconer, 1981).

4 Mortality occurred for all ages based on sex specific mortality functions. Male (0.05×1.16^{Age}) and female (0.03×1.15^{Age}) mortality functions included a starting mortality value and a multiplier raised by the age of an individual. The multiplier was used to ensure 100% mortality was observed at a biologically realistic age (20 for males, 25 for females).

5 Culling of yearlings was completed. The number of male and female yearlings to cull was calculated by subtracting the target number of individuals for each sex (half of total target population) from the total number of individuals of each sex. Individuals were iteratively culled through one of the strategies being tested until the number of culls calculated in the previous step was completed. If the number of males and females to be culled was unequal, individuals of the sex requiring the greater number of culls were first removed until the sex ratio to be culled was equalized. At that point, individuals of alternating sex were culled, starting with a male, with MAF or MK values being recalculated between each individual cull.

6 All individuals were aged 1 year. Steps 2–6 were repeated for 100, 200 or 500 years. Summary statistics for genetic variation and inbreeding were calculated on a yearly basis, immediately following Step 6. Summary statistics included allelic richness (A) measured as the mean number of alleles per locus, observed heterozygosity (H) calculated directly for each locus across all individuals and then averaged across loci (Hartl & Clark, 1997), proportional GD (expected heterozygosity) calculated as $1 - \overline{MK}$ (where $\overline{MK}$ is the average MK in the population; Ballou & Lacy, 1995), and average inbreeding in the population (F), equal to the kinship between an individual's sire and dam averaged across all individuals ($\overline{F}$; Falconer, 1981). Measures of allelic richness and observed heterozygosity were calculated separately for target and non-target loci.

Evaluation of culling strategies

Culling strategies were evaluated through a variety of genetic variation and inbreeding measures (A, H_o, GD and $\overline{F}$), which were averaged across 1000 simulation iterations. Summary statistics were reported at 100, 200 and 500 year intervals. The coefficient of variation (CV) was used to characterize summary statistic variability across iterations in relation to the mean.

Sensitivity analysis

The sensitivity of the simulation to input parameters was evaluated by analyzing the response of the genetic outputs to variations in target population size, mortality and proportion of breeding males. We tested three alternative target population sizes (200, 500 and 1000 individuals) and three alternative levels of mortality [200%, 300% and 400% of the starting mortality values (0.05 for males and 0.03 for females)]. We also tested three alternative percentages of total breeding males (25%, 50% and 100%); to observe only the effect of the proportion of breeding males, no males were categorized as dominant.

Results

Founding population summary statistics

The founding population had a mean allelic richness of 4.418 for the target set of loci (used by the MAF strategy) and 4.397 for the non-target set of loci. Average observed heterozygosity was 0.585 for target loci and for non-target loci. Since all founding individuals were assumed to be unrelated, GD started at 0.998 and the average inbreeding coefficient was 0.000 (Table 2).

Evaluation of model output

As predicted for any population of finite size, we observed a reduction in allelic richness and GD, and an increase in inbreeding, for all strategies. Heterozygosity increased or decreased depending on the strategy employed. All strategies succeeded in maintaining the target population size and a balanced sex ratio. Differences among strategies in the amount of genetic variation retained and the extent of inbreeding were evident at the 100-year time step and became more pronounced over time. Differences in the pattern of genetic variation loss were also detected between the target and non-target microsatellite loci for some culling strategies.

Of the three culling strategies, the RANDOM strategy preserved the least variation, as measured by allelic richness and observed heterozygosity (Fig. 2; Table 2). This strategy also yielded the lowest GD and highest average inbreeding coefficient across all years of the model (Fig. 2; Table 2). Outcomes of the RANDOM strategy were similar for the target and non-target sets of microsatellite loci; after 500 years, both sets of loci exhibited comparable decreases in allelic richness (44.3% and 44.8% reductions) and heterozygosity (34.9% and 36.5% reductions). GD decreased by 36.4% and inbreeding increased to 0.360 (Fig. 2). The RANDOM strategy exhibited the largest variation across simulation iterations, yielding among the highest CV values for all genetic diversity measures (Table 2).

The MAF strategy retained the highest allelic richness (decrease of 16.3%) and increased the observed heterozygosity (increase of 17.1%) relative to the founder population after 500 years, but only at the target microsatellite loci used to inform culls (Table 2; Fig. 2). At the non-target set of loci, genetic variation was lost at a rate comparable to the RANDOM strategy (allelic richness decreased by 44.0% and heterozygosity decreased by 33.5%). However, genome-wide measures of variation indicated better retention of diversity

Table 2 Measures of genetic variation for the founding population under each culling strategy at each time step (100, 200, 500 years)

Measures of genetic variation	RANDOM				MAF				MK			
	Founding population	100 years	200 years	500 years	Founding population	100 years	200 years	500 years	Founding population	100 years	200 years	500 years
Target *A*	4.418	3.688 (0.022)	3.250 (0.031)	2.459 (0.052)	4.418	3.922 (0.017)	3.809 (0.024)	3.696 (0.047)	4.418	3.824 (0.018)	3.480 (0.023)	2.787 (0.035)
Non-target *A*	4.373	3.626 (0.055)	3.186 (0.051)	2.413 (0.060)	4.491	3.702 (0.024)	3.258 (0.032)	2.516 (0.044)	4.327	3.684 (0.025)	3.351 (0.025)	2.707 (0.035)
Target *H*	0.585	0.541 (0.026)	0.494 (0.038)	0.381 (0.076)	0.585	0.669 (0.036)	0.687 (0.039)	0.685 (0.039)	0.585	0.557 (0.022)	0.524 (0.031)	0.437 (0.050)
Non-target *H*	0.586	0.529 (0.045)	0.484 (0.056)	0.372 (0.086)	0.591	0.538 (0.026)	0.497 (0.038)	0.393 (0.069)	0.578	0.543 (0.022)	0.512 (0.033)	0.426 (0.054)
GD	0.998	0.903 (0.008)	0.825 (0.016)	0.635 (0.041)	0.998	0.907 (0.007)	0.836 (0.012)	0.663 (0.026)	0.998	0.931 (0.003)	0.876 (0.005)	0.732 (0.010)
F	0.000	0.089 (0.079)	0.168 (0.077)	0.360 (0.072)	0.000	0.086 (0.070)	0.157 (0.064)	0.332 (0.051)	0.000	0.061 (0.049)	0.116 (0.034)	0.262 (0.027)

Values for simulations were averaged over 1000 iterations with the coefficient of variation provided in parentheses.
MAF, mean allele frequency; MK, mean kinship; *A*, allelic richness; *H*, heterozygosity; *GD*, gene diversity.

(*GD* decreased by 33.6%) and lower accumulation of inbreeding (0.332) over 500 years under the MAF strategy compared to RANDOM (Table 2). The MAF strategy yielded very different patterns of variation among iterations for the target and non-target sets of loci. The strategy was very consistent among iterations for allelic richness and heterozygosity for target loci, as well as for *GD*. However, the CV was on par with the RANDOM strategy for non-target loci (Table 2).

The MK strategy resulted in the highest retention of allelic richness and heterozygosity for the non-target set of loci (Fig. 2; Table 2). Target and non-target loci exhibited similar reductions in allelic richness (36.9% and 37.7%) and heterozygosity (25.3% and 26.3%; Table 2). The MK strategy also resulted in the highest *GD* (decrease of 26.3%) and accumulated the least inbreeding (0.262) than all other strategies at the 500-year time step (Fig. 2). The MK strategy had the lowest variation among iterations for inbreeding and *GD*, and the lowest CV values for allelic richness and heterozygosity for non-target loci (Table 2). Variation among iterations was similar for target and non-target loci.

Sensitivity analysis

The three culling strategies proved to be robust to changes in target population size, proportion of successful breeding males, and mortality for each age and sex class. As the target population size increased above the original value of 350 individuals, allelic richness, heterozygosity, and *GD* were higher and inbreeding ($\overline{F}$) was lower, but the overall pattern for each strategy remained the same (Supporting Information Table S1a). Generally, more variation among culling strategies was observed as the proportion of males that successfully bred was reduced (Supporting Information Table S1b). Overall, decreasing the sex- and age-specific mortality values resulted in less variation among culling strategies (Supporting Information Table S1c).

Discussion

Wildlife management strategies are often designed to control a population's size and demography, but such strategies also can inadvertently impact a population's genetic variation. For species like bison, where management includes the regular removal of individuals to maintain small population sizes on restricted landscapes, management actions can be tailored to address genetic diversity retention. Our research evaluated three alternative wildlife culling strategies to determine which strategy would provide the greatest advantage for conserving a population's genetic variation while maintaining a particular target size. Our simulations demonstrated that the information used to select individuals for removal notably influence the rate at which a population loses various measures of genetic variation (Fig. 2). Furthermore, our results indicated that incorporating genetic data into culling decisions, rather than relying solely on demographic parameters, generally improves the retention of genetic variation and reduces the accumulation of inbreeding over time.

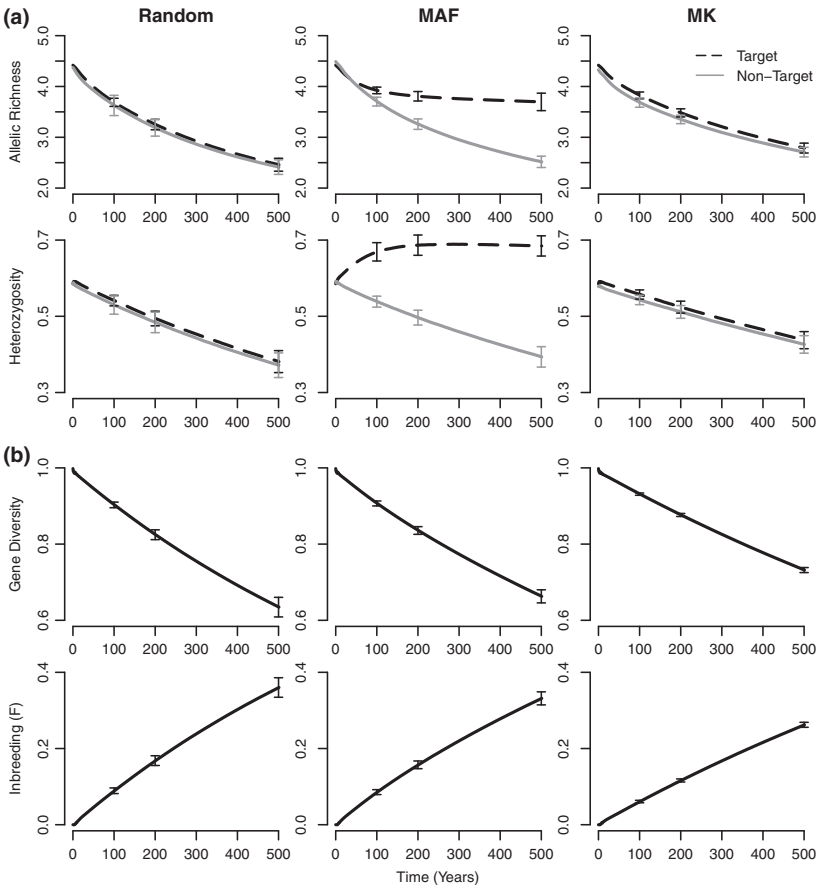


Figure 2 Average allelic richness and observed heterozygosity for both target and non-target loci (a) and genomic measures of variation (gene diversity and inbreeding) (b). Error bars represent one standard deviation at 100, 200, and 500 years.

Loss of alleles and a reduction in genome-wide heterozygosity in small populations result in loss of overall genetic variation. Since loss of genetic variation can be partially mitigated by increasing population size (e.g. Supporting Information Table S1a), wildlife managers often attempt to maximize the population size to minimize the effects of genetic drift (Epps *et al.*, 2005; Dixo *et al.*, 2009) and the related accumulation of inbreeding (Soulé & Mills, 1998). As population size decreases, maintaining stable demography and retaining genetic variation become increasingly important to prevent local extinction (Lande, 1988). In our study, the differences in genetic variation became more profound as population size decreased, demonstrating that the choice of management strategy becomes increasingly important as population size decreases (Supporting Information Table S1a). For range-restricted species such as bison, where habitat is limited and populations must be maintained at particular target sizes, management has historically focused on removal strategies based on demographic parameters to select individuals for cull. The advantage of such strategies is that they require only limited data and resources to implement. Our RANDOM culling strategy relied solely on demographic data (an individual's age and sex) to inform culls. At the end of 500 years, the RANDOM strategy yielded the lowest allelic richness, observed heterozygosity and *GD*, as well as the highest average inbreeding of the three tested culling strategies (Table 2). Further, the RANDOM, as well as the MAF, culling strategies exhibited high variance in measures of genetic variation across iterations, indicating less predictability in the outcome of these strategies and potentially important impacts on population persistence. These results indicate that although demographically based removal strategies can be easy to implement and effective at maintaining sex and age ratios, incorporating genetic data into culling decisions improves a population's long-term retention of genetic variation and thus, its adaptive potential.

We tested two alternative culling strategies (MAF and MK) that utilized genetic data. Although such strategies require additional resources and can be challenging to implement when compared to a demographically based removal strategy, both our MAF and MK strategies generally performed better at retaining genetic variation and limiting inbreeding than our RANDOM strategy. The MAF strategy was designed to maximize the retention of genetic variation by conserving as many different alleles as possible within a target set of loci used to inform culls. A perceived advantage

of this strategy was that it did not designate particular alleles as important or 'conservation-worthy', but rather aimed to conserve as many alleles as possible at as equal frequencies as possible. In theory, such an allele conservation strategy could produce a population with a higher heterozygosity than was present prior to management actions by creating more equal allele frequencies than existed in the founder population. This result was in fact observed, with the MAF strategy consistently retaining both the highest heterozygosity and allelic diversity at the suite of target loci used to inform culls (Table 2; Fig. 2). A potential drawback of this culling technique was that it aimed to maximize genetic variation at specific target loci with no regard for how the rest of the genome might be affected. In fact, although the MAF strategy effectively maximized genetic variation at a suite of target loci, it was ineffective in maintaining genetic variation at non-target loci and thus genome-wide variation. In contrast, the MK culling strategy performed the best at maximizing the retention of genome-wide variation (Table 2; Fig. 2). Therefore, of the three culling strategies tested, we found the MK strategy to be the superior method of culling intensively managed wildlife populations with respect to genome-wide measures of variation and inbreeding.

Our MK culling strategy is similar in concept to the pedigree-based strategies used by captive breeding programs that utilize MK for selecting breeding pairs (Ivy & Lacy, 2012). Pedigree-based breeding strategies that minimize the overall kinship in a population have been shown by both computer simulations (Ballou & Lacy, 1995; Fernández & Toro, 1999; Sonesson & Meuwissen, 2001) and empirical data (Montgomery *et al.*, 1997) to be the best strategies for retaining genetic variation, while limiting inbreeding, in conservation breeding programs. Our data extend these findings to demonstrate that our MK strategy outperformed both alternative strategies at limiting inbreeding and retaining genome-wide variation (as measured by pedigree-based measures and empirically calculated heterozygosity at a suite of non-target loci; Table 2). Although previous evaluations of pedigree-based culling strategies for wildlife management are rare (but see Eggert *et al.*, 2010), it is perhaps not surprising that our data support the utility of pedigree-based approaches to directly manage genetic variation in wildlife populations. An individual's MK is a measure of its genetic distinctiveness in a population; individuals with low MKs have few relatives and rare alleles, while individuals with high MKs have many relatives and common alleles. Thus, by preferentially selecting individuals with low MKs to breed, conservation breeding programs equalize, to the extent possible, the genetic representations of a population's founders and thereby maximize the retention of genetic variation over time. Our simulations indicate that MKs also are useful for selecting individuals to cull because such a strategy similarly equalizes founder genome representations by preferentially removing individuals whose genomes are over-represented in the population as a whole.

Better retention of genetic variation through direct genetic management has been demonstrated when selecting breeders to maintain captive populations (Ballou & Lacy, 1995; Ortega-Villaizan, Noguchi & Taniguchi, 2011) and choosing individuals for reintroductions (Haig *et al.*, 1990; Miller *et al.*, 2009; Jamieson, 2010; Tracy *et al.*, 2011). However, the stipulation that direct genetic management should focus on genomic measures of variation is important. Hedrick & Miller (1994) simulated captive breeding strategies that prioritized the retention of alleles at a suite of functional immune genes, the major histocompatibility complex (MHC), and observed the effect on variation across the rest of the genome. The authors characterized genome-wide reductions in genetic variation and fitness associated with selection for variation at the MHC and urged caution in the use of this genetic management technique due to its impact on variation at non-target portions of the genome. Although we did not model effects on functional loci, the decrease in genome-wide variation with the MAF strategy, and the associated increase in inbreeding, also could be expected to lead to detrimental declines in fitness (Charlesworth & Charlesworth, 1999). Furthermore, results similar to those reported by Hedrick & Miller (1994) are expected when selecting for variation at neutral loci, particularly if the effects of genetic hitchhiking are strong (Charlesworth & Guttman, 1996; Hey, 1999; Otto, 2000). Our results further support this assertion by demonstrating that our MAF strategy, which retained high allelic diversity and heterozygosity at targeted neutral loci, retained less variation at non-target loci than a strategy that utilized a genomic measure of variation for decisions (our MK strategy). If many more loci were used in the target panel, genetic diversity estimates would more closely approximate genome-wide variation (Miller *et al.*, 2014). This should yield convergent allelic richness and heterozygosity values for target and non-target loci as the MAF strategy was applied over time. Additional research would be necessary, however, to determine the degree of convergence between the overall results of the MAF and MK strategies when using increasing numbers of loci. There is a fundamental difference between culling individuals with common alleles (MAF) and culling those that are, on average, highly related to the population (MK). As an example, consider two full-siblings; while the MK strategy would treat those individuals as genetically identical and interchangeable, the MAF strategy would prioritize one over the other for cull based on which happened to receive more 'common' alleles through Mendelian inheritance. Thus, given these complexities, more research is warranted to determine the number of loci at which the MAF strategy is expected to converge with, or even possibly surpass, the MK strategy performance.

Our results suggest wildlife management strategies that incorporate goals for retaining genetic variation are better suited to preserving the evolutionary potential of wildlife populations than those that focus solely on a target size and demographic stability. Declines in genetic variation not only limit the evolutionary potential of a population, but can also have direct and immediate effects on factors such as the response to diseases and new pathogens (O'Brien & Evermann, 1988). For these reasons, bison are an exemplary example of a species in need of genetic management. Bison, as a species, underwent a severe bottleneck in the late

1800s, and were further bottlenecked as conservation herds were founded with few individuals. Thus, all contemporary bison populations can be assumed to have accumulated some level of inbreeding, with Hedrick (2009) estimating 0.367 inbreeding (equal to two generations of full sibling matings) in the Texas State Bison Herd. Although the direct effects of inbreeding in bison are unclear, even small amounts of inbreeding have been correlated with the susceptibility to bacterial disease in other wildlife populations (Acevedo-Whitehouse *et al.*, 2003). Historical erosion of genetic variation due to severe bottlenecks, serial founding events, and current levels of inbreeding make the preservation of remaining genetic variation through effective management strategies even more imperative to the persistence of bison.

Although the focus of our research was to evaluate culling strategies for wildlife populations managed *in situ*, our results also are applicable to captive population management. Although using euthanasia as a management tool is controversial in these settings (Penfold *et al.*, 2014), there are a number of challenges that culling could address. For example, management euthanasia of post-reproductive animals not critical to a population's social structure could be utilized to free 'space' that would allow for additional breeding in populations that are tightly maintained at carrying capacity (Lacy, 1991). A second application of management euthanasia, similar in concept to the culling scenario described for bison, is the removal of surplus offspring produced when specific breeding recommendations cannot be implemented. Species maintained in herds, flocks, schools or other similar groups (e.g. antelope, flamingos, bats, fish, frogs) can only be loosely managed by MK-based breeding strategies because specific breeding pairs cannot be dictated. Although the long-term genetic impacts of MK-based management euthanasia have not been tested against those of imperfect MK-based breeding strategies, we speculate that culling would provide greater long-term genetic benefits.

Finally, one of the more compelling reasons for captive breeding programs to consider management euthanasia is related to reproductive health. Penfold *et al.* (2014) summarized data for a set of taxonomically diverse species (including canids, felids, rhinoceros, bats, wildebeest and stingrays); their findings suggested that prolonged interruptions in breeding (such as produced with some forms of contraception), during which a female does not produce offspring, can jeopardize a female's future fertility and increase probabilities of uterine pathologies. To help ensure both female reproductive health and population viability, the authors suggested that captive breeding programs could adopt mixed management strategies that breed genetically valuable females at more regular intervals while judiciously using all available tools, including both culling and contraception, to manage the number of offspring produced (Penfold *et al.*, 2014). If such strategies are indeed to be adopted by captive breeding programs, our research suggests that modifying the pedigree-based breeding strategies already in use to cull genetically over-represented individuals would provide the greatest long-term genetic benefits.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Figure S1. Model flow for each simulation.
Figure S2. Mortality functions for males (solid red line) and females (dotted black line) were generated using known average adult mortality (0.05 for males; 0.03 for females), juvenile mortality (0.05), and age expectancy for the Fort Niobrara bison herd.
Table S1. Genetic variation measures averaged over 1000 iterations from the 500-year time step of the sensitivity analysis reflecting the genetic variation measures under each culling strategy with (a) different target population sizes (200, 500 and 1000), (b) with different proportions of the male population of breeding age able to breed (25%, 50% 100%), and (c) and alternative levels of mortality (200%, 300% and 400% of original).

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Bison Conservation Genetics Workshop: Report and Recommendations

Natural Resource Report NPS/NRPC/BRMD/NRR—2010/257



ON THE COVER
Bison grazing at the National Bison Range in Montana
Photograph by Ryan Hagerty, USFWS

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Executive Summary

One of the first outcomes of the Department of the Interior (DOI) Bison Conservation Initiative was the Bison Conservation Genetics Workshop held in Nebraska in September 2008. The workshop brought together scientists from government agencies and non-governmental organizations with professional population geneticists to develop guidance for the genetic management of the federal bison herds. The scientists agreed on the basic tenets of genetic management for the DOI herds and discussed different approaches to meeting those goals.

First, the 12 DOI herds are an irreplaceable resource for the long-term conservation of North American plains bison. Most of the herds show low levels of cattle introgression dating from the time when they were saved from extirpation; those herds should not be mixed without careful consideration as to their origin. Herds that show no evidence of cattle ancestry by the current molecular methods are the highest priority for protection from genetic mixing with any other bison herds.

Second, despite the fact that most of the herds now managed by the U.S. government were founded with very few bison and have been maintained for many generations at relatively low population sizes, they do not show obvious effects of inbreeding. They have retained significant amounts of genetic variation by the standard measures, heterozygosity and allelic diversity. This may be explained in part by the fact that most of these herds are not remnants of a single population.

Third, to preserve genetic variation in federal bison herds over decades and centuries, herds should be managed at a population or metapopulation level of 1,000 animals or more, with a sex ratio that enables competition between breeding bulls. The parks and refuges that currently have bison herds, with the exception of Yellowstone National Park, do not have enough land to support a population of this size. In the short term, it will be important to develop satellite herds to attain population targets, and develop a metapopulation structure between herds.

Fourth and finally, the current methods used to evaluate the DOI bison herds, using mitochondrial DNA and a suite of nuclear DNA microsatellites, are highly informative at the herd level. They have confirmed relatedness of herds that we know from historical records have a common origin. They have detected cattle ancestry in most of the herds where it was suspected and have shown some loss of rare alleles. However, they do not sample across the bison genome, and the use of neutral genetic markers as the basis for selection of individual bison—either to breed or move to other herds—would be better supported by more high-resolution molecular methods currently under development.

Introduction

Bison are an iconic animal of the American frontier, represented on both the Department of the Interior (DOI) seal and the National Park Service (NPS) arrowhead. The first principle of DOI Bison Conservation Initiative was to base management of its herds on the best available science. One of the priorities of the initiative was to convene a conservation genetics workshop focused on bison to develop genetic management guidelines, including the appropriate role in future conservation actions for bison with cattle ancestry. The NPS organized the workshop at the Lied Lodge on September 2–5, 2008, and brought together a diverse group of scientists to identify and recommend management actions and research needs important to the conservation genetics of DOI bison herds.

The DOI Bison Genetics Workshop came out of significant recent developments in North American bison conservation. Renewed public interest in bison, both as a natural food source and for their historic ecological role in western landscapes, underscored the importance of the DOI bison herds in conservation of the species. At the same time, recent published studies advanced understanding of the genetic status of these bison herds.

The workshop brought together population geneticists and other biologists from the Department of the Interior, Canadian Wildlife Service, Parks Canada, Texas Parks and Wildlife, academic institutions, and non-governmental organizations, including conservation organizations and zoos (see Appendix A for a participant list). The perspective of zoos was important, as most government herds, while roaming over large areas, are still captive populations facing fences and annual round-ups. The group heard presentations on the history of conservation of North American bison and the government role in these conservation efforts, reviewed the general principles for maintaining allelic diversity within a species, and received reports on the status of DOI bison herds addressing issues of allelic diversity and introgression of livestock genes in the North American bison genome (see Appendix B for the workshop agenda).

While there was agreement on the principles that should guide the management of DOI bison herds, consensus on the management practices that would best achieve those genetic principles was not achieved in the three-day meeting. To provide clear guidance, this report has been through multiple drafts. Workshop participants Peter Dratch, Eric Lonsdorf, and Peter Gogan and NPS writer-editor Virginia Reams all contributed to writing the final report, and most of those who attended the workshop have made substantial comments to the drafts. The recommendations primarily represent the views of the population geneticists that gave their time to address the challenge of conserving North American bison on the timescale of centuries.

The participants were asked to address three questions important to the public in developing the guidelines:

1) What criteria best describe a herd of wild bison?

2) How well do bison herds under DOI management authority meet the criteria for wild bison?

3) What steps can be taken to ensure that management of the DOI herds contributes to the future of wild bison in North America?

The participants established the criteria for a wild bison herd as one with a large enough population size to prevent loss of genetic variation and with low levels of cattle or subspecies introgression, and subject to some of the forces of natural selection, including competition for breeding opportunities. The desired minimum size of a population to maintain genetic variation in bison over two centuries is estimated at 1,000 individuals (Gross and Wang 2005, Gross et al. 2006, Boyd et al. 2010). This could be achieved through establishment of a single population or management of several smaller populations as a metapopulation. While recognizing that hybridization with cattle was not natural, and mixing between bison subspecies rare, participants discussed a threshold of cattle ancestry (all of the DOI herds have less than 2% cattle genes for currently used DNA markers) in evaluation of DOI bison herds. This definition of wild bison is more restrictive than that of a bison "conservation herd," which may be defined as any herd managed by a government or non-government organization with the primary mission of nature conservation (Gates and Ellison 2010).

While the group looked at the history of both plains bison and wood bison in North America, the recommendations focus on plains bison herds in the United States managed by DOI. Addressing the question of how well do DOI bison herds meet the criteria for wild bison, the participants noted that DOI herds meet the basic threshold for genetic integrity. However, most herds are managed at numbers well below a population size of 1,000, and there are no management plans in place to manage any group of spatially isolated herds as a metapopulation. In addition, the herds are not of equal value for long-term conservation of bison.

There was a consensus among workshop participants that herds with no evidence of cattle hybridization are particularly important resources that must be safeguarded from potential introgression of livestock genes. Lineages within all DOI herds that are representative of historical conservation efforts and confirmed by genetic analysis of herds should be preserved until issues of livestock introgression are resolved with DNA analysis at higher resolution. While no DOI herds are currently subject to the full range of historic natural selective forces that influence genetic variation, management actions should maximize population size, minimize selection for docility and other traits related to domestication, strive for an even sex ratio considering differential survival, and minimally interfere with social behavior.

Finally, the DOI bison herds have a crucially important role in long-term bison conservation. Almost all herds must be increased in size to avoid negative genetic effects on a decades-to-century time scale (Gross et al. 2006). Since DOI herds are generally at or near capacity within federal boundaries, establishing satellite herds that can contribute to metapopulations is an important first step. Further, managing bison herds across current jurisdictional boundaries is an important step to long-term bison conservation. The DOI herds also are valuable source bison with which to start new conservation herds proposed by other federal, state/provincial, or tribal governments/First Nations, and others. Any new efforts should move toward establishing satellite herds that can eventually serve as interbreeding populations or metapopulations with total herd sizes of 1,000 bison to sustain genetically healthy animals over time.

Background

Brief History of American Bison Conservation

The American bison (*Bison bison*) is an icon of the conservation movement in North America. It was one of the first animals that stirred citizens and governments to intervene on behalf of a species on the verge of extinction (Coder 1975, Lothian 1981). Due largely to commercial, sport, and subsistence hunting, as well as possibly exotic bovine diseases and forage competition with domestic stock (Flores 1991), plains bison (*B. b. bison*) were reduced from tens of millions at the time of European colonization (Shaw 1995) to a few hundred by the mid-1880s (Hornaday 1889, Isenberg 2000). The other subspecies of American bison, the wood bison (*B. b. athabascae*), an inhabitant of the woodlands of northern Canada and Alaska, was reduced to an estimated 250 animals by the end of the 19th century (Hornaday 1889, Soper 1941).

While there was sentiment in the 1800s to halt the destruction of bison in North America (Dary 1989), protective legislation in Canada and the United States was not enacted until bison were near extinction. In Canada, the 1877 Buffalo Protection Act was the first attempt to legislate protection (Hewitt 1921). This measure was ineffective, however, due to lack of enforcement. In 1894, the Dominion Government passed a law protecting the surviving wood bison (Soper 1941); by this time, wild plains bison were extirpated in Canada. Plains bison were extirpated from Mexico by the 1820s (List et al. 2007).

Plains bison disappeared from the wild in the United States except in Yellowstone National Park (NP). The states of Idaho, Wyoming, and Montana implemented statutes to reduce the killing of game, including bison, between 1864 and 1872, but—like the 1877 Canadian measure—these laws were largely ineffective due to limited enforcement. The Act to Protect the Birds and Animals in Yellowstone National Park and to Punish Crimes in Said Park was signed by President Grover Cleveland in 1894, halting the extirpation of the last free-ranging plains bison population in North America (Meagher 1973). By 1902, however, fewer than 50 wild bison were estimated to remain in the remote Pelican Valley of Yellowstone NP (Meagher 1973).

Plains bison were saved from extinction by the independent actions of private citizens (Dary 1989, Coder 1975). Between 1873 and 1889, several individuals in locations ranging from Manitoba to Texas captured the last of the wild plains bison, except for the few remaining in Yellowstone NP. William Hornaday, director of the New York Zoological Park, and other wildlife advocates concerned about the loss of this symbol of the American West formed the American Bison Society (ABS) in 1905. The ABS successfully lobbied for the creation of several public reserves in the United States, which the ABS then populated with bison from private herds and the Bronx Zoo (Coder 1975, Isenberg 2000).

In Canada, the national parks system first became involved in plains bison conservation in 1897 when three animals were purchased from Charles Goodnight in Texas. A more significant early contribution by the Canadian government occurred in 1907 when it purchased the privately owned Pablo-Allard herd in Montana. The herd was shipped first to Elk Island National Park, then on to a new park, Buffalo National Park, in the grasslands of east-central Alberta (Lothian 1981, Brower 2008). With protection, the numbers of plains bison increased rapidly, and the danger of extinction was averted in both countries (Hornaday 1927, Potter et al. 2010).

The early efforts to save the bison at a crucial time have rightfully been regarded as a conservation success story. The best current estimate is that about 430,000 plains and wood bison now exist in North America (Gates and Ellison 2010). Of these, only 20,500 plains bison and 11,000 wood bison are in publicly owned herds (Gates and Ellison 2010); the remainder are privately owned. Plains bison are classified as endangered in Mexico (Aune and Wallen 2010). Wood bison are classified as endangered under the U.S. Endangered Species Act and threatened under Canada's Species at Risk Act (Aune and Wallen 2010).

Many Indian tribes and First Nations maintain bison herds for cultural, nutritional, and commercial purposes. Some of these herds have the potential to contribute to species conservation. Most privately owned plains bison today are selected for meat production, protected from natural predators, and managed as small herds in fenced paddocks. More than 90% were founded with animals that have evidence of cattle ancestry and show significant amounts of cattle introgression. These herds are not considered wild and are not included in conservation planning for the species. Most publicly owned plains bison populations in North America are directly descended from only a few founders—an effective population size of fewer than 50 (Hedrick 2009). They constitute a critical resource for long-term bison conservation.

Department of the Interior agencies (the National Park Service and U.S. Fish and Wildlife Service [USFWS]) have a record of cooperation in bison management (see Appendix C for detailed histories of the DOI bison herds). Bison from the Pablo-Allard herd (now National Bison Range) and Goodnight herd (now Texas State Bison Herd) were provided to augment the remnant herd at Yellowstone NP in 1902 (Coder 1975, Meagher 1973). Yellowstone NP bison were provided to found a bison herd at Fort Niobrara National Wildlife Refuge (NWR) in 1913 (Coder 1975, Halbert 2003, Halbert and Derr 2007a). Similarly, in 1956 bison from Fort Niobrara NWR were the source stock used to establish bison herds within the North and South units of Theodore Roosevelt NP. This latter group of three herds constitutes a metapopulation (Halbert 2003, Halbert and Derr 2007a). The bison herd at Badlands NP was established with animals from Fort Niobrara NWR and the South Unit of Theodore NP in 1963 and augmented with bison from the former herd at Colorado National Monument in 1983 (Berger and Cunningham 1994).

The New York Zoological Park also cooperated extensively in the establishment of DOI bison herds: the bison herd at Wind Cave NP was established with bison from New York Zoological Park in 1913 and Yellowstone NP in 1916. The bison herd at Wichita Mountains NWR was established with bison from the New York Zoological Park in 1907 (Coder 1975, Halbert 2003, Halbert and Derr 2007a). The known genetic relatedness of contemporary DOI bison herds is depicted in Figure 1.

The Department of the Interior is the primary federal agency for management of bison within the United States. Currently, the Department of the Interior maintains exclusive management authority over 12 plains bison herds at 10 locations (Table 1). Two additional herds at two sites are managed under cooperative plans with the states of Montana and Wyoming, respectively (Gates and Ellison 2010, Aune and Wallen 2010). Of these, the National Park Service maintains exclusive management authority for bison within Yellowstone and Grand Teton national parks. Yellowstone bison are managed by the State of Montana beyond the park boundaries. The interagency management plan calls for more aggressive management of bison when they leave

the park when population estimates exceed 3,000 (USDI and USDA 2000, Plumb et al. 2009). Jackson bison are managed cooperatively by the National Park Service within Grand Teton NP, the U.S. Fish and Wildlife Service on the National Elk Refuge (NER), and the State of Wyoming on lands adjacent to Grand Teton NP and the NER. The target population objective for the Jackson herd is approximately 500 bison (USFWS and NPS 2007). Most herds managed by the Department of the Interior are relatively small, genetically isolated, and separated from natural predators. Some show evidence of cattle ancestry, and some do not (Table 1).

Management recommendations need to consider the consequences of small population size for genetic health as well as the prevention of further introgression of cattle genes, particularly into bison herds with no evidence of hybridization. For each major concern (genetic diversity and cattle ancestry), we present background and specific recommendations based upon our current knowledge and suggest research needs where additional information may be required. Current information on genetic variation in the DOI bison herds is summarized in Table 1. The U.S. Fish and Wildlife Service has implemented translocations of bison within herds under its management authority since completion of the assessment of genetic variation. The genetic status of the newly established herds is unknown.

General Principles for Maintaining Genetic Diversity in Bison

Effective population size (N_e) is an important measure used for the maintenance of genetic diversity. Genetic drift leads to the loss of genetic diversity, and the rate of loss is expected to correlate negatively with effective population size (Hartl and Clark 2007). Declining genetic diversity and increasing inbreeding depression may interact with the stochastic process of genetic drift (Hartl and Clark 2007) and demographic stochasticity to amplify extinction risk in small populations (Saccheri et al. 1998, Westemeier et al. 1998).

Genetic drift resulting in declining allelic diversity within populations along with reductions in gene flow between populations is of particular concern for species such as bison that evolved in large, outcrossing populations. Genetic drift leads to reduced performance in many fitness-related traits (Menges 1991, Keller and Waller 2002). Small and isolated populations are more prone to extinction than larger populations due to the consequences of demographic, genetic, and environmental stochasticity (Lande 1988).

Loss of genetic variation in bison herds is more likely when the number of breeding animals is small. Our best estimates are that bison populations can generally be considered of sufficient size for genetic purposes when the population size is 1,000 animals or more and the size of the population is stable over time. A population must have a sufficient number of mature bulls to enable breeding competition. In all populations, the expected loss of genetic diversity over time is directly related to how rapidly individuals in a population replace themselves (generation time) and to the effective population size. Most guidelines for genetic management can be understood in the context of just these two factors.

Biologists are concerned about the genetic health of bison herds because all North American herds were founded by a few individuals and have generally been maintained at small population sizes (Boyd et al. 2010). Most DOI herds were established from groups of 20–50 bison (Halbert 2003, Halbert and Derr 2008), and DOI herds have largely been managed to maintain a size of fewer than 500 animals. The relatively small size and isolation of most DOI bison herds has led

to concerns about their long-term genetic health. A summary provided by Halbert and Derr (Table 1) of the current state of bison genetic diversity indicates that genetic drift may already be causing a detectable loss of allelic diversity. For example, rare alleles present in bison at both units of Theodore Roosevelt NP are no longer present in the source population at Fort Niobrara NWR.

The status of the Texas State Bison Herd underscores the potential problems with maintaining small, isolated populations of bison. The interplay of a small number of founder animals, subsequent bottlenecks in population size, and long-term small population size with genetic drift has resulted in low levels of genetic diversity (Halbert 2003, Halbert et al. 2004). This contributed to high calf mortality and low recruitment rates. Population viability analysis predicted the demise of the herd within 50 years without the infusion of genetic material from another bison herd (Halbert 2003, Halbert et al. 2004). Bison bulls were brought in for breeding with an immediate positive effect (D. Sweptson, pers. comm., 2008)

Current Evidence of Cattle Ancestry

Bison and domestic cattle (*Bos taurus*) can produce fertile offspring from human-controlled crosses (Jones 1907; Boyd 1908, 1914; Goodnight 1914). The two species are not known to produce hybrids naturally, and even carefully controlled crosses result in a low birthrate of viable first-generation hybrid offspring (Boyd 1908, Steklenev and Yasinetskaya 1982). In addition, most viable offspring are female, as are first generation backcrosses (Boyd 1908, Hedrick 2009). This typically leads to higher levels of mtDNA than autosomal DNA in introgressed bison herds (Hedrick 2010).

Each of the ranchers involved in establishing the five plains bison foundation herds in the late 1800s either experimented with domestic cattle-bison crosses or purchased bison from others who were involved in such experiments (Garretson 1938, Coder 1975, Brower 2008). Consequently, both mitochondrial (Polziehn et al. 1995, Ward et al. 1999) and nuclear (Halbert et al. 2005) evidence of domestic cattle ancestry has been identified in both public and private plains bison herds (Halbert and Derr 2007a). In a recent study, 14 unlinked microsatellite markers with non-overlapping allele size ranges between bison and domestic cattle were used to identify bison populations with evidence of nuclear domestic cattle introgression; regions of introgression were subsequently confirmed through analysis of microsatellites linked to the original diagnostic loci (Halbert et al. 2005). To date, evidence of mitochondrial or nuclear domestic cattle gene introgression has been identified in all but six of 14 U.S. and Canadian public bison populations (Ward et al. 1999, Halbert et al. 2005, Halbert and Derr 2007a). Only one of the more than 50 private bison herds examined to date showed no evidence of cattle gene introgression (J. N. Derr, pers. comm.).

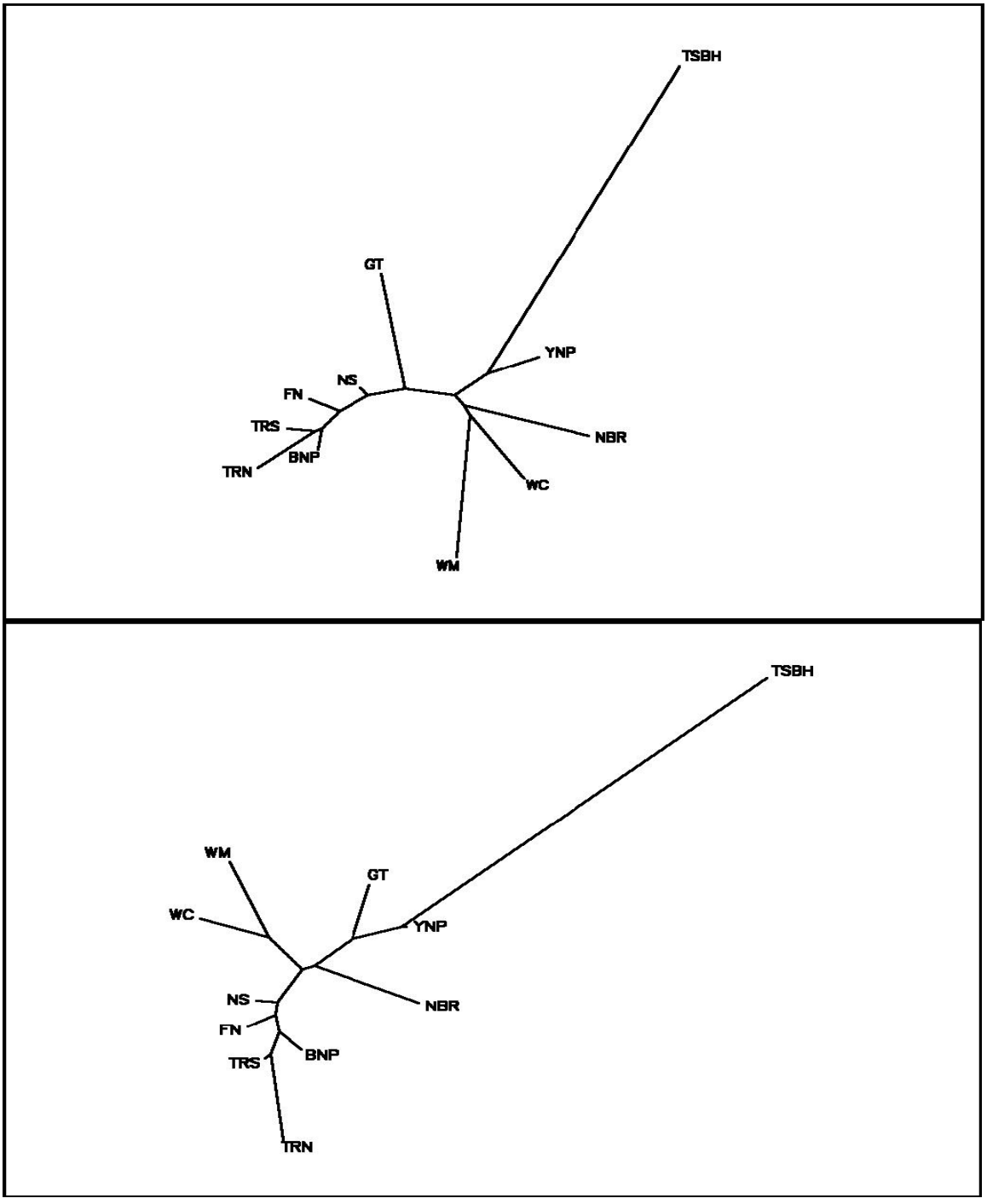


Figure 1. Neighbor-joining tree diagrams for DS (top) and $(\delta\mu)^2$ (bottom) distance measures for DOI bison herds as of 2003 (Halbert 2003:50). Herd abbreviations as in Table 1. TBSH is the Texas State Bison Herd; NS herd in these diagrams no longer exists.

Table 1. Summary of herd size and indicators of genetic diversity for U.S. Department of the Interior bison herds (after Halbert and Derr 2007a; Halbert et al. 2008; L. Jones, pers. comm. 2010, Robert Schnabel, pers. comm. 2010).

Herd name (abbreviation)	Estimated population size	Introgression present[a]	Allelic richness[c]	Expected heterozygosity[d]	Average F_{ST}[e]	Unreplicated conservation unit[h]
Fort Niobrara NWR (FN) – original herd	290	Yes	4.23	65.1	0.106	
Ft. Niobrara NWR (FNSH) – formerly located at Sullys Hill*	61	Suggested[b]	3.91	59.9	NA[f]	
Theodore Roosevelt NP – North (TRN)	312	Yes	3.16	52.2	0.139[g]	
Theodore Roosevelt NP – South (TRS)	371	Yes	3.80	58.2	0.111	
National Bison Range (NBR)	350	Yes	4.51	66.4	0.133	Yes
Neal Smith NWR (NS)**	71	Suggested[b]	4.43	66.8		
Rocky Mountain Arsenal (RMA)***	44	Suggested[b]	4.44	64.2		
Wichita Mountains NWR (WM)	650	Yes	4.16	61.2	0.149	Yes
Badlands NP (BNP)	875	Yes	3.86	57.8	0.107	
Grand Teton NP (GT)	900	Suggested[b]	3.19	53.5	NA[f]	
Wind Cave NP (WC)	350	Suggested[b]	4.29	65.2	0.123	Yes
Yellowstone NP (YNP)	3,000****	None detected	4.15	62.5	0.133	Yes

[a] Based on mitochondrial DNA typing following Ward et al. 1999 and a panel of 14 nuclear microsatellites following Halbert et al. 2005.
[b] Introgression was not directly detected in these herds using microsatellite markers, but it is highly suggested due to the source of the herd and/or initial testing using single nucleotide polymorphisms (Robert Schnabel, pers .comm.).
[c] R_A, average of allelic richness values across markers; calculated based on a minimum sample size of 15 (El Mousadik and Petit 1996).
[d] H_E, average expected heterozygosity (Nei 1987).
[e] F_{ST} averaged across clusters assigned by STRUCTURE (Evanno et al. 2005) analysis.
[f] These (composite) herds were assigned to multiple clusters. Average F_{ST} calculations not possible.
[g] The TRN herd is directly descended from the TRS herd, which was in turn derived directly from the FN herd. It is well-established from other indices that these three herds (TRN, TRS, and FN) are closely related. Drift has likely acted to drive allele frequencies within this herd and differentiation of this herd such that inflated average F_{ST} values are detected.
[h] Based on analysis of herd contribution to overall diversity, following Petit et al. 1998. These herds represent unique sources of bison diversity which is unreplicated among the DOI herds.
* The entire Sullys Hill herd was moved to Fort Niobrara NWR in 2006. They are maintained separately from the original Fort Niobrara herd.
** Based on genetic evaluation, in 2006, all bison at Neal Smith were donated to a local Native American tribe, and a new herd was established with 39 bison from the National Bison Range.
*** Established with bison from the National Bison Range in 2006–2007.
**** Yellowstone bison of are two distinct but closely related types (Halbert and Derr 2007b, Gardipee 2007).

Workshop Recommendations

Recommendations emerging from the Bison Genetics Workshop addressed the two long-term challenges facing DOI herds where genetic conservation is a primary management goal: actions to limit the effects of historical introgression and actions to maintain genetic diversity. Implementing the following actions will help sustain the genetic integrity of DOI bison herds. In addressing these challenges, research recommendations are made to resolve identified uncertainty and to allow for more informed decision-making in the future. These recommendations are summarized in Tables 2, 3, and 4.

Management to Limit Introgression

We recommend management actions that decrease or prevent the spread of cattle ancestry in any existing herds or new conservation herds.

Because of the cattle-bison hybridization that occurred in private herds when plains bison were saved from extinction in the 1800s and because animals from those herds were used to found or augment the DOI herds, no herd can be absolutely assured to have no cattle ancestry. That said, conservation herds, including those of the Department of the Interior, can be grouped into four classes: 1) those with no molecular evidence of cattle introgression; 2) those with molecular evidence of low levels of cattle introgression; 3) those with historical inference of cattle ancestry but no molecular evidence with the current DNA markers; and 4) those where molecular markers indicate high levels of cattle ancestry and/or recent hybridization with domestic cattle. We have specific recommendations for each of these classes, but all follow from the overarching recommendation to prevent the increase of bison with cattle ancestry in DOI herds.

1) No molecular evidence of cattle ancestry: Herds with no molecular evidence of cattle ancestry constitute a genetic resource that must be protected from inadvertent introgression. Yellowstone National Park has the only DOI herd where there is no suggestion of cattle introgression using all of the available molecular methods. The Yellowstone bison population requires further testing, as do non-DOI herds established with Yellowstone bison. There should be no introduction of bison to these herds from herds that show molecular evidence of cattle ancestry or for which the genetic status in unknown. High priority should be given to creating satellite herds for these herds on DOI-managed lands. Moreover, where the risk is great for inadvertent interbreeding with bison from adjacent herds that show high levels of cattle ancestry, herd boundaries should be secured by the appropriate means, trespass animals should be removed, and genetic testing should be conducted to confirm that the two herds are not mixing.

2) Molecular evidence of low-level cattle ancestry: Bison in DOI herds demonstrated to have detectable cattle ancestry at low levels have important genetic value and contain unique genetic variation that is absent from Yellowstone or other conservation herds with no molecular evidence of cattle ancestry. All DOI herds fall well below 2% of cattle genes at the current molecular markers and a threshold for conservation herds was suggested at the workshop. These herds should not be used to augment herds with no molecular evidence of cattle ancestry. While removal of individuals with cattle mtDNA haplotypes is warranted, selection on the basis of cattle alleles at nuclear loci could have unintended consequences of reducing overall variation. Herds with low levels of cattle ancestry that are not genetically unique should be the lowest

priority for herd expansion and transfer to other locations. The historical Fort Niobrara bison and the two bison herds at Theodore Roosevelt NP should be identified and managed as a metapopulation to ensure the persistence of rare alleles in all three herds.

The National Bison Range (NBR) herd is of interest because it represents a geographic lineage from the northern Montana region. An introduction of bison into this herd with molecular evidence of recent cattle introgression was reversed by DNA detection and swift management action (L. Garner, pers. comm. in Halbert 2003). Molecular evidence indicates that bison with introgressed cattle genes joined this herd prior to the 1980s (Halbert 2003, Halbert and Derr 2007a). Moreover, there are three state-owned plains bison herds in Alaska that may represent an unbranched lineage to the NBR herd that predates any introgression of cattle genes. If genetic testing identifies sufficient numbers of NBR-source bison free of cattle ancestry and with sufficient genetic variation, then the establishment of herds using these animals should be a high priority.

3) Historical suggestion of cattle ancestry: There is the possibility of cattle ancestry in all DOI herds, since those herds with no molecular evidence of cattle ancestry have Yellowstone origins and three male bison from the Goodnight herd (now Texas State Bison Herd) were introduced to Yellowstone in 1902 (Coder 1975, Meagher 1973). It is not clear whether cattle-bison breeding experiments had begun in the Goodnight herd prior to translocation of bull bison to Yellowstone NP, or whether he would have sent hybrids to Yellowstone NP. In some cases, the historical suggestion is stronger, such as with the Grand Teton/National Elk Refuge herd, which was augmented with 12 bison from Theodore Roosevelt NP, where cattle ancestry had been detected in 1964. To date there is no molecular evidence that these animals contributed to the current population (Halbert and Derr 2007a). In this case, as in others, higher resolution DNA testing may reveal traces of cattle ancestry, but the herds nonetheless have an important contribution to bison conservation.

4) Molecular evidence of higher levels of cattle ancestry: This category does not apply to any DOI herds but does apply to a number of other conservation herds that border DOI lands. Because the goal is for some DOI bison herds to move across landscapes and jurisdictions, evaluation of neighboring herds is important. When the level of cattle introgression is high, augmentation or systematic herd replacement should be considered, using animals made available from DOI herds or other sources that represent the same lineages. Genetic monitoring is a key part of management to determine the effectiveness of these efforts.

Management to Retain Genetic Diversity

We recommend that each DOI herd achieve a population size of 1,000 animals in the next 10 years. This can include identification of existing satellite and closely related herds, as well as the establishment of new satellite herds to achieve metapopulations of 1,000 bison.

With respect to the risk of losing genetic diversity, it is well understood that population size is a strong correlate of the rate of loss of genetic diversity. Therefore, we group DOI herds into three population size classes: 1) those with a population of greater than 1,000 bison; 2) those with between 500 and 1000 bison; and 3) those with fewer than 500 bison. We have specific

recommendations for each of these classes, but all follow from the overarching need to prevent the loss of genetic diversity by creating large herds. The last of these categories requires the most attention and additional research to resolve uncertainty regarding how best to slow the loss of genetic diversity.

1) Populations estimated at greater than 1,000: Yellowstone bison constitute the only DOI herd with a population size greater than 1,000, and even in this population the degree of genetic structure within the entire herd is unresolved (Halbert 2003, Gardipee 2007). In addition, the current practice of culling bison at the park's boundaries may lead to the removal of matrilineal groups and thereby allelic diversity (Halbert 2003). Further assessments of population substructure and the potential impacts of the current culling practices are recommended.

2) Populations estimated at 500–1,000: Three current herds—Wichita Mountains National Wildlife Refuge (WM), Badlands National Park (BNP), and Grand Teton/Elk Refuge (GT/NER)—have estimated population sizes greater than 500, and herd-specific management plans should be created for each within the next five years. The goal of these plans would be to manage each herd to approach 1,000 bison, either as a single herd or by creating metapopulations with formal plans for moving animals within metapopulations. The plans should ensure that there is no risk of interbreeding with other bison of uncertain genetic status or with known cattle introgression. These populations should be monitored for changes in heterozygosity and other measures of genetic diversity to ensure maintenance of genetic diversity and monitored for signs of demographic fitness changes (e.g., mating rates, reproduction, and survival).

3) Populations below 500: The remaining nine herds are at risk due to the loss of genetic diversity. We recommend immediate and aggressive actions to increase the size of these herds. A combination of actions may be needed to prevent rapid loss of diversity. Within this critical population size class, we have a set of recommended management actions and recommended research to support more effective small-population management.

Small-population management

First, because many of these small herds are limited by the size of their park or reserve, we recommend reviewing current unit management plans to explore the possibility of increasing the size of each bison herd to greater than 500. This may be achieved by establishing satellite herds to comprise a metapopulation, adjusting the abundance of other ungulate populations, and increasing bison carrying capacity by range expansion through identification of neighbors willing to have bison on their lands.

Second, intensive genetic and demographic management of the herds is vital to slowing the loss of genetic diversity. We recommend that several actions be taken until these populations can be increased:

- *Maintain stable population sizes*: Based on well-established genetic population theory, fluctuations in population size increase the rate of genetic loss. Any necessary population reductions should be small and frequent to create minor adjustments as opposed to large and infrequent adjustments.

- *Maximize the number of breeding males*: Observation has shown that there can be strong sexual selection in small bison herds. That is, the majority of offspring come from a small proportion of males, which reduces the effective population size and increases the loss of genetic diversity over time. As an initial step, we recommend using DNA methods to measure genetic contribution of individual males in small isolated herds. Restricting the breeding opportunity of successful bulls, however, should not be a routine practice.

- *Approach a 1:1 sex ratio:* We know from genetic theory that the loss of genetic diversity is slowest when the number of males approaches the number of females. In small herds, chance events (demographic stochasticity) can lead to uneven sex ratios. When the number of males drops below 40%, there is also the potential for reduced competition and loss of fitness. Culling and translocation plans should strive to approach an even sex ratio in herds, considering differential mortality.

- *Remove young animals:* When herd size is limited by carrying capacity and bison are removed annually (or every other year), more young bison should be removed to reflect natural predation mortality. In the smallest of herds, the loss of genetic diversity can be reduced by increasing the age of reproduction (Gross et al. 2006). It is suggested that herd demographics in small populations should be influenced by culling and providing young animals to establish new herds rather than through contraception.

- *Increase genetic diversity*: Finally, we recommend augmenting herds with additional animals if genetic testing for heterozygosity shows results below 0.5. No DOI herd currently approaches this threshold, but it has occurred in the Texas State Bison Herd when the herd also showed a substantial decline in reproduction. It is therefore important to also monitor fitness values and their possible decline. Augmentation with additional animals has increased genetic diversity and removed the manifestations of inbreeding depression in the Texas State Bison Herd and in other confined species**.** We recommend similar actions if any DOI herd experiences symptoms of poor genetic health, and we recommend following the guidelines in the introgression section whenever translocation is performed.

Research Recommendations

We recommend the development and application of more high-resolution molecular markers to identify the presence of cattle ancestry in existing herds, to prevent the spread of cattle ancestry to new conservation herds, and to monitor the genetic variation in DOI herds.

Continue to identify and develop a suite of molecular markers, including single nucleotide polymorphisms that are used for on-going genetic sampling of all DOI herds. Encourage other managers of conservation herds to apply the markers and protocols to their bison herds. New markers should be evaluated in peer-reviewed literature before they are added to herd genetic-sampling protocols.

Research to address uncertainty in small-population management

We know that the bison population sizes of 1,000 and 500, whether they represent survey, census, or breeding numbers, are significantly below the effective population size that many population geneticists see as necessary to secure genetic variation in bison over centuries. Theoretically the loss of genetic diversity is proportional to the effective population size (N_e, essentially, the number of individuals that contribute to breeding). We know that the effective population size of bison herds is lower than the breeding number and probably significantly lower than the estimated population size (N), but we do not know how much lower. To better manage small herds, we need more accurate estimates of the N_e/N ratio over time in existing populations and an analysis of the magnitude of the effect of factors that influence N_e/N (e.g., sex ratio, sexual selection, population age distribution, and other factors).

Intensive breeding management is being used in some of the smaller DOI herds, with all animals genetically screened and individuals selected so that all bison alleles are conserved in each generation. This strategy had support at the workshop for the elimination of cattle mitochondrial DNA haplotypes, where it is well established that selection could be occurring. Selection for particular alleles of neutral microsatellite loci would not eliminate cattle characters or change cattle ancestry and was not supported, as it could result in loss of the bison genetic variation it seeks to preserve.

Even with the existing data on bison, more informed management decisions could be made by using decision-support tools that use models to evaluate costs and benefits of management alternatives. For example, Halbert et al. (2005) created and used an individual-based model to evaluate management strategies for the Texas State Bison Herd that exhibited low genetic diversity and signs of low fitness, and Gross et al. (2006) evaluated a range of management alternatives and population targets to retain genetic diversity in bison herds. Incorporating extensive genetic data into a model would allow quantitative evaluation of a number of different strategies and provide transparency to the final decision. Other models have used stochastic simulation processes to determine which management strategies would result in the greatest genetic diversity over time for wood bison (Macfarlane et al 2006). In a structured decision process, models are essential.

Additional research to minimize potential introgression events

The risk of increasing the proportion of cattle ancestry in a herd is a major factor in selecting bison for movement between herds. It is important, therefore, to reduce uncertainty about the history of cattle ancestry in DOI and other conservation herds. The projects below are intended to provide the information necessary to minimize further introgression of livestock genes into DOI bison herds.

Develop and apply higher resolution molecular techniques to guide bison management:
Molecular methods currently utilized in bison management (mtDNA and microsatellites) are only capable of resolving hybridization at the herd level. While these measurements can determine the presence of cattle genes, the absence of detectable cattle genes does not indicate unequivocally that hybridization has not occurred historically. The development and application of new molecular methods, such as single nucleotide polymorphic (SNP) markers, can provide much higher resolution, and these markers are already being developed for other ruminants (Van Tassel et al. 2008, Pertoldi et al. 2010, Decker et al. 2009). These markers could be used to

detect recent hybridization and to reduce its effect on conservation herds by removing specific individual bison from an existing herd, or for selecting non-introgressed individuals for translocation. These markers will also have value beyond detection of cattle ancestry. They can be used to monitor genetic variation in herds and to choose animals for transfer between closely related herds, and to better understand the relation between census and effective population size. New markers should be evaluated in peer-reviewed literature before they are added to genetic-sampling protocols.

Evaluate historic lineages and spatial genetic structure: The previous century of bison management (e.g., anthropogenic movement and re-establishment of herds) has likely wiped out the plains bison historical genetic structure. Reconstructing this history is likely to provide valuable insight into resolving and maintaining lineages to allow or prevent herd mixing. We recommend studies to analyze historical structure:

- *Analyze bison samples that were collected before widespread introgression.* Sources include museums, archeologists, and historic buffalo jumps. Extract DNA from teeth, bone, and untanned capes, in that order.

- *Create mtDNA maps for historic herd structure and spatial structure* by sampling contemporary bison herds.

Conclusions

The bison herds of the U.S. Department of the Interior constitute an invaluable resource and a keystone species in prairie and woodland ecosystems. By the efforts of citizens that saved the remnant bison and of the managers that have been entrusted with them, a remarkable amount of the North American bison genome has been preserved. No emergency actions are necessary to continue that preservation, but concerted actions by researchers and managers are needed if North American bison are to be conserved in their diversity for decades and centuries.

Herd sizes must be increased, and where there is not adequate land to support larger populations, satellite herds must be established with exchange of animals to constitute metapopulations. This requires close cooperation between government agencies, including the integration of management plans. Most importantly, management of bison must be refocused to the landscape scale, where natural selection can work to preserve variation.

Table 2. Recommendations to limit bison introgression in DOI bison herds.

	INTROGRESSION		
	Recommendation	**Mechanism**	**Management**
Maintain genetic integrity	Introduce individuals to a herd only when they do not increase overall levels of cattle ancestry	Test both donor and recipient herd for cattle markers before any translocation	Perform regular sampling and routine testing of DOI herds either during handling or by remote methods
	As a very high priority, maintain genetic isolation of herds that exhibit no DNA evidence of cattle ancestry	Secure boundaries by all appropriate means. Remove or eliminate trespass animals; test to confirm origin of trespass animals whenever possible	Install secondary fencing and perform regular testing
	Minimize historic cattle ancestry when establishing new herds, while maximizing preservation of existing genetic variation	Test herds to confirm that they do not have cattle mtDNA haplotypes and for the presence of bison with cattle microsatellite alleles	Perform genetic monitoring of satellite herd to test for drift as well trespass animals
	Separate wood and plains bison herds to avoid interbreeding and to maintain morphological and behavior differences that have a genetic basis	Use genetic analysis to evaluate the current distinctiveness of wood and plains bison herds	Support Wood Bison Recovery Strategy. As more bison markers are developed, test plains and wood bison for significant differences in marker frequency

Table 3. Recommendations to retain genetic diversity in DOI bison herds.

	PRESERVING VARIATION		
	Recommendation	**Mechanism**	**Monitoring**
Population size (loss of genetic variance over time)	Achieve herd size of 1,000 bison or more at a location whenever possible	If 1,000 or more, no action (herds with more than 1,000 bison do not require active genetic management under normal conditions) If fewer, attempt to increase size/capacity	Census or survey: The goal is to move conservation herds to a size where they do not require active genetic management
	Regularly test herds of 500 to 1,000 for heterozygosity and other measures of genetic diversity. Seek ways to increase effective herd size	Develop herd-specific management plan within (5) years	
	Actively manage herds of fewer than 500 bison to sustain adequate genetic variation	Occasionally supplement with additional genetic material, following guidelines for donor animals	
Demography – effective population size	In small(er) herds, minimize fluctuations in population size to maximize N_e	For managed populations, conduct removals frequently, rather than less frequent large removals	
	In small herds, maintain a sex ratio approaching 1:1, but no more than 60% of either sex	Remove animals of relevant sex	Monitor demographics; measure genetic contribution of bulls
	In small herds, use management strategies that maintain generation interval	In the absence of predation, remove young animals in preference to old	Monitor lifetime reproductive success, particularly of bulls
Manage to minimize inbreeding	Supplement herds with additional genetic material if heterozygosity falls below 0.50 based on the 33 microsatellites	Move animals into herds based on guidelines for animal movements	Herds approaching threshold should be monitored for heterozygosity every year to avoid or alleviate signs of inbreeding depression
Facilitate adaptation and natural selection	When removing animals to control herd size, do not select for traits such as docility, body conformation, etc.	Randomly remove animals from within sex and age classes to achieve desired population structure	
	Maintain and allow the full range of natural selection pressures to operate where possible (e.g., predation, competition for mates)	Provide sufficient space for normal range of behaviors	

	To extent possible, retain spatial substructure of populations	Remove animals from all spatial segments of the population. Provide sufficient space for herds to naturally subdivide
	Maintain and allow the full range of natural selection pressures to operate where possible (e.g., predation, competition for mates)	Provide sufficient space for normal range of behaviors
	To extent possible, retain spatial substructure of populations	Remove animals from all spatial segments of the population. Provide sufficient space for herds to naturally subdivide
Minimize risk among population of losing genetic diversity to drift	Establish multiple populations of highly valued herds	
	Create guidelines for prioritizing establishment of new populations	
	When considering exchange between populations (lineages), use the best information (preferably results from historical genetic analyses) to determine and maintain historical genetic patterns and lineages of the species to the extent possible	
	If conserving lineages is important, the ideal donor herd should have a genetic, ecological, or historical link to the recipient herd	Examine genetic correspondence of potential donors and match to recipient, considering ability of donors to achieve other recommendations (e.g., achieve diversity goal)
	Attempt to replicate significant lineages (YELL, WM, WC) via satellite herd establishment	

Table 4. Recommendations for research priorities in bison genetics.

	RESEARCH		
Purpose	**Recommendation**	**Mechanism**	**Monitoring**
Resolving introgression	Identify and develop a suite of molecular markers, including Single Nucleotide Polymorphism (SNP) technology, for testing of all DOI herds	Transfer development of SNP technology from cattle to bison	Sample all DOI herds and conservation herds managed by other federal and state/provincial agencies, tribal/First Nation organizations, and NGOs in North America
	Develop models utilizing decision-support tools to evaluate costs/benefits of alternative management strategies for bison conservation	Fund model development	Use models to evaluate a range of specific management strategies prior to translocation of bison between herds and establishment of new herds
	Evaluate historic lineages and spatial genetic structure	Analyze historic samples utilizing advanced DNA methodologies, including SNPs when available	Include in decision-support models to assess bison translocations
	Estimate effective population size and N_e/N ratio in existing populations and evaluate sources of variation	Perform genetic testing and characterization of entire herds over a period of years to establish breeding success	Test all animals during management of small herds

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Appendix A. Participants in the Bison Conservation Genetics Workshop held in Nebraska City, Nebraska

Name	Affiliation	Position
Kaush Arha	Department of the Interior	Deputy Assistant Secretary Fish, Wildlife & Parks
Keith Aune	Wildlife Conservation Society	Senior Conservation Scientist
Scott Baker	Oregon State University	Associate Director, Marine Mammal Institute
James Derr	Texas A&M University	Professor of Genetics, College of Veterinary Medicine and Biomedical Sciences
Peter Dratch	National Park Service	Zoologist, Endangered Species Program Manager
Peter Gogan	U.S. Geological Survey	Research Wildlife Biologist, Northern Rocky Mountain Science Center
John Gross	National Park Service	Ecologist, Inventory and Monitoring Program
Natalie Halbert	Texas A&M University	Research Assistant Professor
Phil Hedrick	Arizona State University	Ullman Professor of Conservation Biology
Briar Howes	Parks Canada	Species at Risk Biologist
Lee Jones	U.S. Fish & Wildlife Service	Wildlife Health Biologist
Eric Lonsdorf	Lincoln Park Zoo	Director, Urban Wildlife Institute
Cecilia Penedo	University of California, Davis	Associate Director, Veterinary Genetics Laboratory
Kent Redford	Wildlife Conservation Society	Vice President, Conservation Strategies
Tom Roffe	U.S. Fish & Wildlife Service	Wildlife Disease Ecologist
Oliver Ryder	San Diego Zoo	Kleberg Associate Director, Head of Genetics Division
Danny Swepston	Texas Parks and Wildlife	Wildlife Biologist
Greg Wilson	Canadian Wildlife Service	Species at Risk Biologist

Appendix B. Workshop Agenda

Bison Genetics Workshop Lied Conference Center September 2–5, 2008

Tuesday, September 2

4:30 p.m.	Gather – introductions and agreement on meeting objectives Peter Dratch, Eric Lonsdorf
6:00	Dinner
7:00	Welcome and charge – Deputy Assistant Secretary Kaush Arha A brief history of bison conservation – Kent Redford

Wednesday, September 3 Issue: Introgression and hybridization

6:30–8:30 a.m.	Breakfast buffet
8:30	Gather and informal discussion Genetic management plans that take a century view – Ollie Ryder The tools of the trade: molecular methods in use – Cecilia Penado
10:30	Break
11:00	Evidence of introgression in NA bison herds – Jim Derr Hybridization of wood and plains bison – Greg Wilson
Noon	Lunch
1:00 p.m.	Establishing thresholds for cattle introgression – Eric Lonsdorf Maintaining distinctness of NA bison subspecies
3:00	Break
	Developing suggested guidelines on hybridization Research priorities and their implications
6:00	Dinner
7:30	Subgroups working on introgression and research meet

Thursday, September 4 Issue: Maintaining variation in bison herds

6:30–8:30 a.m.	Breakfast buffet
8:30	Gather and report back of subgroups Maintaining intraspecific variation – John Gross Methods and measures for preserving variation – Tom Roffe Heterozygosity, allelic richness, etc. Remote biopsy sampling and genetic monitoring – Scott Baker
10:30	Break
11:00	Comparison of variation in conservation herds – Natalie Halbert Examining relationship between herds
Noon	Lunch
1:00 p.m.	Establishing targets for genetic variation – Eric Lonsdorf Minimum herd size; sex and age structure Methods of gene exchange in a conservation framework
3:00	Break
3:30	Developing guidelines for genetic health of NA bison Sample collection, storage and distribution
6:00	Dinner
7:30	Subgroups working on variation and sampling meet

Friday, September 5

6:30-8:30 a.m.	Breakfast buffet
8:30	Gather and report back of subgroups – Eric Lonsdorf Discussion of final recommendations on bison hybridization Discussion of final recommendations on bison variation
10:00	Break
10:30	Discussion of final recommendations on research and sampling Closing comments
11:30	Adjourn

Appendix C. U.S. Department of the Interior Herd Histories

Badlands National Park

Bison have continued to be the dominant large herbivore of Badlands National Park (BADL) since their establishment in 1963 through the restoration of 25 bison from Theodore Roosevelt National Park in North Dakota and three bison from Fort Niobrara National Wildlife Refuge in Nebraska. All of these animals originated from the Fort Niobrara herd. Twenty additional bison were restored to BADL in 1983 from Colorado National Monument (CNM), whose original lineage was from a 1925 Denver, Colorado, herd. All animals from both lineages have had the opportunity to interbreed since 1983.

The bison herd at BADL increased dramatically from these original bison restorations in 1963 and 1983. Between the years of 1983 and 1987, an extensive research effort was conducted at BADL. The population peaked at more than 1,000 animals, and annual recruitment rates were greater than 50%. The current population is regulated opportunistically when numbers exceed 600 animals. BADL conducted annual roundups from 2002 through 2007, and bison of different ages and sexes were given to the InterTribal Bison Cooperative (ITBC) and Ogalala Sioux Parks and Recreation Authority (OSPRA). The ITBC distributes bison to Native American tribes trying to establish bison populations on their lands. Donating the bison to the ITBC and OSPRA are the main avenues that BADL uses to regulate the current population that inhabits the 64,000-acre Sage Creek Unit of the BADL Wilderness Area.

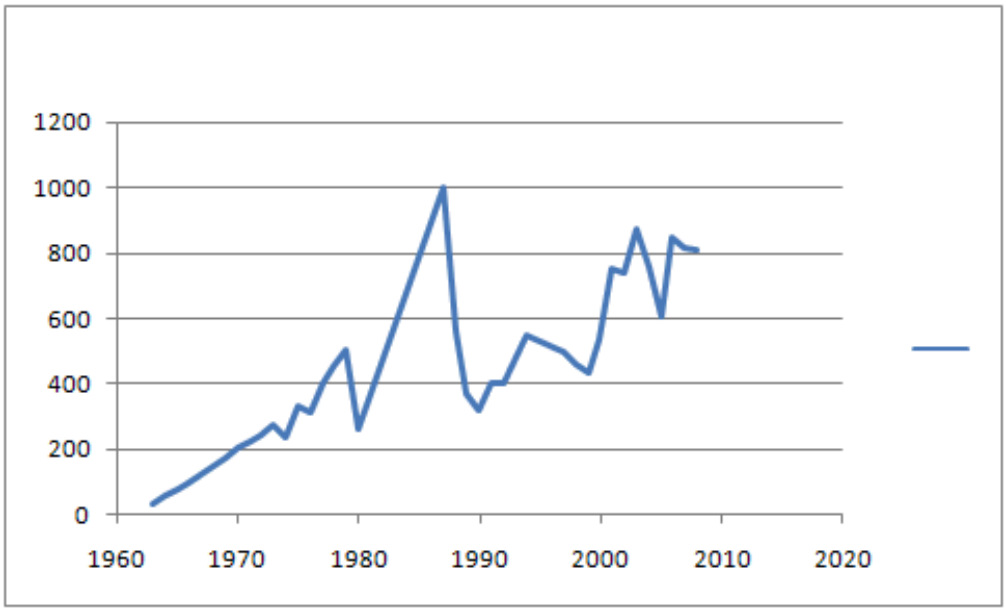


Figure 2. Badlands National Park bison herd population, 1963 to 2009.

Fort Niobrara National Wildlife Refuge

Fort Niobrara National Wildlife Refuge (NWR) consists of 19,131 acres located in north-central Nebraska along the Niobrara River. The refuge was established in 1912 as a "preserve and breeding ground for native birds." Later that same year, its purpose was expanded to include the conservation of bison and elk herds representative of those that once roamed the Great Plains. Prescribed fire and planned periods of rest, or non-disturbance, are used in combination with grazing by bison and elk in an effort to mimic historic processes that helped shape the native plant communities on the refuge. As many as 100,000 people visit Fort Niobrara NWR each year to see, appreciate, and learn about wildlife and their habitats.

The Fort Niobrara bison herd was founded in 1913 with the donation of six bison from J.W. Gilbert of Friend, Nebraska, and the transfer of two males from Yellowstone National Park. Additional introductions were made in 1935 (Custer State Park), 1937 (Custer State Park), and 1952 (National Bison Range).

Bison have been rounded up by refuge staff on horseback annually since the early 1930s to remove surplus animals, complete health testing, vaccinate, and/or mark animals. The entire bison herd tested negative for brucellosis in 1965 and was declared brucellosis-free in 1974 by the State of Nebraska. A comprehensive bison herd health monitoring program was initiated in 2003, and bison are no longer routinely vaccinated. The animals are individually identified with microchips.

Currently, both the Fort Niobrara and Sullys Hill bison herds are managed separately by fence on the refuge. In order to manage the refuge within carrying capacity (approximately 350 bison total), the Fort Niobrara herd will likely be reduced in future years to accommodate the growing Sullys Hill herd.

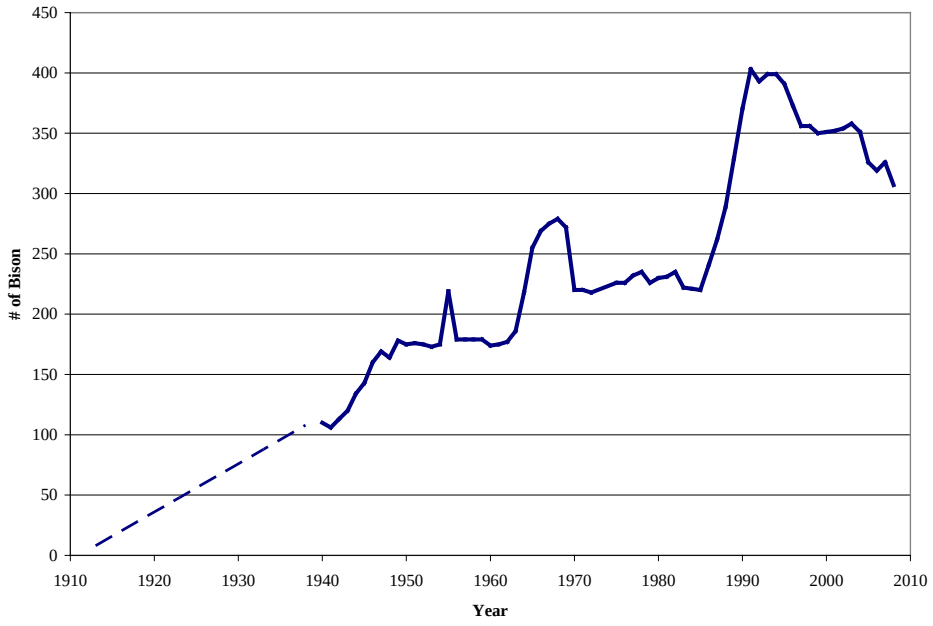


Figure C-2. Fort Niobrara National Wildlife Refuge bison herd population, 1913 to 2009.

Grand Teton National Park – National Elk Refuge (Jackson Bison Herd)

Bison were extirpated from Wyoming around Jackson Hole by the mid-1880s. In 1948, 20 bison from Yellowstone National Park were reintroduced to the 1,500-acre Jackson Hole Wildlife Park near Moran, Wyoming. A population of 15–30 bison was maintained there in a large exclosure until 1963, when brucellosis was discovered in the herd. All the adult animals were destroyed, but four vaccinated yearlings and five vaccinated calves were retained. Twelve certified brucellosis-free bison were added soon afterward from Theodore Roosevelt National Park. In 1968, the herd (down to 11 animals) escaped from the confines of the wildlife park, and a year later the decision was made to allow them to range freely. In 1975, the small Jackson Bison Herd began wintering on the National Elk Refuge, and the use of standing forage by bison on this winter range was viewed as a natural behavior and was not discouraged by managers. By 1980, however, the bison began eating supplemental feed provided for the elk, and they have continued to do so every winter since.

The discovery of supplemental feed by bison has had several consequences, including a decline in winter mortality and an increase in the population's growth rate. The Wyoming Game and Fish Department implemented a bison hunting season on lands outside Grand Teton National Park and the National Elk Refuge in 1997, but typically only 40 animals were harvested per year, and the effect on the population was minimal. The population increased approximately 10–14% per year between 1990 and 2007 and peaked at 1,059 animals in 2007. The Elk and Bison Management Plan and EIS was adopted in 2007. Under this plan the post-hunt objective is 500 bison, and the open hunting area was expanded to include the National Elk Refuge. During the 2007 harvest, 266 animals were removed, reducing the population to 920 during the 2008 winter count. The objective is to harvest 300 bison per year until the 500 objective is reached, at which time harvest levels will be reduced to maintain the population at 500.

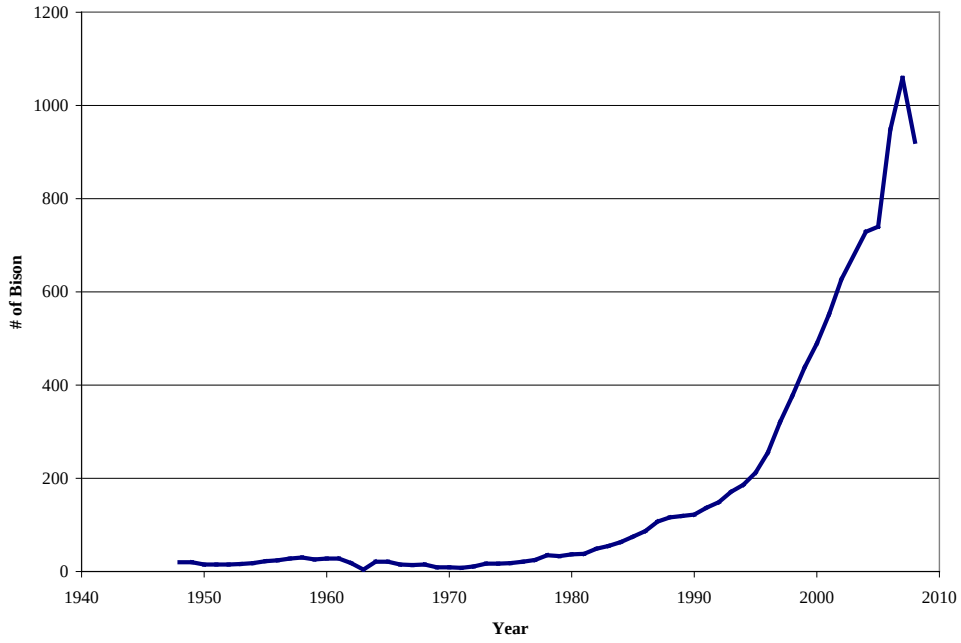


Figure C-3. Jackson Bison Herd (Grand Teton National Park/National Elk Refuge) population, 1948 to 2008.

National Bison Range

The National Bison Range, established in 1908 with the first Congressional appropriations ever made for the purchase of lands for a wildlife refuge, consists of 18,799 acres of Palouse prairie in northwest Montana. The refuge was established to provide "…for a permanent national bison range for the herd of bison…" Its purpose was expanded in 1921 to function "…as refuges and breeding grounds for birds," and again in 1958 "… to provide adequate pasture for the display of bison in their natural habitat at a location readily available to the public…" The refuge currently supports bison, elk, pronghorn antelope, Rocky Mountain bighorn sheep, mule deer and white-tailed deer, black bear, coyote, mountain lion, and more than 200 species of birds. As many as 250,000 visitors come to the refuge each year.

The herd was founded in 1909 from 34 northern plains bison purchased by the American Bison Society from the Conrad herd in Kalispell, Montana, plus two additional Conrad bison that were donated to the American Bison Society. One additional animal came from the Goodnight herd in Texas. In 1910, three additional northern plains bison were introduced from the Corbin herd. Subsequent additions include two bison in 1939 (7-Up Ranch, origin unknown); four in 1952 (Fort Niobrara); two in 1953 (Yellowstone National Park); and four in 1984 (Maxwell State Game Refuge).

The bison are rounded up annually by horseback to keep the population within the refuge carrying capacity, and a comprehensive herd health monitoring program has been in effect since 2000. The animals are individually identified with microchips, and the population is currently at approximately 320 bison.

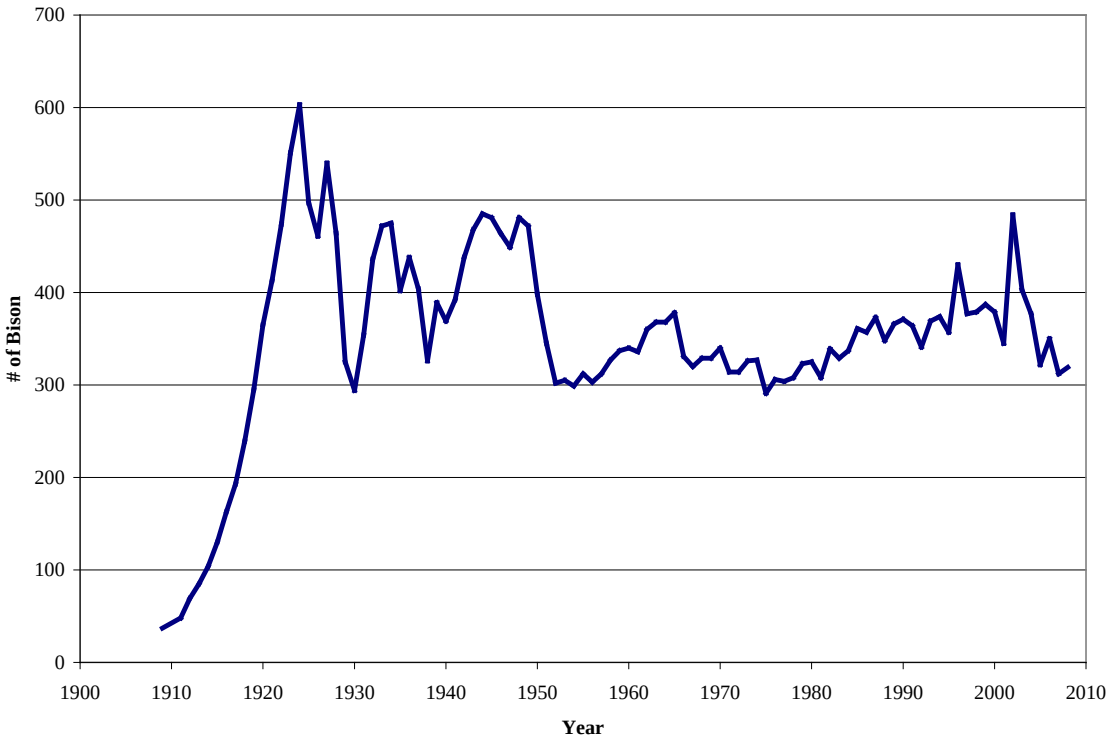


Figure C-4. National Bison Range bison herd population, 1909 to 2009.

Neal Smith National Wildlife Refuge

Neal Smith National Wildlife Refuge, located just east of Des Moines, Iowa, was established in 1991. Its mission is to re-construct tallgrass prairie and restore oak savanna on 8,654 acres of the Walnut Creek watershed and to provide a major environmental education facility focusing on prairie, oak savanna, and human interaction. Habitat management involves reclaiming agriculturally degraded land using grazing, prescribed fire, and other tools to restore tallgrass prairie and savanna habitat. Approximately 200,000 visitors come to the refuge every year. The refuge has been designated a U.S. Fish and Wildlife Service Land Management and Research Demonstration Area to facilitate development, testing, teaching, publishing, and demonstration of state-of-the-art management techniques for fish, wildlife, and plant conservation.

In 1996, bison were reintroduced from several other refuges around the country (not shown in graph below). However, recently completed genetics data suggested that the Neal Smith bison population contributed relatively little to national bison conservation efforts, and a new herd was established in 2006 with 39 animals transferred from the National Bison Range. The bison are rounded up annually to manage the population within refuge carrying capacity and to conduct health monitoring. The animals are individually identified with microchips, and the population is currently estimated at 71.

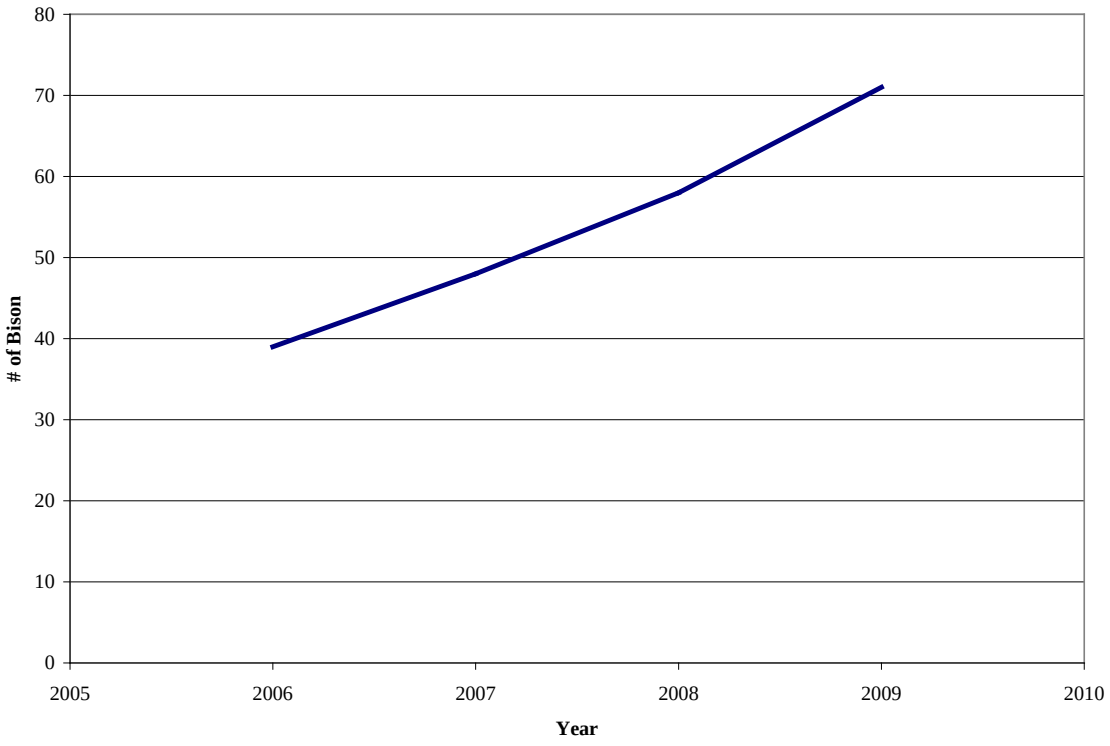


Figure C-5. Neal Smith National Wildlife Refuge bison herd population, 2006 to 2009.

Rocky Mountain Arsenal National Wildlife Refuge

In 1942, the U.S. Army bought thirty square miles of farmland to establish the Rocky Mountain Arsenal, a chemical weapons factory. After World War II, the army leased land to private companies that produced commercial pesticides. During the early Cold War of the 1950s, the U.S. Army again produced chemical weapons. While the industrial core of the site was contaminated, deer, prairie dogs, coyotes, and many species of hawks, owls, and other birds thrived in the abandoned fields, grasslands, and woodlots that had been protected from forty years of urban sprawl and development.

In 1992, Congress passed the Rocky Mountain Arsenal National Wildlife Refuge Act, designating the site as a future refuge. Since then, the U.S. Fish and Wildlife Service has managed the site "as if it were a refuge," monitoring wildlife health, restoring native prairie habitats, and providing opportunities for wildlife-dependent recreation. Located just northeast of downtown Denver, Colorado, the refuge is the largest contiguous open space in the Denver metropolitan area. The site is currently undergoing a major environmental restoration program and will become one of the largest urban national wildlife refuges in the United States.

The bison herd at the Rocky Mountain Arsenal was established in 2007 with 16 animals transferred from the National Bison Range as part of a pilot project. In spring 2008, two yearlings from Sullys Hill National Game Preserve, also of National Bison Range foundation, were added to the population. The population is currently estimated at 44, and the bison are individually identified with microchips. The refuge is planning to develop facilities to conduct annual roundups in an effort to manage the population within carrying capacity and complete herd health monitoring in future years.

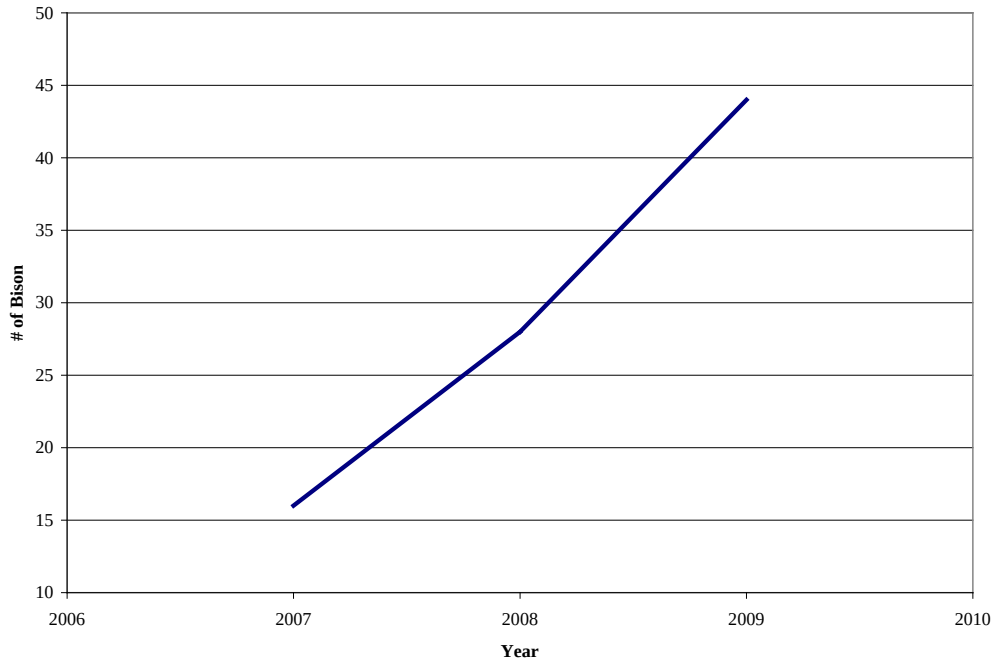


Figure C-6. Rocky Mountain Arsenal bison herd population, 2007 to 2009.

Sullys Hill National Game Preserve

Sullys Hill National Game Preserve, located on the south shore of Devils Lake, North Dakota, was established in 1904 by Teddy Roosevelt. In 1914, Sullys Hill was named a "Big Game Preserve" by Congress, and in 1921, President Warren Harding reserved the area as a refuge and breeding grounds for birds and all wildlife. Purposes include: "…a big game preserve, refuge, and breeding grounds for wild animals and birds…" and "…refuge and breeding grounds for birds." Sullys Hill National Game Preserve currently consists of 1,674 acres of wooded hills and open meadows.

Six bison were brought to Sullys Hill in October 1918 from the Portland City Park in Portland, Oregon, including the herd matriarch and her offspring. Based on historical documentation, it is believed that the herd matriarch was obtained by the Portland City Park from Ravalli, Montana, around 1906 through a trader named B.H. Denison. In 1932, the first addition to the herd, a bull from Wind Cave National Park, was made. Nine other introductions occurred between 1941 and 1997, including bison from the National Bison Range, Fort Niobrara NWR, and Theodore Roosevelt National Park.

Since 1980, average herd size has been approximately 30 animals at Sullys Hill, with about eight removed annually until 2006, when the entire herd was relocated to Fort Niobrara NWR to allow the population to expand. The population all currently contains 61 bison, and the animals are individually identified with microchips.

Seven bison from the National Bison Range were transported to Sullys Hill in 2006 to provide environmental education, outreach, and viewing opportunities for refuge visitors. This replacement herd is not included in the graph below.

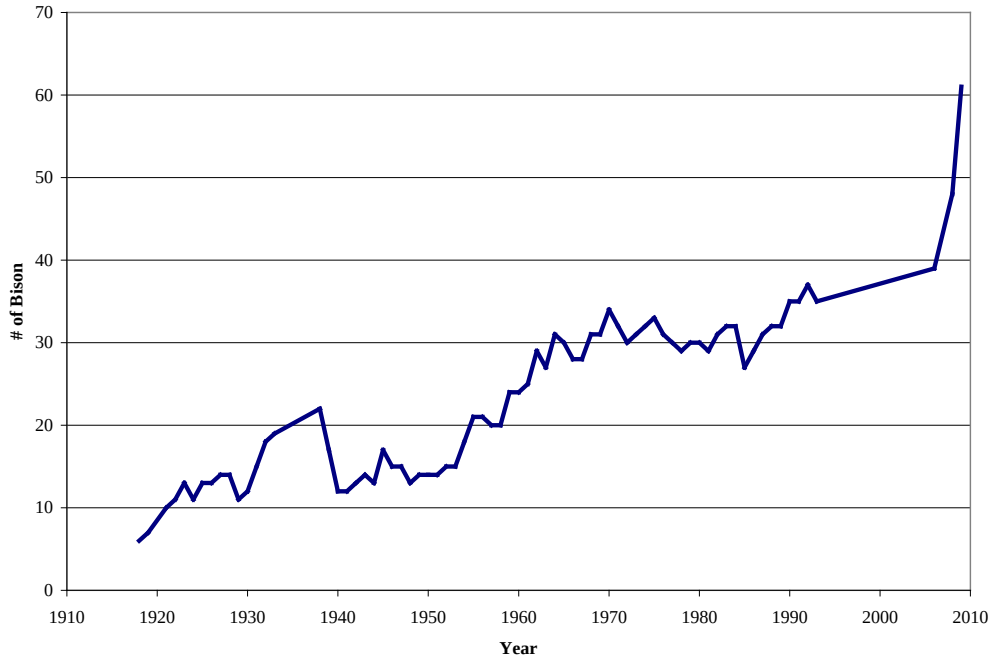


Figure C-7. Sullys Hill bison herd, 1918 to 2009 (relocated to Fort Niobrara in 2006).

Theodore Roosevelt National Park

Theodore Roosevelt National Park consists of three distinct areas totaling 70,446 acres (North Unit, 24,070; Elkhorn Ranch, 218; South Unit, 46,158). In 1956, 29 bison from Fort Niobrara NWR were reintroduced in the South Unit of the park, and in 1962, 20 bison from that population were released into the North Unit (there are no bison at the Elkhorn Ranch). Population objectives for bison in the North and South units were set at 100–300 and 200–500, respectively, using a park-specific forage allocation model, and since the initial releases, populations have ranged from 20 to 360 bison in the North Unit and from 29 to 472 in the South Unit.

Population monitoring prior to 1975 should be considered informal, and most estimates were made prior to roundups that occurred annually in the South Unit from 1962 through 1973. Records from 1975 to the present are more accurate and based on total-herd counts from complete park coverage by riders, aircraft, or both. During roundup years, the estimate reflects the population prior to culling the herd.

Each unit has its own wildlife-handling facility, holding and sorting pastures, a chute system, holding pens, and loading ramps. As bison are processed, morphometric and demographic data are collected, and each is identified with a micro-chip and federal identification tag in the right ear. Each bison is tested for brucellosis (*Brucella abortus*), and additional samples are archived for other studies (e.g., genetic purity, heterozygosity, etc.). No bison from either unit has tested positive for brucellosis.

The decision for culling an individual is based on population and demographic goals for that unit. Theodore Roosevelt National Park does not have sale authority for bison. Under a cooperative agreement, bison culled from the park are brokered through the Inter-Tribal Bison Cooperative, and other federal, state, and non-profit entities.

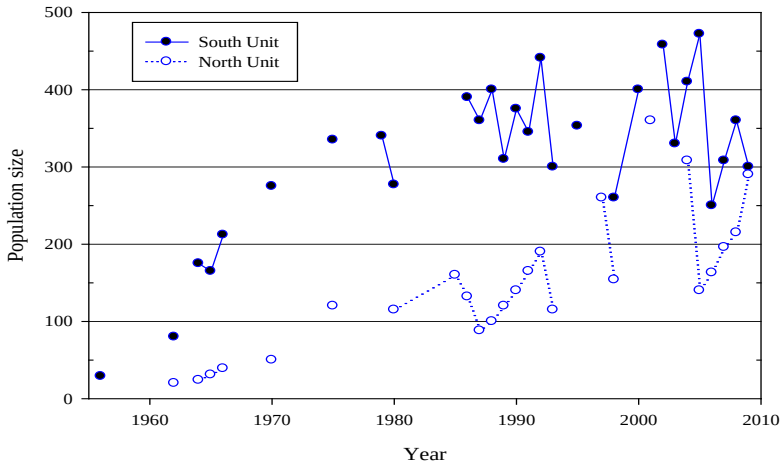


Figure C-8. Theodore Roosevelt National Park bison herd population, 1956 to 2009.

Wichita Mountains Wildlife Refuge

Wichita Mountains Wildlife Refuge, established in 1901, consists of 59,020 acres of mixed grass prairie in the Wichita Mountains of southwest Oklahoma. The refuge provides habitat for large native grazing animals such as bison, Rocky Mountain elk, and white-tailed deer. Texas longhorn cattle also share refuge rangelands as a cultural and historical legacy species. More than one million visitors come to the refuge each year.

Through the efforts of the American Bison Society and the New York Zoological Society, an offer was made to donate 15 bison to the Wichita National Forest and Game Preserve in the early 1900s. Congress set aside $15,000 for this purpose, and on October 11, 1907, 15 bison from the New York Zoological Park were shipped by rail to the refuge. Four bison from the Fort Niobrara NWR were added to the herd in 1940.

The current population is approximately 650 bison, and an annual roundup is conducted to keep the population within refuge carrying capacity and to conduct herd health monitoring. The refuge began inserting microchips in 2007 to identify individuals, and approximately 90% of the bison herd has been microchipped to date.

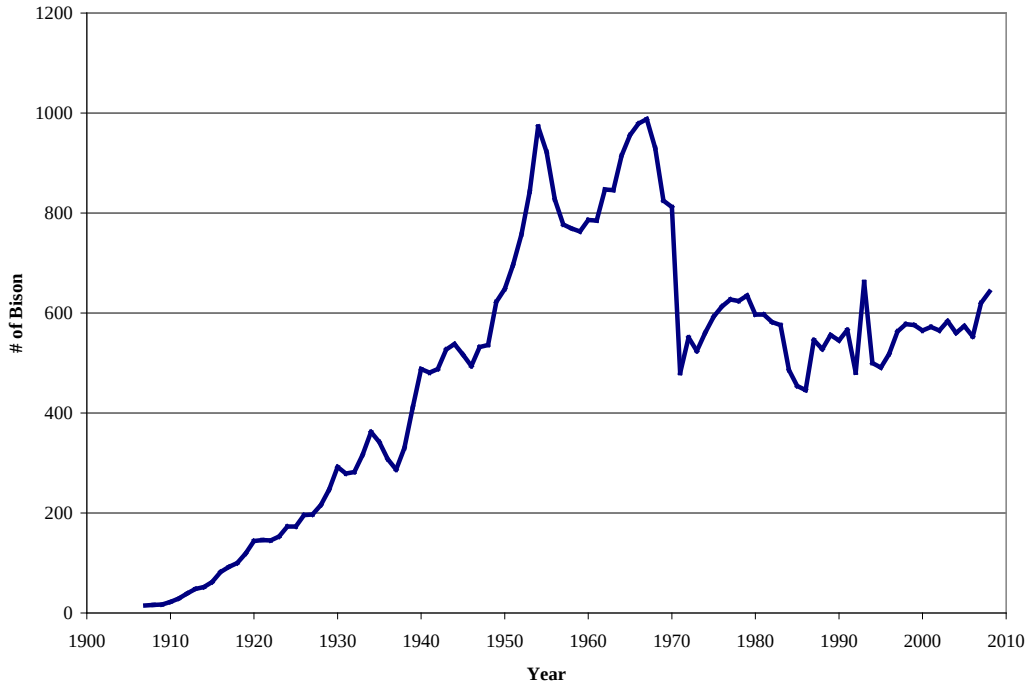


Figure C-9. Witchita Mountains Wildlife Refuge bison herd population, 1907 to 2009.

Wind Cave National Park

The Wind Cave National Park bison herd was originally established in 1913 on the Wind Cave Game Preserve, administered by the U.S. Department of Agriculture (USDA) Bureau of Biological Survey. This initial group consisted of 14 bison (six bulls and eight cows) and was a gift from the New York Zoological Society through the American Bison Association. Six more bison (two bulls and four cows) were brought to the game preserve from Yellowstone in 1916. These 20 animals were the founders of the current Wind Cave bison herd. In 1935 the Wind Cave Game Preserve was transferred from administration by the USDA to the Department of the Interior, and became part of Wind Cave National Park. A 1938 law authorized the park to sell or otherwise dispose of surplus buffalo and elk, and until 1943 bison were sold live or culled. Under an agreement with South Dakota in 1952, bison were baited into Custer State Park (CSP). This was the major means of disposing of bison until 1961 when the agreement to bait the bison into CSP was terminated in 1964 due to the high incidence of brucellosis in the Wind Cave herd, and the initiation of a calf-hood vaccination program by CSP.

As the park was expanded from 10,500 to 28,295 acres, the bison herd was allowed to increase. In the mid-1960s, the park established a target bison management population of between 350 and 500 animals. In 1960, brucellosis test results revealed approximately 75% of 52 bison tested were reactors. This lead to the initiation of a brucellosis control program in 1964 in which 220 bison were shot in the field, reducing the herd from 440 to 220. The park was placed under quarantine by South Dakota from 1982 to 1986. There have been no positive brucellosis reactors from 1985 to the present.

When a roundup is conducted, as many bison as possible are captured, tested, and released back into the park or shipped to various Native American tribes, non-profit organizations, and state and federal agencies. From 1965 to 1987, the bison herd was reduced by sending to slaughter the first bison to be rounded up regardless of age or sex. Since then, the park primarily reduces the herd by live shipment of yearlings and sometimes two-year-olds, keeping 8–10 of each sex and age class. A total of 1,489 have been distributed live between 1987 and 2007. Bison are allowed to die naturally, and their remains are left on the landscape.

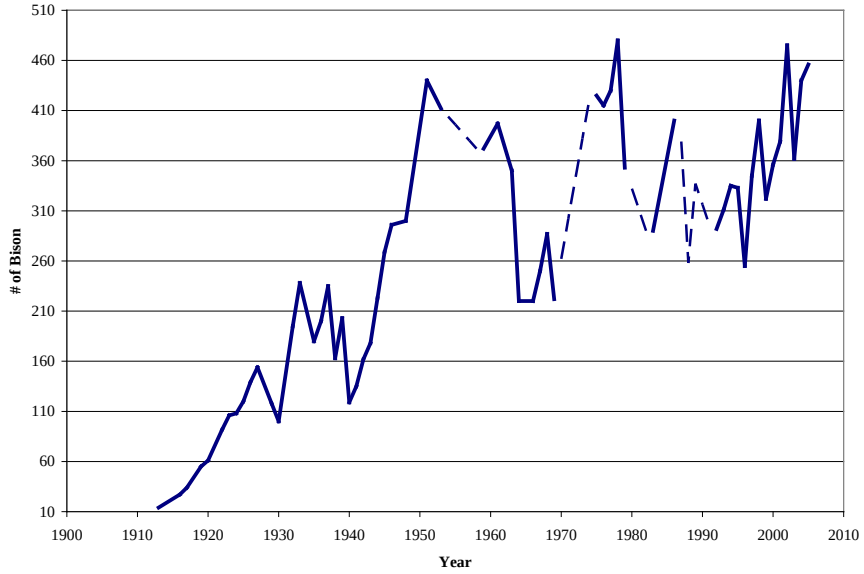


Figure C-10. Wind Cave National Park bison herd population, 1913 to 2009.

Yellowstone National Park

Yellowstone bison historically occupied approximately 20,000 km^2 in the headwaters of the Yellowstone and Madison rivers. Historical accounts of wild bison adjacent to and within the present-day Yellowstone National Park note that substantial numbers occupied the high plateaus in all seasons. When the park was established in 1872, the population of bison likely numbered in the several hundreds, but by 1900 the population had declined in abundance to less than 50 (actual count of 23) individuals located in the interior valley of Pelican Creek.

A restoration program on the northern range of Yellowstone was initiated in 1902 by translocating three adult males from Texas and 18 females from western Montana. This population was supplemented with a few calves from the Pelican Valley herd. The restoration program actively managed the bison by growing and feeding hay until the early 1950s and removing bison to manage abundance and sex ratio until the mid 1960s. Following a new 1968 management policy, the population increased to 4,000 by 1994 and to 5,000 bison in 2005. Conservation of Yellowstone bison is complicated by relatively high rates of *Brucella abortus* infection, their spring migratory behavior to low-elevation ranges along and outside the national park boundary, and especially with brucellosis detections in greater Yellowstone area livestock. The moderate to high population growth rate exacerbates the issue in the conflict zone at the conservation area boundary. The conservation area boundary was designated through negotiations with the State of Montana and does not include fencing to contain bison. Yellowstone bison occupy a range of about 2,300 km^2.

The current Yellowstone bison management program is a collaborative effort with four other state and federal management agencies, directed by a long-term management plan signed by the Secretary of the Interior in 2002. The program uses a conservation strategy to manage for fluctuations in population abundance between 2,500 and 4,500 bison in order to balance the influence bison have on the park's forage base, conservation of the genetic integrity of the bison population, protection of migratory tendencies that wild bison exhibit, meeting brucellosis risk management responsibilities negotiated with state wildlife managers, and other constraints that influence human tolerance for wild bison outside Yellowstone National Park. An active surveillance program includes annual monitoring of the population to track demographic rates, brucellosis exposure, and brucellosis sero-conversion rates by maintaining a cohort of radio-marked individuals. Periodic roundups of bison at capture pens at the perimeter of the conservation area occur in which a few to more than 1,000 bison are removed per year depending on the population abundance and the prevailing weather conditions. Removals are focused on migrants to the boundary ranges, and in some years bison that are found to be brucellosis sero-negative are released after testing.

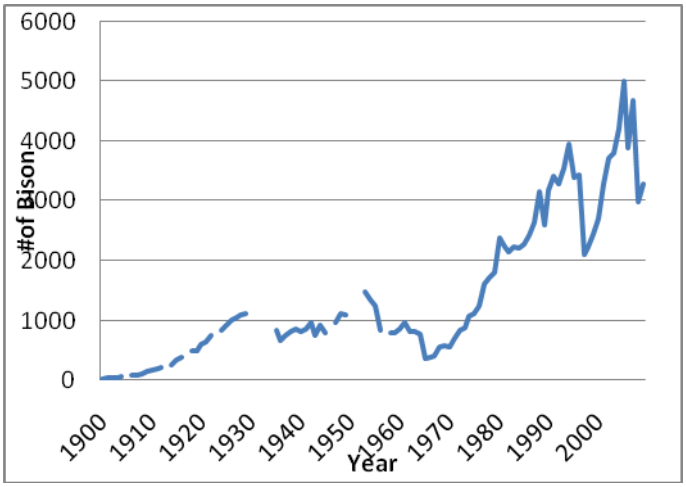
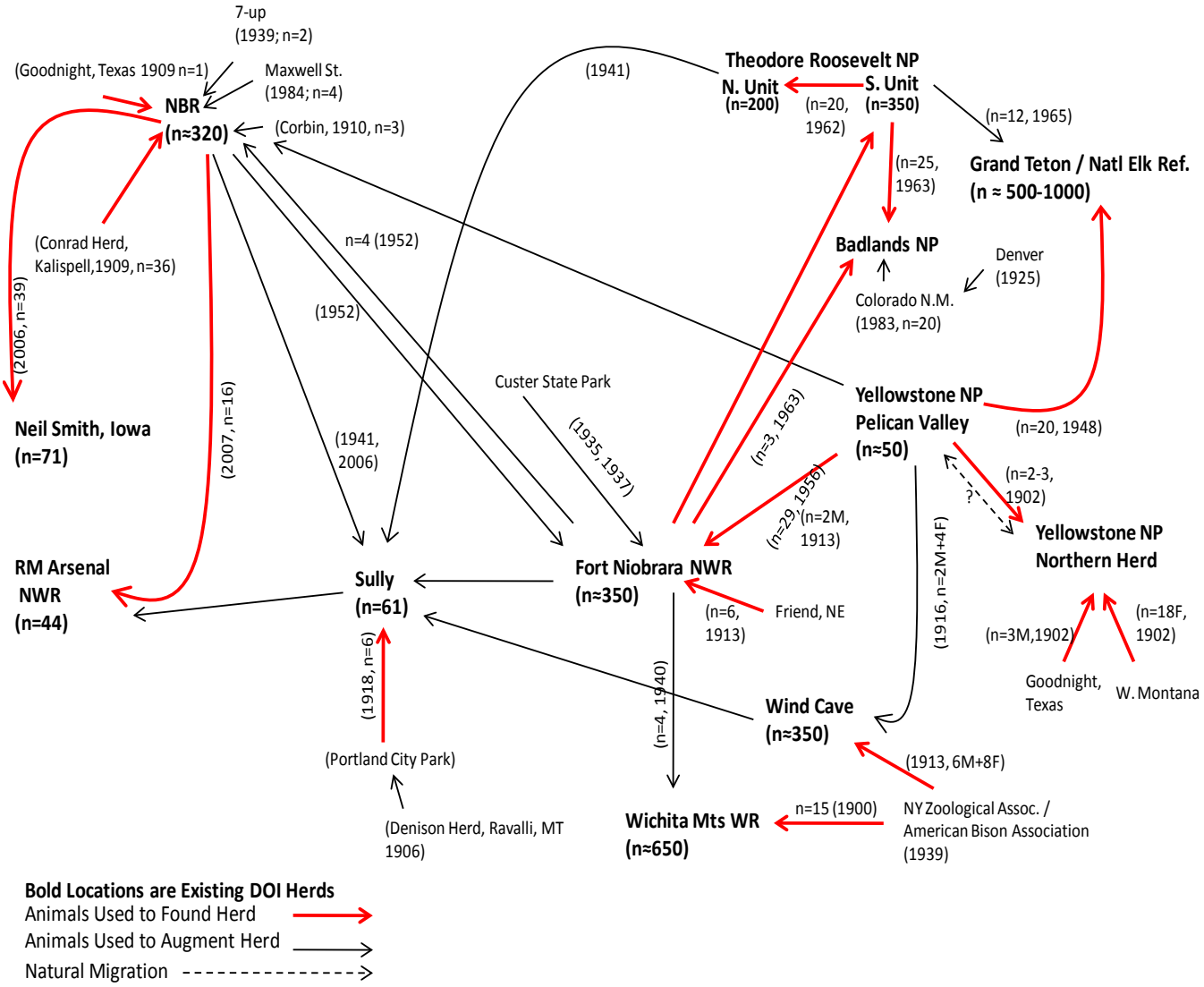


Figure C-11. Yellowstone National Park bison herd population, ca. 1900 to 2009.

Appendix D. Sources and Movement of DOI Bison (M. Schwartz 2010)



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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American Bison

Status Survey and Conservation Guidelines 2010

Edited by C. Cormack Gates, Curtis H. Freese, Peter J.P. Gogan, and Mandy Kotzman



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Group

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IUCN SSC Bison Specialist Group

The Bison Specialist Group is a voluntary network of people professionally involved in the study, conservation, and sustainable management of bison in Europe and North America. The BSG consists of two divisions, the European Bison Specialist Group and the American Bison Specialist Group (ABSG). The ABSG is committed to the development of comprehensive and viable strategies and management actions to enhance conservation and achieve ecological restoration of American bison as wildlife where feasible throughout the original range of the species. The ABSG operates under the authority of the Species Survival Commission of IUCN—International Union for Conservation of Nature.

American Bison

Status Survey and Conservation Guidelines 2010

Edited by C. Cormack Gates, Curtis H. Freese, Peter J.P. Gogan, and Mandy Kotzman



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Acronyms

ABS	American Bison Society
ABSG	American Bison Specialist Group, a division of the IUCN BSG
ADFG	Alaska Department of Fish and Game
AGFD	Arizona Game and Fish Department
ALCES®	A Landscape Cumulative Effects Simulator, FOREM Technologies
ANPP	Herbaceous above ground net primary productivity
APF	American Prairie Foundation
APFRAN	Animal Plant and Food Risk Assessment Network, Canada
APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
BLU	Bluetongue
BNP	Badlands National Park, South Dakota
BRCP	Bison Research and Containment Program, Northwest Territories
BSE	Bovine spongiform encephalopathy
BSG	IUCN Bison Specialist Group
BTB	Bovine tuberculosis
BVD	Bovine viral diarrhoea
CAMP	Conservation Action Management Plan process, IUCN Captive Breeding Specialist Group
CATG	Council of Athabascan Tribal Governments, Alaska
CBA	Canadian Bison Association
CBD	International Convention on Biological Diversity
CBSG	IUCN/SSC Conservation Breeding Specialist Group
CDOJ	Canadian Department of Justice
CFIA	Canadian Food Inspection Agency
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMN	Canadian Museum of Nature
CONANP	Comision Nacional De Areas Naturales Protegidas, Mexico
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSP	Custer State Park, South Dakota
CWS	Canadian Wildlife Service
CWCS	Comprehensive Wildlife Conservation Strategy
DNDC	The Department of National Defence, Canada
EHD	Epizootic hemorrhagic disease
EINP	Elk Island National Park, Alberta
EIS	Environmental Impact Statement
ESA	U.S. Endangered Species Act
ESU	Evolutionarily significant unit
FAD	Foreign Animal Disease
FEARP	Federal Environmental Assessment Review Panel, Canada
FMD	Foot-and-mouth disease, or heartwater
FNNWR	Fort Niobrara National Wildlife Refuge, Nebraska
GEU	Geminate evolutionary unit
GTNP	Grand Teton National Park, Wyoming
GWBE	Greater Wood Buffalo Ecosystem, Canada
GWBNP	Greater Wood Buffalo National Park, Canada
GYA	Greater Yellowstone Area
HMSP	Henry Mountains State Park, Utah
HOAA	Health of Animals Act, Canada
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
ITBC	Intertribal Bison Cooperative
IUCN SSC	IUCN Species Survival Commission
IUCN SUSG	IUCN Sustainable Use Specialist Group
JD	Johne's disease
MBS	Mackenzie Bison Sanctuary, Northwest Territories
MCA	Montana Code Annotated
MCF	Malignant catarrhal fever
MDOL	State of Montana Department of Livestock
MFWP	State of Montana Department of Fish, Wildlife and Parks
MLVA	Multiple locus, variable number, tandem repeat analysis
MtDNA	Mitochondrial deoxyribonucleic acid
N	Population size

NBA	National Bison Association, U.S.A
NBMB	Northern Buffalo Management Board, Canada
NBR	National Bison Range, Montana
NCC	Nature Conservancy of Canada
Ne	Effective population size
NEP	Nonessential experimental population
NEPA	National Environmental Policy Act, U.S.A
NER	National Elk Refuge, Wyoming
NGO	Non-governmental organisation
NPS	U.S. National Park Service
NRCS	Natural Resource Conservation Service, U.S.A
NWT	Northwest Territories, Canada
NTENR	Northwest Territories Environment and Natural Resources
OIE	World Organization for Animal Health
PANP	Prince Albert National Park, Saskatchewan
PCA	Parks Canada Agency
PES	Pay-for-Environmental Services
PHVA	Population and Habitat Viability Assessment
PPAs	Private protected areas
PVA	Population viability analysis
RAC	Research Advisory Committee for bison disease research in WBNP
RDR	Reportable Diseases Regulations
$\hat{r}$	Observed exponential rate of population increase
r_m	Maximum exponential rate of population increase
RMEF	Rocky Mountain Elk Foundation
SAGARPA	Secretary of Agriculture, Livestock Production, Rural Development, Fishery and Food, Mexico
SCBD	Secretariat of the Convention on Biological Diversity
SDGFP	South Dakota Game, Fish and Parks
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales, México
SENASICA	Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria, Mexico
SERI	Society for Ecological Restoration International
SERS	Society for Ecological Restoration Science
SHNGP	Sully's Hill National Game Preserve, North Dakota
SRL	Slave River Lowlands, Northwest Territories, Canada
SNMNH	Smithsonian National Museum of Natural History
SWAP	State Wildlife Action Plan (name varies by state)
TB	Tuberculosis
TGPP	Tallgrass Prairie Preserve, Oklahoma
TNC	The Nature Conservancy
TRNP	Theodore Roosevelt National Park, North Dakota
TSE	Transmissible spongiform encephalopathies
TESF	Turner Endangered Species Fund
USNARA	U.S. National Archives and Records Administration
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGSBRD	U.S. Geological Survey Biological Resources Division
VJDHSP	Voluntary Johne's Disease Herd Status Programme (for cattle)
WBNP	Wood Buffalo National Park, Alberta and Northwest Territories
WBP	Wainwright Buffalo Park, Alberta
WCNP	Wind Cave National Park, South Dakota
WCS	Wildlife Conservation Society
WHO	World Health Organization
WMNWR	Wichita Mountains National Wildlife Refuge, Oklahoma
WWF	World Wildlife Fund
YDOE	Yukon Department of the Environment
YNP	Yellowstone National Park, Idaho, Montana and Wyoming
YT	Yukon Territory, Canada

Executive Summary

Curtis H. Freese and C. Cormack Gates

The publication of this IUCN American Bison Status Survey and Conservation Guidelines is timely owing to a recent convergence of factors: new research findings on bison genetics and ecology, assessment and awareness of the precarious status of many bison conservation herds, new initiatives by government and non-profit institutions to improve management of existing herds and to establish conservation herds, growing interest among Native Americans in restoring bison as part of their cultural heritage, and an increasing awareness by the commercial bison industry that conservation of wild-type bison is in the long-term interest of the industry. There is also a growing body of evidence that the biodiversity of ecosystems within the original range of bison can benefit from bison restoration, from the desert grasslands of northern Mexico, through the Great Plains, to the lowland meadow systems of interior Alaska. The ten chapters of this book examine these and other aspects of the biology and conservation of the species, and offer guidelines for what we anticipate will be a new era of bison conservation in North America. Under the auspices of the IUCN American Bison Specialist Group, twenty-nine chapter coordinators and contributors share their knowledge and ideas in this comprehensive review of the diverse topics that need to be considered by researchers, managers, policy makers and others interested in restoring and conserving this magnificent animal.

In the introductory chapter, C. Gates and P. Gogan explain the overall purpose of the IUCN American Bison Specialist Group and this document. The Specialist Group is composed of more than 60 registered members and numerous collaborators from the three nations comprising North America and ranging from Chihuahua State in Mexico to the State of Alaska. The Group operates under the aegis of the IUCN Species Survival Commission. The authors note that the purpose of this volume is to contribute to the development of strategies and actions that, where feasible, will conserve and ecologically restore bison as wildlife throughout their original range. Gates and Gogan acknowledge that large-scale restoration of bison is an ambitious and complex undertaking, perhaps unparalleled in species conservation efforts in North America. Their introduction briefly reviews the major issues facing bison conservation and the strong influence that bison historically exerted on ecosystems across much of the continent. Apart from the ecological importance of bison, the social and cultural significance of bison restoration is recognised when they state, “no other wildlife species has exercised such a profound influence on the human history of a continent.”

In Chapter 2, B. Potter and co-authors trace the evolutionary and recent history of bison, beginning with the earliest fossil records showing bison in Asia at least two million years ago, and continuing with their expansion, much later, into North America across the Bering Land Bridge during the middle Pleistocene. The evolution and distribution of various bison species and subspecies in North America present a complex story shaped, in large part, by bison habitat and ranges that shifted widely with advancing and retreating continental ice sheets. The result of this evolutionary history today is two species, the European bison and American bison, and two subspecies of American bison, wood bison and plains bison. Five hundred years ago, tens of millions of plains bison probably inhabited North America, from southern Canada to northern Mexico, and from nearly the west coast to the east coast, with the Great Plains as their centre of abundance. Wood bison, because of a more restricted boreal forest habitat, were much less numerous. For many native peoples of North America, thousands of years of coexistence had led to bison being central to their survival and cultures, a history that Potter *et al.* explore in some detail. European colonisation of North America brought rapid change to both bison and Native Americans. Commercial hunting, competition with livestock, killing of bison as government policy to subjugate Indian tribes, and other causes led to the precipitous decline of both plains and wood bison. By the end of the 19th Century a few hundred bison survived in various small captive and wild herds across North America. Fortunately, conservation efforts quickly emerged in both Canada and the United States (U.S.) and, once protected, bison numbers began to recover. Their iconic status now seems to be recovering also. Potter *et al.* echo what other authors of this volume have expressed when they note that no other North American species holds such great cultural and political significance.

In Chapter 3, D. Boyd and co-authors review the confusing and disputed evidence for, and diverse opinions about, bison taxonomy. Agreement seems to end with the consensus that bison belong to the family Bovidae. Much of the debate centres on whether bison belong to the genus *Bos*, the genus of cattle, guar, yak, and oxen, or to their own genus, *Bison*. Both names are currently used in the scientific literature. Differences of opinion are largely based on the importance of morphological (phenetic) versus molecular (phylogenetic) lines of evidence, and on historical precedence and usage. Within *Bison*, there are also some people who question the designation of European bison and American bison as separate species. Boyd *et al.* conclude

that "Further research and debate by taxonomists, and the bison conservation community, is required to reconcile molecular, behavioural and morphological evidence before a change in nomenclature could be supported, and thus, for this document, the American Bison Specialist Group adheres to the genus *Bison* with two species, *B. bonasus* and *B. bison*. Not surprisingly, disagreement also exists regarding the subspecies status of wood and plains bison. However, Boyd *et al.* emphasise that this debate does not negate the importance of conserving the two forms as separate entities. From a conservation perspective, the goal is to conserve "evolutionarily significant units" or "distinct population segments," among other terms used to define geographic variation among populations, a concept recognised by both the U.S. Endangered Species Act and the Committee on the Status of Endangered Wildlife in Canada. Keeping wood bison and plains bison as separate non-interbreeding units is the recommended precaution.

Genetics play a particularly complex and important role in bison conservation, as explained by D. Boyd and co-authors in **Chapter 4.** The rapidly advancing science of genetics has recently brought new information and insights into not just the evolutionary relationships among bison taxa, but also to managing for viable bison populations and conserving the wild bison genome. Boyd *et al.* review the current state of bison genetics and what needs to be done to address the major threats to genetic diversity and integrity—demographic bottlenecks, founder effects, genetic drift, and inbreeding—all of which bison have experienced. Although population bottlenecks can lead to significant loss of genetic diversity, bison appear to have largely avoided this problem during their population bottleneck in the late 1800s. Given the good diversity within the bison gene pool, and recent evidence that shows several conservation herds are genetically distinguishable, one of the most important management questions is how to manage the population genetics of these often relatively small herds. Should this be accomplished as one large metapopulation or as closed herds to maintain localised diversity? The best conservation strategy is to do both, and, where possible, to increase the size of small herds to attain a large effective population size. Hybridisation also poses challenges for bison conservation. Although the introduction of plains bison into wood bison range has resulted in some hybridisation, the two forms remain distinct and avoiding further hybridisation is a priority. Much more widespread, and of greater concern, is the introgression of cattle genes into the bison genome, a legacy of attempts to cross-breed cattle and bison that began when bison numbers were still low in the early 1900s. Genetic testing reviewed by Boyd *et al.* indicates that most conservation herds have some level of cattle-gene introgression in the nuclear and (or) mitochondrial DNA. By inference this strongly suggests that a vast majority of commercial herds have cattle-gene introgression. The effects of introgression on bison biology are largely unknown. No introgression has been detected in several conservation herds, which consequently deserve priority attention for maintaining in reproductive isolation, and as source stock for establishing new conservation herds. Finally, Boyd *et al*. note that the approximately 400,000 bison in commercial herds in North America, some 93% of the total continental population, are undergoing artificial selection for domestic traits, such as ease of handling, body conformation, carcass composition, and so on. Domestication, whether intentional or not, poses a special challenge to conserving the wild bison genome.

In Chapter 5, K. Aune and co-authors provide a comprehensive review of how diseases, particularly those that are "reportable" according to federal or state/provincial regulations, have a major influence on bison restoration and management. They describe the characteristics and implications of nine diseases for bison conservation, ranging from anthrax and bluetongue to bovine brucellosis and bovine spongiform encephalopathy. Federal and state/provincial regulations for, and management responses to, a particular disease depend on several factors, including potential effects on bison, threat to livestock and humans, and whether it is indigenous or exotic to bison and the ecosystem. The authors describe the complex and difficult management challenges that diseases present in three of North America's most important conservation herds: the plains bison herds of Yellowstone National Park (YNP) and Grand Teton National Park/National Elk Refuge that harbour brucellosis, and the wood bison herds in and around Wood Buffalo National Park that are infected with both bovine tuberculosis (BTB) and brucellosis. Diseases such as brucellosis also severely limit the translocation of bison from infected, important conservation herds, such as the Yellowstone herd, to establish new herds in new areas because of concerns about potential transmission to cattle. While the policies and legal framework for controlling disease in domestic livestock are well established, they do not work well when applied to wildlife, including bison, because they often conflict with conservation goals and our ability to manage and maintain wild populations. The recent development of national wildlife health strategies in both Canada and the U.S. could help address this problem.

Chapter 6, by P. Gogan and co-authors, addresses general biology, ecology, and demographics of bison. Bison are remarkably adaptable to a wide range of ecosystems and climatic regimes. Physiologically, bison are much better adapted to climate extremes than cattle. Behaviourally, bison exhibit a relatively simple social structure with cow-calf pairs at the core and, more loosely and somewhat seasonally, large groups of cows, calves and immature males, and separate, smaller groups of mature bulls. Bison exhibit individual and group defence against large predators such as wolves. Historically, plains bison made seasonal migrations between summer and winter ranges, in some cases north-south and in others between the prairies

and foothills. Bison have a profound influence on ecosystems and create habitat heterogeneity through various means. As primarily graminoid (grasses and sedges) eaters, variable grazing pressure by free-ranging bison and their interaction with fire create habitat patchiness on which grassland bird diversity depends. Wallowing behaviour further promotes heterogeneity by forming temporary pools and changing surface hydrology and runoff and creating local patches of disturbed soil in which some flowering plant species prosper. Bison are dispersers of seeds, and are sources and redistributors of nutrients for predators, scavengers, plants, and ecosystem processes. Gogan *et al.* describe foraging patterns and habitat use by wood and plains bison in various ecoregions, from the arid southwest to humid cold boreal regions. The authors also review bison population structure and reproduction and demonstrate that under natural conditions newly established bison populations can double every four to six years. Population numbers are affected by both density-independent events, such as severe winters and wild fires, and density-dependent factors such as disease and wolf predation. While humans were a bison predator for thousands of years, the advent of firearms greatly increased human predation, so that by the mid-1800s, an estimated 500,000 plains bison were killed annually for subsistence and 100,000 for hides. The human-firearm-commerce combination, it would seem, largely voided the density-dependent relationship between bison and human predation until it was almost too late for the American bison.

In Chapter 7, C. Gates and co-authors assess the status of conservation herds using seven criteria: numerical status, geographic status, population size and class distribution, opportunity for mate competition among mature males, presence of wolves, presence of diseases that could affect conservation status, and occurrence or likely occurrence of cattle-gene introgression. The designation "conservation herd" is assigned to herds managed by federal or state/provincial governments or non-governmental organisations (NGOs) whose mission is nature conservation. Remarkably, little progress has been made in recent decades in increasing the number of animals in conservation herds. From the few hundred that remained in the late 1800s, the number of animals in conservation herds increased in the first half of the 1900s, but then levelled off, or in the case of the wood bison, even declined, while the number of conservation herds has continued to grow to the present day. As of 2008, there were 62 plains bison conservation herds containing about 20,500 animals, and 11 conservation herds of wood bison containing nearly 11,000 animals. Meanwhile, starting in the 1980s, the commercial bison industry prospered with the total population growing to around 400,000 animals in 2007, roughly evenly divided between the U.S. and Canada. Although a few conservation herds exceed 1,000 animals, most conservation herds of both wood and plains bison have fewer than 400 animals and, in the case of the plains bison, many are fenced in areas of only a few thousands hectares and not subject to natural predation. Until recently, there was a wild bison herd inhabiting a trans-boundary area between Mexico and the U.S., the only herd meriting conservation status in Mexico. But now, it has been restricted to a private ranch on the U.S. side. The American bison nearly qualifies for listing as Vulnerable Ca2(1) under IUCN criteria and is currently listed as Near Threatened on the IUCN Red List.

As K. Aune and co-authors describe in **Chapter 8**, bison conservation must deal with a complex maze of legal and policy issues. Much of this complexity is due to a history of bison being treated like livestock. As the authors note, "During the great restoration period of wildlife management, bison were routinely classified and managed by state/provincial and federal agencies across North America as a form of livestock, while other wildlife were classed and managed as free-roaming wild animals." They subsequently provide a detailed review of the legal status of, and conservation initiatives underway for, bison in Mexico, the U.S., and Canada. The legal recognition of bison as wildlife or livestock, or both, varies across various federal, state, and provincial jurisdictions in North America. For example, only ten U.S. states, four Canadian provinces and two territories, and one Mexican state classify bison as wildlife; all other states and provinces within the bison's historic range designate them as domestic livestock. Overlaying this legal map for bison are several stakeholder groups that manage bison: public wildlife and land management agencies, Native American groups, non-profit conservation organisations, and private producers. Reportable diseases present another set of legal issues that affect international and interstate transport of bison. Aune *et al.* suggest that a paradigm shift is required whereby the public recognises bison as wildlife, and that there is much greater social tolerance, especially in the agricultural community, if major progress is to be made in re-establishing free-ranging bison on their native range. Moreover, large-scale restoration over big landscapes will typically require partnerships and co-management among multiple landowners and resource managers, and more enlightened and coordinated government regulations and policies.

In Chapter 9, J.E. Gross and co-authors provide guidelines for population, genetic, and disease management for both existing conservation herds and for the full recovery of bison over both the short and long term. As the authors explain, conservation focuses on retaining existing ecological, cultural, and genetic characteristics of bison, whereas full recovery entails a broader vision of bison inhabiting landscapes that permit the full expression of natural behaviours and ecosystem interactions that once existed. The guidelines first address bison behaviour, particularly the importance of ensuring natural mating systems that involve avoiding a skewed sex ratio and allowing

competition among bulls, as well as other factors, such as natural movements and mortality rates. Given the small size of many existing herds and newly established herds, guidelines for population and genetic management are particularly important. Herds of 1,000 or more animals are important for conserving genetic diversity, and factors such as non-random mating, skewed sex ratios, and large swings in population size need to be avoided in relatively small herds. Managing bison for restoring and maintaining biodiversity involves allowing animals to naturally move and forage across the landscape, and to interact with other natural processes such as fire, drought, and snow cover. Guidelines are provided for active management, including handling and herding and the type of infrastructure required, with the caveat that active management and handling should be minimised. Disease guidelines address prevention, surveillance and, when pathogens are detected, management. Gross *et al.* stress the importance of well-designed reintroduction programs for establishing new herds and offer suggestions ranging from stakeholder involvement to sourcing animals and ensuring proper herd structure. Given concerns about the genetic uniqueness of some herds and cattle-gene introgression, similar care needs to be given in transferring animals between herds with the goal of maintaining genetic diversity and (or) aiding in the recovery of small or threatened herds. The chapter concludes with recommendations for using modelling and computer simulations to assess bison populations and habitat.

The concluding chapter (10) on guidelines for ecological restoration by C. Gates and co-authors is directed at establishing new, large populations of bison on large landscapes. Because bison were an ecologically dominant species over much of their range, restoring historic ecological processes and biodiversity in areas they once inhabited depends on restoring large, free-roaming herds. Full ecological restoration is defined as "the re-establishment of a population of several thousand individuals of the appropriate subspecies in an area of original range in which bison interact in ecologically significant ways with the fullest possible set of other native species and biophysical elements of the landscape, with minimal necessary management interventions." Although the focus of this chapter is on restoring large herds over large areas, where processes such as migration and natural selection are most likely fulfilled, Gates *et al.* point out that small herds can also contribute to restoring many ecological processes that occur at smaller scales. The chapter provides guidelines for planning and executing large-scale re-introductions, including a feasibility analysis that addresses both biological questions and a thorough assessment of socioeconomic variables and legal requirements, sourcing and then reintroducing suitable stock, and follow-up monitoring, evaluation and adaptation as experience is gained and lessons learned. As noted as well in chapter 8, one of the biggest challenges facing large-scale restoration is that assembling a landscape of hundreds of thousands or millions of hectares will usually require partnerships and co-management of multiple landowners, both public and private, and the support of many stakeholders.

Chapter 1 Introduction: The Context

Lead authors: C. Cormack Gates and Peter J. P. Gogan

1.1 The Species Survival Commission and the American Bison Specialist Group

The International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) is a science-based network of approximately 8,000 volunteer experts from almost every country of the world, working together towards *"A world that values and conserves present levels of biodiversity."* Within the SSC, over 100 specialist groups and more than 15 independent Red List Authorities are set up to track species' status, monitor biodiversity, analyse issues, develop solutions, and implement actions (SSC Strategic Plan 2001-2010). Among them, the Bison Specialist Group is distinguished by two organisational units, one for the European bison (*Bison bonasus*), and the other, for the American bison (*Bison bison*).

The primary goals of the American Bison Specialist Group (ABSG), and the intent of this document, are to contribute to the development of comprehensive and viable strategies and management actions to promote conservation and ecological restoration of bison as wildlife where feasible throughout the original range of the species. Conservation and ecological restoration of bison, as wildlife, at the scale of its original continental range are ambitious and complex endeavours, perhaps more so than for any other North American species. Enhancing the long-term security of bison, as wildlife, will require the commitment and participation of key sectors, including public wildlife and land management agencies, non-government environmental organisations, aboriginal governments and communities, local communities, and conservation-oriented commercial producers. Toward this goal, the ABSG was established to include a broad network of people interested in bison conservation and recovery. There are more than 60 registered members and numerous other collaborators. As with other specialist groups, this network of volunteers represents the functional capacity of the IUCN to monitor the status and management of American bison in relation to global and local biodiversity. Specialist Group participants contributed the scientific and practical knowledge assembled in this report, and can offer expert advice and, in many instances, the means to make things happen on the ground by implementing actions or encouraging and facilitating others to advance the conservation and ecological restoration of bison as wildlife.

The ABSG is a group of volunteers representing a variety of disciplinary backgrounds, expertise, and professional experience. They are geographically distributed across the breadth of the original continental range of the species, from Mexico to Alaska, and from the Tallgrass Prairie in the east to the intermountain west. They work for a variety of institutions including governments, conservation organisations, and academic institutions (see Acknowledgements).

The primary goal of the American Bison Specialist Group (ABSG) is to contribute to the development of comprehensive and viable strategies and management actions to enhance conservation and achieve ecological restoration of bison as wildlife where feasible throughout the original range of the species.

1.2 Context

Prior to European settlement, the American bison had the largest original distribution of any indigenous large herbivore in North America, ranging from the desert grasslands of northern Mexico to the floodplain meadows of interior Alaska (List *et al.* 2006; Stephenson *et al.* 2001) and almost from coast to coast. The ecological scope of the species was limited only by its habitat requirements and specialised diet. An obligate grazer, grasses and sedges present in grasslands and meadows are the mainstay of the American bison's diet and habitat. Bison have been continuously present in North America for at least 300,000 years, persisting in various forms during the late Pleistocene through sequential glacial and interglacial periods, then into the Holocene and present times (MacDonald 1981; Shapiro *et al.* 2004; Wilson *et al.* 2008). They have been associated with successive cultures since humans first occupied the continent about 12,000 years ago.

Over hundreds of thousands of years, bison have contributed to the co-evolution of other biota, including grazing adaptations in plants, mutualistic, commensal and trophic interrelationships, and bison have functioned as a key component of the native biodiversity in vast areas of the continent. Key species, such as bison, have a marked influence on the patterns of occurrence, distribution, and density of other species (Meffe and Carroll 1994; Paine 1969). Where present, bison play important ecological roles by influencing the structure, composition and stability of both plant (Campbell *et al.* 1994; Knapp *et al.* 1999) and animal communities (Bogan 1997; Roe 1970; Truett *et al.* 2001).

No other wildlife species has exercised such a profound influence on the human history of a continent. As the great ice sheets receded, and grasses and sedges colonised the emerging landscape, beginning 14,000 years ago, bison, then human cultures followed. Widespread and abundant (Shaw 1995), bison were a staple resource for more than 12,000 years in the subsistence economies of successive cultures of Native North Americans. During brief recent history, over the last 500 years or so, Europeans colonised the eastern seaboard, explored westward into the Native-occupied prairies and the North, fought for resources, dominated indigenous peoples, and prospered as new settlers and industrial societies. Trading posts recruited indigenous people to harvest bison for meat and pemmican for the forts and to fuel the trade in furs (Gates *et al.* 1992). Armies clashed under the prairie skies (Greene 1996) and railways were built to connect the West to eastern markets. Millions of plains bison were killed for their meat, hides for machine belts and robes, for sport, and to subjugate the First Nations, making way for settler society and domestic European livestock (Hornaday 1889; Isenberg 2000). In less than a century, from Chihuahua State in Mexico to the State of Alaska, the most abundant indigenous large herbivore in North America was driven close to extinction. Had it not been for the interest of private citizens in rearing a few survivors in captivity (Coder 1975), and the remoteness of a lone wild population in what is now Yellowstone National Park (YNP) (Meagher 1973), plains bison would have disappeared from the continent. Similarly, by the end of the "Great Contraction" of plains bison late in the 19th Century (Flores 1996), wood bison were also reduced to a single surviving population of fewer than 300 animals in a remote area in the forested borderlands of Alberta (AB) and the Northwest Territories (NWT) (Gates *et al.* 1992; 2001).

During the 20th and into the 21st Century, federal and state/provincial agencies and conservation organisations played an important role in the conservation and recovery of bison as wildlife. Sixty-two plains bison and 11 wood bison herds have been established for conservation, representing about 7% of the continental population. In parallel, since about 1980, the number of bison raised under captive commercial propagation has increased markedly, and now represent about 93% of the continental population (Chapter 7).

1.3 Current Challenges for Conservation and Ecological Restoration of Bison as Wildlife

Conservation of any wildlife species requires ensuring both long-term persistence of a sufficient number of populations and maintaining the potential for ecological adaptation resulting from natural selection operating on individuals in viable populations in the wild (IUCN 2003; Secretariat of the Convention on Biological Diversity 1992; Soulé 1987). In wild mammal populations, limiting factors, such as predation, seasonal resource limitation, and mate competition, contribute to maintaining the wild character, genetic diversity, and heritable traits that enable a species to adapt to, and persist, in a natural setting (Knowles *et al.* 1998). The long-term conservation of American bison as wildlife is faced with several important challenges that need to be acknowledged and addressed by public agencies, non-profit organisations and producer organisations. They include the rarity of large wild populations in extensive native landscapes, conserving the wild character and genome of bison, and the presence of regulated diseases.

1.4 Large Wild Populations

Bison can best achieve their full potential as an evolving, ecologically interactive species in large populations occupying extensive native landscapes where human influence is minimal and a full suite of natural limiting factors is present. While such conditions remain available in the north of the continent, it is challenging to find extensive landscapes for restoring and sustaining large free-roaming wild bison populations in southern, agriculture-dominated regions. Ecological restoration is the intentional process of assisting recovery of an ecosystem that has been modified, degraded, damaged or destroyed relative to a reference state or trajectory through time (SERI and IUCN Commission on Ecosystem Management 2004). As described by the IUCN Commission on Ecosystem Management, ecological restoration has, as its goal, an ecosystem that is resilient and self-sustaining with respect to structure, species



Plate 1.1 *Free ranging bison in Yellowstone National Park. Photo: John Gross.*

composition and function, as well as being integrated into the larger landscape, and supporting sustainable human livelihoods. Ecological restoration involving bison as an integral component of ecosystems faces two major challenges: 1) how to undertake restoration across large areas with diverse land-use and ownership patterns; and 2) how to undertake restoration in a way that improves both biodiversity and human wellbeing. Large-scale ecological restoration involves biological and social complexity. Attitudes, economics and politics, from local to regional and international scales, will shape the future of bison conservation on occupied lands. These challenges are addressed in Chapter 10.

1.5 Conserving the Wild Character and Genome of Bison

Bison in captive herds may be managed to achieve various objectives, including the ecological services that bison provide (e.g., grazing, nutrient cycling, and terrain disturbance), education and display, commercial production, and conservation of bison as wildlife. Conserving bison as wildlife is not necessarily served by managing a population for other purposes. For example, the ecological effects of herbivory may be achieved by grazing a variety of livestock species. Although some rangelands formerly used for cattle production have been converted to bison production, the substitution of bison for cattle production does not, by itself, necessarily contribute to bison conservation, or to ecological restoration of bison as wildlife. Similarly, display herds may serve conservation education objectives without otherwise contributing to species conservation.

In the absence of intentional policies and actions to conserve the wild character and genome of bison, captivity and commercialisation can lead inadvertently or intentionally to a variety of effects that may be deleterious to bison as a wildlife species in the intermediate to long term (Chapter 4). These include effects on the genome: founder effect; reduced genetic diversity; persistence and phenotypic penetration of deleterious genes; or inadvertent selection for heritable morphology, tameness or adaptation to captivity. Small populations are particularly susceptible to such effects. The sex and age structure of captive conservation populations may be manipulated to reduce the risk of escape, remove aggressive animals, or to alter fecundity or the rate of population increase. The age composition of males in captive herds is typically substantially different from wild populations.

The common practice in captive commercial herds of eliminating males, before they become morphologically and behaviourally mature, poses a challenging question about the roles of mate competition and natural selection for fitness in such populations. In general, selection pressures on captive wildlife are substantially different from those in the wild. O'Regan and Kitchener (2005) posited that domestication may occur inadvertently in captive wild mammals through passive selection for individuals behaviourally suited to captivity, with concomitant morphological changes over several generations. Most changes are thought to result from increasing paedomorphosis, whereby juvenile characteristics are retained in the adult form of an organism (O'Regan and Kitchner 2005). Clutton-Brock (1999) described changes in large mammals under captive conditions including reduced body and brain size, altered external appearance, the gaining of a fat layer beneath the skin and a reduction of the facial region. Inadvertent selection for tameness and adaptation to a captive environment is typical in mammals (Frankham *et al.* 1986), and in addition to altering "wildness", can reduce the chances for successful reintroduction of captives into the wild. A loss of response to predators and alteration of defensive and sexual behaviours have also been reported in captive wildlife (Price 1999; 2002). Many commercial bison producers directly select for marketable traits such as early maturity, coat colour, body size and conformation. The latter "show ring traits" are promoted in bison industry advertisements, publications and at auctions.

The large size of the commercial captive population is the basis for a popular misconception that the species is "secure", leading wildlife management agencies to ignore actions necessary for conservation of wild type bison. Today, among North American jurisdictions, there is a confusing array of classifications of bison as wildlife, domestic livestock, or both (Chapter 8).

Hybridisation with cattle is another serious challenge for bison conservation. In the U.S., Canada, and Europe, agricultural interests attempted to develop an improved range animal by hybridising bison and cattle. Forced-mating of bison and cattle can be readily achieved in a controlled environment. However, they preferentially mate with their own species under open range conditions (Boyd 1908; Goodnight 1914; Jones 1907). In Europe, the European bison (*Bison bonasus*), a relative of the American bison, and the aurochs (*Bos taurus primigeneus*), progenitor of modern cattle, were sympatric, yet evolutionarily divergent, units. Typical of sympatric species occupying similar trophic niches, behavioural and ecological specialisation provides niche separation, leading to reproductive isolation and progressively to speciation (Bush 1975; Rice and Hostert 1993). Species divergence and reproductive incompatibility are evident from the low fertility of first generation (F1) bison x cattle offspring (Boyd 1908; Steklenev and Yasinetskaya 1982) and the difficulty producing viable male offspring (Boyd 1914; Goodnight 1914; Steklenev and Yasinetskaya 1982; Steklenev *et al.* 1986). Unfortunately, forced hybridisations between *B. bison* and *Bos taurus* in North America have left a legacy of cattle mitochondrial (Polziehn *et al.* 1995; Ward *et al.* 1999) and nuclear DNA (Halbert 2003; Halbert *et al.* 2005). This introgression is

widespread among contemporary bison populations, in both public and private sector herds (Chapter 4). The implications for bison conservation are just beginning to be understood and appropriate interventions considered.

1.6 Reportable Diseases

Bison host numerous parasites and pathogens (Reynolds *et al.* 2003; Tessaro 1989), some of which are important to conservation. Livestock diseases that restrict trade or pose a risk to human health and are 'reportable' under federal, provincial, and state legislation are particularly important because they may induce management actions that negatively affect bison conservation and restoration (Chapter 5). Management interventions may include depopulation, limiting dispersal and range expansion to protect adjacent bison or livestock populations, and restraining translocations. The presence or perceived risk of reportable diseases in bison devalues them as wildlife and constrains conservation and recovery potential. Large free-ranging bison populations are infected with exotic (non-native) reportable diseases in two areas of the continent, the Greater Yellowstone Area (GYA) mainly in Montana and Wyoming (bovine brucellosis), and the Greater Wood Buffalo Ecosystem in Alberta and the Northwest Territories (bovine brucellosis and tuberculosis). Balancing conservation with intensive interventions is a perpetual challenge for the agencies responsible for managing these populations.

1.7 Purpose of this Document

This document provides an authoritative summary of the biology and status of American bison, including: prehistoric to recent history and cultural context (Chapter 2); taxonomy and related issues (Chapter 3); genetic variation and effects of human interventions on the genome (Chapter 4); diseases that directly or indirectly affect bison conservation (Chapter 5); biology and ecology of the species (Chapter 6); the numeric and geographic status of American bison, emphasizing herds managed primarily for conservation (Chapter 7); legislation and policies pertaining to bison in all range states (Chapter 8). Guidelines for bison conservation are provided in the final two chapters of this document (Chapter 9 Population and Genetics Guidelines; Chapter 10 Ecological Restoration Guidelines). Throughout the document reference is made to challenges requiring actions ranging from urgent to long term.

Non-prescriptive guidance is offered on how conservation and ecological restoration of bison as wildlife may be achieved, while respecting the principles of democratic governance in the three nations forming North America, the sustainability of economic use of ecological resources, cultural heritage values, and ecological values of intact ecosystems.

Chapter 2 History of Bison in North America

Lead Authors: Ben A. Potter, S. Craig Gerlach, and C. Cormack Gates,
Contributors: Delaney P. Boyd, Gerald A. Oetelaar, and James H. Shaw

2.1 Palaeobiology and Phylogeny

Bison have existed in various forms for more than 2,000,000 years (Danz 1997; McDonald 1981). Early forms originated in Asia and appear in Villafranchian deposits, and in the early fossil record in India, China, and Europe (Guthrie 1990; Shapiro *et al.* 2004). Bison occupied Eurasia about 700,000 years ago then moved across the Bering Land Bridge into Alaska during the middle Pleistocene 300,000–130,000 years ago (Illinoin Glaciation; Marine Oxygen Isotope Stages (MIS) 8 to 6 (Shapiro *et al.* 2004). All Siberian and American bison shared a common maternal ancestor about 160,000 years ago (Shapiro *et al.* 2004). Fossil evidence indicates there was a single species, or at least a similar large-horned form with variable species/sub-species designations, the steppe bison, *Bison priscus*, throughout Beringia (Guthrie 1990).



Plate 2.1 *Skull of* Bison priscus, *Yukon Canada. Photo: Cormack Gates.*

Steppe bison probably reached their maximum distribution and abundance during the last glacial period (Wisconsinan, 100,000–12,000 years B.P.; MIS 2-4 and 5a-d). These are the typical bison fossils found in the Yukon and Alaska during that period. Steppe bison had relatively long hind legs, similar to the European bison (*B. bonasus*), and large horns with tips curved back, and a second hump (Guthrie 1990). Analysis of ancient mitochondrial DNA (mtDNA) (Shapiro *et al.* 2004) suggests that Late Pleistocene bison, found from the Ural Mountains to northern China, were descendants of one or more reverse dispersals from North America. The most recent common ancestor of bison specimens analysed by Shapiro *et al.* (2004) existed towards the end of the Illinoian Glacial Period (MIS6).

Villafranchian: a major division of early Pleistocene time, named for a sequence of terrestrial sediments studied in the region of Villafranca d'Asti, an Italian town near Turin. This was a time when new mammals suddenly appeared.

Holarctic: a term used by zoologists to delineate much of Eurasia and North America, which have been connected by the Bering land bridge when sea levels are low during glacial periods.

Plesitocene: Ice Age. A division of geological time; epoch of the Quaternary period following the Pliocene. During the Pleistocene, large areas of the northern hemisphere were covered with ice and there were successive glacial advances and retreats.

Beringia: a 1,000 mile wide ice-free grassland steppe, in Asia and North America linked together by the "Bering Land Bridge" when sea levels were low. Animals traveled in both directions across this vast steppe, and humans entered the Americas from what is now Siberia.

Glacial periods: There have been at least four major ice ages. The present ice age began 40 million years ago with the growth of an ice sheet in Antarctica. Since then, the world has seen cycles of glaciation with ice sheets advancing and retreating on 40,000- and 100,000-year time scales. The most recent glacial period ended about ten thousand years ago.

Marine isotopic stages (MIS): alternating warm and cool periods in the Earth's ancient climate, deduced from oxygen isotope data reflecting temperature curves derived from data from deep sea core samples.

Ural Mountains: a mountain range that runs roughly north and south through western Russia. They are sometimes considered as the natural boundary between Europe and Asia.

Phenotype: Observable physical or biochemical characteristics of an organism. Phenotype is determined by both genetic makeup and environmental influences.

Clade: A biological group (taxa) that share features inherited from a common ancestor.

Holocene: A geological period, which began approximately 11,550 calendar years B.P. (about 9600 BC) and continues to the present. It has been identified with MIS 1 and can be considered an interglacial in the current ice age.

Phylogenetics: The study of evolutionary relatedness among groups of organisms.

Glacial maximum: The time of maximum extent of the ice sheets during the last glaciation (the Würm or Wisconsin glaciation), approximately 20,000 years ago.

Taphonomic processes: The transition of the remains, parts, or products of organisms in soil, e.g. the creation of fossil assemblages through burial.

Taxonomy: The science of classification of organisms. Nomenclature is the system of naming organisms in relation to their phylogeny.

Bison moved south into the grasslands of central North America when the ice sheets retreated at the beginning of the Sangamon Interglacial (MIS 5e) 130,000-75,000 years B.P. (MacDonald 1981), evolving there into a large form, *B. latifrons*. This giant bison possessed a horn span of more than two metres and was abundant in the central continent during the Sangamon Interglacial. It underwent a gradual reduction in body size and horn span (Guthrie 1980; van Zyll de Jong 1993). During the subsequent Wisconsin Glaciation (110,000-12,000 years B.P.; MIS 2-4 and 5a-d), Beringian and southern populations became separated as the Laurentide continental ice sheet extended into western Canada from 20,000-13,000 years B.P. (Burns 1996; Wilson 1996). Geographic separation had profound biological, taxonomic, and evolutionary effects. Southern bison evolved into distinctive phenotypes (van Zyll de Jong 1993) and separate mtDNA clades. All modern American bison now belong to a single clade that is distinct from Beringean bison, with a most recent common ancestor between 22,000 and15,000 years B.P. (Shapiro *et al.* 2004). This interpretation is consistent with complete separation between northern and southern populations at the time of the last glacial maximum (20,000-18,000 years B.P.).

Data presented by Shapiro *et al.* (2004) and Wilson *et al.* (2008) support the hypothesis that modern bison are descended from populations that occurred south of the ice sheet before the Last Glacial Maximum. Southern bison underwent rapid *in situ* evolution during the early Holocene from *B. antiquus* to an intermediate form *B. occidentalis*, then to the modern form *B. bison* (Wilson *et al.* 2008). When the continental ice sheets began to melt, bison invaded the emerging ice-free corridor from the south where thawing and melting occurred first. Colonisation from Beringia was limited (Shapiro *et al.* 2004). Overlap between northern and southern bison occurred in the vicinity of the Peace River in north-eastern British Columbia where northern bison were present by 11,200-10,200 years B.P. (Shapiro *et al.* 2004), and southern forms of bison were present 10,500 years B.P. Molecular research by Shapiro *et al.* (2004) indicates that all modern bison are descended from populations living south of the ice sheet before the Last Glacial Maximum. The two modern North American subspecies (plains bison and wood bison) diverged by about 5,000 years ago (Gates *et al.* 2001; van Zyll de Jong 1986). The wood bison (*B.b. athabascae*) was the most recent variant to occur in Alaska, the Yukon and Northwest Territories and the plains bison (*B.b. bison*) is the most recent southern variant of the North American species (van Zyll de Jong 1993 Stephenson *et al.* 2001). Small-horned bison similar to wood bison also occurred in northern Eurasia during the Holocene (Flerov 1979; Lazarev *et al.* 1998; van Zyll de Jong 1986, 1993). Although the European bison (*B. bonasus*) is morphologically similar to and readily interbreeds with the American bison, they form distinctly different clades based on mtDNA sequences of the 273 bp-long fragment of cytochrome b gene (Prusak *et al.* 2004). This is consistent with geographic separation between these two species starting during the mid-Pleistocene and before reverse-dispersal occurred from North America to Siberia.

2.2 Original Range

Previous typologies divide the Holocene range of bison into "prehistoric" and "historic" periods (van Zyll de Jong 1986). The distinction between them is not based on objective or biologically meaningful criteria, and provides an artificial and confusing temporal dichotomy that persists despite well-informed arguments to the contrary (Stephenson *et al.* 2001). A preferred and more accurate alternative is to refer to the previous range of bison as "original" range, thereby avoiding the necessity to distinguish between written records and other sources including zooarchaeological evidence and orally transmitted knowledge (Gates *et al.* 2001).

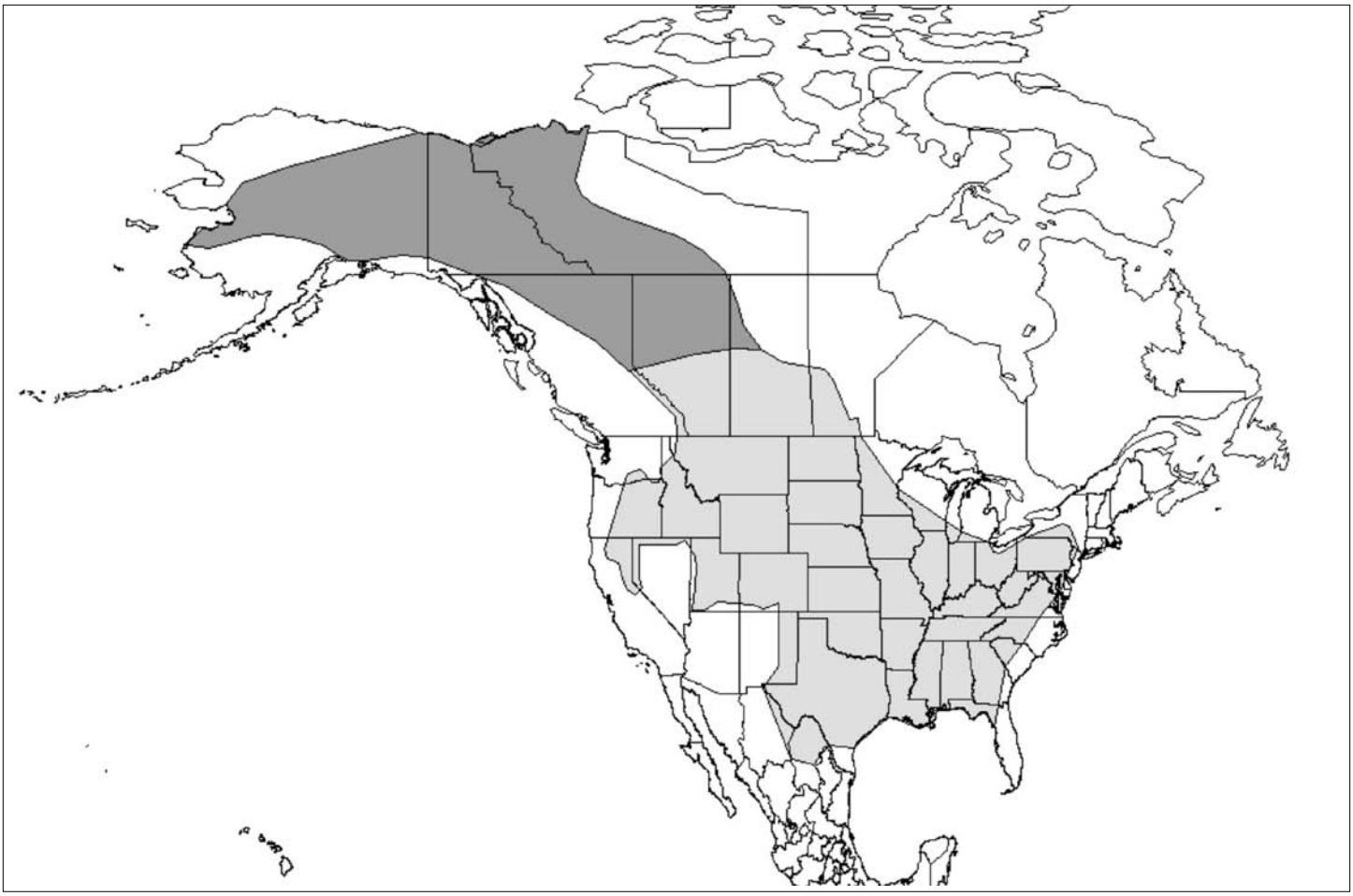


Figure 2.1 *Original ranges of plains bison and wood bison. Recreated by Boyd (2003) based on van Zyll de Jong (1986) and Stephenson et al. (2001).*

Modern bison originally ranged across most of North America (Figure 2.1). Plains bison were most abundant on the Great Plains, but also radiated eastward into the Great Lakes region, over the Allegheny Mountains toward the eastern seaboard, northward as far as northern New England, and then south into Florida; westward, they were found in Nevada and parts of the Great Basin, the Cascade and Rocky Mountains northward to mid-Alberta and Saskatchewan prairie lands, and further south along the Gulf of Mexico into Mexico (Danz 1997; Reynolds *et al.* 1982). There are records of bison occurring at surprisingly high elevations in mountainous regions, particularly along the Front Range of the Rocky Mountains (Fryxell 1928; Kay and White 2001; Meagher 1986). Evidence also indicates that bison inhabited areas of the Greater Southwest, including Arizona, New Mexico, and northern Mexico, areas not generally recognised as within the original range of plains bison (Truett 1996). Whether apparent or real, bison scarcity in the American Southwest is usually attributed to a combination of insufficient water and grass and human hunting (Truett 1996). The original range of wood bison includes northern Alberta, north-eastern British Columbia, a small area of north-western Saskatchewan, the western Northwest Territories, Yukon, and much of Alaska (Stephenson *et al.* 2001). More recent research incorporating oral narratives of aboriginal people in Alaska, Yukon, and Northwest Territories, in combination with archaeological and palaeontological records, demonstrates that wood bison were present in the Yukon and Alaska within the last two centuries, and that these areas are within the original range of the subspecies (Lotenberg 1996; Stephenson *et al.* 2001).

2.3 Abundance

Historical and archaeological records demonstrate that plains bison thrived on the grasslands of the Great Plains (Malainey and Sherriff 1996; Shaw and Lee 1997). Explorers, settlers, and Euroamerican hunters described enormous herds of plains bison, with population estimates ranging from 15 to 100 million (Dary 1989; Shaw 1995). In the 1890s, naturalist Ernest Thompson Seton posited the widely accepted estimate for American bison at 60 million (Dary 1989; McHugh 1972; Roe 1970; Shaw 1995).

Several quantitative and qualitative methods have been used to estimate pre-settlement bison abundance, including direct observation, carrying capacity calculations, and counts of bison killed for market in the late 1800s. Even when used in combination, all methods are fraught with uncertainty, untested,

even unwarranted assumptions, and arbitrary population attributions (Shaw 1995). Regardless, there is little doubt that prior to Euroamerican settlement, plains bison numbered in the millions, and probably even in the tens of millions (Shaw 1995).

Wood bison were not as numerous as plains bison owing to limited habitat, although they did inhabit a vast region of the boreal forest in north-western North America (Gates *et al.* 2001c). Soper (1941) estimated the total wood bison population in 1800 to be 168,000, an estimate that was highly speculative. The Soper estimate is based on the number and distribution of wood bison existing in Wood Buffalo National Park (WBNP) during the 1930s, with some fuzzy extrapolation from the WBNP density to the presumed area of the original wood bison range. The estimate did not account for regional variability in habitat availability. Furthermore, Stephenson *et al.* (2001) documented a considerably larger original range than Soper (1941). Therefore, wood bison may have been more numerous than estimated by Soper.

2.4 Extirpation

Continental bison numbers declined dramatically and rapidly following European settlement. Specific regional impacts on numbers, distribution, and abundance are recorded in many historical accounts and references (e.g., Dary 1974). Large-scale seasonal migrations of both the northern and southern plains bison herds may have temporarily masked their decline, although by the late 1800s it was obvious that the American bison population had been decimated and was in serious decline (Krech 1999). Commercial hunting by Euroamericans and some Native North Americans for meat and hides was a primary cause (Hornaday 1889; Isenberg 2000). The American military quietly approved illicit market hunting on federally protected tribal lands in the northern and southern plains. Other factors included indiscriminate slaughter for sport and recreation. Sport hunting was exacerbated by the westward push of colonization from the east and across the prairies with the implicit and explicit approval of politicians and military leaders anxious to resolve the food supply side of the so-called "Indian problem." (Danz 1997; Dary 1989; Hewitt 1919; Isenberg 2000; McHugh 1972).

Environmental factors, such as regional drought, introduced bovine diseases, and competition from domestic livestock (horses, cattle, sheep) and wild horses also played a role in reducing bison numbers (Flores 1991; Isenberg 2000). Furthermore, because bison provided sustenance for North American aboriginals and commodities for their barter economy, the elimination of bison was viewed by Euroamericans as the most expedient method to subjugate the Native Americans and force them onto reserves, making way for agrarian settlement and continued western development (Danz 1997; Geist 1996; Isenberg 2000; Mayer and Roth 1958). To this end, the U.S. government unofficially supported the slaughter of bison by providing ammunition and supplies to commercial buffalo hunters (Mayer and Roth 1958). Although an overt political policy to decimate bison was never formally established, the Canadian and U.S. governments capitalised on widespread hunger among aboriginal communities caused by the near extirpation of bison as a means to subjugate and control the aboriginal population (Geist 1996; Stonechild and Waiser 1997). By the late 19th Century it was estimated that there were fewer than 1,000 remaining bison in North America (Hornaday 1889; Seton 1927). Wood bison were concentrated in northern Alberta and the Northwest Territories, and plains bison were scattered in isolated groups across the Central Great Plains and, notably, in what is now Yellowstone National Park (YNP).

2.5 Early Recovery

As the great herds diminished, there was some public outcry, but few laws were enacted to protect the bison (Danz 1997). Most early plains bison conservation efforts happened through the independent actions of private citizens. Prominent figures in the conservation movement included James McKay and

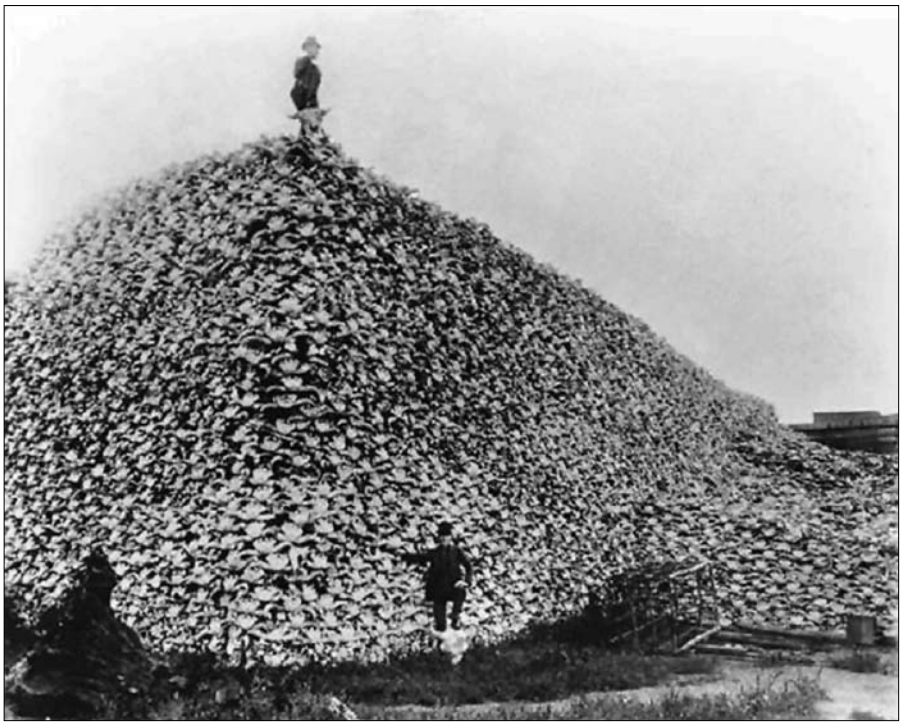


Plate 2.2 *An enormous pile of bison skulls waiting to be ground for fertilizer (c. mid-1870s). Copyright expired - Courtesy of the Burton Historical Collection, Detroit Public Library - downloaded from English Wikipedia 20 Aug 2009.*

Charles Alloway (Manitoba), Charles Goodnight (Texas), Walking Coyote (Montana), Frederick Dupree (South Dakota), Charles J. Jones (Kansas), and Michel Pablo and Charles Allard (Montana) (Coder 1975; Danz 1997; Dary 1989; Geist 1996). Their efforts to establish herds from the few remaining bison secured the foundation stock for most contemporary public and private plains bison herds. Formed in 1905, the American Bison Society (ABS) pressed Congress to establish several public bison herds at Wichita Mountains National Wildlife Refuge, the National Bison Range (NBR), Sully's Hill National Game Preserve (SHNGP), and Fort Niobrara National Wildlife Refuge (Coder 1975; Danz 1997). National parks in both the U.S. and Canada also figured prominently in bison recovery efforts (Danz 1997; Ogilvie 1979).

Once plains bison were protected from hunting (beginning in the 1870s), their numbers increased considerably, doubling between 1888 and 1902. By 1909, the subspecies was considered safe from extinction (Coder 1975). Initially sparked by nostalgia and reverence for the animal, motivations for bison recovery became increasingly driven by their commercial value (Yorks and Capels 1998). By 1970, there were 30,000 plains bison in North America, with approximately half in public herds located in national parks, wildlife refuges, and state wildlife areas, and half in private herds (Shaw and Meagher 2000). As reviewed in chapter 7, the number of plains bison currently is more than 20,500 in 62 conservation herds, while the number under commercial propagation is about 400,000.

The wood bison population fell to a low of 250 animals at the close of the 19th Century, then slowly grew to 1,500-2,000 by 1922 owing to the enforcement of Canadian laws enacted to protect the animal (Gates *et al.* 2001c; Soper 1941). In 2008, there were about 10,870 wood bison in 11 conservation herds (Chapter 7).

2.6 Cultural Significance

Few species enjoy a history as rich in archaeology, palaeontology, story and legend, oral and documentary history as the American bison. Nor is there another North American species for which the cultural and political significance of an animal is so great. For thousands of years various forms and populations of bison have coexisted with humans in North America, providing sustenance and shaping human social and economic patterns, and influencing national history and international political relationships. Although a comprehensive review of human-bison interactions from the colonisation of North America to recent times is encyclopaedic in scope, a brief summary and discussion is provided here.

Bison were important in the subsistence economies of the first Beringian colonisers of the western hemisphere, and later figured prominently, but differentially, in Palaeo-Indian, Archaic, and subsequent North American cultural horizons and traditions. Bison were economically and culturally important throughout most of North America, including interior Alaska, Yukon and Northwest Territories, but they were particularly significant for groups living in the Great Plains, from north-central Texas to southern Alberta. Various forms of bison have been identified as key subsistence resources in the Palaeolithic of north-eastern Asia, forming part of a megafaunal complex adapted to the steppe-tundra of Late Pleistocene northern Eurasia and Beringia, along with mammoths and horses (Guthrie 1990). While bison remains are commonly found in Siberian archaeological sites, standard zooarchaeological methods (Ermolova 1978) indicate they do not appear to have contributed greatly to subsistence. By comparison, reindeer, mammoths, and horses are relatively abundant in Siberian archaeological sites. Bison seem to have played a more important role in North American archaeological complexes. In Alaska, there is empirical evidence from numerous archaeological complexes spanning 12,000 to 1,000 years B.P. that links bison with cultural traditions using conservative,

Palaeo-Indian: (12,000-6,000 B.P.) A group of Late Pleistocene–Early Holocene cultures associated with the colonisation of central North America. While their subsistence economies are debated, many archaeologists consider them to be big game hunting specialists (including mammoth).

Folsom: (11,000-10,200 B.P.) A Palaeoindian culture, characterised by very high mobility and specialised bison hunting.

Archaic: (6,000-2,300 B.P.) A group of Middle Holocene cultures characterised by broad spectrum foraging (i.e., subsisting on a wide variety of big and small game, fish, shellfish, and plant foods). They do not have permanent villages or agriculture.

Plains Woodland: (2,300-1,000 B.P.) A group of Late Holocene cultures characterised by semi-permanent villages, horticulture (maize and beans) in addition to hunting and gathering.

Altithermal: also the Holocene Climate Optimum. A warm period during the interval 9,000 to 5,000 years B.P. This event is also known by other names, including: Hypsithermal, Climatic Optimum, Holocene Optimum, Holocene Thermal Maximum, and Holocene Megathermal.



Plate 2.3 *Arvo Looking Horse performing a ceremony honouring slaughtered bison after a harvest near Yellowstone National Park. Photo: Jim Peaco, National Park Service.*

efficient microblade technology (Holmes and Bacon 1982; Potter 2005; 2008). Microblades are small elongate sharp stone blades inserted into pieces of bone or wood to make composite tools (Guthrie 1983).

Bison played a key role in Palaeo-Indian, Archaic, and later economies in North America, particularly in the Great Plains. While some have questioned early Palaeo-Indian dependence on bison and other large-bodied ungulates (Grayson and Meltzer 2002), other studies show a clear pattern of specialised large mammal hunting during the Late Pleistocene and Early Holocene in North America (Hofman and Todd 2001; Waguespack and Surovell 2003). Although there are disagreements as to whether Early Palaeo-Indians should be classified as specialised big-game hunters or broad-spectrum foragers, bison evidently played an important role in their subsistence economies. A recent survey by Waguespack and Surovell (2003) reported that 52% of 35 Early Palaeo-Indian components (Clovis, 11,300-10,900 years B.P.) included bison remains. With the extinction of the mammoth and other Pleistocene megafauna, bison became a greater economic focus for late Palaeo-Indian complexes (Folsom and others present during the Early Holocene). Changes in projectile point forms have been linked to specialisations for bison hunting (Stanford 1999). In particular, Folsom complex adaptations have been linked to intensive bison hunting (Amick 1996). Communal bison hunting probably played an important role in seasonal aggregations of Palaeo-Indian populations, with human groups combining to hunt and then dispersing into smaller groups in relation to seasonal bison migrations (Kelly and Todd 1988).

On the Great Plains, the Holocene Climatic Optimum or Altithermal (about 7,500 years B.P. in mid-latitude North America) resulted in warmer and drier conditions and increased seasonality. Climate change apparently limited bison abundance and geographic distribution, and induced human adaptations to new climatic and ecological conditions (Sheehan 2002; but see Lovvorn *et al.* 2001). Human populations adjusted primarily by developing new economic strategies, termed "Archaic" by North American archaeologists. Adaptations involved new technologies such as ground stone for processing a variety of plant foods, and incorporating a more diverse array of smaller game and plants into the subsistence economy. During this period, some portions of the Great Plains appear to have been abandoned entirely by people (Meltzer 1999). However, the dearth of sites could also be explained by taphonomy (deep burial or destruction through erosion) (Artz 1996; Walker 1992). Some evidence indicates that during this period bison and people concentrated their activities in localised refugia, such as river valleys (Buchner 1982). Throughout North America, there was a general shift to mixed foraging economies based on more locally abundant resources, with bison playing a much smaller role except in specific areas of the Great Plains.

After 2,000 years B.P., archaeological records for the North American grasslands show evidence of widespread human occupation and regional specialisation in habitat use (Manning 1995; Speth 1983). The so-called Plains Woodland complexes showed local patterns of adaptation represented as widespread networks of cultural interactions that linked the eastern woodlands, and perhaps even the Greater Southwest, to the grasslands through trade and religious or ceremonial interactions (Frison 1991). Technologies shifted again to include bows and arrows, pottery and distinctive regional ceramic traditions. Much later, the use of horses formed the basis for the mounted,

nomadic "Plains Indian Culture" observed by European explorers and missionaries at first contact (Duke 1991; Wedel 1959). Native North Americans, during, and even after the Plains Woodland tradition, lived in larger more permanent villages. They depended on maize, bean, and gourd horticulture to name some of the most important domesticates, with winter dependence on deer and seasonal movements in the fall and spring to take advantage of migrating bison herds (Wilson 1987). This pattern is well represented ethnographically in the Middle Missouri Region. Groups like the Siouxan-speaking Mandan and Hidatsa, and the Caddoan-speaking Pawnee and Arikara, with the Wichita and others, were scattered along major Prairie rivers and tributaries like the Loup, Lower Loup, Canadian, and Washita, as far south as Nebraska, Kansas, and Oklahoma (Weltfish 1965). Large kill events, such as those represented at the Head-Smashed-In site in Alberta, generally did not occur until very late in the history of bison hunting on the Plains, and are represented from the Late Archaic and later periods (Byerly *et al.* 2005). The shift in hunting strategies may have been a response to increasing herd sizes, introduction of bow and arrow, and/or changes in social organisation (Driver 1990; Reeves 1990; Walde 2006).

With increased resolution and clarity afforded by ethnohistoric and ethnographic investigations, human-bison interactions among historic native peoples are better described and documented than for the late Pleistocene and Holocene. Bison continued to be the preferred game for many native North American cultures, especially on the Great Plains and Prairies, providing food, clothing, shelter, and tools (Geist 1996; Roe 1970). Sustained by bison and plant resources, many native groups likely affected densities of other large herbivore species (Kay *et al.* 2000; Martin and Szuter 1999). In addition to significant ecological relationships, the bison was a central element in oral tradition, rituals, dances, and ceremonies of native peoples of the Plains (Wissler 1927), and it remains symbolically important in the cultural traditions of many native Tribes to this day.

The arrival of Europeans in North America, after 1492, resulted in significant changes in human-bison interactions, and changed the fabric of Native American life forever. Introduced diseases such as smallpox decimated indigenous human populations (Crosby 1986), and altered subsistence, settlement, demography, and social organisation for many different groups. Bison hunting by native people was seasonal in nature. Bison were incorporated into a broad spectrum of plant and animal procurement activities (Holder 1970; Isenberg 2000). Bison provided the economic basis for stable, resilient land use regimes and social systems. However, effects of Native American warfare and raiding during the historic period disrupted and destabilised these land use and social systems. The spread of horses into Great Plains aboriginal economies by the 1750s, and increasing commoditisation of bison products caused by the emergence of a European commercial market for wildlife products by the 1820s, contributed to the near extinction of the bison (Flores 1994; Isenberg 2000:27). Native peoples traded bison hides for Euro-american commodities, with the market in bison robes reaching a peak in the 1840s. Hide hunters began to significantly participate in the market hunting of plains bison in the 1850s, and by the 1890s had decimated the herds. Even bones were cleaned for sale to the eastern fertilizer market, an activity that continued to 1906 (Dary 1974).

Numerous native North American tribes manage bison on native and tribal lands, but cultural, social and spiritual relationships with this animal are changing. For many Native Americans there is still a strong spiritual and symbolic connection, but for others it is the potential commercial value of bison that is most important. For still others, it is the pragmatic use of bison for food, and the relationship between local control over food production and land, food security, tribal sovereignty, and decreasing reliance on outside sources for food and commodities that is emerging as a topic of concern, and a theme underlying tribal decision-making.

It is not just the relationship between Native Americans and bison that is changing, but the role of bison in the overall North American food system is changing as well. The North American perspective is shifting from the view that bison are an artifact from the past to be viewed as such in parks and preserves, to one that sees bison as a dynamic component of the American diet. Along with a new vision for a healthy ecological and genetic future for the American bison, food system researchers, food system enthusiasts, and the biomedical research community envision a new role for bison in the American diet. This role elevates the animal to priority over industrially raised beef and pork, and secures for it a place as the healthy alternative to a fatty, sugar-based diet that already has significant health impacts in terms of increased rates of cardiovascular disease, colorectal and other forms of cancer, and diabetes. Free-range bison meat is higher in omega-3 fatty acids than are grain-fed animals, perhaps even as high as wild salmon and other cold water fish species, and it is also high in conjugated linoleic acid, a fat-blocker and anti-carcinogen with the potential to reduce the risk of cancer, diabetes, and obesity. The extent to which bison can be produced efficiently and in healthy ways that do not further degrade ecosystems and ecosystem services, and marketed as a healthy food at an affordable price, will perhaps be the tipping points for how important bison become in a future American food system.

Whether Native American or not, cultural values, attitudes, and perspectives are reflected in how we think about, manage, and handle animals in the wild, in commercial production systems, and after butchering and processing through marketing. Bison are perhaps unique in that we manage them both as wildlife and

as livestock, with wood bison in Alaska and Canada an example of the former, and plains bison in the Canadian and American Plains an example of the latter. The jury is probably still out on whether we will manage bison as wildlife, as livestock, or as both in the future, but it is clear that there is a bright role for this animal in an emerging North American food system and tradition. Native Americans are both recovering and restoring their long-established cultural relationship with the American bison, and Native Americans and other non-native North Americans are finding new ways to relate to this animal in ways that will enhance the conservation of the species.

Chapter 3 Taxonomy and Nomenclature

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The purpose of naming organisms is to facilitate recognition and communication and to identify patterns and apply practical structure to the natural world. Taxonomy can support the conservation and sustainable use of biological diversity by contributing to identification, assessment, and monitoring programmes (Environment Australia 1998). Taxonomy is also vital for the creation and interpretation of laws, treaties, and conservation programmes because it creates legal identities for organisms (Geist 1991). While it is important to strive for accuracy in taxonomic classification, semantic issues and uncertainty can create substantial management challenges by distracting conservation decision makers from the issues threatening a taxon or biological unit worthy of conservation.

Despite the extensive history, and the economic and symbolic importance of bison to North American societies, there remains significant confusion and disagreement about bison taxonomy. The issues range from an historical discrepancy over the common name, to ongoing scientific debate over the systematics of the genus, species, and subspecies designations.

3.1 An Historical Misnomer: Bison vs. Buffalo

The bison is not a buffalo. True 'buffalo' are native only to Africa (cape buffalo, *Syncerus caffer*) and Asia (four species of water buffalo, *Bubalus spp.*). The use of the term buffalo for American bison derived perhaps from other languages used by explorers to describe the unfamiliar beast, e.g., *bisonte, buffes, buffelo, buffles*, and *buffilo* (Danz 1997; Dary 1989). These terms are similar to *bufle* and *buffe*, which were commonly used to refer to any animal that provided good hide for buff leather (Danz 1997). Despite the misnomer, the term 'buffalo' has been used interchangeably with "bison" since early explorers first discovered the North American species (Reynolds *et al.* 1982). The term has become entrenched as a colloquialism in North American culture and language. Although scientific convention dictates use of 'bison', the term 'buffalo' persists as an accepted, non-scientific convention for habitual and nostalgic reasons.

3.2 Genus: *Bos* vs. *Bison*

When Linnaeus first classified the bison in 1758 for his 10th Edition of the *Systema Naturae*, he assigned the animal to *Bos*, the same genus as domestic cattle (Wilson and Reeder 2005). During the 19th Century, taxonomists determined that there was adequate anatomical distinctiveness to warrant assigning the bison to its own genus (Shaw and Meagher 2000). Therefore, in 1827, C. Hamilton Smith assigned the sub-generic name *Bison* to the American bison and the European bison (Skinner and Kaisen 1947). In 1849, Knight elevated the subgenus *Bison* to the level of genus (Skinner and Kaisen 1947). Since then, taxonomists have debated the validity of the genus, some arguing that bison are not sufficiently distinct from cattle, guar, yak, and oxen to warrant a distinct genus (Gardner 2002, personal communication). During the last two decades, as molecular genetic and evolutionary evidence has emerged, scientists have used *Bos* with increasing frequency. Discrepancies in the genus are reflected in major cataloguing centres and books. For example, the Canadian Museum of Nature (Balkwill 2002, personal communication) and the Smithsonian National Museum of Natural History in its publication *Mammal Species of the World* (Wilson and Reeder 2005) use *Bison*, while the Royal Ontario Museum (Eger 2002, personal communication) and the Museum of Texas Tech University, in its *Revised Checklist of North American Mammals North of Mexico* (Jones, Jr. *et al.* 1992; Jones *et al.* 1997; Baker *et al.* 2003), have reverted to *Bos*.

The debate over the appropriate genus arises from the conflict between the traditional practice of assigning names based on similar features distinguishable by morphology (the phenetic approach) versus using evolutionary relationships (the phylogenetic approach) (Freeman and Herron 2001; Winston 1999). Systematists develop evolutionary trees by analysing shared derived characteristics (Freeman and Herron 2001; Winston 1999). In this scheme, only monophyletic groups, or clades, which represent all descendants of a common ancestor, are named. A phenetic scheme might assign names to partial clades, or paraphyletic groups, which exclude one or more descendants (Freeman and Herron 2001). Some taxonomists and systematists suggest that the traditional naming system be replaced with a phylogenetic scheme (Freeman and Herron 2001). While not all biologists agree this is prudent, given that a strictly phylogenetic scheme could ignore functionally and ecologically important differences among species (Freeman and Herron 2001), the phylogenetic approach provides some useful insights about evolutionary relationships within the family Bovidae.

Bison reside in the family Bovidae, subfamily Bovinae, tribe Bovini, which currently contains four genera: *Bubalus* (Asian water buffalo); *Syncerus* (African buffalo); *Bos* (domestic cattle

and their wild relatives), and *Bison* (bison) (Wall *et al.* 1992; Wilson and Reeder 2005). Studies of nuclear-ribosomal DNA (Wall *et al.* 1992), mitochondrial DNA (Miyamoto *et al.* 1989; Miyamoto *et al.* 1993), and repetitive DNA sequences (Modi *et al.* 1996) within this tribe have revealed that the genus *Bos* is paraphyletic with respect to the genus *Bison*. Mitochondrial DNA studies do not support the traditional organisation of the tribe Bovini because the yak (*Bos grunniens*) is more closely related to bison than to its congener cattle (*Bos taurus*) (Miyamoto *et al.* 1989; Miyamoto *et al.* 1993). Ribosomal DNA studies have not fully clarified this relationship (Wall *et al.* 1992). However, skeletal analysis by Groves (1981) noted that bison and yak have 14 thoracic vertebrae while other members of the Tribe *Bovini* have only 13, underscoring the importance of considering heritable morphological differences that may not be revealed using molecular methods.

A comparison of various phylogenetic trees for the tribe Bovini further illustrates the naming conflict. Figure 3.1(a) depicts a conventional scheme based on morphological characteristics (Bohlken 1958), while Figures 3.1(b-d) show different interpretations based on cranial or genetic evidence. Although non-conventional schemes do not share identical branching patterns for every species, the position of *Bison* within the pattern of development for each alternative is equally incongruous. In the conventional scheme, *Bos* branched off the tree later than *Bison*; however, the arrangements based on more recent evidence suggest that a *Bos* branch was followed by *Bison*, then by *Bos*. Each alternative demonstrates that *Bos* is paraphyletic because it is lacking one of its descendant branches (denoted as *Bison*). Under a phylogenetic scheme, bison would be included in the *Bos* clade to correct this incongruity.

For four decades, there have been suggestions to combine *Bison* and *Bos* into one genus (Baccus *et al.* 1983; Gentry 1978; Groves 1981; Miyamoto *et al.* 1989; Modi *et al.* 1996; Stormont *et al.* 1961; Van Gelder 1977). Studies of DNA, blood types, and chromosomal, immunological, and protein sequences

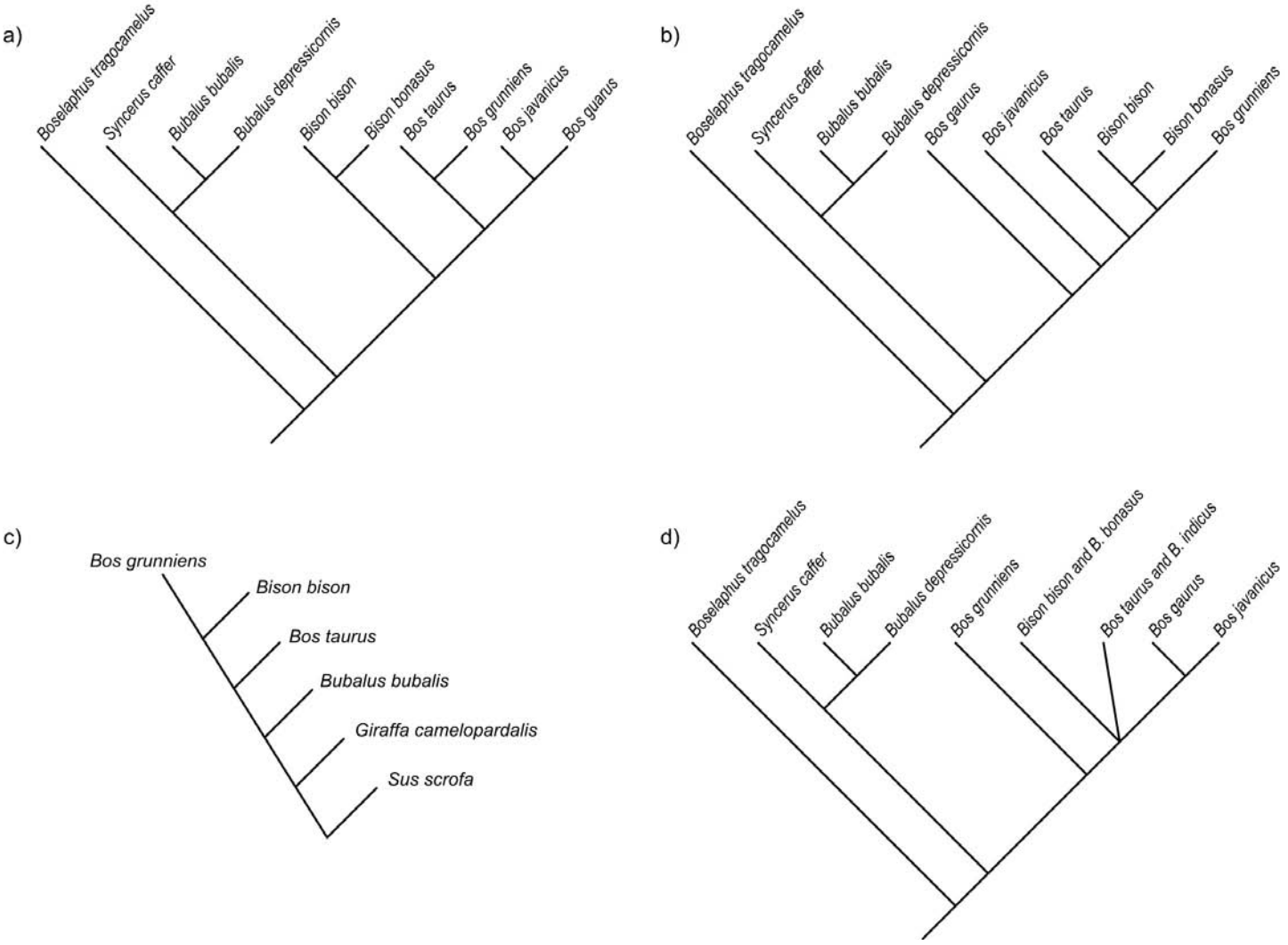


Figure 3.1 *Comparison of phylogenetic hypotheses for the tribe Bovini based on: (a) conventional morphological analysis (Bohlken 1958); (b) cladistic analysis of cranial characteristics (Groves 1981); (c) mtDNA sequences (Miyamoto et al. 1989); and (d) ribosomal DNA analysis (Wall et al. 1992).*

demonstrate that *Bison* and *Bos* were genetically similar, given molecular methods existing at the time (Beintema *et al.* 1986; Bhambhani and Kuspira 1969; Dayhoff 1972; Kleinschmidt and Sgouros 1987; Stormont *et al.* 1961; Wilson *et al.* 1985). Additionally, the percent divergences among mitochondrial DNA (MtDNA) sequences of *Bison bison*, *Bos grunniens*, and *Bos taurus* were comparable to those calculated among other sets of congeneric species assessed until 1989 (Miyamoto *et al.* 1989). Reproductive information also supports the inference of a close phylogenetic relationship between *Bos* and *Bison*; *Bison* and some members of *Bos* can hybridise under forced mating to produce partially fertile female offspring (Miyamoto *et al.* 1989; Van Gelder 1977; Wall *et al.* 1992; Ward 2000). Species divergence and reproductive incompatibility are evident with the low fertility of first generation (F1) bison x cattle offspring (Boyd 1908; Steklenev and Yasinetskaya 1982) and the difficulty producing viable male offspring (Boyd 1908; Goodnight 1914; Steklenev and Yasinetskaya 1982; Steklenev *et al.* 1986). Behavioural incompatibility is also evident. Although mating of bison and cattle can readily be achieved in a controlled environment, they preferentially associate and mate with individuals of their own species under open range conditions (Boyd 1908; 1914; Goodnight 1914; Jones 1907). Differences in digestive physiology and diet selection between cattle and American bison (reviewed by Reynolds *et al.* 2003) and European bison (Gębczyńska and Krasińska 1972) provide further evidence of the antiquity of divergence between cattle and bison. Based on palaeontological evidence, Loftus *et al.* (1994) concluded that the genera *Bos* and *Bison* shared a common ancestor 1,000,000–1,400,000 years ago.

In North America, sympatry between bison and cattle is an artefact of the recent history of colonisation by Europeans and their livestock. However, in prehistoric Europe, the wisent (*Bison bonasus*) and aurochs (*Bos taurus primigeneus*), the progenitor of modern cattle, were sympatric yet evolutionarily divergent units. The divergence in behaviour, morphology, physiology, and ecology observed between bison and cattle is consistent with the theory that ecological specialisation in sympatric species occupying similar trophic niches provides a mechanism for reducing competition in the absence of geographic isolation (Bush 1975; Rice and Hostert 1993).

The assignment of an animal to a genus in traditional naming schemes can be subjective, and changing generic names can create confusion and contravene the goal of taxonomy, which is to stabilise nomenclature (Winston 1999). However, we caution that maintaining a stable nomenclature should not occur at the expense of misrepresenting relationships. A change of *Bison* to *Bos* may reflect inferred evolutionary relationships and genetic similarities between *Bison* and *Bos* species. It could also potentially provide continuity and stability to the scientific reference for bison, which currently has two species names in use (*B. bonasus* and *B. bison*). However, and in contrast, based on divergence on a cytochrome b gene sequence analysis, Prusak *et al.* (2004) concluded that although American and European bison are closely related, they should be treated as separate species of the genus *Bison*, rather than subspecies of a bison species. There is also the potential that changing the genus from *Bison* to *Bos* would complicate management of European (three subspecies) and American bison (two subspecies) at the subspecies level and disrupt an established history of public policy and scientific community identification with the genus *Bison*.

Further research and debate by taxonomists and the bison conservation community is required to reconcile molecular, behavioural and morphological evidence before a change in nomenclature could be supported by the American Bison Specialist Group (ABSG). In consideration of the uncertainties explained above, and in keeping with the naming conventions for mammals used for the 1996 Red List and the 2008 Red List (Wilson and Reeder 1993; Wilson and Reeder 2005), the ABSG adheres to the genus *Bison* with two species, European bison (*B. bonasus*) and American bison (*B. bison*), in this document.

3.3 Subspecies

A controversial aspect of American bison taxonomy is the legitimacy of the subspecies designations for plains bison (*B. Bison bison*) and wood bison (*B. bison athabascae*). The two subspecies were first distinguished in 1897, when Rhoads formally recognised the wood bison subspecies as *B. bison athabascae* based on descriptions of the animal (Rhoads 1897). Although the two variants differ in skeletal and external morphology and pelage characteristics (Table 3.1), some scientists have argued that these differences alone do not adequately substantiate subspecies designation (Geist 1991). The issue is complicated by the human-induced hybridisation between plains bison and wood bison that was encouraged in Wood Buffalo National Park (WBNP) during the 1920s. Furthermore, the concept of what constitutes a subspecies continues to evolve.

The assignment of subspecific status varies with the organism, the taxonomist, and which of the various definitions of subspecies is applied. Mayr and Ashlock (1991:430) define a subspecies as *"an aggregate of local populations of a species inhabiting a geographic subdivision of the range of the species and differing taxonomically from other populations of the species."* Avise and Ball (1990:59-60) adapted their definition from the Biological Species Concept, which defines species as groups of organisms that are reproductively isolated from other groups (Mayr and Ashlock 1991): *"Subspecies are groups of actually or potentially interbreeding populations phylogenetically distinguishable from, but reproductively compatible with, other such groups."*

Table 3.1 *Comparison of structural and pelage characteristics for the two bison subspecies.*

Plains bison *Bison bison* ***bison***	**Wood bison** *Bison bison* ***athabascae***
	
Pelage characteristics	
Dense woolly bonnet of hair between horns	Forelock dark, hanging in strands over forehead
Thick beard and full throat mane, extending below rib cage	Thin beard and rudimentary throat mane
Well-developed chaps	Reduced chaps
Well-demarcated cape, lighter in colour than wood bison	No clear cape demarcation, hair usually darker than plains bison
Structural Characteristics	
Highest point of the hump over front legs	Highest point of the hump forward of front legs
Horns rarely extend above bonnet	Horns usually extend above forelock
Smaller and lighter than the wood bison (within similar age and sex classes)	Larger and heavier than plains bison (within similar age and sex classes)

Crucial to this definition is the argument that evidence for phylogenetic distinction must derive from multiple concordant, independent, genetically-based (heritable) traits (Avise and Ball 1990). Essentially, subspecies should demonstrate several conspicuous morphological differences, geographic allopatric population patterns, and normally possess genetic divergences at several genes (Winston 1999). Hybridisation between subspecies is possible along contact interfaces (Winston 1999).

The fossil record and observations of variability among living bison suggest that the species exhibited considerable geographic variation. This variation led to claims identifying various forms of the species, most notably a northern and a southern plains bison, which differed in pelage and conformation (van Zyll de Jong 1993). Analysis of cranial, horn, and limb measurements for plains bison suggests clinal variation along a north-south axis (McDonald 1981; van Zyll de Jong 1993). It is possible that external characteristics, such as pelage colouration, also varied along this axis (van Zyll de Jong *et al.* 1995). Therefore, the continuous gradation of intermediate bison forms prevents definitive recognition of northern and southern forms of plains bison at the trinomial level.

Unlike the clinal variation reported for plains bison, a phenotypic discontinuity exists between plains bison and wood bison (van Zyll de Jong 1993), reflected in size and in morphological differences independent of size (van Zyll de Jong 1986; Gates *et al.* 2001). Discontinuous variation occurs when a barrier impedes gene flow between populations of a species, causing genetic differences to accumulate on either side of the barrier (van Zyll de Jong 1992). Reproductive isolation caused by differing habitat preferences and seasonal movements, and the natural barrier formed by the boreal forest, contributed to maintaining the phenotypic differences between plains bison and wood bison (van Zyll de Jong 1986; van Zyll de Jong 1993; Gates *et al.* 2001). The Society for Ecological Restoration International (SERI) and IUCN Commission on Ecosystem Management (2004) explicitly recognise the continuous nature of biological processes, such as speciation, in its guidelines for restoration of ecosystems that have been *"… degraded, damaged, or destroyed relative to a reference state or a trajectory through time"* (Chapter 9). Analysis of ancient mtDNA indicates that modern American bison are derived from a most recent common ancestor existing 22,000 to 15,000 years B.P. (Shapiro *et al.* 2004; Chapter 2).

The allopatric distribution and quantified phenotypic differences between the bison subspecies are consistent with the subspecies concept. Nevertheless, there has been a suggestion that the two subspecies are actually ecotypes, that is, forms exhibiting morphological differences that are simply a reflection of local environmental influences rather than heritable traits (Geist 1991). This hypothesis is not supported by observations of transplanted plains and wood bison. Wood bison transplanted

from their original habitat near the Nyarling River in WBNP to very different environments in the Mackenzie Bison Sanctuary (MBS) (in 1963) and Elk Island National Park (EINP) (in 1965) do not differ from each other, or from later specimens taken from the original habitat (van Zyll de Jong 1986; van Zyll de Jong *et al.* 1995). Furthermore, despite the passing of over 40 years, the EINP wood bison, which live under the same conditions as plains bison residing separately within the park, show no evidence of morphological convergence with the plains bison form (van Zyll de Jong 1986; van Zyll de Jong *et al.* 1995). Similarly, plains bison introduced to Delta Junction, Alaska (in 1928) from the National Bison Range (NBR) have clearly maintained the phenotypic traits of plains bison (van Zyll de Jong 1992; van Zyll de Jong *et al.* 1995). Such empirical evidence suggests that the morphological characteristics that distinguish plains and wood bison are genetically controlled (van Zyll de Jong *et al.* 1995).

Hybridisation between the subspecies in WBNP after an introduction of plains bison during the 1920s has complicated the consideration of subspecies designations. The controversial decision to move plains bison from Wainwright Buffalo Park (WBP) in southern Alberta to WBNP (from 1925 to 1928) resulted in the introduction of domestic bovine diseases to wood bison (Chapter 5), and threatened the distinctiveness and genetic purity of the subspecies. In 1957, Canadian Wildlife Service researchers discovered a presumably isolated population of 200 wood bison near Nyarling River and Buffalo Lake. The researchers believed that this herd had remained isolated from the hybrid herds, and therefore, represented the last reservoir of original wood bison (Banfield and Novakowski 1960; Ogilvie 1979; Van Camp 1989). In an effort to salvage the wood bison subspecies, bison from the Nyarling herd were relocated to establish the MBS and EINP wood bison herds in the 1960s. Later analysis has indicated that the Nyarling herd, and bison elsewhere in WBNP and adjacent areas, did have contact with the introduced plains bison (van Zyll de Jong 1986; Aniskowicz 1990), but it was minimal enough that the animals continued to exhibit predominately wood bison traits (van Zyll de Jong *et al.* 1995). Studies on the impact of the plains bison introduction have determined that the hybridisation did not result in a phenotypically homogeneous population, as was feared (van Zyll de Jong *et al.* 1995). Sub-populations within WBNP demonstrate varying degrees of plains bison traits depending on their proximity to, or ease of access from, the original plains bison introduction site (van Zyll de Jong *et al.* 1995).

Although descriptive morphology and quantitative morphometry provide substantial evidence supporting the subspecific designations (van Zyll de Jong *et al.* 1995), early analysis of blood characteristics and chromosomal homology did not detect a difference (Peden and Kraay 1979; Stormont *et al.* 1961; Ying and Peden 1977). Preliminary analysis of growth regulating genes within the two subspecies suggests that the bison subspecies have reached a stage of evolutionary divergence due to geographic isolation (Bork *et al.* 1991); however, under the Biological Species Concept, subspecies may be defined at the next stage of speciation, that is when hybrid offspring exhibit reduced fitness, which does not appear to be the case in WBNP (Bork *et al.* 1991). Furthermore, analysis of mtDNA from Nyarling River wood bison and plains bison did not produce monophyletic groups (Strobeck 1991; 1992). This, however, does not mean that there is no difference. In isolated populations, mtDNA diverges at a rate of 1 to 2% per million years (Wilson *et al.* 1985). It is estimated that the two bison subspecies diverged approximately 5,000 years ago (van Zyll de Jong 1993; Wilson 1969), and human-induced subspecies hybridisation further complicated the phylogeny. Therefore, current genetic analysis techniques may not be able to detect existing differences in the mitochondrial genome. In addition, because mtDNA is maternally inherited, mtDNA within the Nyarling River herd, as well as other herds in WBNP, reflects the contributions from maternal populations, which had a biased representation of plains bison cows (Gates *et al.* 2001). Therefore, the inability to detect a difference with a molecular test comparing limited sequences of genomic material does not necessarily mean there is no genetic difference; it may just be beyond the current resolution of technology.

Recent studies of DNA microsatellites indicate that the genetic distances between plains bison and wood bison are greater than those within either of the two subspecies (Wilson 2001; Wilson and Strobeck 1999). The wood bison populations studied formed a distinctive group on a Nei's minimum unrooted tree; a strong grouping despite the pervasive hybridisation with plains bison (Wilson 2001; Wilson and Strobeck 1999). Wilson and Strobeck (1999) and Wilson (2001) concluded such a strong clustering indicates wood bison and plains bison are functioning as distinct genetic entities, and should continue to be managed separately. Based on the available evidence, Canada's National Wood Bison Recovery Team concluded: (1) historically, multiple morphological and genetic characteristics distinguished wood bison from the plains bison; (2) wood bison and plains bison continue to be morphologically and genetically distinct, despite hybridisation; and (3) wood bison constitute a subspecies of bison, and therefore, should be managed separately from plains bison (Gates *et al.* 2001).

The issue of subspecies designations is relevant to conservation in that a decision to combine forms at the species level would invite hybridisation and effectively eliminate any evolutionary divergence that had occurred. Establishing definitive recognition of bison subspecies is complicated by ongoing change of genus, species and subspecies concepts (Winston 1999). However, other classifications and concepts, such as the evolutionarily significant unit (ESU; Ryder 1986), and genetic and ecological

exchangeability, move beyond traditional trinomial taxonomy to incorporate evolutionary considerations. Conservation biologists are reconsidering definitions of conservation units that incorporate both the history of populations reflected in molecular analysis, and adaptive differences revealed by life history and other ecological information (Crandall *et al.* 2000; DeWeerdt 2002). For example, the geminate evolutionary unit identifies conservation units that are genetically similar but ecologically or behaviourally distinct (Bowen 1998). Crandall *et al.* (2000) argue for a broad categorisation of population distinctiveness based on non-exchangeability of ecological and genetic traits. Each of these concepts presents challenges, as does any concept that attempts to divide the biological continuum for the convenience of human interests. Essentially, differentiation on any level within a species warrants a formal decision and recognition. Of note, The U.S. Endangered Species Act recognises this conservation issue and provides for protection of "distinct population segments". Similarly, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which is responsible for assessing the status of wildlife, includes any indigenous species, subspecies, variety or geographically defined population of wild fauna or flora as a "species".

While there appear to be sufficient grounds for formal recognition of American bison subspecies, the debate may continue. This, however, should not preclude conservation of the two forms as separate entities (van Zyll de Jong *et al.* 1995; Wilson and Strobeck 1999). Regardless of current genetic, biochemical or other evidence about the subspecies question, there are notable phenotypic differences, and potentially other types of variation that may not be detectable with technologies available at this time. Geneticists predict that genetic analysis in the future will be able to better identify groupings within species (Wilson 2001).

Although genetic and morphological evidence often correspond, this is not always the case (Winston 1999). This can lead to debate over recognising variation that cannot be measured using alternative morphological or molecular methods. Nevertheless, all forms of geographic and ecological variation within a species contribute to biodiversity (Secretariat of the Convention on Biological Diversity 2000). All variants of a species may carry evolutionarily important ecological adaptations (Chapter 4), and possess the potential to develop genetic isolating mechanisms leading in evolutionary time to new species (O'Brien and Mayr 1991). Prediction of which variants will evolve to become species is not possible; this is an outcome of natural selection and chance. Therefore, to maintain biodiversity and evolutionary potential, it is important to not dismiss any form of differentiation within a species, and to maintain the opportunity for evolutionary processes to function (Crandall *et al.* 2000). Debating whether a name is warranted within a relatively arbitrary taxonomic system does not absolve humans of the responsibility to recognise and maintain intraspecific diversity as the raw material of evolution. The risk of losing evolutionary potential suggests it would not be prudent to prematurely dismiss existing groupings such as the plains and wood bison.

Chapter 4 Genetics

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As a science, population genetics is concerned with the origin, nature, amount, distribution and fate of genetic variation present in populations through time and space. Genetic variation constitutes the fundamental basis of evolutionary change and provides the foundation for species to adapt and survive in response to changing intrinsic and extrinsic stressors. Therefore, loss of genetic diversity is generally considered detrimental to long-term species survival. In the short-term, populations with low levels of genetic diversity may suffer from inbreeding depression, which can increase their probability of extirpation and reduce fitness. Plains and wood bison experienced severe and well-documented population declines in the 19th Century that reduced the census size of this species by over 99.99%. The spectacular recovery to around 430,000 animals today (Chapter 7) is a testament to their genetic constitution, and represents one of the most significant accomplishments in modern conservation biology. American bison have, however, undergone artificial hybridisation with domestic cattle, been subjected to domestication and artificial selection, and been separated into many relatively small isolated populations occupying tiny fractions of their original range. As well, all wood bison populations contain some level of plains bison genetic material due to artificial hybridisation between the subspecies. All of these factors have had an effect on the current levels of genetic diversity and on the integrity of the bison genome. As a result, preservation of bison genetic diversity is a key long-term conservation consideration. The following sections discuss some of the major issues that are important for the genetic management of this species into the future.

4.1 Reduction of Genetic Diversity

Within species, genetic diversity provides the mechanism for evolutionary change and adaptation (Allendorf and Leary 1986; Chambers 1998; Meffe and Carroll 1994; Mitton and Grant 1984). Reduction in genetic diversity can result in reduced fitness, diminished growth, increased mortality of individuals, and reduced evolutionary flexibility (Allendorf and Leary 1986; Ballou and Ralls 1982; Franklin 1980; Frankham *et al.* 1999; Mitton and Grant 1984;). There are four interrelated mechanisms that can reduce genetic diversity (heterozygosity and number of alleles): demographic bottlenecks, founder effects, genetic drift, and inbreeding (Meffe and Carroll 1994). Unfortunately, over the last two centuries, bison in North America have, to some degree, experienced all of these mechanisms.

As American bison approached extinction in the late 1800s, they experienced a severe demographic bottleneck, leading to a concern that extant bison populations may have lower genetic diversity than pre-decline populations. The consequences of a genetic bottleneck depend on the pre-bottleneck genetic diversity within a species, the severity of the decline, and how quickly the population rebounds after the bottleneck (Meffe and Carroll 1994; Nei *et al.* 1975). The decline of bison was severe, with a reduction from millions to fewer than 1,000 individuals. Recovery efforts, however, enabled bison populations to grow quickly, more than doubling between 1888 and 1902 (Coder 1975). Although the effects of the bottleneck on the genetic diversity of the species are not clear (Wilson 2001), there are several possible repercussions. First, after a severe reduction in population size, average heterozygosity is expected to decline (Allendorf 1986; Nei *et al.* 1975). Heterozygosity is a measure of genetic variation that is a direct reflection of the past breeding history of a population. Heterozygosity values are expressed as the frequency of heterozygotes (i.e., genes with dissimilar alleles) expected at a given locus (Griffiths *et al.* 1993). A reduction in the level of heterozygosity can result in inbreeding effects. At the same time, a loss of alleles may limit a population's ability to respond to natural selection forces and reduce the adaptive potential of a population (Allendorf 1986; Meffe and Carroll 1994; Nei *et al.* 1975; Robertson 1960).

After the demographic crash, several small bison herds remained in North America, many of which were derived from very few animals. Overall levels of genetic variation in current populations can, in theory, vary directly with the number of original founders (Meffe and Carroll 1994; Wilson and Strobeck 1999). Remnant populations may not have been representative of the original gene pool and, consequently, suffered reduced genetic variability. Through time, the detrimental effects of genetic drift may have compounded the effects of the earlier bottleneck. Genetic drift involves the random change in gene frequencies and leads to the loss of alleles over time. The rate of this loss, or fixation of alleles, is roughly inversely proportional to the population size (Allendorf 1986; Meffe and Carroll 1994). However, the actual count of breeding individuals in a population is not appropriate for determining the rate of genetic drift because factors such as unequal sex ratios, differential reproductive success, overlapping generations, and non-random mating result in the "effective" population size always being less than the census size. For bison, the ratio of effective population size (N_e) to the census population size (N) has most commonly

been estimated to be between 0.16 and 0.42 (Berger and Cunningham 1994; Shull and Tipton, 1987; Wilson and Zittlau, 2004), although Shull and Tipton (1987) suggested that the ratio could be as low as 0.09 in some managed populations.

It is possible that American bison experienced reductions in overall genetic diversity due to the population bottleneck of the late 1800s; however, this effect may not have been as great as once expected. McClenaghan, Jr. *et al.* (1990) found that plains bison have greater genetic variability than several other mammals that experienced severe demographic bottlenecks. Furthermore, Wilson and Strobeck (1999), Halbert (2003) and Halbert and Derr (2008) found levels of DNA microsatellite variability in bison populations to be similar to other North American ungulates. Some authors speculate that prior to the bottleneck, the American bison, with the possible exception of the wood bison, expressed surprising homogeneity despite its extensive range (Roe 1970; Seton 1910). Plains bison ranged over large areas. This suggests that extensive animal movements, and thereby gene flow, may have existed among populations (Berger and Cunningham 1994; Wilson and Strobeck 1999). Similar to other large mammals, bison are expected to be less genetically diverse than small mammals (Sage and Wolff 1986). Despite founder effects and low gene flow, which increase genetic distance values, recent studies demonstrate that the genetic distances between existing bison herds are lower than expected, indicating that existing isolated populations are likely derived from one large gene pool (Wilson and Strobeck 1999). Furthermore, foundation herds for contemporary bison originated from across the species' range, suggesting that much of the pre-existing diversity was likely retained (Halbert 2003). Analysis of ancient DNA may provide an opportunity for assessing pre-bottleneck genetic diversity for comparative purposes (Amos 1999; Cannon 2001; Chambers 1998). Unfortunately, it is not possible to recover the genetic material lost as a result of the bottleneck underscoring the importance of maintaining existing genetic diversity while minimising any future genetic erosion.

Inbreeding, or the mating of related individuals, can lead to the expression of deleterious alleles, decreased heterozygosity, lower fecundity, and developmental defects (Allendorf and Leary 1986; Berger and Cunningham 1994; Lande 1999; Meffe and Carroll 1994). Inbreeding is difficult to assess and does not always have measurable deleterious consequences (Berger and Cunningham 1994; Meffe and Carroll 1994); however, it remains a potential cause of reduced diversity in bison. To decrease the effects of inbreeding, some bison herds were founded or augmented with animals from different regions (Wilson 2001). Over time, the translocation of animals among herds may have reduced the impacts of inbreeding and founder effects, which are most severe in isolated, small populations with low levels of genetic diversity. While few bison herds have truly exhibited signs thought to be the result of inbreeding depression, such as high rates of physical abnormalities, reduced growth rates, and reduced fertility, inbreeding depression has been linked to low levels of calf recruitment and high levels of calf mortality in a plains bison herd (Halbert *et al.* 2004; 2005), and has been suggested to affect male reproductive success in another population (Berger and Cunningham 1994).

Although existing bison populations may be derived from a largely homogeneous gene pool, recent studies using DNA microsatellites reveal that several plains bison herds are genetically distinguishable (Halbert and Derr 2008; Wilson and Strobeck 1999). This raises the issue of whether conservation herds should be managed as a large metapopulation, with translocation of bison among herds to maintain local diversity, or as closed herds to preserve emerging localized differentiation. Some populations may be adapting to non-native habitats or changing conditions in the natural environment, and would, therefore, benefit from localized differentiation. Other populations may be adapting to, or inadvertently selected for, unnatural conditions, and would benefit from periodic augmentation (Wilson *et al.* 2002b). A precautionary approach may be to diversify conservation efforts by transferring randomly selected animals among some herds, to maximise intra-population genetic diversity, while maintaining other herds as closed populations with the possibility of the establishment of satellite populations to increase overall effective population sizes (Halbert and Derr 2008). Managers should carefully consider the implementation of metapopulation management plans as a tool to preserve genetic diversity due to historical differences in morphology, behaviour, physiology, and disease status (Lande 1999; Ryder and Fleischer 1996; Wilson *et al.* 2002b) and to limit the spread of domestic cattle genes between bison populations (Halbert *et al.* 2005a; 2006).

Genetic analysis could be used to monitor genetic diversity by building an inventory of diversity held within conservation herds. There are several measures of genetic diversity including heterozygosity, alleles per locus, and proportion of polymorphic loci (Amos 1999; Templeton 1994; Wilson *et al.* 2002b). While early work on bison genetics involved blood groups (Stormont 1982; Stormont *et al.* 1961), some authors suggest that such studies are inappropriate for assessing genetic diversity because selection for blood group type may be high, violating the assumption of selective neutrality (Berger and Cunningham 1994; Knudsen and Allendorf 1987; Yamazaki and Maruyama 1974). More recent studies have used allozymes (Knudsen and Allendorf 1987; McClenaghan *et al.* 1990), mitochondrial DNA (MtDNA) (Polziehn *et al.* 1996), nuclear DNA restriction fragment length polymorphisms (Bork *et al.* 1991), and DNA microsatellites (Wilson and Strobeck 1999) to assess diversity. Investigation of individual genomic regions can reflect overall diversity, allowing for data from various techniques to be combined to provide an accurate representation of genetic diversity (Chambers 1998).

Selection for diversity in one system, such as blood group proteins, or biased selection for maintaining specific rare genetic characteristics could lead to reduced diversity in other parts of the genome (Chambers 1998; Hedrick *et al.* 1986). Biased selection for maintaining rare alleles is especially questionable if it is not known what the rare allele does, or if it is detrimental (i.e., it may be rare because it is being expunged from the bison genome through natural selection). Variation throughout the genome, rather than the maintenance of one specific rare allele, conveys evolutionary flexibility to a species (Chambers 1998; Vrijenhoek and Leberg 1991). Therefore, it is crucial for a genetic management plan to consider all available measures for managing genetic diversity in the policies and procedures for breeding and culling decisions.

An assessment of overall genetic diversity should examine at least 25-30 loci distributed across the nuclear genome (Chambers 1998; Nei 1987). While genetic diversity for some herds has been assessed (Baccus *et al.* 1983; Berger and Cunningham 1994; Knudsen and Allendorf 1987; Wilson and Strobeck 1999), these studies did not include a sufficient number of loci and comparisons between studies are not possible due to differences in marker systems (allozymes vs. microsatellites). Other studies have included larger numbers of loci and populations; however, several conservation herds have not been fully examined (e.g., some U.S., Canadian and Mexican state, federal and private bison herds; Halbert 2003; Halbert and Derr 2008). Clearly it is important to create a more complete assessment of bison genetic diversity to allow for more informed management decisions.

In general, maintaining genetic diversity of American bison requires an understanding of herd population dynamics to assess the probability of long-term persistence of that diversity. Most bison populations are composed of fewer than 1,000 individuals, and it is possible for a relatively small number of dominant males to be responsible for a high percent of the mating in a given year (Berger and Cunningham 1994; Wilson *et al.* 2002; Wilson *et al.* 2005; Halbert *et al.* 2004). This, in turn, can reduce genetic diversity over time, especially in the absence of natural migration and exchange of genetic diversity among populations (Berger and Cunningham 1994). The potential for disproportionate reproductive contributions emphasises the importance of maintaining large herds with large effective population sizes, that given proper management, will prevent loss of genetic diversity (Frankham 1995; Franklin 1980). Assessment of genetic uncertainty, based on Ne, founder effects, genetic drift, and inbreeding, is a required component of a population viability analysis (PVA) (Gilpin and Soulé 1986; Shaffer 1987).

4.2 Hybridisation

Hybridisation involves the interbreeding of individuals from genetically distinct groups, which can represent different species, subspecies, or geographic variants (Rhymer and Simberloff 1996). Some authors argue that hybridisation is a potentially creative evolutionary force, which generates novel combinations of genes that can help species adapt to habitat change, although such hybrids often experience reduced fitness (Anderson and Stebbins 1954; Lewontin and Birch 1966; Hewitt 1989). Hybridisation through artificial manipulation or relocation of animals, however, can compromise genetic integrity through genetic swamping of one genome over another and disruption of locally adapted gene complexes (Avise 1994). It can also produce offspring that are devalued by the conservation and legal communities (O'Brien and Mayr 1991; Chapter 7). The genetic legacy of introducing plains bison into a wood bison population in northern Canada, and crossbreeding bison and cattle, have made hybridisation a controversial topic in bison conservation.

4.2.1 Plains bison x wood bison

Based on their geographic distribution and morphology, plains bison and wood bison were historically distinct entities (Chapter 3). It can be argued that the introduction of plains bison into range occupied by wood bison was a "negligible tragedy" (Geist 1996), because some consider the two groups to be ecotypes (Geist 1991). Others maintain that the interbreeding of these two types should have been avoided to preserve geographic and environmental variation (van Zyll de Jong *et al.* 1995). The introduction of either subspecies into the original range of the other could, in theory, erode the genetic basis of adaptation to local environmental conditions (Lande 1999). Therefore, hybridisation between plains and wood bison should be considered detrimental to maintaining the genetic integrity and distinctiveness of these two geographic and morphologically distinct forms.

While historically there may have been natural hybridisation events between the subspecies in areas of range overlap, the current hybridisation issue is the consequence of an ill-advised and irreversible decision made nearly 85 years ago. In 1925, the Canadian government implemented a plan to move more than 6,000 plains bison from the overcrowded Wainwright National Park to Wood Buffalo National Park (WBNP). Biological societies from U.S. and Canada strenuously challenged this action, as interbreeding would eliminate the wood bison form, resulting hybrids might not be as fit for the environment, and diseases such as bovine tuberculosis (BTB) would spread to formerly healthy animals (Howell 1925; Harper 1925; Lothian 1981; Saunders 1925). Proponents of the plan countered the criticism by questioning the subspecies designations, arguing



Plate 4.1 *Hereford x bison hybrid; cattle gene introgression is morphologically evident. Photo: Bob Heinonen.*

that the introduction site was isolated from, and unused by, the wood bison population, and suggesting that the introduced animals were too young to carry BTB (Fuller 2002; Graham 1924). These arguments did not consider the future habitat needs of the growing wood or plains bison populations, nor the likelihood that the two subspecies would not remain isolated. As well, a recommendation that only yearlings that passed a tuberculin test be shipped to WBNP was rejected (Fuller 2002).

It was not until 1957 that the discovery of a seemingly isolated herd of 200 animals near the Nyarling River and Buffalo Lake alleviated fears that wood bison was lost to hybridisation (van Camp 1989). Canadian Wildlife Service researchers determined that these animals were morphologically representative of wood bison (Banfield and Novakowski 1960). To salvage the wood bison subspecies, bison from the Nyarling herd were captured and relocated to establish two new herds. Sixteen animals were moved to the MBS north of Great Slave Lake in 1963 (Fuller 2002; Gates *et al.* 2001c), and 22 animals were successfully transferred to Elk Island National Park (EINP) east of Edmonton, Alberta in 1965 (Blyth and Hudson 1987). Two additional calves were transferred to EINP between 1966 and 1968 (Blyth and Hudson 1987; Gates *et al.* 2001c). Of those bison transferred, 11 neonates formed the founding herd.

Subsequent studies revealed that there was contact between the Nyarling herd and the introduced plains bison (van Zyll de Jong 1986). Although hybridisation within WBNP did not result in a phenotypically homogenous population (van Zyll de Jong *et al.* 1995), genetic distances among subpopulations in the park are small, indicating that there is gene flow and influence of the plains bison genome throughout all regions of the park (Wilson 2001; Wilson and Strobeck 1999). Despite hybridization, genetic distances between plains and wood bison are generally greater than those observed within subspecies. Moreover, wood bison form a genetic grouping on a Nei's minimum unrooted tree, suggesting genetic uniqueness (Wilson 2001; Wilson and Strobeck 1999).

Morphological and genetic evidence suggest that care should now be taken to maintain separation between these historically differentiated subspecies. Efforts are in place to ensure representative wood bison and plains bison herds are isolated from each other to prevent future hybridisation between these important conservation herds (Harper *et al.* 2000).

4.2.2 Domestic cattle x bison

The concept of crossing bison with domestic cattle dates back to Spanish colonisers of the 16th Century (Dary 1989). There are many accounts of historical attempts to hybridise bison and cattle (Coder 1975; Dary 1989; Ogilvie 1979; McHugh 1972; Ward 2000). Private ranchers involved with salvaging bison had aspirations to combine, through hybridisation, the hardiness and winter foraging ability of bison with the meat production traits of cattle (Dary 1989; Ogilvie 1979; Ward 2000). The Canadian government actively pursued the experimental production of crossbred animals from 1916-1964 (Ogilvie 1979; Polziehn *et al.* 1995).

Historical crossbreeding attempts have created a legacy of genetic issues related to the introgression of cattle DNA into bison herds. Introgression refers to gene flow between populations caused by hybridisation followed by breeding of the hybrid offspring to at least one of their respective parental populations (Rhymer and Simberloff 1996). The introgressed DNA replaces sections of the original genome, thereby affecting the genetic integrity of a species, and hampering the maintenance of natural genetic diversity. Many contemporary bison herds are founded on, and supplemented with, animals from herds with a history of hybridisation (Halbert 2003; Halbert *et al.* 2005a; 2006; Ward *et al.* 1999; 2000). This extensive history of hybridisation between these two species raises questions about the integrity of the bison genome and the biological effects of cattle DNA introgression.

Fertility problems thwarted many of the original crossbreeding attempts because crosses result in high mortality for offspring and mother (Ward 2000). Experimentation has revealed that crosses of bison females with domestic cattle males produce less mortality in the offspring than the more deadly reverse

cross, however, the latter is more common because it is very difficult to compel domestic cattle bulls to mate with bison females. All F1 generation hybrids experience reduced fertility and viability relative to either parent: F1 males are typically sterile, but the fertility of F1 females makes introgressive hybridisation possible (Ward 2000). Genetic studies have found no evidence of cattle Y-chromosome introgression in bison, which is supported by the sterility of F1 hybrid males from the cross of cattle males with bison females, and by the behavioural constraint preventing domestic bulls from mating with female bison (Ward 2000).

However, a number of studies using modern molecular genetic technologies have reported both mtDNA and nuclear DNA introgression in plains bison from domestic cattle. The first of these studies (Polziehn *et al.*1995) found cattle mtDNA among Custer State Park plains bison. Subsequently, more comprehensive examinations of public bison herds revealed cattle mtDNA in seven of 21 bison conservation herds (Ward 2000; Ward *et al.* 1999), suggesting that hybridisation issues between these two species were widespread and a significant concern to long-term bison conservation efforts. Further investigations based on high-resolution nuclear DNA microsatellites detected domestic cattle nuclear DNA markers in 14 of these 21 U.S. federal conservation herds (Ward 2000).

All major public bison populations in the U.S. and Canada have now been examined using mtDNA, microsatellite markers, or a combination of these 2 technologies. Combining evidence from both mtDNA and nuclear microsatellite markers with information regarding population histories provides a more complete view of hybridisation between the two species. To date, no genetic evidence of domestic cattle introgression has been reported in 9 of these conservation populations (plains bison unless otherwise noted; n = sample size examined): EINP (wood bison, n = 25); MBS (wood bison, n = 36); WBNP (wood bison, n = 23); EINP plains bison (n = 25); GTNP (n = 39); HMSP (n = 21); SHNGP (n = 31); Wind Cave National Park (WCNP)(n = 352); and YNP (n = 520) (Halbert *et al.* 2005a; 2006; Ward *et al.* 1999).

However, the ability to detect nuclear microsatellite DNA introgression is highly dependent on the number of bison in each population, the number of bison sampled from each population and the actual amount of domestic cattle genetic material present in the population (Halbert *et al.* 2005a). Considering statistical confidence (greater than 95%) allowed by detection limits of the technology (Halbert *et al.* 2006), adequate numbers of bison have been evaluated from only two of these herds that displayed no evidence of hybridisation (WCNP and YNP). These two herds represent less than 1.0% of the 420,000 plains bison in North America today (Freese *et al.* 2007; Chapter 7) and both of these herds are currently providing animals for the establishment of new satellite herds for conservations efforts (Chapter 7). Further evaluation is urgently needed to more accurately assess levels of domestic cattle genetics in other public bison herds.

Hybridisation issues with domestic cattle must be considered along with other genetic and non-genetic factors in determining which populations are designated as 'conservation herds'. For example, although some public herds are known to have low levels of domestic cattle genetics, these herds may also represent distinct lineages that reflect historical and geographic differences in genetic diversity (Halbert 2003; Halbert and Derr 2006; Halbert and Derr submitted). Caution is needed in long-term conservation planning to ensure that genetic diversity that represents historical bison geographic differences is identified and conserved for all important populations and not just those thought to be free of domestic cattle introgression. Nevertheless, defining genetic histories that include hybridisation is a first step in developing a species-wide conservation management plan. Given that there are several substantial bison herds that appear to be free of cattle gene introgression, it is of paramount importance to maintain these herds in reproductive isolation from herds containing hybrids.



Plate 4.2 *Custer State Park plains bison bull; a high level of cattle gene introgression is not morphologically evident. Photo: Cormack Gates.*

4.3 Domestication

The number of bison in commercial herds has grown rapidly over the past five decades as many ranchers enter the bison industry to capitalise on the economic opportunities offered by this species (Dey 1997). The increase in commercial bison production may reflect the recognition of the advantages afforded by the adaptations and ecological efficiency of bison as an indigenous range animal. Bison possess several traits that make them preferable to cattle as a range animal, including a greater ability to digest low quality forage (Hawley *et al.* 1981; Plumb and Dodd 1993), the ability to defend against predators (Carbyn *et al.* 1993), the ability to survive harsh winter conditions, and a low incidence of calving difficulties (Haigh *et al.* 2001). According to federal government surveys, the commercial bison population in North America is about 400,000, divided almost equally between the U.S. and Canada (Chapter 7). Despite the current plateau in beef and bison meat prices, both the Canadian Bison Association and the U.S.-based National Bison Association predict very favourable long-term growth of the bison industry. The number of bison in conservation herds is currently estimated at only 20,504 plains bison and 10,871 wood bison. Therefore, approximately 93% of American bison are under commercial production and experiencing some degree of domestication.

Domestication is a process involving the genotypic adaptation of animals to the captive environment (Price 1984; Price and King 1968). Purposeful selection over several generations for traits favourable for human needs, results in detectable differences in morphology, physiology, and behaviour between domestic species and their wild progenitors (Darwin 1859; Clutton-Brock 1981; Price 1984). Humans have practiced domestication of livestock species for at least 9,000 years (Clutton-Brock 1981). As agriculture precipitated the settlement of nomadic human cultures, the domestication of several wild mammal species made livestock farming possible (Clutton-Brock 1981). Intensive management practices and competition between domesticated animals and their wild ancestors often pushed wild varieties and potential predators to the periphery of their ranges or to extinction (Baerselman and Vera 1995; Hartnett *et al.* 1997; Price 1984). Examples of extinct ancestors of domesticated animals include the tarpan (*Equus przewalski gmelini*), the wild dromedary (*Camelus dromedarius*), and the aurochs (*Bos primigenius*) (Baerselman and Vera 1995).

The domestication of cattle provides a relevant history from which to consider the issues of bison domestication. Before cattle (*Bos taurus*) were introduced to North America they had experienced thousands of years of coevolution with human cultures in Europe (Clutton-Brock 1981; Hartnett *et al.* 1997). During the domestication process cattle were selected for docility and valued morphological and physiological traits, but not without adverse consequences. Genetic selection has produced an animal that is dependent on humans, is unable to defend itself against predators, and has anatomical anomalies, such as a smaller pelvic girdle, which cause calving and walking difficulties (Kampf 1998; Knowles *et al.* 1998; Pauls 1995). Domestication has altered the wild character of cattle, producing animals maladapted to the natural environment. Furthermore, because the aurochs, the wild ancestor of European domestic cattle, became extinct in 1627 (Silverberg 1967), domestic cattle have no wild counterpart to provide a source of genetic diversity for genetic enhancement and maintenance.

While it has been suggested that domesticated animals can be reintroduced into the wild and revert to a feral state (Kampf 1998; Lott 1998; Turnbull 2001), such attempts do not restore the original genetic diversity of a species (Price 1984; van Zyll de Jong *et al.* 1995). Experience has shown that recovery of original genetic diversity is difficult or impossible once domestic breeds are highly selected for specific traits and wild stocks are extinct (Price 1984; Turnbull 2001; van Zyll de Jong *et al.* 1995). For example, in the 1920s, two German brothers, Heinz and Lutz Heck, set out to "re-create" the aurochs by back-breeding domestic cattle with other cattle demonstrating aurochs-like qualities (Fox 2001; Silverberg 1967; Turnbull 2001). They produced one successful line, the Hellabrunn breed, also known as Heck cattle. This is an animal that looks very much like an aurochs, but is devoid of the wild traits and hardiness of the original wild form (Fox 2001; Silverberg 1967). This illustrates that the original wild genotype is no longer available to the cattle industry for improving domestic breeds. The history of the aurochs offers a lesson for bison: domestication can lead to altered genetically based behaviour, morphology, physiology, and function, and the loss of the wild type and the genetic diversity it contains.

The primary goal of many commercial bison ranchers is to increase profits by maximising calf production, feed-to-meat conversion efficiency, and meat quality (Schneider 1998). This requires non-random selection for traits that serve this purpose, including conformation, docility, reduced agility, growth performance, and carcass composition. Selection for these traits reduces genetic variation and changes the character of the animal over time (Schneider 1998). Although a growing number of consumers prefer naturally produced meat products without hormones, antibiotics, or intensive management (Morris 2001), the demand for bison cannot currently compete with the much larger scale of the beef industry. Therefore, many bison producers apply cattle husbandry practices and standards to bison. Artificial selection based on husbandry and economics may make good business sense in the short term, but it will not conserve native bison germplasm.

The long term objectives and goals that drive commercial bison production generally differ from the major issues associated with

the conservation of the wild species. Furthermore, commercial bison operations could pose a threat to conservation populations through a form of genetic pollution if genetically selected commercial animals are mixed into conservation herds or escape and join wild herds. The most prudent action is to identify and maintain existing conservation herds, and avoid mixing commercially propagated stock into those herds. Bison producers and the bison industry could benefit in the long term by supporting efforts to restore and maintain conservation herds, particularly those subject to a full range of natural selection pressures (Chapter 7). Conservation herds secure the bison genome for the future use of producers—an option not available for most other domestic animals.

Chapter 5 Reportable or Notifiable Diseases

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Throughout their range, bison host numerous pathogens and parasites, many of which also occur in domestic cattle (see reviews: Berezowski 2002; Tessaro 1989; Reynolds *et al.* 2003). In this review, we consider only infective organisms that may negatively affect bison populations, or their conservation, either through direct pathobiological effects, or indirectly as a consequence of management interventions. Livestock diseases that restrict trade or pose a risk to human health may be "reportable" or "notifiable" under federal and provincial/state legislation.

In Canada, reportable and immediately notifiable diseases are listed nationally under the authority of the Health of Animals Act and Regulations (http://laws.justice.gc.ca/en/H-3.3/, accessed 15 April 2009) and under provincial statutes and legislation. The Canadian Health of Animals Act requires owners and anyone caring for animals, or having control over animals, to immediately notify the Canadian Food Inspection Agency (CFIA) when they suspect or confirm the presence of a disease prescribed in the Reportable Diseases Regulations. The CFIA reacts by either controlling or eradicating the disease based upon a programme agreed to by stakeholders (CFIA 2001).

In the U.S., the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) conducts federal eradication programmes for several reportable livestock diseases and is involved in a negotiated multi-jurisdictional brucellosis management programme for bison in Yellowstone National Park (YNP) (APHIS, USDA 2007; NPS-USDOI 2000). In both countries, Federal legislation supersedes state and provincial disease control legislation. In the U.S. and Canada there are specific state and provincial regulations that require testing for, and reporting of, various diseases. These regulations may be more extensive than federal requirements, but typically include those diseases regulated by the federal animal health authorities.

Much like the U.S and Canada, Mexico has federal animal disease regulations that are administered by the Secretary of Agriculture, Livestock Production, Rural Development, Fishery and Food (SAGARPA). Disease surveillance programmes and zoosanitary requirements, including disease reporting, are established by federal law to protect trade in Mexico and are administered by a decentralised branch of SAGARPA titled the National Service of Health, Safety, and Agricultural Food Quality (SENASICA, see http://www.senasica.gob.mx). SAGARPA also negotiates bi-lateral disease management agreements for important livestock diseases along the U.S. border, including bovine tuberculosis, brucellosis, and screwworm.

In addition to federal, state and provincial regulatory agencies there is an international organisation that influences animal disease reporting in North America. The World Organization for Animal Health (OIE) is an intergovernmental organisation created by international agreement in 1924. In 2008 the OIE had 172 member countries. Every member country is committed to declaring the animal diseases it may detect in its territory. The OIE disseminates this information to help member countries to protect themselves from the spread of disease across international boundaries. The OIE produces sanitary codes with rules that must be observed by member countries to prevent the spread of significant diseases around the world. OIE has established Sanitary Codes for Terrestrial Animals, and the Manual for Diagnostic and Vaccine Tests for Terrestrial Animals, which may influence the international movement of bison (http://www.oie.int/eng/normes/mcode/en_sommaire.htm). All three countries in North America are members of OIE.

Depending on the nature of the disease, management of reportable diseases in captive or commercial herds in North America may involve development and application of uniform protocols to reduce disease prevalence, zoning of management areas by disease status, or imposition of procedures for disease eradication, including test and slaughter, or depopulation. Where reportable diseases are detected, federal, state or provincial legislation affects management of wild bison populations. Interventions may include limiting the geographic distribution of an infected wild population, (e.g., removals at park boundaries to reduce the risk of the disease spreading to adjacent livestock population), quarantine, treatment, or eradication of infected captive conservation breeding herds, or limiting inter-population or inter-jurisdictional transport of bison. Public perception of bison as specific, or non-specific, carriers of diseases is a potential barrier to re-establishing conservation herds, particularly in regions where conventional livestock grazing occurs. National and state/provincial governments may restrict the import/export of bison for conservation projects based on real or perceived risks of infection and transmission of reportable diseases.

5.1 Diseases of Conservation Concern

The American Bison Specialist Group (ABSG) recognises nine federally listed diseases of concern for bison conservation in North America. Regulations applicable to each disease may vary among jurisdictions and in their impact on bison conservation and restoration efforts. The OIE lists seven of these diseases as "notifiable" under international standards.

5.1.1 Anaplasmosis

The etiologic agent of anaplasmosis is *Anaplasma marginale*, a rickettsia that parasitises the red blood cells of host animals. The organism is transmitted by blood sucking insects, such as ticks, which serve as a vector between hosts (Radostits *et al.* 2000). The interplay of susceptible wild ruminants and arthropod vectors is critical to the epizootiology of the disease. Anaplasmosis is a disease of international regulatory concern and, therefore, significantly impacts livestock trade between Canada and the north-central and north-western U.S. Anaplasmosis is a disease of major economic importance to the cattle industry in infected regions. Bison are known hosts of *A. marginale* (Zaug 1986) and wild bison have demonstrated serologic titres for the disease (Taylor *et al.* 1997). They have also been experimentally infected (Kocan *et al.* 2004; Zaugg 1986; Zaugg and Kuttler 1985). Serodiagnosis in wild ungulates has proven largely unreliable, but modern molecular diagnostic procedures have provided an excellent alternative (Davidson and Goff 2001). Naturally occurring infections have been reported in the National Bison Range (NBR), Montana, where 15.7% of bison tested positive for anaplasmosis (Zaugg and Kuttler 1985). Recent studies demonstrated *A. marginale* infection in two widely separated bison herds in the U.S., one in Oklahoma (Nature Conservancy Tallgrass Prairie Preserve) and one in Saskatchewan (De La Fuente et al. 2003). In the Canadian herd, serology and polymerase chain reactions indicated that 10 individuals were infected with *A. marginale* whereas 42 of 50 bison culled from the Tallgrass Prairie Preserve (TGPP) tested positive serologically as carriers of *A. marginale*. The U.S. bison isolate of *A. marginale* was found to be infective when inoculated into susceptible splenectomised calves. Clinical symptoms in bison are similar to those described for cattle. They include anaemia, jaundice, emaciation, and debility (Radostits *et al.* 2000). Experimentally infected bison calves demonstrated mild clinical signs suggesting that bison may be more resistant than cattle (Zaugg and Kuttler 1985). The disease occurs commonly in Africa, the Middle East, Asia, Australia, the U.S., Central and South America, and southern Europe. If anaplasmosis is diagnosed in Canadian cattle or bison, Canada's current foreign animal disease strategy calls for its eradication through the testing of infected and exposed herds and the removal of infected individuals. Every bison imported into Canada from the U.S. must be quarantined from the time of its importation into Canada until it proves negative to tests for anaplasmosis performed at least 60 days after it was imported into Canada (CFIA 2007). Programmes for managing this disease in domestic animals include vector control, vaccination and antibiotic therapy (Davidson and Goff 2001). Anaplasmosis is not infectious to humans.

5.1.2 Anthrax

Anthrax is an infectious bacterial disease caused by the endospore-forming bacterium *Bacillus anthracis* (Dragon and Rennie 1995). After inhalation or ingestion by a susceptible host, *B. anthracis* endospores germinate and the vegetative form of the bacterium replicates in the bloodstream, releasing toxins that cause septicaemia and death (Dragon and Rennie 1995; Gates *et al.* 2001b). Upon release from a carcass, highly resistant endospores can remain viable in the soil for decades before infecting a new host (Dragon and Rennie 1995). Humans have played an important role in the evolution of anthrax by increasing the proliferation and dispersal of this global pathogen. Observations of the role of climatic factors, such as season of year, ambient temperature, and drought in promoting anthrax epizootics have been made for several decades (APHIS, USDA 2006). The commonality of summer months, high ambient temperatures, drought, and anthrax epizootics are non-contentious. The roles of environmental factors such as soil types and soil disturbances via excavation are poorly defined despite attempts to evaluate these potential factors.

Bacillus anthracis is divided into three genotype branches with distinct geographic sub-lineage compositions that vary regionally around the globe (Van Ert 2007). Van Ert (2007) analysed 273 isolates of *B. anthracis* in North America, reporting a cosmopolitan assortment of 44 multiple locus, variable number, tandem repeat analysis genotypes. One hypothesis holds that *B. anthracis* was introduced from the Old World to the New World in spore-infected animal products (wool, skins, bone meal, shaving brushes) transported to the south-eastern seaboard during the European colonial-era (Hanson 1959; Van Ness 1971). Consistent with this hypothesis, Van Ert (2007) found a single dominant sub-group in North American (A.Br. WNA; 70% of genotypes) that is closely related to the dominant European sub-group A.Br.008/009. The diversity of sub-lineages represented varies geographically in North America. A.Br.WNA predominates in the north, while the industrialised south-eastern region of the continent contains a cosmopolitan assortment of less common *B. anthracis* genotypes in addition to the dominant form A.Br.WNA.

The geographic pattern of sub-lineage occurrence in North America is consistent with the hypothesis of an early initial introduction of a limited number of sub-lineages (perhaps

one) followed by its widespread dispersal and ecological establishment. Wild bison were abundant and widely distributed at the time of European colonisation. Once infected with anthrax they may have played an important early role in the ecological establishment and widespread dispersal of A.Br.WNA. The broad diversity of anthrax lineages represented in the industrialised south-eastern region of the continent (Van Ert *et al.* 2007) is suggestive of the accumulation of additional sub-group types over time. A likely mechanism is importation of contaminated animal products into mills and tanneries on the eastern seaboard and New England which process imported hair, wool, and hides. The World Health Organisation (WHO 2008) commented on the role of tanneries as a point source of anthrax outbreaks. Contaminated products come from animals that died of anthrax. Wastewater effluent from plants can contaminate downstream sediments and pastures with anthrax spores, providing a source of local outbreaks in livestock and further proliferation of novel introduced variants of the pathogen. Marketing of inadequately sterilised bone meals and fertilisers, rendered from contaminated materials, can result in long distance redistribution and introducing "industrial" strains to livestock remote from the original source (Hugh-Jones and Hussaini 1975).

Under certain environmental conditions, concentrations of endospores have caused periodic outbreaks among wood bison in the Slave River Lowlands (SRL), Mackenzie Bison Sanctuary (MBS), and Wood Buffalo National Park (WBNP) (Dragon and Elkin 2001; Gates *et al.* 2001b; Pybus 2000). Between 1962 and 1971, anthrax and the associated depopulation and vaccination programmes employed to control the disease, accounted for over 2,800 wood bison deaths (Dragon and Elkin 2001). Further outbreaks occurred in the MBS in 1993, in the SRL in 1978, 2000 and 2006, and in WBNP in 1978, 1991, 2000, and 2001 (Gates *et al.* 1995; Nishi *et al.* 2002c). Four factors that are associated rather consistently with these epizootics are high ambient temperatures, intense mating activity, high densities of insects, and high densities of bison as they congregate and compete for diminishing water and food supplies (APHIS, USDA 2006). Based on these four factors, two hypotheses have been proposed to explain outbreaks of anthrax in bison in northern Canada: (1) "the modified host resistance hypothesis" (Gainer and Saunders 1989) and (2) "the wallow concentrator hypothesis" (Dragon *et al.*, 1999). These two hypotheses are not mutually exclusive.

A recent outbreak was reported in a commercial herd in south-western Montana that killed over 300 bison pasturing on a large foothills landscape beneath the Gallatin Mountain Range (Ronnow 2008). Despite mass deaths of bison during anthrax outbreaks, the sporadic nature of outbreaks and predominance of male deaths suggest that the disease plays a minor role in long-term population dynamics unless operating in conjunction with other limiting factors (Joly and Messier 2001b; Shaw and Meagher 2000). Anthrax is not treatable in free-ranging wildlife, but captive bison can be vaccinated or treated with antibiotics (Gates *et al.* 1995; Gates *et al.* 2001b). Carcass scavenging facilitates environmental contamination with anthrax spores (Dragon *et al.* 2005); therefore timely carcass treatment and disposal during an active outbreak in free-ranging bison is considered an important preventative strategy for reducing the potential for future outbreaks (Hugh-Jones and de Vos 2002; Nishi *et al.* 2002a). Anthrax is a public health concern and humans are susceptible, however, exposure from naturally occurring outbreaks requires close contact with animal carcasses or hides. In addition, humans have rarely been exposed to anthrax through the purchase of curios purchased by tourists (Whitford 1979).

5.1.3 Bluetongue

Bluetongue (BLU) is an insect-borne viral hemorrhagic disease affecting many ungulates in the lower latitudes of North America. The BLU virus is a member of the genus *Oribivirus* of the family Reoviridae. Worldwide there are 24 known BLU serotypes, but only six are active in domestic and wild ruminants from North America (Pearson *et al.* 1992). Bluetongue viruses are closely related to the viruses in the epizootic hemorrhagic disease and BLU is known to infect a wide variety of wild and domestic ruminants (Howerth *et al.* 2001). Bison are susceptible to BLU, and the virus has been isolated under field, captive, and experimental conditions (Dulac *et al.* 1988). The arthropod vectors of the bluetongue virus are various species of Culicoides midges (Gibbs and Greiner 1989; Howerth *et al.* 2001). Clinical symptoms include fever, stomatitis, oral ulcerations, lameness, and occasionally, reproductive failure (Howerth *et al.* 2001). There are subacute, acute, and even chronic expressions of the disease in many wild ungulates and domestic livestock. BLU typically occurs in the late summer and early fall depending upon the seasonal patterns of vector activity (Howerth *et al.* 2001). Factors influencing the frequency and intensity of disease outbreaks are innate herd immunity, virulence factors associated with viruses, and vector competency and activity. BLU occurs in livestock over much of the U.S. and its distribution parallels that of domestic livestock. Its distribution is more limited in Canada where it once was a regulated disease until rules were relaxed in July 2006 (CFIA website). There is considerable difference in the epidemiology of the disease between northern and southern portions of North America depending on the consistency of vector activity. In the southern areas, vector activity is more common and animal populations exhibit a higher prevalence of seroreactivity and antibody protection. BLU has not been widely reported in bison herds in North America. Serologic surveys of several Department of Interior bison herds in the U.S. have not found seroreactors for bluetongue virus (T. Roffe personal communication; Taylor *et al.* 1997). The U.S. Fish and Wildlife Service (USFWS) has opportunistically examined bison

near a recent outbreak of BLU in deer and found no evidence of exposure (T. Roffe personal communication). As with many vector-born diseases, climate change is a potential factor affecting the distribution of vectors and therefore the occurrence of BLU (Gibb 1992). There is no effective treatment and, under natural conditions, the disease is not considered a significant threat to human health. There has been one human infection documented in a laboratory worker (WHO website).

5.1.4 Bovine spongiform encephalopathy

Bovine spongiform encephalopathy (BSE), or "mad cow disease" as it is commonly known, is one of a suite of distinct transmissible spongiform encephalopathies (TSE) identified during the past 50 years. TSEs are apparently caused by rogue, misfolded protein agents called prions (PrPSC) that are devoid of nucleic acids (Prusiner 1982). No other TSE in man or animal has received more worldwide attention than BSE (Hadlow 1999). It was first identified in 1986 in England and has since had far reaching economic, political, and public health implications. BSE is a neurologic disease characterised by spongiform change in gray matter neurophil, neuronal degeneration, astrocytosis, and accumulation of misfolded PrPSC (Williams *et al.* 2001). Clinically the disease is progressive, displaying gradual neurologic impairment over months or years and is usually fatal. The disease causes progressive weight loss, low-level tremors, behavioural changes, ataxia, and postural abnormalities. Substantial evidence exists for genetic variation in susceptibility among and within species (Williams *et al.* 2001). Cases of BSE were identified in 10 species of Bovidae and Felidae at a zoological collection in the British Isles (Kirkwood and Cunningham 1994). At least one of these cases included bison. Worldwide, other species susceptible to BSE include cheetah, macaques and lemurs (Williams *et al.* 2001). The recent BSE epidemic in Europe was linked to oral ingestion of contaminated feed (containing ruminant derived protein), however, there is some evidence for low-level lateral transmission. There are no known treatments or preventions for BSE. The human form called new variant Creutzfeldt-Jakob disease has been linked to consumption of BSE contaminated foods. Due to the risk of human exposure to BSE, this disease is highly regulated worldwide. Recent cases of BSE have been reported in Canada and the U.S. but are extremely rare in the livestock industry. Canada reported a case in 1993 that was imported from England and the first domestic case was detected in 2003. The U.S. reported its first case of BSE in 2003. Since then, protein by-products were banned in livestock feed, national surveillance was implemented in both countries, and several regulations were promulgated to restrict imports and exports across the U.S.-Canada boundary. Although bison are considered to be susceptible, there has not been a case of BSE reported in American bison.

5.1.5 Bovine brucellosis

Bovine brucellosis, also known as Bang's disease, is caused by infection with the bacterium *Brucella abortus* (Tessaro 1989; Tessaro 1992). The primary hosts for bovine brucellosis are cattle, bison, and other bovid species (Tessaro 1992), however, other wild ungulates such as elk (*Cervus elaphus*) are also susceptible and seem to play a role in interspecies transmission in the Greater Yellowstone Area (GYA) (Davis 1990; Rhyan *et al.* 1997; Thorne *et al.* 1978). Evidence suggests that brucellosis was introduced to North America from Europe during the 1500s (Meagher and Mayer 1994; Aguirre and Starkey 1994). The disease is primarily transmitted through oral contact with aborted foetuses, contaminated placentas, and uterine discharges (Reynolds *et al.* 1982; Tessaro 1989). The impacts of brucellosis on female bison include abortion, inflammation of the uterus, and retained placenta (Tessaro 1989). Greater than 90% of infected female bison abort during the first pregnancy; however, naturally acquired immunity reduces this abortion rate to 20% after the second pregnancy, and to nearly zero after the third pregnancy (Davis *et al.* 1990; Davis *et al.* 1991). Male bison experience inflammation of the seminal vessels, testicles, and epididymis, and, in advanced cases, sterility (Tessaro 1992). Both sexes are susceptible to bursitis and arthritis caused by concentrations of the bacterial organism in the joints, resulting in lameness, and possibly increased vulnerability to predation (Tessaro 1989; Tessaro 1992).

Serology is used to detect exposure to *B. abortus* by identifying the presence of antibodies in the blood. Sero-prevalence is the percentage of animals in a herd that carry antibodies (Cheville *et al.* 1998). A sero-positive result, indicating the presence of antibodies, does not imply current infection, and may overestimate the true level of brucellosis infection (Cheville *et al.* 1998; Dobson and Meagher 1996) because the organism must be cultured from tissue samples to diagnose an animal as infected. However, a disparity between serology results and level of infection could also be attributed to false negative culture results related to the difficulties in isolating bacteria from chronically infected animals (Cheville *et al.* 1998).

There is currently no highly effective vaccine for preventing bovine brucellosis (Cheville *et al.* 1998; Davis 1993). Strain 19 (S19) was a commonly used vaccine administered to cattle from the 1930s until 1996 (Cheville *et al.* 1998). It was only 67% effective in preventing infection and abortion in cattle (Cheville *et al.* 1998). S19 was found to induce a high frequency of abortions in pregnant bison (Davis *et al.* 1991). Other studies failed to demonstrate efficacy of S19 as a bison calfhood vaccine (Templeton *et al.* 1998). A newer vaccine, strain RB51, is now preferred over S19 because it does not induce antibodies that can interfere with brucellosis serology tests for disease exposure (Cheville *et al.* 1998; Roffe *et al.* 1999a). RB51 protects

cattle at similar levels to S19 (Cheville *et al.* 1993). Doses of RB51 considered to be safe in cattle were found to induce endometritis, placentitis, and abortion in adult bison (Palmer *et al.* 1996). However, Roffe *et al.* (1999a) found RB51 had no significant adverse effects on bison calves. The safety and efficacy of RB51 in bison remains unclear but, nonetheless, it was provisionally approved for use in bison in the U.S. The vaccine is not recognised in Canada and vaccinated cattle are not allowed into the country (CFIA 2007). Every bison imported into Canada from the U.S. must be quarantined from the time of its importation into Canada until it proves negative to tests for brucellosis performed not less than 60 days after it was imported into Canada (CFIA 2007).

Quarantine protocols have been developed for bison to progressively eliminate all animals exposed to brucellosis from a population (APHIS, USDA 2003; Nishi *et al.* 2002b). These protocols have been successful for eliminating brucellosis in wood bison through the Hook Lake project and are currently being attempted in the GYA (Aune and Linfield 2005; Nishi *et al.* 2002b). Results from these two studies, and other case studies (HMSP, WCNP and EINP), have shown that brucellosis can be effectively eliminated from exposed populations with a high degree of certainty using test and slaughter protocols.

5.1.6 Bovine tuberculosis

Bovine tuberculosis (BTB) is a chronic infectious disease caused by the bacterium *Mycobacterium bovis* (Tessaro *et al.* 1990). The primary hosts for BTB are cattle and other bovid species, such as bison, water buffalo (*Bubalus bubalis*), African buffalo (*Syncerus caffer*), and yak (*Bos grunniens*). Primary hosts are those species that are susceptible to infection and will maintain and propagate a disease indefinitely under natural conditions (Tessaro 1992). Other animals may contract a disease, but not perpetuate it under natural conditions; these species are secondary hosts. The bison is the only native species of wildlife in North America that can act as a true primary host for *M. bovis* (Tessaro 1992). Historical evidence indicates that BTB did not occur in bison prior to contact with infected domestic cattle (Tessaro 1992). Currently, the disease is only endemic in bison populations in and near WBNP, where it was introduced with translocated plains bison during the 1920s. BTB is primarily transmitted by inhalation and ingestion (Tessaro *et al.* 1990); the bacterium may also pass from mother to offspring via the placental connection, or through contaminated milk (FEARO 1990; Tessaro 1992). The disease can affect the respiratory, digestive, urinary, nervous, skeletal, and reproductive systems (FEARO 1990; Tessaro *et al.* 1990). Once in the blood or lymph systems the bacterium may spread to any part of the host and establish chronic granulomatous lesions, which may become caseous, calcified, or necrotic (Radostits *et al.* 1994; Tessaro 1992). This chronic disease is progressively debilitating to the host, and may cause reduced fertility and weakness; advanced cases are fatal (FEARO 1990). The disease manifests similarly in cattle and bison (Tessaro 1989; Tessaro *et al.* 1990). Both the U.S. and Canada perform nationwide surveillance of abattoir facilities to monitor BTB infection in cattle and domestic bison. There is no suitable vaccine available for BTB (FEARO 1990; CFIA 2000; APHIS USDA 2007). Every bison imported into Canada from the U.S. must be quarantined from the time of its importation into Canada until it proves negative to tests for BTB performed at least 60 days after it was imported into Canada (CFIA 2007). A quarantine protocol has been developed and an experimental project was attempted to salvage bison from a BTB exposed population (Nishi *et al.* 2002b). Although at first it appeared to be a successful tool for salvaging bison from an exposed herd, after 10 years, several of the salvaged animals expressed BTB, and in 2006 all salvaged animals were slaughtered (Nishi personal communication). There is some evidence that BTB can be treated in individual animals using long term dosing with antibiotics, but the duration of treatment, costs of therapy, and the need for containment make this option impractical for wildlife. The only definitive method for completely removing BTB from a herd is depopulation (CFIA 2000; APHIS USDA 2005). The only alternative to depopulation is controlling the spatial distribution and prevalence of disease through a cooperative risk management approach involving all stakeholders. The basic prerequisites for effectively addressing risk management associated with BBTB in bison are teamwork, collaboration across professional disciplines, and respect for scientific and traditional ecological knowledge among technical and non technical stakeholders (Nishi *et al.* 2006). BTB can infect humans, but it is treatable with antimicrobial drugs. Human TB due to *M. bovis* has become very rare in countries with pasteurised milk and BTB eradication programmes.

5.1.7 Bovine viral diarrhoea

Bovine viral diarrhoea (BVD) is a pestivirus that infects a wide variety of ungulates (Loken 1995; Nettleston 1990). Serologic surveys in free-ranging and captive populations demonstrate prior exposure in more than 40 mammal species in North America (Nettleston 1990; Taylor *et al.* 1997). The suspected source of BVD in wild animals is direct contact with domestic livestock. Infections in wild ruminants, like cattle, are dependent upon the virulence of the isolate, immune status of the animal host, and the route of transmission. Infections in cattle are usually subclinical, but some infections may cause death or abortions in pregnant animals. Factors influencing the persistence of BVD include population size and density, herd behaviour, timing of reproduction, and survivorship of young (Campen *et al.* 2001).

Positive serologic evidence was reported for blood samples from bison in the GYA (Taylor *et al.* 1997; Williams *et al.* 1993),

Alaska (Zarnke 1993) and from bison at Elk Island National Park (EINP) in Alberta (Cool 1999; Gates *et al.* 2001b). In YNP, positive antibody titres were detected in 31% of tested animals (Taylor *et al.* 1997). There are unpublished data regarding sero-reactivity from bison transported to Montana from WCNP in South Dakota (K. Kunkel, personal communication). The Jackson bison herd, with a known history of commingling with cattle, has demonstrated low-level titres, but no evidence of BVD antigen or clinical disease has been found (T. Roffe, personal communication). Clinical BVD was reported in the EINP plains bison herd in 1996, prompting a serological survey of plains bison and wood bison herds (Cool 1999; Gates *et al.* 2001b). Forty-seven percent of 561 plains bison from EINP tested sero-positive for BVD; one tested positive for the virus antigen. At least six plains bison deaths in EINP were attributed to the BVD virus (Cool 1999). Tissues from the suspected cases of BVD infected plains bison were submitted to the Animal Disease Research Institute, Lethbridge, Alberta, Canada, and type 1 BVD virus was isolated (Tessaro and Deregt 1999). None of 352 wood bison in the Park tested sero-positive for BVD at the time. Both plains and wood bison populations at EINP are vaccinated for BVD during annual roundups. However, calves used in translocations are not vaccinated to allow future screening of recipient populations for BVD. In Poland, Sosnowski (1977) reported BVD in a captive European bison. BVD is common in cattle in North America and poses no known risk to humans.

5.1.8 Johne's disease

Johne's disease (JD) is caused by the etiologic agent *Mycobacterium avium* subsp*. paratuberculosis*, a hardy bacterium related to the agents of leprosy and tuberculosis. It occurs worldwide affecting a variety of domestic and wild ruminants including bison, cattle, and sheep (Buergelt *et al.* 2000; Williams 2001). Infections often lead to chronic granulomatous enteritis with clinical signs of diarrhoea, weight loss, decreased milk production, and mortality. JD is common in cattle. Recent studies have shown that more than 20% of dairy herds in the U.S. have JD (Chi *et al.* 2002; Ott *et al.* 1999) causing an estimated economic loss of more than US$200 million annually. JD typically enters a herd when infected, asymptomatic animals are introduced. Unpasteurised raw milk or colostrum may be a source of infection for artificially raised calves. Animals are most susceptible to infection during their first year of life. Neonates most often become infected by swallowing small amounts of contaminated manure from the ground or from their mother's udder. Animals exposed to a very small dose of bacteria at a young age, and older animals, are not likely to develop clinical disease until they are much older. After several years, infected animals may become patent and shed mycobacteria in their faeces. Typically, pre-patent animals do not show symptoms of disease; consequently, most infections go unnoticed and undiagnosed. There is no treatment for animals infected with JD and prevention is the best control measure. Humans are not considered susceptible, but *M. a. paratuberculosis* has been isolated in patients with chronic enteritis (Crohn's disease) (Chiodini 1989). JD is not considered to be a disease problem when bison are on open rangelands and managed at low density. However, restrictions may apply to inter-jurisdictional movement of animals from known infected herds. Hence, maintaining low risk status for bison herds used as a source for conservation projects is an important consideration.

In 1998, the U.S. Animal Health Association approved the Voluntary Johne's Disease Herd Status Program for cattle (VJDHSP). The VJDHSP provides testing guidelines for States to use to identify livestock herds as low risk for JD infection. With numerous tests over several years, herds progress to higher status levels. The higher the status level, the more likely it is that a herd is not infected with JD. In April 2002, USDA-APHIS-Veterinary Service incorporated portions of this programme into national programme standards: Uniform Program Standards for the Voluntary Bovine Johne's Disease Control Program (VBJDCP). VBJDCP-test-negative herds serve as a source of low JD risk stock. Testing for JD in conservation herds has been sporadic and opportunistic. Diagnostic tools are being developed and improved. There are no reports of JD in conservation bison herds in the literature, however, some commercial operations have discovered JD, and in many cases are managing to prevent its spread and reduce its impact on the industry.

5.1.9 Malignant catarrhal fever (sheep associated)

Malignant catarrhal fever (MCF) is a serious, often fatal disease affecting many species of the Order Artiodactyla. It is caused by viruses of the genus *Rhadinovirus*. At least 10 MCF viruses have been recognised worldwide and five viruses have been linked to disease. The viruses most significant to livestock are those carried by sheep, goats or wildebeest (*Connochaetes* spp.). Although ovine herpes virus type 2 (sheep associated MCF) does not cause disease in its natural host, domestic sheep, it does cause MCF in bison. Serological testing indicated that it is common in domestic goats (61%) and sheep (53%) in the U.S. (Li *et al.* 1996). MCF is an important disease in the commercial bison industry as it is one of the most infectious diseases of bison, especially at high densities (Heuschele and Reid 2001). It causes highly lethal infections in bison, with the reported incidence of mortality in a herd of up to 100% (Schultheiss *et al.* 2001). Infections proceed rapidly to clinical disease. MCF is expressed in two forms, acute and chronic, but regardless, death ensues in most cases. In the acute form, bison usually die within 7–10 days of infection or within 48 hr of becoming symptomatic. Alternatively, death may ensue as

long as 156 days post-infection. Some animals recover and remain persistently infected (Schultheiss *et al.* 1998). Clinical signs in bison include hemorrhagic cystitis, colitis, conjunctivitis, ocular discharge, nasal discharge, excess salivation, anorexia, diarrhoea, melaena, haematuria, multifocal ulceration of the oral mucosa, fever, circling, ataxia, behaviours suggestive of blindness, lameness, and difficult urination (Liggitt *et al.* 1980; Ruth *et al.* 1977; Schultheiss *et al.* 1998). Lymphadenomegaly and corneal opacity occur in fewer than half the cases (Schultheiss *et al.* 2001). Direct contact between bison and domestic sheep is considered the most likely source of infection. Hence, bison should not be grazed in the same pastures or adjacent to pastures with sheep. Although most infections occur when bison are in close association with domestic sheep, MCF was reported in bison herds that were five kilometres (three miles) from a lamb feedlot (Schultheiss *et al.* 2001). Dr. T. Roffe has conducted serologic surveys of two U.S. Department of the Interior bison herds not associated with domestic sheep and has found no sero-reactors for MCF (T. Roffe, personal communication). There is no vaccine or effective treatment for MCF and the best way to control this disease is to minimise contact with reservoir hosts. There is no evidence that isolates of MCF are infectious to humans (Heuschele and Seal 1992).

5.2 Episodes of Reportable Diseases in Plains Bison

Based on this survey, two plains bison conservation herds in North America have significant chronic disease issues: YNP herd and the Jackson herd in GTNP/NER. These herds, which account for 4,700 bison (as of winter 2008), or 24% of the entire North American plains bison conservation population, harbour brucellosis.

5.2.1 Yellowstone National Park

Brucellosis was first detected in the YNP bison population in 1917 (Mohler 1917). The origin of brucellosis in the park is unclear, but was probably the result of transmission from cattle (Meagher and Mayer 1994). Opportunistic and systematic serological surveys in the area revealed sero-prevalence varying between 20% and 70%, while bacterial cultures indicated an infection prevalence of approximately 10% (Dobson and Meagher 1996; Meagher and Mayer 1994). Although the true prevalence of the disease is unknown, the YNP bison population is considered to be chronically infected with brucellosis (Cheville *et al.* 1998). More recent research on the epidemiology of brucellosis in Yellowstone bison found that 46% of the sero-reactor animals were culture positive (Roffe *et al.* 1999b). Recent demographic analysis indicates that brucellosis has a significant reproductive effect, that the growth rate of the population could increase by 29% in the absence of brucellosis (Fuller *et al.* 2007), and that brucellosis is not a threat to the long-term viability of the YNP bison (Mayer and Meagher 1995; USDOI and USDA 2000). Fuller *et al.* (2007) conducted a detailed analysis of the demographics of the Yellowstone population from 1900-2000 and found evidence of density dependent changes in population growth as numbers approached 3,000 animals. This population appears robust and has grown at times to exceed 4,000, although it was reduced to fewer than 3,000 several times during the past decade under the current herd management regime (R. Wallen, personal communication).

Herd management is affected by the presence of brucellosis primarily because of the potential risk the disease poses to the livestock industry (Keiter 1997). Bison leaving the park could potentially transmit the disease to domestic cattle grazing on adjacent National Forest and private lands in Montana, Wyoming or Idaho (USDOI and USDA 2000). Bison leave the park in the winter on the north and west boundaries within Montana; movement to the east and south is rare because of topographical barriers (R. Wallen, personal communication). Transmission of brucellosis from bison to cattle has been demonstrated in captive studies; however, there are no confirmed cases of transmission in the wild (Bienen 2002; Cheville *et al.* 1998; Shaw and Meagher 2000). Nevertheless, the potential exists, and this has created a contentious bison management issue in the area.

Relying on the Animal Industry Act of 1884, the U.S Department of Agriculture began preventing and controlling the spread of contagious livestock diseases in the U.S. In 1947, federal and state officials began working closely with the livestock industry to eradicate brucellosis (Keiter 1997; NPS USDOI 2000). Each state represented in the GYA is a co-operator in the National Brucellosis Program and has authority to implement control programmes for brucellosis infected or exposed animals within their respective boundaries. Due to the transmission of brucellosis to cattle, presumably by elk, Montana, Wyoming, and Idaho have each periodically lost their brucellosis-free status as certified by APHIS. Transmission of brucellosis to cattle in Montana, Wyoming or Idaho indirectly affects all producers in these states. If their APHIS status is downgraded, other states may refuse to accept cattle from producers in the GYA (Cheville *et al.* 1998).

Resolution of this issue requires the involvement of, and cooperation among, agencies in several jurisdictions: The National Park Service (NPS), the U.S. Forest Service (USFS), APHIS, and the State of Montana Department of Livestock (MDOL) and Montana Department of Fish, Wildlife, and Parks (MFWP). After many years of media and legal controversy over bison management, the agencies acknowledged the need to cooperatively develop a long-term bison management plan (Plumb and Aune 2002). In 1990, they commenced the process

for an interagency environmental impact statement to develop alternatives for the plan (USDOI and USDA 2000). A series of interagency interim plans followed, which progressively incorporated greater tolerance for bison outside the park in certain areas, and enabled NPS and MFWP personnel to lethally remove bison moving from YNP into Montana.

Legal and policy disagreements between the federal agencies and the State of Montana inhibited the development of a long-term interagency management plan until 2000 when court-ordered mediation resulted in a final decision for a long-term management approach. The long-term plan employs an adaptive management approach with three phased steps for each of the north and west boundary areas (USDOI and USDA 2000). The plan incorporates several risk management strategies including spatial and temporal separation of bison and cattle, capture, test, and slaughter of sero-positive bison, hazing of bison back into the park, vaccination, and radio-telemetry monitoring of pregnant bison to locate possible sources of infection if a cow gives birth or aborts outside the park (USDOI and USDA 2000). The ultimate purpose of the plan is to maintain a wild, free-ranging population of bison while, at the same time, protecting the economic viability of the livestock industry in Montana by addressing the risk of brucellosis transmission; it is not a brucellosis eradication plan (Plumb and Aune 2002). Although eradication of brucellosis from bison in the park is a possible future goal, such an effort is complicated by retransmission potential from elk in the GYA, which also harbour the disease (Cheville *et al.* 1998). Development of more effective vaccines and vaccination methods for bison and elk are required before considering eradication alternatives (Cheville *et al.* 1998). Recent research on genes that control natural resistance to brucellosis may also provide future methods for eradicating brucellosis (Templeton *et al.* 1998).

Recent transmission of brucellosis from elk to cattle and the subsequent loss of Montana's brucellosis status have complicated management. Current initiatives are aimed at managing the problem of brucellosis in elk and bison. Changes in the distribution of bison, elk, and cattle will generate further public debate and perhaps legal action. The GYA situation illustrates the tremendous difficulty in managing wild free ranging ungulates affected by a significant disease on a large landscape where human livelihoods are at risk.

5.2.2 Grand Teton National Park/National Elk Refuge (Jackson herd)

The Jackson herd of approximately 1,100 animals resides in the southern end of the GYA (USFWS and NPS 2007), migrating between Grand Teton National Park (GTNP) in the summer and the adjacent National Elk Refuge (NER) in the winter (Cheville *et al.* 1998). As with the YNP herd, the Jackson herd is chronically infected with brucellosis. Williams *et al.* (1993) reported sero-prevalence of 77% and infection prevalence of 36% for the herd. Serology tests over the past five years indicate a sero-prevalence of 80% (S. Cain, personal communication). A reduction of 8% in fecundity has been estimated, however, the population has been increasing since the 1970s despite the disease (S. Cain, personal communication, Chapter 6; USFWS-NPS 2007).

The Jackson herd was founded in 1948 with the reintroduction of 20 bison from YNP to a 1,500-acre display pen. These bison were confined until 1963 when brucellosis was discovered in the herd (Cheville *et al.* 1998). All but four vaccinated yearlings and five vaccinated calves were destroyed. In 1964, Theodore Roosevelt National Park (TRNP) provided 12 brucellosis-free bison to augment the Jackson herd (Cheville *et al.* 1998). In 1968, the herd escaped from the progressively deteriorating enclosure facility (Cheville *et al.* 1998; Williams *et al.* 1993). From that point the park allowed the herd to roam freely. The bison herd discovered the feed ground at the NER in 1980. Although the herd was apparently healthy when released, it is suspected that infected elk on the NER introduced brucellosis to the Jackson bison (Cheville *et al.* 1998).

Similar to the YNP herd, the free-ranging nature of the Jackson herd allows for the possibility of transmitting brucellosis to domestic livestock in the area, although since the NER excludes cattle, there is limited contact between Jackson bison and cattle during the winter feeding period (Cheville *et al.* 1998). There is potential for contact, however, when bison move among private, USFS, GTNP and NER jurisdictions, especially in summer, when cattle are maintained on grazing allotments in GTNP, private ranchlands, and adjacent USFS lands (Cheville *et al.* 1998; Keiter 1997).

A new bison and elk management plan for the NER and GTNP was approved in April 2007. An earlier bison management plan approved in 1996, after undergoing a National Environmental Policy Act (NEPA) process, was subject to litigation by an animal rights group that questioned the inclusion of a sport hunt to manage population levels and the exclusion of an analysis of elk management on the federal lands in the decision process (Cain, personal communication; USFWS-NPS 2001). The court ruled that destruction of bison for population control could not be conducted until the involved agencies analysed the effects of winter feeding on bison and elk through an additional NEPA process (USFWS-NPS 2001). The feeding grounds attract 90% of the Jackson bison and 6,000-8,000 elk to one small area, creating zones of high animal density, where transmission may be enhanced among and between elk and bison (Bienen 2002; USFWS-NPS 2007). GTNP and the NER determined that a combined elk and bison management plan is needed to address the interconnected issues of the two species, including winter feeding and disease management. The Jackson bison

and elk herds migrate across several jurisdictions including the NER, GTNP, YNP, Bridger-Teton National Forest, Bureau of Land Management, State of Wyoming, and private lands. The NPS and FWS coordinated the extensive involvement of the associated agencies, organisations, and private interests affected by this new management plan and Environmental Impact Statement (EIS). The U.S. Department of Interior (USDOI) published a record of decision in April 2007, selecting a management alternative that emphasises adaptive management of elk and bison populations while reducing their dependence upon feed grounds. The plan also calls for a brucellosis vaccination programme for elk and bison conducted by the State of Wyoming. Recent hunting programmes, modification of feeding programmes and disease management have reduced the number of bison to 700 animals and the long-term management of this herd is now prescribed in a long-term plan. Several legal challenges were mounted and the implementation of the plan remains controversial.

5.3 An Occurrence of Reportable Diseases in Wood Bison

Wood bison herds in and around WBNP, including SRL, are infected with BTB and brucellosis (Gates *et al.* 1992; Gates *et al.* 2001c). These diseased herds account for about 50% of the total wood bison conservation population. Joly and Messier (2001a) reported the sero-prevalence of the diseases to be 31% for brucellosis and 49% for tuberculosis. With the exception of free-ranging bison in the WBNP and GYA, aggressive eradication programmes in both the U.S. and Canada have reduced the probability of brucellosis and BTB in domestic cattle and bison herds to extremely low levels. The wild diseased wood bison herds in and near WBNP are the only known reservoirs of BTB among all bison conservation herds (Gates *et al.* 2001c; Reynolds *et al.* 2003; Shaw and Meagher 2000).

BTB and brucellosis were likely introduced to wood bison populations with the transfer of plains bison from Wainwright Buffalo Park in the 1920s (Fuller 2002). In 1925, the Canadian government implemented a plan to move 6,673 plains bison from the overcrowded Wainwright Buffalo Park to WBNP. The transfer proceeded despite opposition from mammalogical and biological societies in the U.S. and Canada, who warned of transmission of BTB to the resident wood bison population (Anonymous 1925; Ogilvie 1979). BTB was first reported in WBNP in 1937 (Fuller 2002; Gates *et al.* 1992; Geist 1996). Although it is not known whether BTB was endemic among wood bison prior to the transfer (Reynolds *et al.* 1982), evidence indicates that the disease was introduced to wood bison with the transfer of plains bison (Fuller 1962). Brucellosis was also present in the plains bison herd and was reported in WBNP in 1956 (Gates *et al.* 1992).

The presence of BTB and brucellosis threatens the recovery of wood bison in several ways. First, the infected animals are subject to increased mortality, reduced fecundity, and increased vulnerability to predation (Gates *et al.* 1992; Joly and Messier 2001a). In 1934, the bison population in WBNP was estimated at 12,000 animals (Soper 1941). The population decreased from approximately 11,000 in 1970 to 2,151 in 1999 (Joly 2001). This decrease has been attributed to the interactive effects of diseases and predation (Carbyn *et al.* 1998; Fuller 1991; Joly and Messier 2001a). Recently, the WBNP population increased to 4,050, although the reasons for this increase are unclear (Bradley 2002, personal communication).

Second, the potential exists for the infected herds to transmit the diseases to healthy herds, most notably the Mackenzie, Nahanni, and Hay-Zama herds (Animal Plant and Food Risk Assessment Network (APFRAN 1999). Since 1987, the Government of the Northwest Territories has managed a 39,000 km^2 Bison Control Area south of the Mackenzie River to prevent movement of diseased bison into the MBS (Nishi 2002). Recent analysis and modelling of bison movements on the landscape have demonstrated considerable risk potential for transmission of diseases to healthy wood bison herds and bison ranches in the vicinity of the diseased herds (Gates *et al.* 2001a; Mitchell 2002). The Government of Alberta announced a new hunting season for the Hay Zama herd in 2008. The purpose of the hunt is to maintain the wood bison population at approximately 400 and limit distribution of these animals until the diseased bison issue, in and around WBNP, is successfully resolved. In particular the hunt will be used to control expansion of the Hay-Zama herd eastward, preventing contact with bison emigrating from WBNP that may be infected with brucellosis or BTB. Although preliminary, results of serological tests and post mortem examination of about 100 bison harvested from the Hay-Zama population in the winter of 2008 were negative for the two bovine diseases (D. Moyles, Alberta Sustainable Resource Development, personal communication).

Much research and debate has been focused on trying to resolve the diseased bison issue in northern Canada. In 1990, the Federal Environmental Assessment Panel released its report on its analysis of the disease issues (FEARO 1990). The panel concluded that eradication of the diseased wood bison populations is the only method for eliminating the risk of transmission of brucellosis and BTB from bison to domestic cattle, non-diseased wood bison, and humans. The panel further recommended that healthy wood bison be reintroduced to the area following depopulation of the diseased herds. Sources of healthy bison for reintroduction could include the EINP wood bison herd and other captive herds supplemented by disease-free animals salvaged from the Northern Bison herds (FEARO 1990). One such salvage operation, the Hook Lake Wood Bison Recovery Project in Fort Resolution, Northwest Territories, was

attempted (Nishi *et al.* 2002b), but failed. In 2006, after 10 years of isolation and rigorous disease testing, BTB-infected bison were detected in the herd.

Several constituencies rejected the FEARO (1990) panel's recommendation to depopulate WBNP herds. The Northern Buffalo Management Board (NBMB) was formed to develop a feasible eradication plan (Chisholm *et al.* 1998; Gates *et al.* 1992). The NBMB recommended further research into bison and disease ecology before planning management actions for the region (RAC 2001). In 1995, the Minister of Canadian Heritage formed the Bison Research and Containment Program (BRCP) to focus on disease containment and ecological and traditional knowledge research (RAC 2001). The Minister then created the Research Advisory Committee (RAC) to coordinate research activities under the BRCP (Chisholm *et al.* 1998). The RAC comprised a senior scientist appointed by Parks Canada, representatives from the Alberta and Northwest Territories governments, Canadian Parks and Wilderness Society, and four aboriginal communities (Chisholm *et al.* 1998). During the mandated five year period (1996-2001), the BRCP funded projects to assess the prevalence and effects of the diseases on northern bison (Joly and Messier 2001a), and to investigate bison movements and the risk of disease transfer (Gates *et al.* 2001a). The RAC produced a future research agenda and budget for minimum research still required under the BRCP mandate (RAC 2001), but the programme was discontinued in 2001. Many of the research needs identified by the RAC align with the recommendations outlined in the National Recovery Plan for Wood Bison prepared by the Wood Bison Recovery Team (Gates *et al.* 2001c). There remains considerable disagreement between federal and provincial governments and aboriginal interests concerning a long-term solution to the WBNP disease issue. Provincial governments support disease eradication, including aggressive intervention to achieve disease eradication within the national park. Parks Canada is concerned about the conservation and biological impacts associated with aggressive intervention. A technical workshop was convened in 2005 to explore the feasibility of removing diseased bison from the Greater Wood Buffalo National Park region followed by a reintroduction of healthy bison (Shury *et al.* 2006), and there was unanimous agreement amongst participants that this option was technically feasible. The only subsequent management action undertaken at the time of writing was the implementation of a hunting season for the Hay-Zama herd in 2008-2009, intended, in part, to test disease status and to reduce the risk of infection with BTB and brucellosis by reducing population size and limiting range expansion towards infected populations (George Hamilton, Alberta Sustainable Resource Development, personal communication).

5.4 Disease Management in Perspective

A primary consideration regarding disease management in wild populations is determining when a disease is a conservation problem and whether intervention is warranted (Gilmour and Munro 1991). It can be argued that parasitism by disease organisms is a crucial ecological and evolutionary force in natural systems (Aguirre *et al.* 1995; Wobeser 2002). Classification of a pathogen as indigenous or exotic to a host species or ecosystem can influence whether a disease should be managed (Aguirre and Starkey 1994; Aguirre *et al.* 1995; National Park Service 2000). BTB and brucellosis are believed to have been transmitted to bison from domestic cattle. Therefore, management of these diseases in bison is warranted based on their exotic origins, as well as the threat they pose to domestic animals. However, many other pathogens have coevolved with bison and do not warrant veterinary intervention and should be managed in accordance with a natural system.

The most significant diseases involving bison as wildlife affect a trinity of players (wildlife, humans, and domestic animals), and involve a tangle of transmission routes (Fischer 2008). Management of wildlife diseases has often been undertaken to minimise risks to humans and domestic animals (Nishi *et al.* 2002c; Wobeser 2002). Reportable disease management for agricultural purposes is typically based on the objective of eradicating the disease from a livestock population (Nishi *et al.* 2002c). The policy and legislative framework for eradicating reportable diseases in domestic animals is well developed, however, when applied to wildlife, the protocols used by agricultural agencies are usually not compatible with conservation goals (e.g., maintaining genetic diversity, minimal management intervention) (Nishi *et al.* 2002c). Increasingly, the broader conservation community is examining wildlife disease issues in the context of their impact on the viability of wild populations, conservation translocation programmes, and global biodiversity (Daszak and Cunningham 2000; Deem *et al.* 2001; Wobeser 2002). Creative disease-ecology research is needed, and an adaptive management framework is required for coping with diseases within a conservation context (Woodruff 1999). An evaluation of the disease management methods presently applied to bison populations is needed and could assist with development of novel conservation-appropriate policies and protocols for managing the health of free-ranging bison populations (Nishi *et al.* 2002c).

Two emerging policy concepts being discussed to manage and control the transmission or distribution of disease at the domestic/wild animal interface include regionalisation and compartmentalisation (CFIA 2002; OIE 2008). Regionalisation offers one means of spatially identifying where disease control measures will occur on the land while compartmentalisation separates the control programmes of wild and domestic animals.

These concepts are being developed and put into practice by state/provincial, federal, and international health agencies to address the complications of managing intractable disease problems in wild animals ranging on large landscapes that also sustain domestic livestock industries and associated local economies (Bengis *et al.* 2002).

National wildlife health strategies have recently been developed in Canada and the U.S. in response to the many difficult disease issues surrounding free-ranging wildlife. The development of national wildlife health programmes paralleled the increasing profile of wildlife health issues in social and political arenas. These national strategies need to provide clear guidance for coordinated conservation action and a countrywide legislative and policy framework that will influence bison restoration and conservation efforts in North America. It is hopeful that mounting tension between the agriculture, human, and wildlife health communities can be mitigated by developing a comprehensive national wildlife health policy, supportive scientific research programmes, broad stakeholder engagement in decision processes, a conservation-sensitive regulatory framework, and open social discussion about the disease risks from wildlife.

Chapter 6 General Biology, Ecology and Demographics

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6.1 General Biology

An understanding of the ecology and biology of bison is fundamental to their successful management, conservation, and restoration. Bison have the broadest original range of any indigenous ungulate species in North America, reflecting physiological, morphological, and behavioural adaptations that permit them to thrive in diverse ecosystems that provide their diet of grasses and sedges. Successful population management, conservation of genetic diversity and natural selection, modelling and predicting population level responses to human activities, and managing population structure all depend on understanding the biological characteristics and ecological roles of bison. The purpose of this chapter is to summarise what is currently known about the biology of bison; for an earlier comprehensive review, see Reynolds *et al.* (2003).

6.1.1 Physiology

6.1.1.1 Metabolism

Bison exhibit seasonal variation in energy metabolism. Christopherson *et al.* (1979) and Rutley and Hudson (2000) observed that metabolisable energy intake and requirements of yearling male bison were markedly lower in winter than summer. This was attributed to a reduction in activity and acclimation. Bison are better adapted to temperature extremes than most breeds of cattle. They expend less energy under extreme cold than do cattle because of the greater insulating capacity of their pelage (Peters and Slen 1964). Cold tolerance of hybrids between bison and cattle is intermediate between the two species (Smoliak and Peters 1955). Tolerance of bison to heat has not been studied, but the original continental range of the species included the dry, hot desert grasslands of northern Mexico, where a small population of plains bison still exists today (List *et al.* 2007).

6.1.1.2 Growth

Birth weights of intensively managed plains bison have been reported as 25 kg for females and 30 kg for males (Agabriel *et al.* 1998; Agabriel and Petit 1996; Rutley *et al.* 1997). Birth weights (near-term foetuses) of free-ranging plains bison range from 14 to 32 kg (McHugh 1958; Meagher 1986; Park 1969). Gogan *et al.* (2005) estimated that the birth weight of free-ranging bison calves is on average 10% less than that of captive bison. Growth from calfhood to adulthood followed a similar pattern to that of adults, with weight gain during the summer and loss during the winter (P.J. Gogan, unpublished data). Weight gain among calf and yearling plains bison was affected by the influence of the timing and magnitude of summer precipitation on graminoid physical structure (Craine *et al.* 2009).

Differences in weights of plains bison in geographically separate herds have been attributed to differences in climate, nutritional plane, and genetic lineages (Berger and Peacock 1988; Lott and Galland 1987). At Elk Island National Park (EINP), female plains and wood bison achieved asymptotic body weight by six years and maximum body weight at 10 years (Olson 2002; Reynolds *et al.* 2003). Female plains bison at Wind Cave National Park (WCNP) reached an asymptotic body and maximum body weight at five years (Figure 6.1). Male plains and wood bison at EINP reached an asymptotic body weight at eight to nine years and maximum body weight by 13 years (Reynolds *et al.* 2003). Male plains bison at WCNP continued to gain weight through the

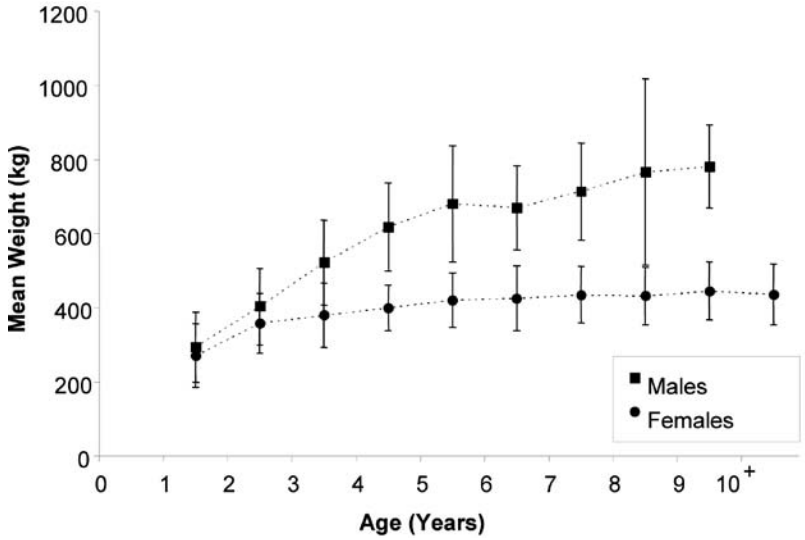


Figure 6.1 *Age-specific live-weights of male and female plains bison at Wind Cave National Park, South Dakota, obtained at fall roundups 1986–1989 and 1991–1999. Data courtesy D. Roddy and B. Meunchau, Wind Cave National Park.*



Plate 6.1 *Plains bison bull tending a cow, Jackson Valley, Wyoming. Photo: Cormack Gates.*

first eight years (Figure 6.1). While differences among populations in body size and weight may be apparent to an observer, comparisons must take in to account the annual cycle of weight gain and loss.

6.1.2 Behaviour

6.1.2.1 Social structure

There are many historical observations of huge plains bison herds roaming the Great Plains (Dary 1989; Hornaday 1889; Isenberg 2000; Roe 1970). Observers of both plains and wood bison consistently report a definable herd structure where cows, calves, and immature males form unstable mixed-sex and age groups, and large bulls form separate, smaller groups throughout much of the year (Allen 1876; Berger and Cunningham 1994; Komers *et al.* 1993; Meagher 1973; Melton *et al.* 1989; Schuler *et al.* 2006). Seasonal variations in group sizes are associated with abundance or dispersion of forage (Jarman 1974; Schuler 2006), landscape features (Berger and Cunningham 1994), breeding behaviour (Berger and Cunningham 1994; Meagher 1973; Melton *et al.* 1989; Komers *et al.* 1993) and population size (Schuler *et al.* 2006). The largest aggregations occur during the breeding season when mature bulls join the mixed-sex and age groups. Mean group sizes during the August rut at Badlands National Park range from a mean of 157 in flat terrain to 79 in broken terrain (Berger and Cunningham 1994). Mean maximum group sizes at Yellowstone National Park (YNP) increased from 140 in May to more than 250 in September (Hess 2002). Groups of more than 1,000 bison have been observed during the rut in contemporary Oklahoma (Schuler *et al.* 2006). Group size rapidly diminishes during autumn in plains bison (Hornaday 1889) to fewer than 30 (Berger and Cunningham 1994; Schuler *et al.* 2006). Similarly, in wood bison, typical group size is greatest during the pre-rut and rut, then declines during the fall (Komers *et al.* 1992). Mean maximum group sizes at YNP declined throughout winter from more than 250 in December to 16 in April as the area occupied by bison increased from 1,000 to more than 1,200 km^2 (Hess 2002).

Male bison form temporary, unstable groups, and exhibit a linear dominance hierarchy, with older, heavier animals dominant over younger smaller males (Komers *et al.* 1994; Roden *et al.* 2005). Dominance is also related to age in female bison (Rutberg 1983). Groups of adult or subadult males rarely exceed 10 individuals (Berger and Cunningham 1994).

Plains and wood bison population substructure occurs at a broad geographical scale due to traditional use of particular parts of a range by segments of a population (Joly and Messier 2001; Olexa and Gogan 2007). Plains bison within the Greater Yellowstone Area show strong fidelity to subpopulations (Christianson *et al.* 2005; Gogan *et al.* 2005; Olexa and Gogan 2007) as do wood bison in the Greater Wood Buffalo Ecosystem (GWBE) (Carbyn *et al.* 1998; 2004; Chen and Morley 2005; Joly and Messier 2004). Bison within subpopulations show stronger cohesion and coordinated movements during summer than in winter (Chen and Morley 2005; Olexa and Gogan 2007).

6.1.2.2 Reproductive behaviour

Sexually mature male plains bison join mixed-sex and age aggregations during the rut. Dominant bulls form so-called "tending bonds" with individual cows just prior to, or during, oestrus (Fuller 1960; McHugh 1958; Meagher 1973). The bull will typically attempt to keep other bulls away and to keep the cow near the edge of a mixed-sex and age group until she accepts copulation (Berger and Cunningham 1994; Lott 2002; McHugh 1958). Mature males move away from mixed-sex and age groups at the end of the rut (Berger and Cunningham 1994; Lott 2002).

Wood bison also aggregate during the summer (Joly and Messier 2001; Komers *et al.* 1992). Male wood bison become more solitary with increasing age, are more frequently aggressive, and test females for oestrus more frequently than do younger bulls (Komers *et al.* 1992). During the rut, mature males join mixed sex and groups to compete for mating opportunities and temporarily leave these groups to recover from high cost breeding activities (Komers *et al.* 1992). In the experimental absence of mature males during the rut, subadult males fed less and interacted more aggressively than when mature males were present (Komers *et al.* 1994).

6.1.2.3 Cow-calf behaviour

Female plains bison close to parturition have been described as restless and excitable (McHugh 1958). A pregnant cow may

leave the herd prior to calving or give birth within the herd (McHugh 1958). Similarly, for wood bison in the Mackenzie Bison Sanctuary (MBS), females have been observed calving in the midst of herds or in extreme isolation in the forest away from any other animals (N.C. Larter, personal observation). Birthing normally occurs while the female is lying down. The mother typically consumes portions of the afterbirth as she frees the calf from the membranes (Lott 2002; McHugh 1958). The female licks amniotic fluid from the calf's fur (Lott 2002). Suckling begins shortly after birth and may last as long as 10 minutes (McHugh 1958); although there was a report of a wood bison mother attacking the newborn calf during suckling (Carbyn and Trottier 1987). The close contact between a cow and calf begins to decline after the calf's first week of life (Green 1992). A calf is typically weaned by seven to eight months of age, although nursing may extend beyond 12 months (Green *et al.* 1993). The longest associations among bison are between cows and their female offspring; while male offspring may remain with the cow through a second summer, female offspring may remain with the cow through a third summer (Green *et al.* 1989; Shaw and Carter 1988).

The cow may use quick charges or steady advances to defend a calf against threats (Garretson 1938; Hornaday 1889; McHugh 1958). An isolated plains bison cow vigorously defended her calf from a grizzly bear (*Ursus arctos*), even though the bear was ultimately successful in killing the calf (Varley and Gunther 2002). Similarly, an isolated cow vigorously defended the calf from wolves (*Canis lupus*) (C. Freese, personal communication).

Cows and other members of mixed-sex and age groups may cooperatively protect calves from predators. In response to the approach of a grizzly bear, a mixed-sex and age group of adult plains bison responded by facing the bear in a compact group, with the calves running behind the adults (Gunther 1991). Wolves preferentially attempt to prey upon wood bison mixed-sex and age groups that include calves (Carbyn and Trottier 1987). During wolf attacks, calves moved close to the cow, or to other bison, or to the centre of the bison group (Carbyn and Trottier 1987; 1988), although this defensive response may break down when bison groups move through forested areas that may impede the movements of the calves (Carbyn and Trottier 1988).

6.1.2.4 Horning and wallowing

All age and sex classes of bison engage in behaviours referred to as horning and wallowing (McHugh 1958). Horning involves an animal rubbing an object, typically a shrub or small tree, with its head, horns, neck, or shoulders (Coppedge and Shaw 1997). Wallowing involves a bison rolling in dry loose ground (or less frequently in wet ground) and tearing at the earth with its horns and hooves as it rolls. Bison prefer to horn aromatic shrubs and saplings (Coppedge and Shaw 1997; Edwards 1978; McHugh 1958; Meagher 1973), which may have insect deterrent properties. Bison have even been observed rubbing on treated telephone posts (Coppedge and Shaw 1997). Soper (1941) observed that horning and rubbing were often associated with harassment by insects. Like wallowing, horning may also constitute aggressive display behaviour.

Bison of both sexes and all age classes engage in wallowing behaviour throughout the year (Reynolds *et al.* 2003), although sexually mature males wallow more frequently during the rut, urinating in the wallow before pawing and rolling (Lott 2002; McHugh 1958). Wallowing by mature males may stimulate oestrus in females (Bowyer *et al.* 1998), and advertise a male's physical condition to other males (Lott 2002). Plains bison may also wallow to cool themselves during the hot summer months, or to achieve relief from biting insects (McMillan *et al.* 2000; Mooring and Samuel 1998). Catlin (in Hornaday 1889) described bison creating wallows in areas with a high water table and rolling in the wallow as it filled with water. The result was pelage matted with mud and clay (Catlin in Hornaday 1889). Coat shedding, rut, and insect harassment occur simultaneously during the summer; therefore in the absence of controlled experimentation, it is not possible to determine the relative influence of these factors on the frequency of horning and wallowing (Coppedge and Shaw 1997).

6.1.2.5 Movements

Plains bison frequently travel in single file along well-established trails when moving between foraging patches (Garretson 1938; Hornaday 1889). Historically, plains bison undertook



Plate 6.2 *Wallowing modifies the landscape. Photos: Dwight Lutesy (inset) and John Gross.*

extensive seasonal north-south movements from summer to winter ranges (Seton 1929) on both sides of the Mississippi River (Garretson 1938; Roe 1970) and from the prairies into the Parkland (Campbell *et al.* 1994). Large herds also remained on the northern prairies throughout winter (Malainey and Sherriff 1996). River valleys were crucial to the survival of bison over-wintering on the grasslands (West 1995). Plains bison also undertook seasonal east-west movements from the prairies to the foothills of the Rocky Mountains in winter (Garretson 1938). Inferences from historical reports of seasonal movement patterns are confounded by the timing of the account relative to the impacts of market hunting, establishment of pioneer trails, and construction of the railroads (Roe 1970). In summer, bison on the Great Plains moved to water on an almost daily basis, and on occasion moved from 80 to 160 kilometres over several days to access water (Dary 1989).

Plains bison currently occupying the YNP spend summer at higher elevations and move to winter ranges at lower elevations (Aune *et al.* 1988; Gates *et al.* 2005; Meagher 1973; Olexa and Gogan 2007). These movements are made over a network of trails, geothermal features, and along the banks of rivers and streams, or along groomed roadways aligned with natural travel routes (Bjornlie and Garrott 2001). Adult males are often the first to pioneer previously unoccupied areas, a behaviour that has been observed in both wood bison and plains bison (Gates *et al.* 2005). Yellowstone bison have expanded their range in response to increased population densities (Taper *et al.* 2000) exacerbated by particularly severe winters (Meagher 1989).

Wood bison at Wood Buffalo National Park (WBNP) annually travel up to 50 kilometres maximum from a centre of activity (Chen and Morley 2005), and individual wood bison at the MBS range over areas of 179 to 1,442 km^2 (Larter and Gates 1990). Wood bison have slowly been expanding their range in the northern boreal forest. Range expansion is generally initiated by large males who then seasonally return from the peripheries of the range to join females and juveniles during the rut (Gates and Larter 1990; N. Larter and J. Nishi unpublished data). Subsequently, mixed-sex and groups move into the expanded peripheral range. Range expansion typically follows periodic high local population densities (Gates and Larter 1990) and is density-driven (Gates *et al.* 2005).

6.2 Ecology

6.2.1 Plains bison

6.2.1.1 Ecological role

Millions of plains bison historically ranged over North America's grasslands and functioned as a keystone species (Knapp *et al.* 1999). They shared this landscape with a variety of other large mammals including pronghorn (*Antilocapra americana*), elk (*Cervus elaphus*), deer (*Odocoileus* spp.), wolves, and grizzly bears. At the landscape level, bison served as ecosystem engineers, both responding to, and creating, heterogeneity. An estimated 100 million bison wallows had a major effect on surface hydrology and runoff (Butler 2006). Ephemeral pools of standing water that persisted in wallows for many days following spring snow melt or rainstorms (Knapp *et al.* 1999) supported a variety of wetland plant species (Collins and Uno 1983; Polley and Wallace 1986). Similarly, bison wallows provided important breeding habitat for the Great Plains toad (*Bufo cognatus*; Bragg 1940) and the plains spadefoot toad (*Spea bombifrons*; Corn and Peterson 1996). Bison directly affect vegetation communities through their grazing, physical disturbance, and by stimulating nutrient recycling and seed dispersal (McHugh 1958). Such activities help to maintain meadows and grasslands on which they, and many other animal and plant species, depend.

In tallgrass prairie, bison grazing of grasses increased soil temperature, light availability, and soil moisture availability to forb species (Fahnestock and Knapp 1993). The net result was beneficial to forbs not eaten by bison (Damhoureyeh and Hartnett 1997; Fahnestock and Knapp 1993), and may thereby have been beneficial for other herbivores such as pronghorn. Bison grazing of short and mixed-grass prairie vegetation increased the rates of nutrient cycling (Day and Detling 1990), modified plant species composition (Coppock and Detling 1986) and increased the nutritive value of grasses (Coppock *et al.* 1983a; 1983b; Krueger 1986). Locally, bison consumed forage resources (England and DeVos 1969; Hornaday 1889) and reduced forage height to levels that facilitate colonisation by prairie dogs (*Cynomys* spp.; Virchow and Hygnstrom 2002). In turn, prairie dog activities enhanced the ratio of plant live: dead material, crude protein content, and digestibility (Coppock *et al.*1983a; 1983b) and thereby encouraged further grazing by bison over more than 20% of the natural short and mixed grass prairie (Whicker and Detling 1988). While bison grazing was independent of pocket gopher (Geomyidae) activities, it influenced gopher distribution by modifying the distribution and abundance of patches of forbs used by gophers (Steuter *et al.* 1995).

Bison grazing, frequently in conjunction with fire and wallowing, enhanced the grassland heterogeneity necessary to provide suitable nesting sites for a variety of obligate grassland nesting bird species (Knapp *et al.* 1999). Bison grazing, particularly on recently burned areas, enhances the abundance of breeding bird species, such as upland sandpipers (*Bartramia longicauda*) and grasshopper sparrows (*Ammodramus savannarum*), in tallgrass prairie (Fuhlendorf *et al.* 2009; Powell 2006). Similarly, a number of bird species endemic to the short and mixed grass prairies of North America, such as the mountain plover (*Charadrius montanus*) and McCown's Longspur (*Calcarius mccownii*), were

historically dependent on a combination of bison wallows and prairie dog colonies for nesting sites. These areas were also utilised by ferruginous hawks (*Buteo regalis*) and long-billed curlew (*Numenius americanus*) (Knopf 1996). Brown-headed cowbirds (*Molothrus ater*), also called buffalo birds, occurred in association with bison throughout central North American grasslands prior to the introduction of livestock (Friedman 1929). Cowbirds feed on insects moving in response to foraging bison (Goguen and Mathews 1999; Webster 2005). Grasshopper species richness, composition, and abundance are strongly influenced by interactions between bison grazing and fire frequency (Joern 2005; Jonas and Joern 2007).

Bison facilitated dispersal of the seeds of many plant taxa as a result of the seeds becoming temporarily attached to the bison's hair (Berthoud 1892; Rosas *et al.* 2008) or via passage through the digestive tract (Gokbulak 2002). Peak passage rate for seeds was 2 days following ingestion (Gokbulak 2002).

Horning damage to trees along grassland borders is effective in slowing invasion of trees into shrub and grassland plant communities or in extending the existing grassland into the forest margin. Bison within YNP rubbed and horned lodgepole pine (*Pinus contorta*) trees around the periphery of open grasslands to the extent that some were completely girdled (Meagher 1973). Similarly horning by wood bison in the MBS has resulted in completely girdled white spruce stands on the periphery of mesic sedge meadows and willow savannas (N.C. Larter, personal observation). Several authors (Campbell *et al.* 1994; Coppedge and Shaw 1997; Edwards 1978) have suggested that bison, in combination with other factors such as fire and drought, significantly limited the historic distribution of woody vegetation on the Great Plains.

A decomposing bison carcass initially kills the underlying plants, but subsequently provides a pulse of nutrients, creating a disturbed area of limited competition with abundant resources that enhances plant community heterogeneity (Towne 2000). Carrion from dead bison is an important food resource for both grizzly and black bears (*Ursus americana*) as well as scavenging birds such as bald eagles (*Haliaeetus leucocephalus*), ravens (*Corvus corax*), and black-billed magpies (*Pica pica*).

6.2.1.2 Contemporary habitat use, nutrition, and foraging

The bison is a ruminant with a four-chambered stomach and associations of symbiotic microorganisms that assist digestion of fibrous forage. On lower quality forage, such as grasses and sedges, bison achieve greater digestive efficiencies than domestic cattle, but on high quality forages such as alfalfa, the digestive efficiency of bison and cattle converge (Reynolds *et al.* 2003). Contemporary studies of plains bison habitat selection in North American grasslands are limited to confined herds artificially maintained at varying densities (Table 6.1)—some of which may differ markedly from pristine conditions (Fahnestock and Detling 2002).

Herbivores, including bison, respond to gradients in forage quality and quantity. Hornaday (1889) described a highly nomadic foraging strategy, where plains bison seemed to wander somewhat aimlessly until they located a patch with favourable grazing. A bison herd would then remain and graze until the need for water motivated further movement. This account contrasts with more recent studies of bison foraging, which have found that plains bison actively select more nutritious forages, and forage in a highly efficient manner that satisfies their nutritional needs and compliments diet selection by sympatric herbivores (Coppock *et al.* 1983a; 1983b; Hudson and Frank 1987; Singer and Norland 1994; Wallace *et al.* 1995). Spatial variation in forage quality and quantity results from natural gradients in soil moisture, soil nutrients, fire, and other disturbance, as well as from the impacts of foraging by bison. Bison exploit variations in forage quality and quantity at all scales; from selecting small patches of highly nutritious forages on prairie dog towns, to undertaking long-distance migration in response to seasonal snowfall or drought.

The following review of bison habitat interactions is based upon North American ecoregions identified by Ricketts *et al.* (1999) and aggregated by Sanderson *et al.* (2008).



Plate 6.3 *Plains bison bull cratering in snow to forage. Photo: Yellowstone National Park.*

Table 6.1 *Diets of plains bison at select locations within North American ecoregions.*

Ecoregion	Location	Season	Plant Type					Reference
			Grasses (%)	Sedges (%)	Forbs (%)	Woody Plants (%)	Others (%)	
Northern Mixed Grasslands	Wind Cave NP, SD	Spring	81	7	9	3		Marlow *et al.* 1984
		Summer	79	9	10	2		Westfall *et al.* 1993
		Autumn	77	12	6	5		
		Winter	79	12	2	7		
		Winter	59	37	4			Wydevan and Dahlgren 1985
Central Shortgrass Prairie	Pawnee Site, CO Lightly grazed	Spring	98		2			Peden *et al.* 1974
		Summer	94		5			
		Autumn	99					
		Winter	94		4			
	Heavily grazed	Spring	95		4			Peden *et al.* 1974
		Summer	96		4			
		Autumn	87		2	12		
		Winter	81		6	11		
Tall Grasslands Prairie and Southern Shortgrass Prairie	Wichita Mountains NWR, OK	Spring & Summer	99					Buechner 1950
	Tallgrass Prairie Preserve, OK	Spring	60	39	1			Coppedge *et al.* 1998
		Summer	88	11	1			
		Autumn	84	16	1			
		Winter	79	21	1			
Northern Fescue Grasslands	National Bison Range, MT	Annual	90	1	2	1		McCullough 1980
Rocky Mountain Forests	Yellowstone Northern Range,WY	Winter	53	44[1]	1	1		Singer and Norland 1994
	Yellowstone Central Range, WY	Summer	55	37		<0.1		Olenicki and Irby 2004
Northern Forests	Elk Island NP, AB	Spring	29	65	6			Telfer and Cairns 1979
		Winter	18	82				
	Prince Albert NP, SK	Spring	35	65				Fortin *et al.* 2002
		Summer	26	73			1	
		Autumn	17	63			20	
		Winter	34	59			7	

[1] Includes rushes (Juncaceae)

6.2.1.2.1 Northern mixed grasslands

In the absence of fire, bison have been observed making extensive use of prairie dog colonies in the northern mixed grasslands ecoregion, where colonies may have covered 2-15% of the short grasslands (Knowles *et al.* 2002; Virchow and Hygnstrom 2002). Bison utilise the forb-dominated centres of prairie dog colonies for resting and wallowing, but feed at the graminoid-dominated periphery of colonies rather than at the colony centre (Coppock and Detling 1986; Krueger 1986). Bison use of prairie dog towns peaks during the summer and declines in the autumn (Krueger 1986) when the available forage biomass is low or the vegetation is senescent (Coppock *et al.* 1983a; 1983b). Bison use of colony sites also declines when recently burned grasslands are available (Coppock and Detling 1986).

Grasses and sedges were almost 90% of the year-round bison diet, and sedges formed 7 to 37% of the seasonal diet in the northern mixed grassland ecoregion (Table 6.1). Bison selected foraging sites containing more than 75% warm season (C4) grasses during the summer growing season (Steuter *et al.* 1995). C4 grasses were approximately 33% of the diet in June, and a maximum of 40% of the bison diet in late summer, but C4 grasses were less in the bison diet in autumn, winter, and spring (Plumb and Dodd 1993). Conversely, cool season grasses formed approximately 50% of the summer diet, but increased to 80% of the diet in September (Plumb and Dodd 1993).

6.2.1.2.2 Central shortgrass prairie

In a lightly grazed site, bison almost exclusively consumed grasses, but consumed more than 10% woody plants in the autumn and winter at a heavily grazed central shortgrass prairie site shared with cattle and sheep (Table 6.1). Three C4 grasses accounted for 65 to 75% of the bison diet (Peden *et al.* 1974; Schwartz and Nagy 1976).

6.2.1.2.3 Tall grasslands prairie and southern shortgrass prairie

Bison in the tall grasslands prairie and southern shortgrass prairie ecoregions utilised only recently burned areas in spring, but selected areas burned annually throughout the year (Shaw and Carter 1990; Vinton *et al.* 1993). Bison grazing and regrazing can maintain areas with a low vegetative cover and standing crop (Coppedge and Shaw 1998; Vinton *et al.* 1993). Areas grazed by bison were characterised by a lower abundance of C4 grasses, a higher abundance of C3 grasses, and greater overall plant species diversity (Hartnett *et al.* 1996). These characteristics were more pronounced in areas burned annually (Hartnett *et al.* 1996), which is consistent with greater bison use of annually burned sites (Shaw and Carter 1990; Vinton *et al.* 1993). Bison grazed little bluestem (*Schizachyrium scoparium*) more frequently post-burning, probably in response to removal of standing dead tillers by fire (Pfieffer and Hartnett 1995). The greater overall plant species diversity in burned areas was linked to increased nitrogen cycling and availability (Bakker *et al.* 2003; Johnson and Matchett 2001).

C3 grasses were the most common dietary item in winter (Coppedge *et al.* 1998). Dietary quality, as measured by faecal nitrogen, peaked in May and June, coincident with a peak in C3 grasses productivity (Post *et al.* 2001). Up to 39% of the spring diet was sedges (Coppedge *et al.* 1998).

6.2.1.2.4 Northern fescue grasslands

Understanding contemporary trophic ecology of bison in this ecoregion is confounded somewhat by a management-imposed rotational grazing, by which bison are moved throughout the National Bison Range (NBR) National Wildlife Refuge, Montana (McCullough 1980). When occupying lower elevation areas of the NBR, bison utilised level to undulating open grasslands. Once herded to higher elevation portions of the range, bison continued to utilise the more level open areas available (McCullough 1980). The year-round distribution of bison was away from higher elevation steep-slope areas. Bison showed no selection for aspect, as they tended to use the more level areas available throughout the year. Bison fed almost exclusively on grasses (Table 6.1; McCullough 1980).

6.2.1.2.5 Rocky Mountain forest

In the high topographical relief of the Rocky Mountains the heterogeneity of herbaceous productivity and standing crop is caused by the spatial distribution of moisture on the landscape. Herbaceous above ground net primary productivity (ANPP) is influenced by site-specific topographic position relative to moisture distribution and aspect (Burroughs *et al.* 2001). Herbaceous ANPP is lower at low elevations with less precipitation and at the highest elevations due to a shorter growing season attributable to lower temperatures than at mid-elevations (Coughenour 2005). In general, herbaceous ANPP occurs as a pulse of nitrogen rich vegetation that sequentially follows an elevational gradient from the lower elevation winter ranges to the higher elevation summer ranges. This pattern of ANPP makes young nutritious and concentrated forage available to bison for up to six months of each year (Frank and McNaughton 1992). Summer movements of bison to higher elevation areas reduces vegetation utilisation at lower elevations and thereby enhances the availability of vegetation at lower elevations during the non-growing season (Frank and McNaughton 1992).

Bison on Yellowstone's northern range forage on sedges within more mesic sites in winter (Meagher 1973) to the extent that the winter diet is more than 95% grasses, sedges, and rushes (Table 6.1; Singer and Norland 1994). Similarly, bison utilising the Yellowstone central range during winter primarily feed on sedges along the edges of thermally influenced drainages and

at other thermal features (Meagher 1973). Upland sagebrush-bunchgrass sites are utilised to a lesser extent in winter (Meagher 1973). The summer diet of Yellowstone bison utilising the Hayden Valley was more than 90% graminoids, with one-half of these being mesic grasses, sedges, and rushes (Olenicki and Irby 2004).

6.2.1.2.6 Northern forests

Bison at EINP are highly selective for upland grasslands year-round, and to a lesser extent, select sedge meadows in winter, and shrubland and aspen forest in spring and summer (Cairns and Telfer 1980; Telfer and Cairns 1979). The bison's year-round diet was virtually exclusively herbaceous vegetation with approximately 80% of the winter diet and 65% of the summer diet sedges (*Carex* spp.; Table 6.1; Telfer and Cairns 1979).

Plains bison foraging at Prince Albert National Park (PANP) selected the sedge *Carex atherodes*, and consumed more sedges than grasses year-round (Table 6.1; Fortin *et al.* 2002). The foraging strategy favoured short-term energy gain over long-term gain for most of the year (Fortin *et al.* 2002). However, bison also selected *Carex* in spring, when a diet of more digestible grasses would have enhanced short-term energy gain (Fortin *et al.* 2002). Bison may avoid shifts in diet to facilitate maintaining a consistent microbial rumen flora (Fortin *et al.* 2002).

6.2.1.2.7 Arctic lowland taiga

Introduced plains bison at Delta Junction, Alaska, feed on sedges and fescue grasses in winter (Campbell and Hinkes 1983). In contrast, plains bison introduced to the vicinity of Farewell, Alaska, feed on willows (*Salix* spp.) almost exclusively in summer, and a mixture of willow and shrubs in the autumn (Waggoner and Hinkes 1986). Some potential exists for competition with moose (*Alces alces*) for willow in riparian, alluvial areas, although the two species select shrubs of different sizes (Waggoner and Hinkes 1986). The drastic differences between the diet of plains bison at Delta Junction and those at Farewell are directly related to forage availability. The Farewell area is almost exclusively riparian willow growth with little in the way of graminoids due to a dominant very rocky braided river substrate. In contrast, the Delta Junction area is characterised by extensive stands of grasses and sedges and domesticated grains. These differences underscore the importance of forage availability in influencing bison diets.

6.2.1.3 Habitat and dietary overlap

Originally, plains bison associated with pronghorn (Allen 1967; Yoakum 2004), elk (Miller 2002) and mule deer (*Odocoileus hemionus*) throughout much of their range, and with moose (Boer 1997) along the northern and high elevation range limits. Of the sympatric species, the seasonal distributions of pronghorn and plains bison were most similar, but their diets were most divergent (Schwartz and Nagy 1976; McCullough 1980; Marlow *et al.* 1984; Wydevan and Dahlgren 1985; Singer and Norland 1994). Although these two species tend to have little dietary overlap, some competition for total biomass may occur (Lovaas and Bromley 1972). Similarly, sympatric plains bison and mule deer may overlap in habitat selection in winter (Cairns and Telfer 1980), but their diets differ (McCullough 1980; Wydeven and Dahlgren 1985; Singer and Norland 1994).

Plains bison and elk exhibit extensive range overlap in winter (Cairns and Telfer 1980; Barmore 2003), but less in spring and summer (Cairns and Telfer 1980). The diets of both species are predominantly graminoids from autumn through spring, with bison favouring sedges and elk favouring grasses (Barmore 2003; Singer and Norland 1994). Dietary overlap with grasses continues into the summer (McCullough 1980; Telfer and Cairns 1979), although the bison's diet contains more grass and less forbs and woody plants than that of elk (Marlow *et al.* 1984; Wydeven and Dahlgren 1985).

Plains bison and domestic cattle diets were most similar for grass consumption during the autumn and winter at a lightly grazed short grassland site, and during the spring at a nearby heavily grazed site (Peden *et al.* 1974). Bison and cattle summer and autumn diets in a shrub-steppe region were almost exclusively grasses (Van Vuren 1984; Van Vuren and Bray 1983). The diets of bison and domestic sheep were most similar during autumn at a lightly grazed short grassland site (Peden *et al.* 1974).

6.2.2 Wood bison

6.2.2.1 Original distribution and ecoregions occupied

Zooarchaeological evidence, combined with documentary records and oral narratives of aboriginal peoples in Alaska, Yukon, and Northwest Territories, indicate that the original range of wood bison included northern Alberta, north-eastern British Columbia east of the Cordillera, the Northwest Territories south and west of Great Slave Lake, the Mackenzie River Valley, and large areas of interior Alaska (Gates *et al.* 1992; Lotenberg 1996; Stephenson *et al.* 2001; van Zyll de Jong 1986). The original distribution of wood bison in northern Alberta and southern Northwest Territories centred on the Interior Plains Physiographic Region, where they ranged over the interconnected and overlapping glacial lake basins and major river valleys, where soil conditions are conducive to development of sedge-grass meadow plant communities (Gates *et al.* 1992). The total range of wood bison was more restricted than that of plains bison. Contemporary wood bison herds in the boreal regions exist in comparatively natural systems. They remain part of a fairly diverse, large ungulate fauna, which represents the prey base for several predators. Wood bison distribution overlaps with that of moose, elk, boreal and northern mountain ecotypes of

woodland caribou (*Rangifer tarandus caribou*), white-tailed deer (*Odocoileus virginianus*), mule deer and possibly stone sheep (*Ovis dalli*). Similarly, wood bison are exposed to the full suite of predators including wolf, grizzly, black bear, wolverine (*Gulo gulo*), cougar (*Felis concolor*), lynx (*Felis lynx*), and coyote (*Canis latrans*). Wolf predation is an especially important mortality factor for northern bison (Carbyn *et al.* 1993; Larter *et al.* 1994; Van Camp 1987). Furthermore, wood bison movements are generally not impeded by fences or other land uses.

6.2.2.2 Contemporary habitat relationships, nutrition, and foraging

Wood bison of the Nahanni population in the south-west Northwest Territories must cross the Liard River as it bisects the bison range for its entirety. Animals of both sexes and all age classes frequently make river crossings (Larter *et al.* 2003) making them susceptible to group mortality during spring ice breakup and rapid snowmelt. Bison use of sedges associated with wet meadows and lakes in winter also makes them susceptible to mass mortality when groups fall through weak ice. A total of 177 animals drowned in the MBS after breaking through the spring ice of Falaise Lake (Gates *et al.* 1991). Abnormally high January 2009 temperatures (+12° C) affected ice conditions which likely caused the drowning of up to 13 animals of the Nahanni wood bison population (N.C. Larter, unpublished data). Spring flooding, notably at WBNP, has caused thousands of bison deaths (Fuller 1962).

Fire, especially in the northern boreal region may improve foraging habitat for bison and, in some areas of the Northwest Territories, prescribed burning has been used as a management tool for habitat enhancement (Chowns *et al.* 1997). However, fire may play less of a role in maintaining lowland meadows than sporadic flooding (Quinlan *et al.* 2003).

6.2.2.2.1 Northern forests

Bison at WBNP and Slave River Lowlands (SRL) utilised mixed woodlands and aspen and poplar stands interspersed with meadows in summer, and upland meadows, lowland floodplains, and delta marshes in winter (Soper 1941). They feed primarily on graminoids (Table 6.2) with two genera, slough sedge (*Carex atherodes*) and reedgrass (*Calamagrostis* spp.), making up most of the annual diet (Reynolds *et al.* 1978). Willows were 8% of the summer diet (Reynolds *et al.* 1978). Bison selectively graze stands of slough sedge characterised by a biomass level that would probably minimise daily foraging time (Bergman *et al.* 2001).

6.2.2.2.2 Subarctic boreal forests

Bison exhibit sex-specific differences in habitat selection with females found in mesic sedge meadows 55% of the time in winter (compared to males, 38%) and willow savannas 77% of the time in summer (compared to males, 48%), even though these two plant communities combined constitute only about 5% of the area (Larter and Gates 1991; Matthews 1991). Both sexes utilised the most abundant coniferous forest in proportion to its availability during autumn (Larter and Gates 1991). Bison frequent areas where frozen lakes, ponds, oxbow lakes, and disturbed sites provide winter access to forage. The bison diet varied seasonally from a more diverse combination of graminoids and woody plants or forbs in summer to approximately one-third lichens and one-third grasses in autumn, to almost exclusively graminoids in winter (Table 6.2). Such feeding patterns were consistent with selection for plants with relatively high available nitrogen (Larter and Gates 1991) and to enhance short-term energy consumption (Fortin *et al.* 2002). This feeding pattern may also be attributed to dedicating time to avoid insect harassment, scanning for predators, maintaining thermal balance, or social interactions (Bergman *et al.* 2001).

In the Nahanni population of south-west Northwest Territories, bison utilise horsetails (*Equisetum*) in summer (Larter and Allaire 2007), a forage that is high in nitrogen, but also high in silica. The high silica causes rapid tooth wear, resulting in teeth wearing out 10 years earlier than in other areas.

6.2.2.3 Habitat and dietary overlap

There is little dietary overlap between wood bison and the various ungulate species that share its range. Competition with moose may occur in the Northwest Territories, where the bison's diet has a high browse component. Bison and boreal caribou in Northwest Territories/Yukon Territory both eat lichens, although during different seasons. Caribou use lichen as a diet staple in winter, whereas bison use of lichen is in autumn, when they disperse into the more forested habitats (Larter and Gates 1991). Fischer and Gates (2005) concluded that food competition between caribou and bison was low in winter.

6.3 Demographics

The abundance of the free-ranging populations of plains and wood bison, so iconic for North America, likely fluctuated considerably by location and through time. These fluctuations were probably driven by a sequence of density-dependent population regulatory factors (Eberhardt 1977; 2002; Fowler 1981; 1987; Gaillard *et al.* 1998); reduced survival of subadults, delayed age of first reproduction, decline in the reproductive rate, and increased adult mortality. This sequence was undoubtedly set back by density independent events such as episodic droughts and severe winters. Droughts and dry seasons in general were characterised by wildfires, which, on occasion, killed bison (Dary 1989; Isenberg 2000). Winters with deep snow and warming periods, resulting in ice crusting on top of

Table 6.2 *Diets of wood bison at select locations within North American ecoregions.*

Ecoregion	Location	Season	Plant Type					Reference
			Grasses (%)	Sedges[1] (%)	Forbs (%)	Woody Plants (%)	Others (%)	
Northern Forests	Wood Buffalo NP and Slave Lake, NWT and AB	Spring	16	81	1	2		Reynolds et al. 1978, Reynolds. 1976 *in* Reynolds and Peden 1987
		Summer	24	59	8	8		
		Autumn	21	71	4	2		
		Winter	36	63		1		
Subarctic Boreal Forests	MacKenzie Bison Sanctuary, NWT	Spring	6	68	1	26		Larter and Gates 1991
		Summer	11	53	2	28	6[2]	
		Autumn	32	15	4	12	37[2]	
		Winter	2	96		2		
	Nahanni Population, NWT	Summer	6	37	29	14	1[3]	Larter and Allaire 2007; Larter, N.C. unpublished data
		Autumn	19	58	7	12	4[3]	
		Early Winter[4]	16	37	10	4	33[3]	
		Mid-Winter[4]	2	89	4	3	2[3]	

[1]Includes rushes (Juncaceae); [2]Lichens; [3]*Equisetum* spp.; [4]November/December is early winter, January/February is mid-winter

the snow, led to major die-offs of bison (Dary 1989). Thousands of bison were drowned in floods that resulted from the spring melting of large snow packs (Dary 1989).

Predation by wolves may have been a significant force, taking the most susceptible age and sex classes at different times of year. Wolves may have preyed heavily on bison calves (Flores 1991) and killed older solitary males (Dary 1989). However, predation may have had little effect on large nomadic or migratory herds of bison (Terborgh 2005). Wolves maintain group territories and bear altricial young, traits that would have made it impossible for wolf packs to sustain sufficient pressure on a wide-ranging, mobile prey (Terborgh 2005). Grizzly bears killed some bison, occasionally from ambush (Dary 1989).

Prior to the availability of firearms, the small number of resident humans, and their relatively ineffective hunting, limited the human toll on bison. Pedestrian harvesting was mostly non-selective and involved surrounding or driving of bison groups over bison jumps (Flores 1991). However, by the late 17th century, firearms-equipped tribes from the Great Lakes region began moving out on to the Great Plains. At the beginning of the 19th century, tribes with horses were beginning to exert pressure on plains bison and select for breeding age females (Flores 1991). At the same time inter-tribal warfare led to buffer zones that served as refugia for bison (Flores 1991; Martin and Szuter 1999). By mid-1800s, an estimated 500,000 plains bison were killed for subsistence, and an additional 100,000 were killed for their hides annually (Isenberg 2000). Bison populations began to decline as increasing numbers of cattle and horses began to compete with bison for forage and water (Flores 1991; Isenberg 2000).

6.3.1 Population structure

Both plains and wood bison can be classified into sex and age classes based on body size and horn morphology. Free-ranging calves are readily distinguishable from all other age classes based upon pelage colour for the first three months of life, but their sexes cannot be distinguished. Yearlings may be distinguished from adults until about one and a half years old, based upon body size and conformation, when examined at close range. Sex can be determined in animals more than two years old on the basis of horn morphology and head shape (Bradley and Wilmshurst 2005; Komers *et al.* 1993), or noting the presence or absence of a penile sheath, but again this requires viewing from close range (Carbyn *et al.* 1998). Komers *et al.* (1993) described criteria for distinguishing between subadult (two to four years old), mature, and old bulls based on body size and horn morphology. The results of composition counts are frequently standardised as a ratio of selected age and sex classes per 100 adult females (Caughley 1977). Typically, within polygynous species such as bison, adult females are the most abundant class in a population and directly determine the size of the youngest age class (McCullough 1994). The presence of new calves in a population is sensitive to the timing of the count relative to the calving

season: Wolfe and Kimball (1989) reported an increase in the percentage of calves from 10.2% in late May to 12.2% in late July (i.e., count too early and you may miss some).

Similarly, segregation of age and sex classes may influence estimates of population composition. Meagher (1973) reported that calves formed 20% of mixed age and mixed sex bison herds, but 11% of the total Yellowstone bison population. Other biases are also possible. Carbyn *et al.* (1998) reported an unweighted average of 36 calves per 100 adult females for bison in Delta Area of WBNP for 1989-1996 (Table 6.3), while others reported between 20 and 30 calves per 100 adult females for the same area and during the same time period (Bradley and Wilmshurst 2005). Similarly, Carbyn *et al.* (1998) reported an average of 20 yearlings per 100 adult females for this time period, while others reported more than 10 yearlings per 100 adult females for only one of those years (Bradley and Wilmshurst 2005). Thus, composition estimates need to be interpreted with considerable caution and would benefit by inclusions of confidence intervals.

Few data sets permit evaluation of reproductive success and survival of young in relation to population densities (Table 6.4). The higher ratios of calves and yearlings per 100 adult females in the Mink Lake area of WBNP compared to MBS (Table 6.4) reflect differences between increasing and declining populations (Larter *et al.* 2000). Lower calf and yearling to adult female ratios were linked to a period of population decline at WBNP (Bradley and Wilmshurst 2005). Reynolds *et al.* (2003) reported density dependent fecundity in bison at EINP.

Information on the age structure of free-ranging bison populations not subjected to regular culling is limited. Wood bison at the MBS were assigned to age and sex classes in July 1993: calves and yearlings were not assigned to sex classes, all females two or more years old were assigned to a single category, and males more than two years old were assigned to one of four age categories following Komers *et al.* (1992). Here, the population age structure is presented with an assumption of an equal sex ratio in calves and yearlings (Figure 6.2). Irrespective of the sex, the relatively low numbers of calves and yearlings suggest a low recruitment rate (Figure 6.2).

6.3.2 Reproduction

The age of first reproduction is sensitive to nutritional condition and, therefore, highly variable. The proportion of females calving as two-year-olds (conceiving as one-year-olds) ranges between 4-12% (Table 6.5). However, female bison typically enter oestrus as two-year-olds, and give birth to their first calf at three years (Table 6.5). Mature females in some populations reproduce each year (Rutberg 1984; Shaw and Carter 1989; Wolff 1998), although in other populations mature females may not breed in some years (Fuller 1962; Green 1990; Halloran 1968; Soper 1941; Van Vuren and Bray 1986; Wolfe *et al.* 1999). This is particularly true of females breeding as two- to four-year-olds (Green 1990). Fuller (1962) noted that for wood bison in the Hays Camp area of WBNP, 21% of the females more than three years old at the time of parturition were lactating, but non-pregnant, while the same was true for 9% of the females in the Lake Claire area of the park. This proportion may vary within the same population at different densities of bison and other ungulate species relative to forage conditions (Halloran 1968; Shaw and Carter 1989). The young born to females following a year of not breeding were larger and more fecund than the young of females who bred the previous year (Green and Rothstein 1991). Females continue to breed until more than 16 years of age (Green 1990). Bison are typically monoparous, with twinning reported only occasionally (Reynolds *et al.* 2003).

Male bison maintained on supplemental feed are physiologically capable of breeding as early as 16 months of age (Helbig *et al.* 2007), and those not receiving diet supplements may breed at two to three years old (Maher and Byers 1987). However, males generally do not breed until they are five or six years old and large enough to compete with older and more experienced bulls (Fuller 1960; Komers *et al.* 1994; Meagher 1973; Rothstein and Griswold 1991).

The age of first successful reproduction may be modified by disease in bison of the Jackson, Yellowstone and GWBE populations. More than 90% of the first pregnancies were lost in brucellosis infected captive female bison (Davis *et al.* 1990; 1991). In free-ranging bison, the impact of brucellosis on the age of first successful reproduction will vary with the proportion of first time breeders in the population, the proportion of those breeders infected with brucellosis, and the severity of the infection (Bradley and Wilmshurst 2005). Diseases may also modify reproductive performance of older females. At WBNP, both tuberculosis (BTB) and brucellosis may impact the reproductive success of females of all age classes within select population segments (Joly and Messier 2004; 2005). In two population segments of wood bison at WBNP, infection with brucellosis or BTB alone did not impact pregnancy status, but infection with both diseases reduced the probability of pregnancy by 30% (Joly and Messier 2005). In a third population segment, infection with BTB alone reduced the probability of pregnancy by 75% (Joly and Messier 2005).

6.3.3 Mortality factors and survival

Proximate causes of mortality in contemporary wood bison herds include wolf predation and the exotic diseases brucellosis and BTB (Fuller 1962; Calef 1984; Carbyn *et al.* 1993; Joly and Messier 2001, 2004; 2005; Wilson *et al.* 1995 in Bradley and Wilmshurst 2005). In addition, some wood bison succumb to irregular outbreaks of anthrax (*Bacillus anthracis*) (Gates *et al.*

Table 6.3 *Ratios of select age classes:100 females among plains and wood bison populations.*

Subspecies	Location	Period of Observation	Adult		Sub-adult		Sub-adult		Reference
			Male	Female	Male	Female	Yearling	Calves	
Plains bison	Henry Mountains, UT	July or September weighted average 1977–1983	54	100			43	53	Van Vuren and Bray 1986
Wood bison	Slave River, NWT	Summer 1978	32	100	4	1	7	35	Van Camp and Calef 1987
	Mackenzie Bison Sanctuary, NWT	July 1993	78	100					Gates *et al.* 1995
	Mackenzie Bison Sanctuary, NWT	July, unweighted average 1984–1998		100			22	41	Larter *et al.* 2000
	Mink Lake, NWT	July, unweighted average 1989–1998		100			30	51	Larter *et al.* 2000
	Wood Buffalo (Delta Area), AB	Spring unweighted average 1989–1996		100			20	36	Carbyn *et al.* 1998

1995). Wallows may serve as focal areas for anthrax spores, and more frequent wallowing by adult males may contribute to greater mortality among adult males than adult females during outbreaks of the disease (Gates *et al.* 1995). Bison have died falling into hot pools and bogs. Accidental drowning of whole herds of bison by falling through thin ice in spring and fall has been reported (Roe 1970; Gates *et al.* 1991). Once bison break through lake or river ice, they are generally unable to haul themselves out and become trapped (Carbyn *et al.* 1993).

Droughts and severe winters, alone or in combination, have led to episodic over-winter mortality in the absence of wolf predation in plains bison of the YNP central herd (Cheville *et al.* 1998; Green *et al.* 1997). Episodic droughts reduce late growing season forage quality and increase the probability of wildland fires that reduce the amount of winter forage available (Frank and McNaughton 1992). Simulations indicate that over-winter survival of YNP northern range bison is most strongly influenced

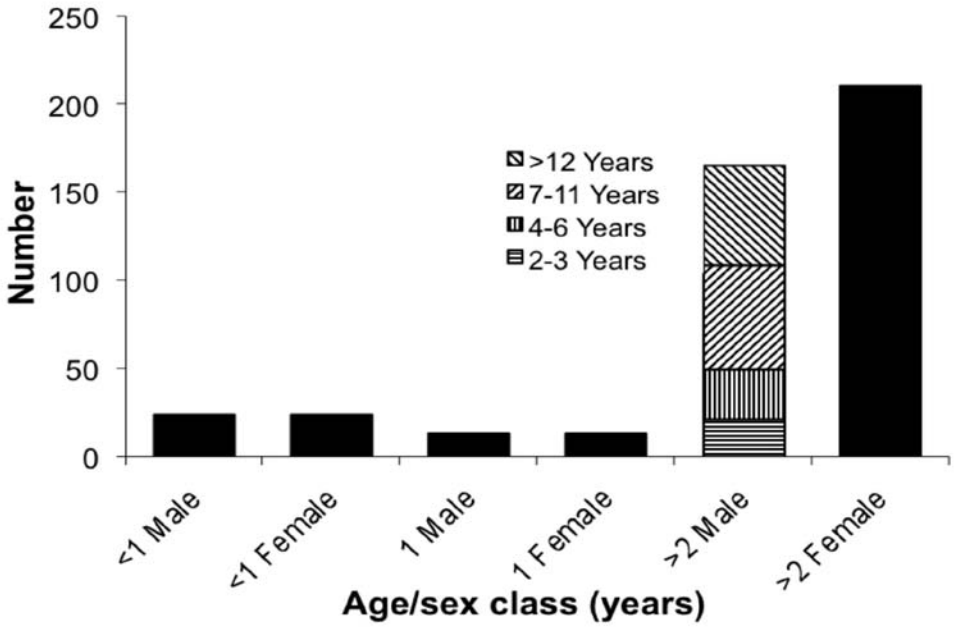


Figure 6.2 *Age and sex class structure of wood bison at Mackenzie Bison Sanctuary, Northwest Territories, assuming an equal sex ratio among calves and yearlings (Gates et al. 1995).*

Table 6.4 *Age-specific reproductive rates (%) of female plains and wood bison at select locations. Ages are female ages at time of birth of offspring (so, a female reported as pregnant at one year by necropsy is shown as giving birth at two years, her second birthday).*

Subspecies	Location	Age			Reference
		2 years	>2 years	>3 years	
Plains bison	Wichita Mountains, OK	13	52	67	Halloran 1968
	Wichita Mountains, OK	12	72		Shaw and Carter 1989
	Fort Niobrara, NB			83	Wolff 1998
	Henry Mountains, UT		52	62	Van Vuren and Bray 1986
	Antelope Island, UT			46	Wolfe *et al.* 1999
	National Bison Range, MT			86	Rutberg 1986
	Konza Prairie, KS			66 – 79	Towne 1999
	Badlands, SD	4		67	Berger and Cunningham 1994
	Wind Cave, SD	5		80	Green 1990, Green and Rothstein 1991
	Yellowstone – Northern Herd, WY/MT			40	Kirkpatrick *et al.* 1996
	Yellowstone – Central Herd, WY			52	Kirkpatrick *et al.* 1996
	Yellowstone – mixed, WY			73	Pac and Frey 1991
	Yellowstone – mixed, WY			79	Meyer and Meagher 1995
Wood bison	Wood Buffalo – Hays Camp, NWT	4		53	Fuller 1962
	Wood Buffalo – Lake Claire, AB	12		76	Fuller 1962
	Wood Buffalo, NWT and AB		76* 70**		Joly and Messier 2004
	Wood Buffalo, NWT and AB			43	Carbyn *et al.* 1993
	Mackenzie Bison Sanctuary, NWT		70		Gates and Larter 1990

* no disease ** infected with brucellosis and bovine tuberculosis

by winter severity and the area of wildland fires (Turner *et al.* 1994; Wallace *et al.* 2004).

Survival of calves to six months is more than 90% in plains bison herds in protected areas, or those that are only lighted hunted in the absence of predators and diseases (Table 6.5). The survival rate for the first six months of life in the presence of wolves at WBNP was 47% (Table 6.5; Bradley and Wilmshurst 2005). At the SRL survival rates for the first six months of life increased from 6% to 30% coincident with a decline in wolf abundance (Table 6.3; Calef 1984). Survival through the first year of life, in the presence of wolves, has been estimated at 10% and 41% for bison at WBNP (Table 6.5; Carbyn *et al.* 1993; Fuller 1962). Calf survival through the first year of life was 95% for an increasing herd at the MBS, when wolf abundance was low (Table 6.5; Calef 1984). There are highly variable estimates on survival patterns in the first year of life (Table 6.5).

Adult survival rates in disease-free, protected, or lightly hunted, populations of plains bison are more than 95% for sexes combined or females only (Table 6.5). Survival rates for both sexes in increasing populations have averaged 75% for wood bison at the MBS, and 95% for the Jackson plains bison herd (Table 6.5; Larter *et al.* 2000; USFWS-NPS 2007). At WBNP, bison infected with both brucellosis and BTB experience lower survival rates than do those infected with only one of the two diseases, or not infected at all (Table 6.5; Bradley and Wilmshurst 2005; Joly and Messier 2001; 2004; 2005).

Table 6.5 *Age-specific survival rates (%) of plains and wood bison at select locations (mm = male; ff = females).*

Subspecies	Location and Years	Age			Comment	Reference
		<6 months %	<1 year %	Adult %		
Plains bison	Henry Mountains, UT	93		96		Van Vuren and Bray 1986
	Badlands, SD			98		Berger and Cunningham 1994
	Jackson, WY			95	Females only. Increasing population.	USFWS and NPS 2007
	Wind Cave, SD	99			1 of 153 calves born died	Green and Rothstein 1991
Wood bison	Wood Buffalo, NWT and AB		<10			Fuller 1962
	Wood Buffalo, NWT and AB		41		Calculated from life table	Carbyn *et al.* 1993
	Wood Buffalo, NWT and AB			92 (mm) 94 (ff)	One or no diseases. Average of Wilson *et al.* 1995 and Joly and Messier 2001	Bradley and Wilmshurst 2005
	Wood Buffalo, NWT and AB			<85 (mm) <87 (ff)	Both diseases	Joly and Messier 2001, Wilson *et al.* 1995 in Bradley and Wilmshurst 2005
	Wood Buffalo, NWT and AB	47	33			Bradley and Wilmshurst 2005
	Mackenzie Bison Sanctuary, NWT		95		Increasing population. Few wolves.	Calef 1984
	Mackenzie Bison Sanctuary, NWT			75	Increasing population. Ad. Female range 67–100: Adult male range 67–100	Larter *et al.* 2000
	Slave River Lowlands, NWT 1974–1976	6				Calef 1976 in Calef 1984
	Slave River Lowlands, NWT 1976–1978	30			Following wolf decline	Van Camp 1978 in Calef 1984

6.3.4 Population growth rates

The rate of increase of a population is influenced by sex ratio and age structure, forage and habitat availability and quality, immigration and emigration combined with reproductive and mortality rates. The highest rates of increase occur in captive bison herds, in the absence of predators, where the sex ratio is skewed towards reproductive age females, some supplemental feeding occurs, and most, or all, of the population is rounded up annually and "surplus" bison removed. The Tallgrass Prairie Preserve (Oklahoma) population attained a rate of increase of about 50% under such conditions (R. Hamilton, personal communication).

The maximum exponential rate of increase (r_m) is the rate at which a population with a stable age structure will grow when resources are not limiting (Caughley 1977). The observed exponential rate of population growth over time ($\hat{r}$) may approximate r_m for populations introduced into areas where resources are abundant (Caughley 1977). The observed rate of growth may be expected to deviate from r_m over time as a population increases, and per capita resources become limiting. The length of time for a population to double in size may be calculated as (natural log (ln) of 2)/ $\hat{r}$ (Johnson 1994).

Plains bison re-introduced to the NBR in 1909 were permitted to increase without management intervention for 14 years (Roelle 1977 in Fredin 1984). The observed exponential rate of growth of the population in this period, with a starting population of 37, was $\hat{r}$ = 0.2053 (Figure 6.3). The population grew at a rate of 20.5% each year, with a doubling time of 3.4 years, or, given the birth-pulse characteristic of bison, it would realistically double every four years. The northern Yellowstone plains bison herd was intensively managed in the early 20th century, with supplemental feed provided in winter (Meagher 1973). Numbers increased from 21 in 1902 to 239 in 1915, after which bison were removed from the herd (Meagher 1973). The observed exponential rate of increase for the northern Yellowstone herd for this 14-year period was $\hat{r}$ = 0.1787. The population doubling time at this rate of increase was four years.

Plains bison, allowed to become free ranging in the Jackson Valley, Wyoming in 1969, experienced minimal management intervention until 1980, when these animals began utilising supplemental forage intended for elk at the NER (USFWS-NPS 2007). Limited numbers of plains bison were killed by agency personnel or licensed hunters between 1980 and 2002 (USFWS-NPS 2007). Plains bison numbers have been estimated annually by staff of GTNP; S. Cain; personal communication). The observed exponential population growth rate for the 33-year period from 1969 to 2002 was 0.129 (Figure 6.4). The observed exponential rate of increase for the Jackson herd for the 14-year period from 1980 to 1993, with a starting population size of 37, was $\hat{r}$ = 0.1197. At these rates of increase, a population would double every six years.

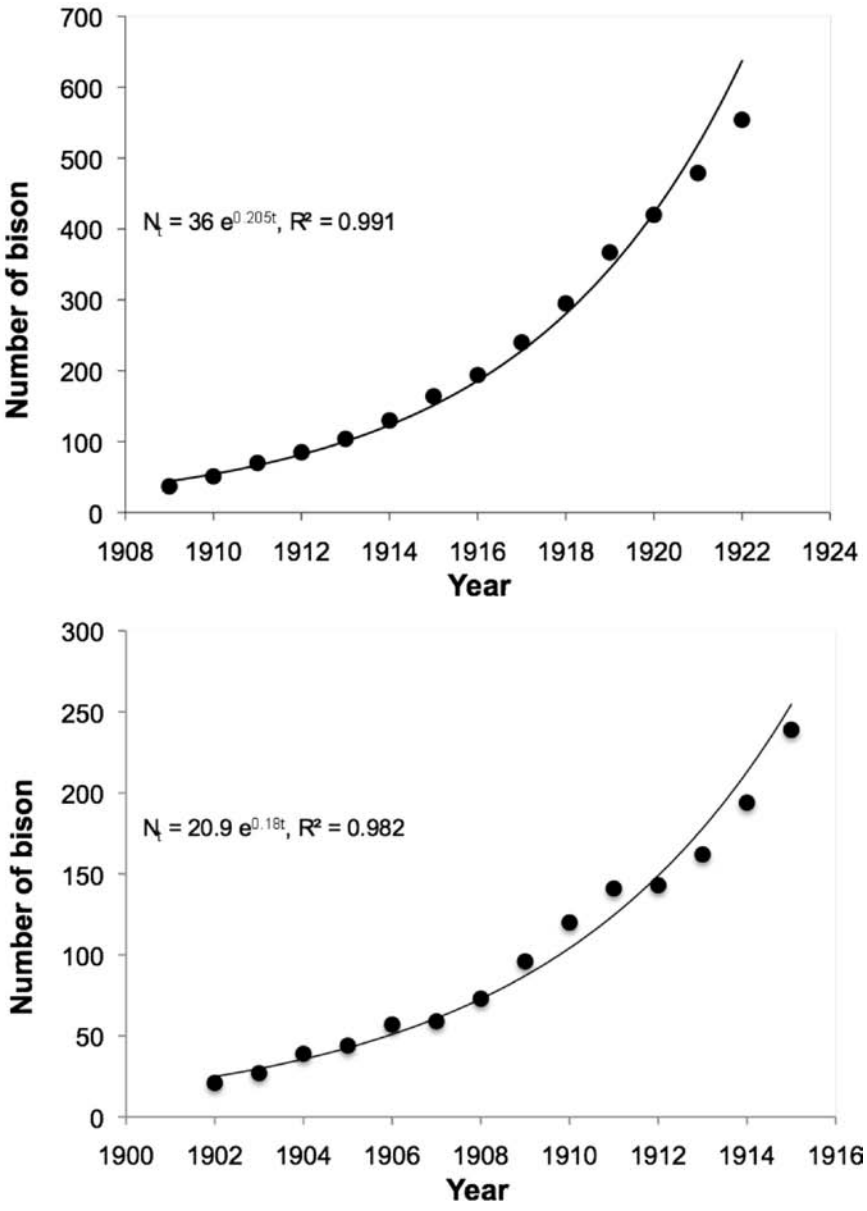
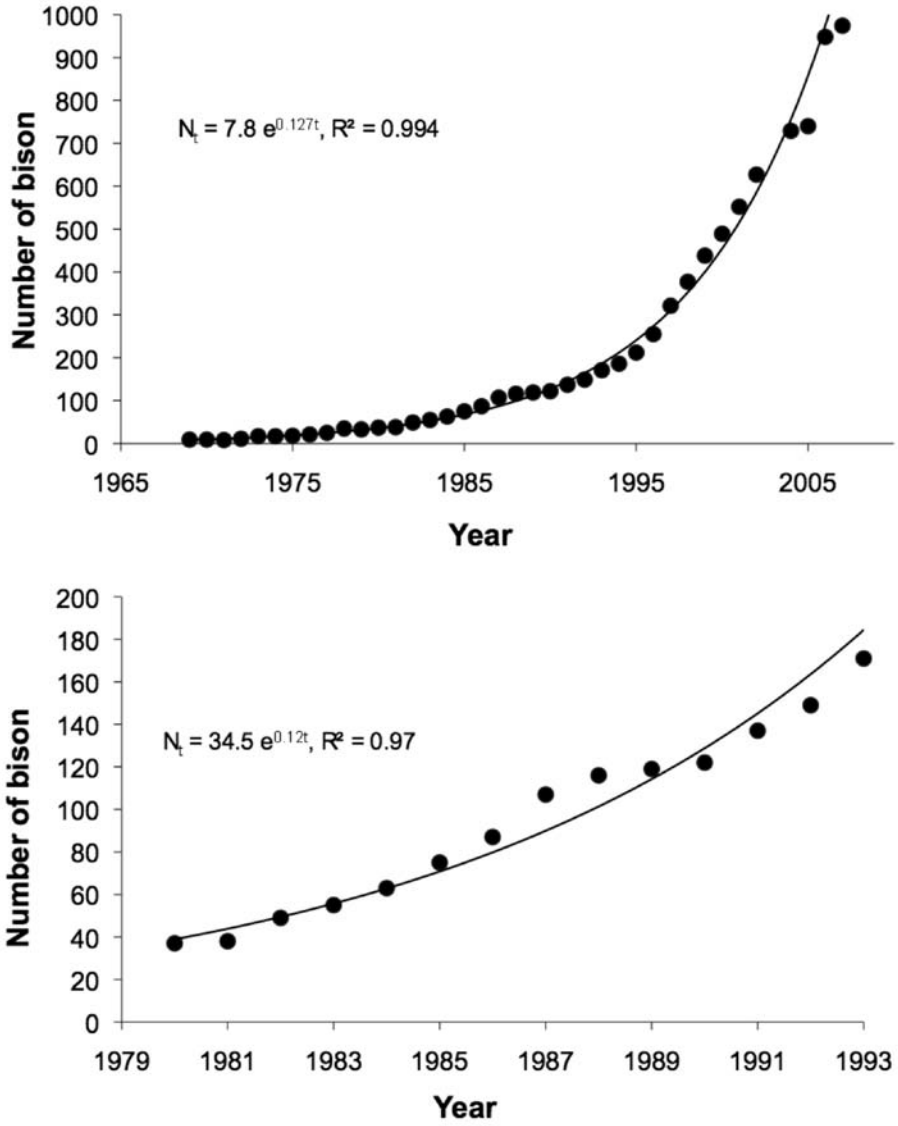


Figure 6.3 *Growth of the National Bison Range plains bison population between 1909 and 1922 (14 years) starting with 37 bison (upper panel), and the northern Yellowstone National Park population between 1902 and 1915 (14 years) starting with 21 bison (lower panel).*

Figure 6.4 *Growth of the Jackson Valley plains bison population in Wyoming between 1969 and 2007 (39 years) starting with 9 bison (upper panel) and between 1980 and 1993 (14 years) starting with 37 bison (lower panel).*

The highest rate of increase reported for a bison population under natural conditions was for the Mackenzie population in the Northwest Territories. It increased at a maximum exponential rate of 0.26, and averaged an annual exponential rate of 0.21 during the first three decades following its establishment (Calef 1984; Gates and Larter 1990).



Chapter 7 Numerical and Geographic Status

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7.1 Introduction

The "Great Contraction", a term used by Flores (1996) to describe the destruction of bison in North America, has been chronicled by numerous authors (Dary 1974; Isenberg 2000; Reynolds *et al.*; 2003; Roe 1970) and was summarised in Chapter 2 of this document. Fewer than 300 wood bison and perhaps only 200 plains bison remained at the turn of the 19th Century. The numerical recovery of plains bison began with the efforts of private citizens in the U.S. and Canada to save a few remaining animals (Freese *et al.* 2007). Governments later became involved in the conservation of plains and wood bison. Protective legislation was implemented first in Canada in 1877 (Gates *et al.* 2001). The first legislation providing specific protection for bison in the U.S. was the National Park Protective Act (Lacey Act) signed on 7 May 1894 by President Cleveland (Boyd and Gates 2006). It imposed a jail sentence and fine for anyone found guilty of killing game in Yellowstone National Park, the range of the last free-ranging plains bison.

Between 1900 and 1970, modest progress was made, increasing the number and populations of bison, largely in public herds. Then in the mid-1980s, the commercial bison industry began to prosper (Freese *et al.* 2007; Renecker *et al.* 1989); the number of bison in North America increased rapidly to more than 430,000, the vast majority of which are under private ownership (Boyd and Gates 2006; Freese *et al.* 2007). However, numerical progress alone cannot be equated with the security of bison as a wildlife species. Conditions under which privately owned bison are raised are commonly motivated by market objectives and there are no regulations or government-supported guidelines requiring private owners to contribute to bison conservation. Domestic bison (those raised for captive commercial propagation) may be subject to small population effects, selection for domestication and market traits including docility, growth performance, conformation and carcass composition, and intentional or unmanaged introgression of cattle genes (Freese *et al.* 2007). Although some private owners exercise their legal property right to manage bison for conservation of the species and/or for their ecological role, the conservation practices of such owners are a matter of personal choice, with no guarantee of persisting beyond the owner's interest in the herd. Currently there are no well-developed regulatory or market-based incentives for managing private commercial herds for species conservation (e.g., independent conservation management certification). Unless effective private-sector incentives are developed, bison populations managed in the public interest as wildlife represent the most secure opportunity for their conservation, adaptation in the evolutionary sense, and viability of bison as an ecologically interactive species in the long term.

Some North American aboriginal communities and individuals also own bison herds. As with other private bison populations, the management of Native-owned bison is not necessarily consistent with conservation policies. Management practices vary from intensive management for commercial production to semi free-ranging herds hunted for subsistence and retention of culture.

It was beyond the scope of this status report to evaluate the management of individual privately owned herds for their conservation value, whether owned by aboriginal or non-aboriginal people. The IUCN Bison Specialist Group acknowledges the important opportunity that Aboriginal Governments, the Intertribal Bison Cooperative, and the Native American Fish and Wildlife Society have to develop guidelines for enhancing the conservation value of herds managed by aboriginal peoples. Similarly, the commercial industry could play a role by providing standards and guidelines and developing incentive-based programmes, such as independent formal certification, for conservation management.

Contemporary conservation is focussed on ensuring long-term persistence and maintaining the potential for ecological adaptation through the effects of natural selection operating in viable populations in the wild (Soulé 1987; IUCN 2003; Secretariat of the Convention on Biological Diversity 1992). Viability relates to the capacity of a population to maintain itself without significant demographic or genetic manipulation by people for the foreseeable future (Soulé 1987). In wild populations, limiting factors, such as predation, resource limitation and mate competition, contribute to maintaining the wild character, genetic diversity, and heritable traits that enable a species to adapt to and survive in a natural setting without human interference (Knowles *et al.* 1998). Therefore, viable wild populations, subject to the full range of natural limiting factors, are of pre-eminent importance to the long-term conservation, security and continued evolution of bison as a wildlife species. We consider the three conservation biology principles proposed by Shaffer and Stein (2000), resiliency, representation, and redundancy, to be relevant for evaluating the geographic and

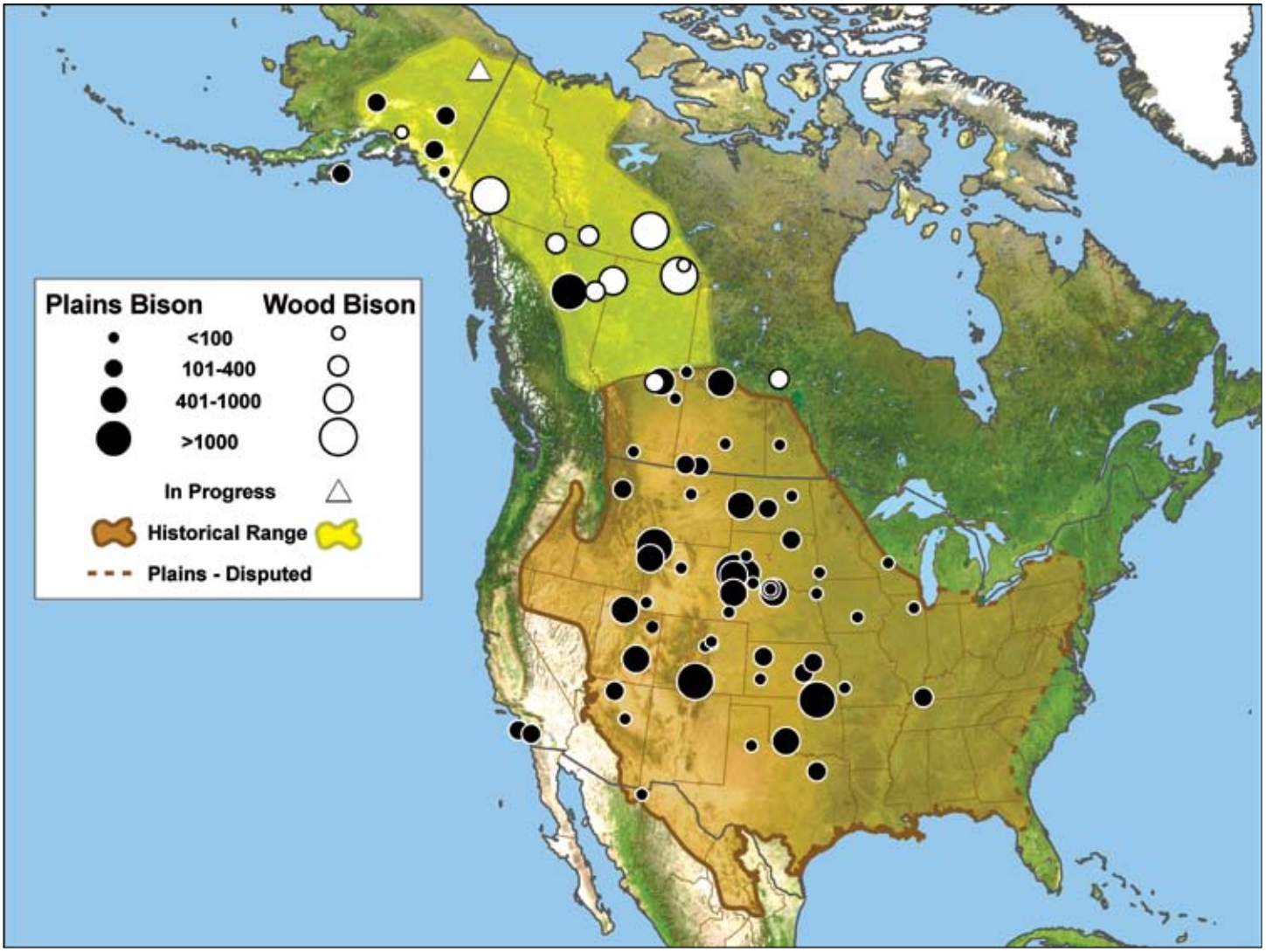


Figure 7.1 *Locations and size classes of bison conservation herds in North America. Historic ranges of wood and plains bison were based on Stephenson et al. (2001) and Sanderson et al. (2008), respectively.*

numerical status of bison. Beyond viability, resiliency refers to the need to preserve individual populations large enough to have a high probability of persisting for extended periods in the presence of minimal management, and which preserve genetic diversity and the potential for adaptation to changing conditions (minimum of 1,000 bison; Gross and Wang 2005). Representation reflects the need to preserve populations of a species across the fullest array of environments in which it occurred originally. Redundancy refers to the need to preserve a sufficient number of large populations to safeguard against local catastrophes.

Here, we provide a summary of the status of wood bison and plains bison populations managed by national or state/provincial public governments and non-governmental organisations whose primary mission is nature conservation. For simplicity, these populations are referred to as "conservation herds". Information on the number of herds and bison under captive commercial propagation is also included. Display herds in zoos were not enumerated. The following seven criteria were considered for reviewing the status of conservation herds: numerical status; geographic status; population size class distribution; opportunity for mate competition among mature males; presence of wolves; the presence or absence of diseases that could affect conservation status (see chapter 5); and presence, or likely presence, of cattle genes based on analysis or stocking history.

7.2 Numerical Status

Numerical status refers to the number of bison and number of populations in North America in conservation herds. Where possible, the reported number of bison in each conservation herd was verified with herd managers in 2008, but the numbers reported here may differ from the actual numbers of animals present because not all herds were surveyed recently, census techniques may not account for every animal, herds are not always managed to achieve a consistent target number, and herd size and productivity vary annually.

Sixty-two plains bison and 11 wood bison conservation herds were enumerated (Figure 7.1 and Appendix A). Although the number of plains bison conservation herds has steadily increased over time, the number of individuals in conservation herds has changed little since 1930 (Freese *et al.* 2007). In 2008, we estimated there were 20,504 plains bison and 10,871 wood bison in conservation herds. Among plains bison there were 9,227 breeding age females (two years old and older), 4,121 mature males (seven years old and older) and 1,230 subadult males (four to six years old). Among wood bison there were 4,892 breeding age females, 2,609 mature males and 652 subadult males.

Since conservation efforts began in the early 1900s, wood bison numbers have fluctuated independently of the number of conservation herds (Figure 7.2). Peak abundance occurred from the 1940s to early 1970s following the introduction of more than 6,000 plains bison into Wood Buffalo National Park (WBNP) in the late 1920s. The number of bison in the Greater Wood Buffalo National Park area declined after 1971 when predator management ceased (Carbyn *et al.* 1993). The number of wood bison conservation herds has increased to 11. However, there are still more bison in the WBNP and Snake River Lowlands (SRL) metapopulation (6,141 animals), which is infected with bovine tuberculosis (BTB) and brucellosis, than in the nine disease-free reintroduced populations (4,730 animals).

Figure 7.2 *Numbers of herds and individual plains bison (upper panel) and wood bison (lower panel) in North America, 1890-2008. Sources for wood bison data: Novakowski 1978; Wood Bison Recovery Team 1987; Reynolds and Hawley 1987; Van Camp 1989; Larter et al. 2000; Gates et al. 2001; www.nwtwildlife.com/NWTwildlife/bison/woodbuffalopark.htm accessed 15 January 2009, and 2008/2009 data from agencies. Plains bison data follow Freese et al. 2007 and current status data from agencies.*

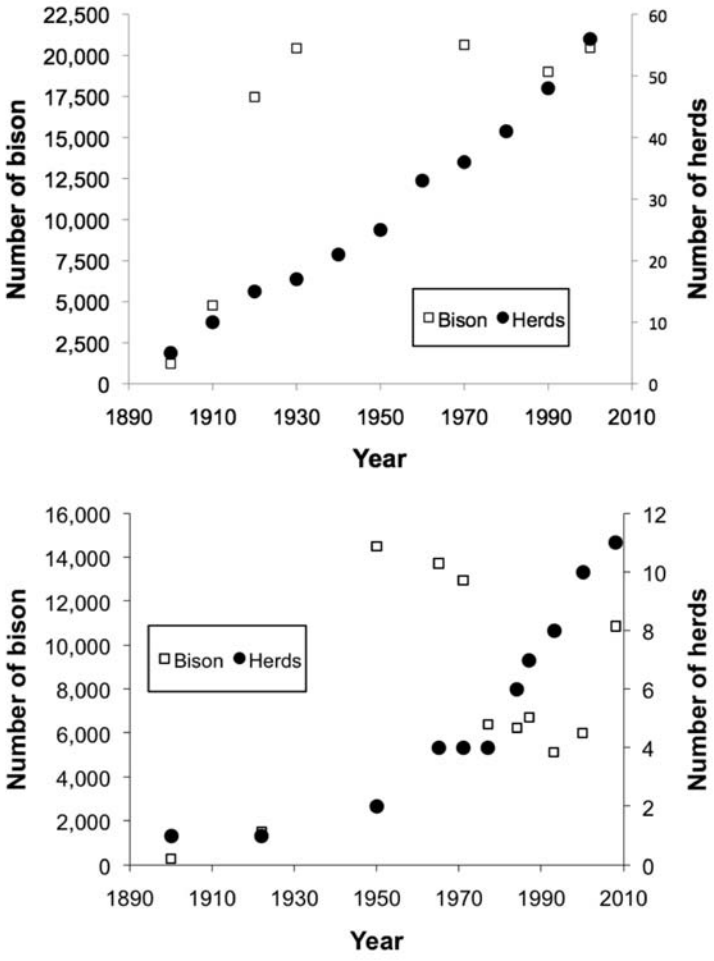




Plate 7.1 *Wood bison near the northern extent of their range in the Yukon, Canada. Photo: Tom Jung.*

The number of bison under commercial propagation has outnumbered those in conservation herds since about 1970 (Freese *et al.* 2007). In 2006, there were 195,728 bison on 1,898 farms reporting in the Canadian National Census (Statistics Canada, www.statcan.gc.ca/daily-quotidien/080125/t080125b-eng.htm, accessed 4 December 2008). The U.S. Department of Agriculture's 2007 Census of Agriculture reported 198,234 bison on 4,499 farms (http://www.agcensus.usda.gov/, accessed 10 February 2008). Thus, based on these numbers, there are nearly 400,000 privately owned bison on around 6,400 farms in Canada and the U.S.

7.3 Geographic Status

The original range of bison extended from lowland meadows in interior Alaska to desert grasslands in Mexico, and included areas as far east as New York and as far west as California (List *et al.* 2007; Reynolds *et al.* 2003). The original range of American bison spanned an area estimated by Sanderson *et al.* (2008) to be 9.4 million km^2, and encompassed 22 major habitat types (derived by Sanderson *et al.* 2008 by combining some of the eco-region classes mapped by Ricketts *et al.* 1999). In assessing geographic status of bison in conservation herds, we considered three criteria: representation of subspecies



Plate 7.2 *Plains bison near the southern extent of their range near Janos, Chihuahua, Mexico. Photo: Rurik List.*

populations within their original range and in major habitat types, and the geographic area occupied by, or potentially available to, individual conservation herds.

Representation within and outside their original range: A displaced population of a subspecies within the original range of another subspecies may occupy habitat otherwise available for the recovery and conservation of the indigenous form. Eighty-seven percent of 62 plains bison conservation herds were located within the original range of plains bison (Figures 7.1 and 7.3). Eight plains bison herds residing in California, northern British Columbia, and Alaska were distinctly outside plains bison original range. Those in Alaska and northern British Columbia occur in the original range of wood bison. Nine of 11 wood bison herds were within original range. The two wood bison conservation populations outside the original range include one free-ranging herd in the Inter-Lake region of Manitoba (originally the range of plains bison) and a fenced herd in central Alberta. The latter wood bison population is Canada's national conservation breeding herd at Elk Island National Park, which also supports a separate herd of plains bison.

Representation in major habitat types: Eighteen major habitat types occur within the original range of plains bison (Figure 7.4). At least one conservation herd is represented in 14 (78%) of them and 10 (56%) major habitat types hold two or more conservation herds. At least one wood bison conservation herd is represented in four (57%) of seven major habitat types in their original range, and four habitat types have two or more herds. With the exception of WBNP and the adjacent SRL bison herds, geographic separation or management of other populations precludes inter-population movements.

Available area: The area available for a herd represents the potential for supporting a large resilient population and opportunities for bison to behave as a "landscape species", interacting with spatially variable resources and a variety of other native species. On small pastures, bison may be unable to segregate into social units (mature bulls, maternal and non-maternal herds) or to move in relation to resource depletion and abundance gradients. In addition, the larger the area available, the greater the number of bison that can be supported sustainably. Landscape area is an important factor in considering the conservation status of bison.

The area of range available to bison conservation herds was classified into four categories (metric conversions are approximate): small areas (less than 20 km^2; 5,000 acres); medium areas (more than 20 km^2 and less than 200 km^2; more

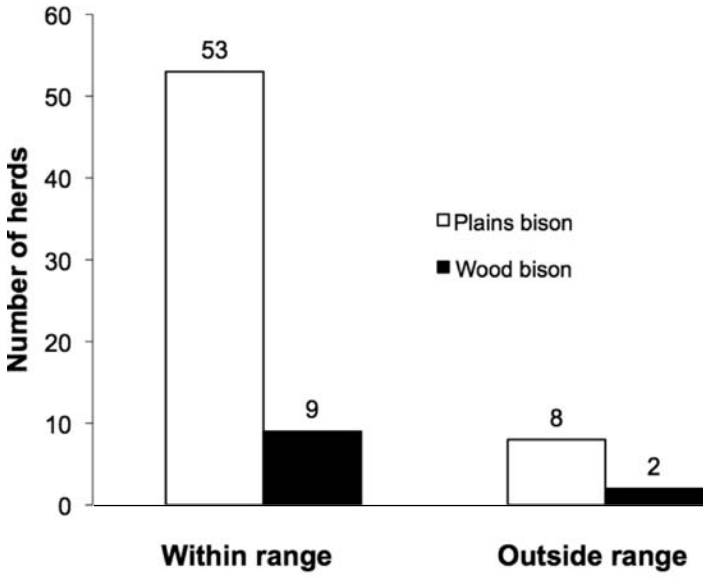


Figure 7.3 *Numbers of plains and wood bison populations within and outside their original range.*

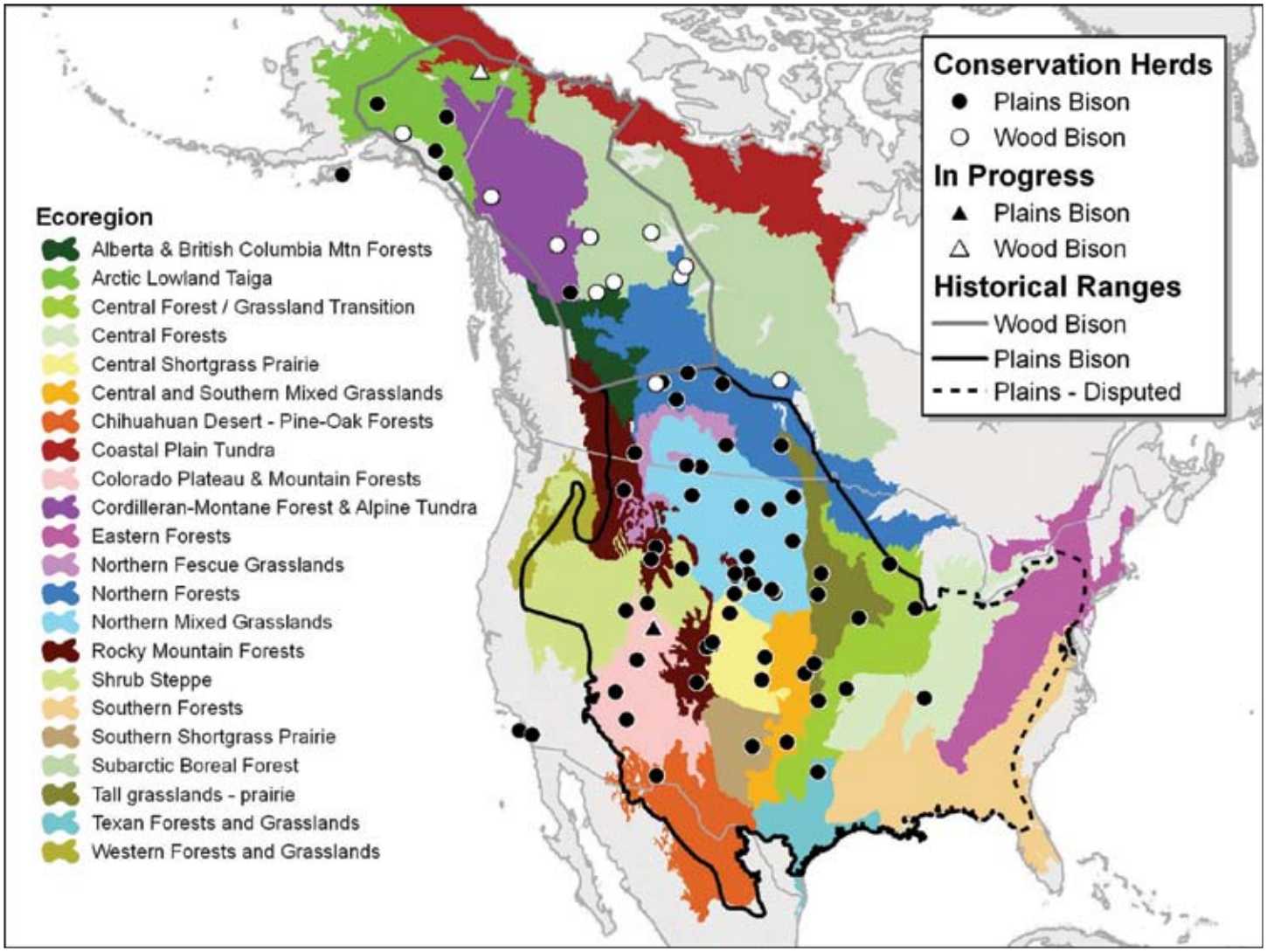


Figure 7.4 *Representation of plains and wood bison conservation herds in original ranges and major habitat types in North America. Habitat types were based on Sanderson et al. (2008).*

than 5,000 acres and less than 50,000 acres); large areas (more than 200 km^2 and less than 2,000 km^2; more than 5,000 acres and less than 500,000 acres); and very large areas (more than 2,000 km^2; more than 500,000 acres). About half of plains bison conservation herds occur on small ranges and only 10% of herds are on very large ranges (Figure 7.5). In contrast, 37% of wood bison herds occur on very large ranges and none occur on small ranges.

7.4 Population Size Distribution

Using a simulation model, Gross and Wang (2005) demonstrated that a minimum population of about 400 animals was needed to retain 90% of selectively neutral variation with a 90% probability for 200 years. Allelic diversity was more sensitive to management treatments than average heterozygosity. On average, a high proportion of alleles with an initial frequency of less than 0.05 were lost when herds had fewer than 400 animals. Differences in generation time accounted for about 75% of variation in retained heterozygosity for populations of 200-800 bison. As population size approached 1,000, the effects of population management on genetic variation were small. Therefore, we considered populations exceeding 1,000 to be more resilient than smaller populations.

Sanderson *et al.* (2008) defined the following size classes for ranking contributions of bison herds to ecological restoration: small contribution, fewer than 400 animals; modest contribution, 400-1,000 animals; large contribution, 1,000-5,000 animals; exceptional contribution, more than 5,000 animals. The frequency distribution of conservation population size (Figures 7.1 and 7.6) illustrates that small populations (fewer than 400 animals) are the most common population size class among both plains and wood bison (74% and 55%, respectively). Five plains bison and three wood bison herds exceed 1,000 animals. Only two populations have encompassed 5,000 animals within their recent range of size variability (Greater Yellowstone Area and Greater Wood Buffalo Park area).

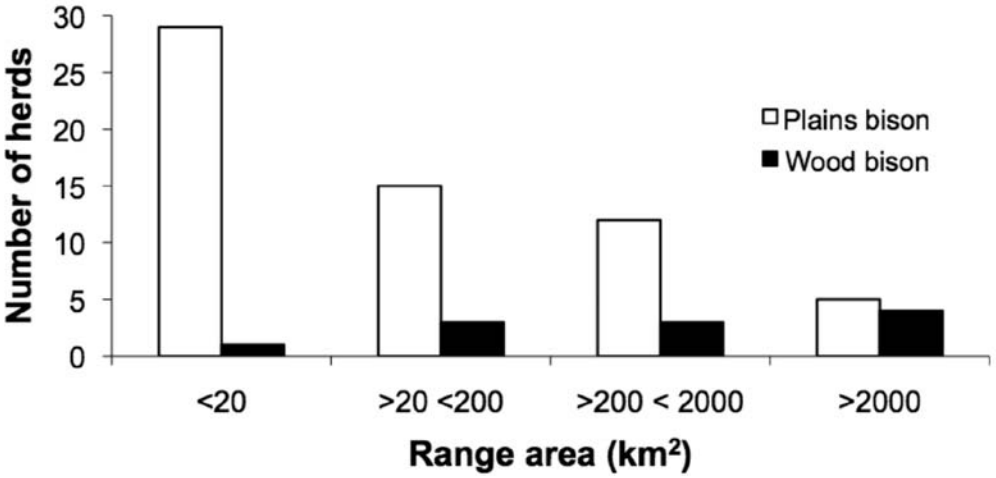


Figure 7.5 *Area classes of ranges available for existing bison conservation herds.*

7.5 Mate Competition

The sex and age structure of small populations are sometimes manipulated to reduce the risk of escapes, remove aggressive animals, compensate for unequal mating by males, alter fecundity, or to increase the rate of population increase. A common practice for both small conservation herds and commercial herds is to remove males before they become morphologically and behaviourally mature (six to seven years old and older), when they may become dangerous to people or other animals and property (e.g., fences). Furthermore, the sex ratio may be manipulated to maintain only sufficient young males to ensure fecundity (e.g. 10 males: 100 females). In contrast, in non-manipulated wild herds the mature male: female ratio can exceed 50:100 (Gates *et al.* 1995) and mate competition among males is assured.

The bison is a polygynous species in which mature males (six or seven years old) compete vigorously for mating opportunities (Komers *et al.* 1992). In the absence of mature males, juvenile and subadult males are capable of breeding successfully, but there is little competition among them for mating opportunities (Komers *et al.* 1994a,b). We considered that the presence of two or more mature males indicates the potential for mate competition. Sixteen percent of plains bison conservation herds did not contain mature males. In contrast, two or more mature males were maintained in all wood bison conservation herds, thus providing opportunity for mate competition.

7.6 Presence of Wolves

Key species, such as bison, have a disproportionate influence on the patterns of occurrence, distribution, and density of other species. Where present, bison influence the structure, composition, and stability of plant (Campbell *et al.* 1994; Knapp *et al.* 1999) and animal communities (Bogan 1997; Roe 1970; Truett *et al.* 2001). Grazers like bison also enhance mineral availability and nutrient cycling through faeces and urine deposition, and carcass decomposition (Augustine and Frank 2001; Towne 2000; Wallis DeVries *et al.* 1998). The presence of wolves, the only effective predator of bison (aside from humans), is an indicator that the maximum number of interactions is possible between bison and other species in an ecosystem. If wolves are present we assumed that all other natural limiting factors would likely be present in the ecosystem. Wolves are associated with only 10% of plains bison conservation herds (6 of 62) in contrast to 82% of wood bison herds (9 of 11).

7.7 Presence of Reportable Diseases

Although diseases may limit bison population growth and productivity they are unlikely to cause extirpation. However, the presence of diseases reportable under federal or state/provincial statutes may lead to management interventions that impact conservation (Chapter 5). The type of intervention varies with the disease and jurisdiction (Chapter 5). For example, captive conservation herds that test positive for BTB or brucellosis would normally be depopulated, while less serious interventions (such as the use of

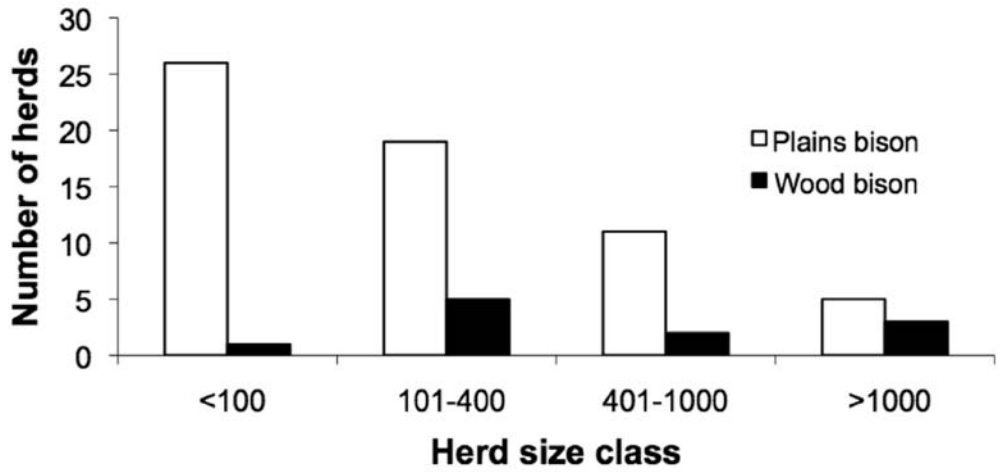


Figure 7.6 *Number of bison conservation herds in four size classes.*



Plate 7.3 *Male plains bison sparring. Photo: Dwight Lutsey.*

control areas) may be applied for infected wild populations in large wilderness areas. The presence of reportable diseases may preclude translocations. Management interventions are possible to control some diseases (anthrax, BVD, JD). Reportable diseases were present in 5 of 62 (8%) of plains bison herds and 3 of 11 (27%) wood bison herds.

7.8 Cattle Gene Introgression

The molecular legacy of historic hybridisation between bison and cattle is a serious challenge for bison conservation today (Halbert and Derr 2007). Forced hybridisation has left a legacy of cattle DNA that is widespread among contemporary bison populations (Chapter 4). The implications for bison conservation are just beginning to be understood and appropriate interventions considered. Available technology allows testing of populations for the presence of markers for the cattle genome and mitochondrial DNA (MtDNA), but all conservations herds have not yet been tested (Figure 7.7). Among those tested, introgression was demonstrated in seven plains bison conservation herds, but none of eight wood bison herds. Based on stocking sources, introgression is likely in 17 plains bison herds and no wood bison herds.

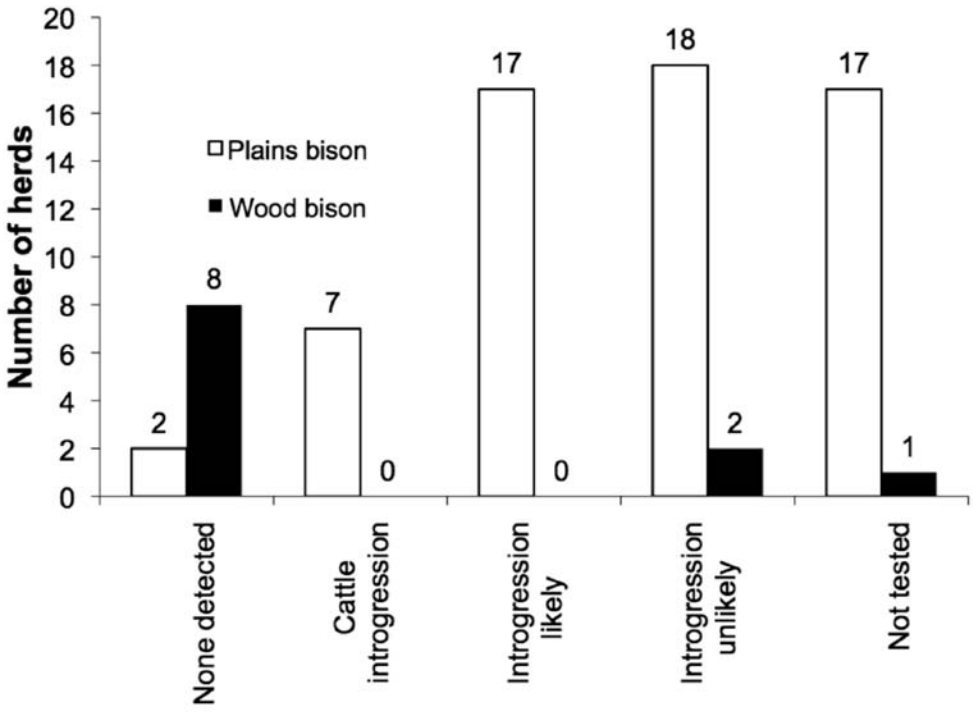


Figure 7.7 *Results of tests for cattle gene introgression in conservation herds.*

7.9 Conclusions

Originally, the American bison ranged from northern Mexico to Alaska. Plains bison occurred from Northern Mexico to central Alberta and wood bison occurred from central Alberta to Alaska. The continental population underwent a dramatic decline during the 19th century, caused by overhunting, but has since partially recovered. Approximately 93% of the continental population is managed for private commercial propagation; very few of these herds are managed primarily for species conservation, and none are managed in the public interest for conservation. Bison currently occupy less than 1% of their original range, and conservation herds occupy a small fraction of that 1%. The number of conservation herds has increased since 1930, but the numbers of individuals in populations managed primarily for conservation has changed little since then. There are 62 plains bison and 11 wood bison conservation herds (managed for conservation in the public interest). Conservation herds are typically small (fewer than 400 animals) and populations are widely dispersed with only one situation that provides geographic conditions for natural movements between population units. The current number of large populations is five plains bison and three wood bison herds. The estimated number of breeding females in conservation populations is 9,227 plains bison and 4,892 wood bison. Their current range is restricted by land use and wildlife

management policies in the south, and by wildlife and reportable disease management policies in the north.

Among North American nations, the species is most limited in Mexico, where an international trans-boundary wild herd recently occurred, but is now limited by management to a private ranch in New Mexico (U.S.), where they are classified as livestock. Several increasing herds or new projects (American Prairie Reserve, Montana; Broken Kettle Grassland Reserve, Iowa; San Luis Valley, Colorado; PANP, Saskatchewan, Canada; Janos Grassland, Chihuahua, Mexico and adjacent New Mexico; Yukon Flats, Minto Flats, and lower Innoko River areas in Alaska) have the potential to develop resilient populations on large landscapes thereby advancing the long-term security of bison as wildlife.

The American bison nearly qualifies for listing as Vulnerable C2a(i) under IUCN criteria and is currently listed as Near Threatened on the IUCN Red List in light of its dependence on ongoing conservation programmes and a very limited number of large resilient populations in the wild (Gates and Aune 2008). Future progress on the conservation and recovery of the American bison will depend on significant changes in its legal status and management as wildlife by federal and state/provincial agencies, harmonisation of policies and activities among agencies at multiple levels, cooperation with landed non-profit organisations, and possibly through the creation of voluntary formal conservation standards for private commercial herds and populations managed by Native American governments.

Chapter 8 Legal Status, Policy Issues and Listings

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8.1 Introduction

The bison is an iconic North American wildlife species that symbolises the wild and open western prairie and boreal forest landscapes of the recent past. Although their decline, and subsequent recovery, is frequently recounted in conservation circles, the ecological recovery of "wild" bison was never really considered, and consequently their restoration has never been fully accomplished (Sanderson *et al.* 2008). Most plains bison in North America are found on farms and ranches (about 400,000) while relatively few (about 30,000) are located on provincial/state, federal, and non-profit conservation reserves (see Chapter 7). Few populations are distributed broadly on native landscapes in suitable habitat, and most do not enjoy equal legal or policy status when compared to other important wildlife species such as elk (*Cervus elaphus*), deer (*Odocoileus* spp.) or pronghorn (*Antilocapra americana*). Wood bison are managed more commonly as wildlife within their historic range than plains bison, but suffer from fragmented distribution and disease issues that complicate their management.

The purpose of this chapter is to evaluate the historic and current legal status of bison in North America and identify legal and policy obstacles relevant to conservation efforts for this species. Due to a historical paradigm that viewed bison as livestock, and past conservation measures that treated them in a manner similar to livestock, bison have not achieved a legal or policy status commensurate with a premier keystone herbivore native to prairie ecosystems. During the great restoration period of wildlife management, bison were routinely classified and managed by state/provincial and federal agencies across North America as a form of livestock, while other wildlife were classed and managed as free-roaming wild animals consistent with wild landscapes.

8.2 History of Protection and Conservation

8.2.1 Early legal and policy efforts by governments to protect plains and wood bison

8.2.1.1 Early policy development in the United States

Outcries during the 19th Century to halt the destruction of bison in the U.S. were largely ignored. In 1820, Major Stephens expressed concern about the excessive killing of plains bison and advocated a law to prevent wanton slaughter (Dary 1989). In 1843, John J. Audubon issued warnings against the slaughter of bison (Dary 1989). Despite their pleas, no conservation policy or protective legislation was enacted for several more decades. Numerous bills to protect plains bison were introduced by members of the U.S. Congress between 1871 and 1876; none was passed into law. Although there were no successful federal interventions to halt the slaughter, several states enacted legislation on their own. Between 1864 and 1872, the states of Idaho, Wyoming, and Montana implemented statutes to reduce the killing of game, including bison. Although these laws reflected deep concern for the conservation of wildlife, they were largely ineffective owing to limited enforcement. In 1872, President Ulysses S. Grant established Yellowstone National Park to protect all resources, including bison, within its borders. The "Act to Protect the Birds and Animals in Yellowstone National Park and to Punish Crimes in Said Park" was signed by President Grover Cleveland in May 1894, providing the means necessary to halt the extirpation of the last free-ranging plains bison population in North America (Gates *et al.* 2005). Despite these efforts, by 1902, fewer than 25 free-ranging plains bison remained, and these were located in the remote Pelican Valley of Yellowstone National Park (YNP) (Meagher 1973). A few wood bison may have persisted into the 20th Century in Alaska, but were soon extirpated (Stephenson *et al.* 2001).

8.2.1.2 Early policy development in Canada

In Canada, early conservation efforts began in 1877 with the passing of the Buffalo Protection Act (Hewitt 1921). In 1883, the Ordinance for the Protection of Game was passed, but it was not effective owing to poor enforcement (Ogilvie 1979). Plains bison were extirpated from the wild in Canada by the 1880s (COSEWIC 2004), but wood bison persisted in a small population in what is now Wood Buffalo National Park (WBNP). The national parks system first became involved in plains bison conservation in 1897, when three animals were purchased from Charles Goodnight in Texas. However, the first significant contribution by the Government of Canada was made in 1907 when it purchased the privately owned Pablo-Allard herd in Montana. The government of Canada enacted the Unorganised Territories Game Preservation Act in 1894, partly as a response

to the decline of wood bison. The 1922 Orders in Council under the Forest Reserves and Parks Act established WBNP in an attempt to save wood bison from extinction (Boyd 2003; Gates *et al.* 2001a; 2001b; Soper 1941).

8.2.1.3 Policy development in Mexico

Historically, bison were present in five states in northern Mexico, but until recently existed in the wild only in the borderlands between the Janos region of Chihuahua and south-western New Mexico (List *et al.* 2007). Mexico first included bison on its red-list of endangered species in 1994. The most recent version (SEMARNAT 2002) specifically lists bison in the Janos-Hildago herd as "endangered wildlife". Although the population is afforded legal protection in Mexico, it is considered livestock when it ranges into New Mexico. See section 8.5.5.3 for more details on this herd.

Bison conservation in Mexico has primarily been implemented through federal programmes; status has not yet been established under state legislation. The National Ministry of Environment (SEMARNAT 2002) managed bison for many years. Recently the responsibility for priority species, including bison, was transferred to the National Commission of Protected Natural Areas. The Institute of Ecology of the National University of Mexico is advocating legal protection of the herd in both countries, including protection under international treaties on migratory wildlife species between Mexico and the U.S. The IUCN Bison Specialist Group (BSG) strongly encourages this protective action and other efforts to restore plains bison to the Chihuahuan Desert grasslands.

8.2.2 Plains bison conservation by the private sector

Private sector conservation efforts can be categorised into two non-exclusive groups: 1) private citizens interested primarily in commercial production of bison and secondarily in bison conservation; and 2) private conservation groups interested in conserving bison as wildlife. The former do not typically have formal constitutions mandating conservation, while the latter institutions typically do. Legislation, regulations, rules, and policies affecting captive herds owned by these sectors are similar to domestic livestock, focusing on transport, trade, export, import, animal health, and use of public grazing lands.

Notably, Turner Enterprises has been involved in the development of production herds on 14 large ranches in the U.S., the largest number of plains bison owned and managed by a single owner. Bison are managed with low management inputs similar to many public conservation herds. Notably, the Castle Rock herd on Vermejo Park Ranch in New Mexico is derived from stock translocated during the 1930s from YNP and showing no evidence of cattle gene introgression. Although some privately owned herds may be valuable for conservation, there is no precedent for assessing their long-term contribution to conservation of bison as wildlife. Recently, the Wildlife Conservation Society developed an evaluation matrix that helps identify the key characteristics and possible management adjustments that would be necessary for privately owned herds to contribute to bison conservation (Sanderson *et al.* 2008). This matrix is still evolving and was recently tested among a small producer group to refine and improve its application. Population and genetic management guidelines presented earlier in this document may also be useful for guiding private producers toward managing their herds in support of conservation. However, a system for certifying herds for conservation management would be required to ensure that guidelines are followed.

Several non-governmental organisations (NGO), particularly The Nature Conservancy (TNC), the Nature Conservancy of Canada (NCC), American Prairie Foundation (APF), and the World Wildlife Fund (WWF) have been active in developing conservation herds. More information on their initiatives can be found in section 8.5.5.4.

8.2.3 Conservation efforts by tribes and First Nations

Many North American Native Peoples have strong cultural, spiritual, and symbolic relationships with bison (Notzke 1994; Zontek 2007). Some tribes believe that because the animals once sustained their Indian way of life, they, in turn, must help the bison to sustain their place on the earth. The conservation of wild bison includes the intangible values these tribes hold for bison. Values vary greatly between tribes, and in some cases, even between members of the same tribe. Some tribal people believe that the status of the bison reflects the treatment of North American Indians. Interest in preserving the cultural significance of bison, and in restoring cultural connections to the species, can be important incentives for Native governments and communities to participate in bison conservation (Notzke 1994; Zontek 2007).

Some tribal bison managers consider all bison as wild animals regardless of the source of stock, genetic introgression from cattle, or domestication history. This can be the basis for conflict with conservation biologists who apply biological criteria when evaluating the conservation merit of a herd. Tribal governments commonly operate under challenging circumstances. Political views can vary between succeeding tribal administrations, creating unstable policies that can affect bison management and conservation practices. Numerous Native Tribes own or influence the management of a significant land base that has the potential to sustain large bison herds. However, there has yet to be a systematic survey of the number of herds or the distribution of bison under Native management—a task of sufficient magnitude and complexity to exceed the scope of this review.

The potential for tribes to participate in bison restoration is improving with the development of tribal game and fish

administrations, and the increasing capacity to implement modern wildlife management for wildlife on tribal lands. Some tribes have developed independent bison projects. Others have joined the Intertribal Bison Cooperative (ITBC) to obtain guidance and support. The ITBC was formed in 1990 with the mission to restore bison to Indian Nations in a manner that is compatible with their spiritual and cultural beliefs and practices (ITBC website: http://www.itbcbison.com/). In cooperation with the Native American Fish and Wildlife Society, the ITBC was able to secure U.S. congressional support for bison restoration in 1991. In 1992, tribal representatives met and the ITBC became an officially recognised tribal organisation in the U.S. The ITBC is a non-profit 501(c)(3) organisation governed by a Board of Directors comprised of a tribal representative from each member tribe. Currently there are 57 member tribes that collectively manage more than 15,000 bison. The role of ITBC is to act as a facilitator for education and training, developing market strategies, coordinating transfer of bison from federal ownership to tribal lands, and providing technical assistance to tribal members to encourage sound management. The ITBC does not have a presence in Canada, nor is there an equivalent organisation there. A summary of tribal bison conservation initiatives is in section 8.5.5.5.

8.3 Important Policy and Regulatory Considerations

8.3.1 Legal status and listings of bison

8.3.1.1 International and global status

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a multilateral agreement among nations to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Species listed in Appendix I are those threatened with extinction, while species listed under Appendix II might soon be if trade is not controlled. Wood bison were transferred from CITES Appendix I to Appendix II in 1997 based on Canada's ability to satisfy the "precautionary measures" of Resolution Conf. 9.24 (Annex 4, paragraphs B.2.b.i and ii). Although bison are in demand for trade, they are managed according to the requirements of Article IV. It was determined that Canada maintains appropriate enforcement controls to prevent the unauthorised taking of wild bison for commercial farming, and that the transfer to Appendix II was consistent with the goals of the government's recovery plan, and would not hamper progress toward the recovery of wood bison in the wild within their original range. Import and export of wood bison is regulated under permit by CITES authorities within member nations. Plains bison are not listed under CITES (http://www.cites.org/).

American bison were recently listed as "Near Threatened" in the IUCN Red List of Threatened Species™ (Gates and Aune 2008). A taxon is Near Threatened when it has been evaluated against the criteria, but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future. No distinction is made between wood and plains bison in the World Conservation Union (IUCN) Red Book.

NatureServe is a non-profit conservation organisation and international network of biological inventories known as natural heritage programmes or conservation data centres operating in all 50 U.S. states, Canada, Latin America and the Caribbean. It assigned an overall conservation status rank to American bison of G4 (Apparently Secure), meaning they are globally common (more than 100 occurrences) generally widespread, but may be rare in parts of their range, and although they are secure in their global range, there may be a concern for their security in the long term (NatureServe 2006). The wood bison is ranked by NatureServe as G4T2Q, where "T" refers to it being an intraspecific taxon (trinomial), "2" means imperilled, and "Q" refers to questionable taxonomy. The plains bison is ranked as G4TU, where "U" means currently unrankable due to a lack of information or substantially conflicting information about status or trends.

8.3.1.2 Status in North America

The wood bison was designated by Canada as "Endangered" in 1978. Owing to progress made towards recovery, it was down listed to "Threatened" in 1988. This designation was re-evaluated and affirmed in May 2000. The wood bison is protected under the Canadian Species at Risk Act (2003), but hunting is allowed in Alberta, the Northwest Territories, and the Yukon, subject to conservation strategies and management regulation. In June 1970, the wood bison was listed under the U.S. Endangered Species Act (ESA) as "Endangered in Canada" to reflect its status in Canada at that time. Canada and the U.S. are undertaking efforts to harmonise the national listings of this subspecies (Gates *et al.* 2001b). A recent petition to down list wood bison from endangered to threatened in the U.S. was submitted and the decision is under 90-day review by the U.S. Fish and Wildlife Service (USFWS).

Although plains bison are currently not listed in the U.S. or Canada under species at risk of extinction legislation, consideration of a listing status is being undertaken (COSEWIC 2004). In 2004, COSEWIC recommended designating plains bison as Threatened under the Species at Risk Act in Canada (Wilson and Zittlau 2004). The proposed change was listed for comment on the public registry in 2005. Criticism ensued from commercial bison producers concerned with the impact on their industry and international trade, and there

was a lack of support by Agriculture and Agri-Food Canada and the provincial governments. In July 2006, The Federal Minister of the Environment recommended that plains bison not be listed because of potential economic implications for the Canadian bison industry (http://canadagazette.gc.ca/partII/2005/20050727/html/si72-e.html).

There are several potential complications that would accompany the process of listing plains bison in North America. One complication regarding the legal status of bison is the issue of hybridisation with cattle. There is considerable uncertainty concerning if, and how, endangered species status should be applied to hybrids in Canada and the U.S. (Boyd and Gates 2006; Campton and Kaeding, 2005). Hybrids are exempt from the Endangered Species Act (ESA) when propagated in captivity, and when they are the progeny from one listed and one non-listed parent (O'Brien and Mayr 1991). A second complication is the consideration of commercial bison production in evaluating the numerical status of this species. A third complication is the legal distinction and status of wild and captive bison should listing be considered for the wild form (Boyd 2003).

Bison often enjoy protected status in Canadian and U.S. national parks as a result of the legal status of the habitat. The Canadian National Parks Act protects bison and their habitat in national parks. In Canada, provincial and territorial governments can also use the federal Wildlife Trade Act to control the movement of bison across their borders. In the U.S., enabling legislation attached to each national park when it was established, typically protect bison as wildlife unless they are not considered native to the region. Where they are not considered native to a region, or are known to be cattle hybrids, national parks often consider them invasive and may consider removal or eradication.

The United Stated Forest Service (USFS) classifies the American Bison as "Not Sensitive in Region 2 and Not of Concern" by its Species Conservation Program assessment (USDA Forest Service 2009). The rationale for this classification is that populations and habitats are currently stable or increasing. This USFS review suggests that while the species may warrant restoration as an ecological keystone species, it does not warrant sensitive status.

Conservation and restoration programmes for American bison are confounded by socioeconomic challenges resulting from the confusing legal status for this species. The legal status of bison ranges from domestic livestock to wildlife among various federal, state, and provincial jurisdictions across North America (Table 8.1). The legal recognition of bison as wildlife is often impeded by their historic, or in many cases dual, classification as domestic livestock. Where they have attained their status as wildlife, they are routinely managed within fenced preserves where some, if not all, natural selective processes are curtailed.

Ten states in the U.S., four provinces in Canada, and one state in Mexico classify bison as wildlife (Table 8.1). All other states and provinces within their original range designate bison solely as domestic livestock. Plains bison are designated and managed as wildlife in Alaska, Arizona, Utah, Montana, Wyoming, British Columbia, Alberta, Saskatchewan, and Chihuahua. Four other states consider bison as wildlife, but do not have free ranging populations to manage; Idaho (extreme rarity), Missouri (extirpated), New Mexico (no longer occurring), and Texas (extirpated). Plains bison are listed and managed as wildlife, but are considered extirpated, in Alberta and Manitoba. Wild bison are preserved, as a public trust resource, managed to protect natural selection processes, and hunted as free roaming wildlife in Alaska, Arizona, Utah, Montana, Wyoming, British Columbia, Alberta, and Saskatchewan. Wood bison are designated and managed as wildlife under provincial statutes in Manitoba, Alberta, British Columbia, Yukon, and the Northwest Territories. Wood bison enjoy protected status in all of these provinces. There are legal restrictions on hunting and other activities such as capture and harassment. Subsistence hunting by aboriginal peoples is allowed under strict regulation in Northwest Territories and Yukon.

Under Mexican law, wildlife belongs to the nation. However, Mexico has only recently developed a wildlife conservation and management system that entitles a landowner to be registered in the programme (*Unidades de Manejo y Aprovechamiento)* and to receive the benefits of harvest and commercial use of wildlife. This programme has doubled the landscape available for wildlife protection in Mexico. In 1995, the federal government established a bureau managed by the Secretary of the Environment. Within this organisation is a department for the administration of wildlife conservation programmes. In 2007, the conservation of threatened species is becoming the responsibility of the National System of Protected Natural Areas.

There is only a limited state or local wildlife management infrastructure to support federal wildlife conservation efforts in Mexico. Local communities are only now beginning to accept and appreciate the value of free-ranging wildlife on landscapes that they own and manage. Until a broader legal and policy infrastructure is established, federal law and policy will continue to direct wildlife management conservation in Mexico. Federal policy is primarily aimed at developing partnerships with landowners and cooperatively identifies conservation measures acceptable to individual landowners. In addition, federal conservation law and policy drives the protection of land to establish "Natural Protected Areas" to conserve species associated with those landscapes. Public interest has increased in developing wildlife programmes for economic and conservation purposes. Interest in conservation

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Table 8.1 *Current legal status of plains and wood bison (Excluding portions of bison range where large landscapes are no longer available).*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
United States	Yes	Yes	Plains bison petitioned under ESA but denied; Managed as captive wildlife on USFWS Refuges; USFS R-2 classifies bison as not sensitive; Managed as wildlife (captive or free-ranging) in several National Parks. Recent petition to downlist wood bison to "Threatened" is under 90-day review.	No comprehensive strategy; Activity limited to and fragmented among NGOs, very few states, National Parks and USFWS Refuge System.	NEPA; National Refuge Act; Each National Park has its own organic legislation- Interpreted by each Park Superintendent; Wood bison are listed as Endangered under ESA; Animal Health Protection Act (7#U. S.C. 8301 et seq.).	No	Absence of strategic planning; Multiple jurisdictions and coordination of agencies; Management in captivity under refuge policy; Disease transmission to livestock; Limited involvement and interest by many state wildlife agencies; Confused regulatory status in many states.
Alaska	Yes	Yes	4 introduced plains bison herds are "Wildlife"; One plains bison herd on Popof Island; Maintain a hunting programme by permit only.	Long-term goals being established for wild wood bison in State Wildlife Action Plan (SWAP) and reintroduction programmes; Management planning for the 4 introduced plains bison herds.	ESA 10(J) status for wood bison - Minto Flats introduction; Title 16 in Alaska state statutes designates bison as wildlife; Delta Bison Mgt. Plan; Wood bison Conservation Plan in progress; Livestock manages captive bison under Title 3 in Alaska state statutes. Domestic bison governed under same rules as domestic cattle.	Yes; Yukon and Minto Flats Wood Bison Restoration is underway.	Plains bison outside their original range; Aboriginal hunting rights; USFWS interpretations of legal status of wood bison under ESA.
Arizona	Yes	Yes	Bison are wildlife, specifically big game, and are managed by AGFD on two state wildlife areas (House Rock and Raymond Ranch).	Yes, in SWAP.	Title 12, R12-4-401 Game and Fish Commission Rules for Live Wildlife; R-12-4-406 Restricted Live Wildlife Section B9.d exempts restrictions on possessing captive bison (permit not required to possess); A.R.S 17-101 A22 defines wildlife and 101B defines bison as a game animal.	No	Arizona is at the edge of bison original range; Current strategic plan limits conservation to two existing populations; House Rock population hybridised with cattle; Agriculture and forestry conflicts.
Colorado	No	Yes	Bison are exempt from the requirements of wildlife commission regulations. Today, captive herds are designated as livestock. Conservation herds exist in two Denver City parks, one USFWS Refuge and one TNC preserve.	Yes; On Two USFWS Refuges and one TNC preserve.	Chapter 11, Section 406-8 Wildlife, Parks and Unregulated Wildlife; Wildlife Commission Regulation #1103 exempts bison from all wildlife commission regulations, as domestic animals	No	Agriculture and forestry conflicts; Regulatory status.

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Idaho	Yes	Yes	Identified as S1 species in wildlife commission status report. S1= critically imperilled species at high risk because of extreme rarity.	No	Livestock regulations chapter 210 section 01.a; Not mentioned in SWAP.	No	Disease Status in YNP; Agriculture and forestry conflicts; Regulatory status.
Illinois	No	Yes	Considered extirpated in Illinois.	No	Managed as livestock under state statute Chapter 225 part 650/1; Not mentioned in SWAP.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land; Regulatory status.
Iowa	No	Yes	Considered extirpated in Iowa; Found only on one small National Wildlife Refuge.	Yes; Only on one National Wildlife Refuge.	Managed as livestock under state animal health statutes. Bison statutes combined with those of cattle; Not mentioned anywhere in wildlife regulations or wildlife conservation strategies.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land; Regulatory status.
Kansas	No	Yes	Considered extirpated prior to 1900; Designated domestic under beef rules; State wildlife department manages bison on two small game ranges; TNC has two additional preserves.	Yes; Only on TNC and state preserves	Identified in SWAP as not meeting criteria for species of greatest conservation need; Chapter 60 section 4001 in livestock regulations.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land; Regulatory status.
Louisiana	No	Yes	All bison are considered livestock.	No	Louisiana Code of regulations 7: XXI.11705; No mention of bison in SWAP or in wildlife regulations.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land; Regulatory status.
Minnesota	No	Yes	Wild bison are considered extirpated in MN; Found only on a couple of small preserves	No	Minnesota statutes for livestock (17A.03); Bison not mentioned in SWAP.	No	Agriculture and forestry conflicts; Regulatory status.
Missouri	Yes	Yes	Wild bison are considered extirpated in Missouri.	No	Identified as class 1 wildlife in title 3 Code of State Regulations (CSR) 10; Identified as livestock in title 2 CSR 30.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land.

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Montana	Yes	Yes	Game animal status; Tier 1 species in SWAP; Species in need of management in YNP; Managed in habitats adjacent to YNP. On NBR; Ownership of NBR is in dispute; American Prairie Reserve (APF).	Yes in SWAP; National Bison-Refuge Plan; Yellowstone Interagency Bison Management Plan; APF Bison Reintroduction and Conservation Plan.	Montana Environmental Policy Act (Montana Code Annotated (MCA) 75-1-102); Legislative authority to manage wild bison in Montana (MCA 81-2-120; MCA 87-2-130); SWAP; Interagency Bison Management Plan-EIS, 2000.	Yes; Charles M. Russell Refuge Plan	Agriculture and forestry conflicts; Disease status in YNP.
Nebraska	No	Yes	Wild bison are considered extirpated in the state; Bison are defined as livestock; Found only on several small preserves.	Yes; Only on National Wildlife Refuge and TNC preserves.	Bison found only in the Department of Agriculture regulations. Title 23 and 54; Section 54 defines the required health regulations for cattle and bison;	No; Possibly tribal efforts.	Agriculture and forestry conflicts.
New Mexico	Yes	Yes	Classified as game animals in 1978; Identified in wildlife database as "apparently no longer occurring" but not identified as extirpated or extinct; Included in SWAP.	Yes	Title 17-2-3 New Mexico Administrative Code (NMSA) 1978 classifies bison as game animals except where raised in captivity for commercial purposes; Title 19 (Wildlife) chapter 31 describes the legal weapons for taking of bison yet there are no hunting regulations for bison (19.31.10.16); Title 19 Chapter 26 describes livestock (and names bison) as domestic animals raised on a ranch (19.26.2.7); Title 21 (agriculture and ranching) has many references toward management of bison.	No	Agriculture and forestry conflicts; Lack of suitable habitat.
North Dakota	No	Yes	Classed as non-traditional livestock; Bison are found only in Theodore Roosevelt National Park and managed as domestic livestock outside the National Park.	Yes; Only on two federal and one TNC preserves.	Unable to find any reference to bison in agriculture regulations (Title 4) or wildlife regulations (Title 20).	No	Agriculture and forestry conflicts; Regulatory status.

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Nevada	No	Yes	Wild bison are considered extirpated in Nevada and are not classified by the Nevada Dept. of Wildlife; Bison are classified by Nevada Dept. of Agriculture.	No	Bison not referenced in wildlife regulations (Nevada Administrative Code (NAC) 502, 503 or 504); Regulations note that possession of bison does not require a permit; Regulations pertaining to domestic bison are described in NAC 571.	No	Agriculture and forestry conflicts; Regulatory status.
Oklahoma	No	Yes	Classified as domesticated animals; Protected on two preserves (one federal and one private).	Only for Wichita Mountains National Wildlife Refuge and TNC preserve.	There are no references to bison in the Game and Fish regulations in Title 29; Title 800-25-25-3 lists species of wildlife exempt from wildlife permits or license; Regulations pertaining to domestic bison are described in Title 2 (Agriculture) and Title 4 (Animals) of Oklahoma Code.	No	Agriculture and forestry conflicts; Small parcels of public or private conservation land; Regulatory status.
South Dakota	Yes, partially	Yes	Identified as "Wildlife" only in the confines of National Park System; Bison are contained within Custer State Park.	Yes; Only within the State and National Park System and one TNC preserve.	South Dakota statutes Title 41 do not mention bison anywhere in the wildlife regulations; State laws identify bison as livestock.	No	Status of bison is livestock outside the National Park System; Management under captivity; Agriculture and forestry conflicts; Regulatory status.
Texas	Yes	Yes	Texas Parks and Wildlife Department considers wild bison extirpated; Found only in Caprock State Park and on one TNC preserve.	Only within one state park and one TNC preserve.	No longer considered a game animal in Texas - Parks and Wildlife Code Chapter 43; Texas Agriculture Code (chap. 2.005) recognises bison as wild animals indigenous to the state but can be raised for commercial purposes to preserve the species.	No	Agriculture conflicts; Small parcels of public or private conservation land; Regulatory status.
Utah	Yes	Yes	Free roaming populations are found in the Henry Mountains and on Antelope Island; Utah just completed a reintroduction to the Book Cliffs.	Herd management plan being developed for the Henry Mountains population and Book Cliffs.	Wild bison are managed under regulations in Title 23 of Utah Code; Regulations pertaining to domestic bison are described in Title 4 of Utah Code.	Yes; Recent introduction to Book Cliffs.	Agriculture conflicts.

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Wyoming	Yes, partially	Yes	"Wildlife" within national forest and national parks of Park and Teton counties in the GYA; Are classified as domestic animals in the remainder of the state.	Yes, in NER and GTNP Management Plan and EIS; Yellowstone population conserved though Interagency Bison Management Plan with Montana	WY (Wyoming Fish and Game Commission regulation) 11-6-32 vi classifies bison as livestock unless otherwise designated by Livestock Board and Wildlife Commission; WY 23-1-302 xxvi gives authority to designate individual bison or herds as wildlife; Management Plan and EIS for bison and elk on NER and Grand Teton National Park.	Yes; Northern Arapaho re-introduction to the Wind River Reservation.	Status of bison outside of designated areas in statute (Park and Teton Counties); Disease status of YNP and Jackson-Grand Teton bison; Agriculture and forestry conflicts; Regulatory status outside of Parks.
Canada	Yes	Yes	The General Status of Species for plains bison is Sensitive; Plains bison petitioned for endangered status denied-Current Status Threatened; Wood bison are listed as Threatened; Both subspecies are managed as native wildlife on some Canadian Parks and in some provinces	No, plains bison; Yes, wood bison, in National Recovery Plan.	1996 Accord for the Protection of Species at Risk in Canada; Species at Risk Act, 2002; COSEWIC designated plains bison threatened in May 2004; Wood bison were classified as endangered in 1978 moved up to Threatened in 1988 (COSEWIC); Canada National Parks Act (2001); Wood bison are on The Recovery of Nationally Endangered Wildlife (RENEW) priority list.	Yes, in Banff National Park, Waterton Lakes National Park, Grasslands National Park for plains bison; National Recovery Plan for wood bison.	Absence of strategic planning for plains bison; Multiple jurisdictions and coordination of agencies; Agriculture and forestry conflicts; Disease transmission to cattle: Diseased status of some existing wild bison; Management in captivity
Alberta	Yes for wood bison; No for plains bison.	Yes	Consider plains bison as extirpated; Plains bison are not listed under the Alberta Wildlife Act; Plains bison listed at risk in 2000 status report; Lists wood bison as endangered in the Hay-Zama wood bison protection area in NW Alberta.	No for plains bison; Yes for wood bison, with National Recovery Plan.	1985 Policy for the Management of Threatened Wildlife in Alberta; Alberta Wildlife Act (1998) 2000 Status of Alberta Wild Species.	Yes; in Banff and Waterton National Parks.	Legal status of plains bison is "livestock"; Agricultural and forestry conflicts; Conservation status of hybrid bison in WBNP.
British Columbia	Yes	Yes	For plains bison the General Status of Species=Sensitive. General Class is "Big Game" and "Wildlife"; Listed as Vulnerable; Wood bison are on the Provincial Red List-Imperiled subspecies.	No for plains bison; Yes –for wood bison, with National Recovery Plan	British Columbia Wildlife Act (1996) General Status of Species in Canada (CESCC 2001); Provincial Blue List and Provincial Red List (British Columbia Conservation Data Centre 2000).	No for plains bison; Wood bison under National Recovery Plan.	Agricultural and forestry conflicts; Plains bison outside their original range.

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Manitoba	Yes for wood bison; No for plains bison.	Yes	Provincial Heritage Status-S1-Susceptible to Extirpation; Listed as "at Risk" by CESCC; Plains bison are not listed as "Wildlife" but are classed as Livestock; Wood bison are protected in the Chitek Lake area.	No for plains bison; Yes for wood bison, with National Recovery Plan.	Manitoba Wildlife Act (2004); Manitoba Agriculture, Food and Rural Initiatives (2003).	No for plains bison; Wood bison under National Recovery Plan.	Status of plains bison as "livestock"; Agricultural and forestry conflicts.
Sas-katche-wan	Yes	Yes	Provincial Heritage status - S3=Vulnerable; CESCC status as "may be at risk"; Bison are "Wildlife" but there are no open hunting seasons; Department of National Defense offers protection due to prohibition of trespass except by Cold Lake First Nations; First Nations have aboriginal hunting rights; protected in Buffalo Pound Provincial Park, Prince Albert and Grasslands National Parks; Nature Conservancy of Canada (NCC) Old Man on His Back Conservation Area.	No for plains bison except in National or Provincial Parks; Yes for wood bison, with National Recovery Plan.	Saskatchewan Wildlife Act (1998); The Wildlife Regulations, 1981; Saskatchewan Game Farm Policy 1998 includes captive bison; Range Access Agreement between CLFN and DND (2002); Saskatchewan Parks Act (1997); Cooperative Inter-Jurisdiction Plains Bison Management Strategy.	Plains bison in Grasslands National Park; Wood bison under National Recovery Plan.	Agriculture and forestry conflicts; Limited suitable habitat.
Northwest Territories	Yes	Yes	Both plains and wood bison are "Wildlife"; Wood bison are designated as in danger of becoming extinct; Some regulated hunting of wood bison is allowed in designated herds; Importation of plains bison prohibited.	Yes, wood bison in National Recovery Plan; Bison harvest is regulated under a co-management process; Hook Lake is managed under a specific Hook Lake Recovery Plan.	Northwest Territories Wildlife Act (1964) designated wood bison a protected species; Agency policies prevent plains bison ranches or introduction to the wild.	No	Conservation status of hybrid plains/ woods bison in WBNP.
Yukon	Yes	Yes	Both plains and wood bison are "Wildlife"; Wood bison are a protected species; Importation of plains bison prohibited.	Yes, wood bison in National Recovery Plan; Bison are managed on a sustained yield basis under a cooperative management plan.	Yukon Wildlife Act (2002); Agency policies prevent plains bison ranches or introduction to the wild.	No	

Table 8.1 *(continued)*

Country/ State Province	Animal Classification		Protected and/or Wildlife Status	Long Term Conservation Goal	Key Statutes or Policies Affecting Conservation	Proposals for Restoration	Major Legislative and/or Policy Obstacles
	Wildlife	Domestic					
Mexico	Yes	Yes	Appeared as extirpated in 1994; In 2002 red-list Janos bison were listed as endangered.	Not officially, however non-governmental conservation is emerging and proposing a long-term vision for conservation preserves.	Secretaria de Desarrollo Social, 1994-NOM-059-ECOL-1994. Secretaria de Medio Ambiente y Recursos Naturales-NOM-059-ECOL-2001.	Yes, Developing a National Recovery Plan.	Agriculture conflicts; Lack of suitable habitats: Small properties available; Economic and market obstacles; Lack of public interest: A developing wildlife conservation programme; Varied status of the Janos bison at the international border with New Mexico
Tribal and First Nations	Yes	Yes	Varies by tribe or First Nation; Most tribes with strong cultural histories protect bison for tribal use; The Intertribal Bison Cooperative has 57 member tribes that are actively pursuing bison management for cultural and commercial interests.	Yes, depending upon tribal conservation programmes; Some tribes are developing advanced game codes and sophisticated species restoration and management plans.	Varies but generally determined by Tribal Council and managed by Tribal Fish and Game Commissions; Intertribal Bison Cooperative was formed to encourage the restoration of bison; Cultural consideration is primary driver for legal and policy considerations by each tribe.	Yes	Variability of tribal government structure and function; Agriculture conflicts; Variable wildlife conservation and management infrastructure.

and protection of the Janos-Hildago bison herd is an example of this rising conservation interest. Bison in this specific population are protected by endangered species status under federal law. All other bison in Mexico are privately owned and maintained on fenced private property.

Over 93% of the bison in North America are privately owned and managed for commercial production (Chapter 7). Bison can be kept as domestic livestock in all of the U.S. These bison are privately owned and typically managed for meat production or breeding. In Alberta, Saskatchewan, and Manitoba, where bison are regulated as livestock, individuals in the private sector may own bison. In British Columbia, bison may be produced commercially, but a game-farming license is required. Commercial herds owned by individuals, corporations, or NGOs are managed independently, subject to market forces, and regulations governing animal health and trade. In the Yukon and Northwest Territories, existing policy prevents the establishment of plains bison ranches or their introduction into the wild. There is no unified conservation effort or regulatory framework that encourages or facilitates conservation of commercial bison as wildlife at national, state or provincial levels. The “laundering” of wild animals through captive-breeding operations and farms has not been detected in Canada or the U.S

8.3.2 Disease status

Early in the history of bison restoration, diseases were not considered very important and restoration efforts proceeded with limited concern for the transfer of pathogens. As a result of significant failures to guard against disease transfer and control during translocation, bison restoration projects today have to overcome some historic baggage.

With the development of an extensive and aggressive domestic animal disease control programme in North America during the mid to late 1900s, the implications of diseases to wildlife restoration has increased (Friend 2006). Furthermore, with the successful restoration of many wildlife species, and the subsequent increase in their distribution, these same diseases are now very important to the wildlife community (Wobeser 1994). Finally, increased globalisation and the high mobility of society are increasing the likelihood of pathogen transfer across continents, thereby increasing the vigilance of disease control programmes (Friend 2006). As a result, efforts to conduct bison restoration will have to consider the significance of diseases in restoration projects. For a comprehensive review of diseases significant to bison conservation, the reader should refer to Chapter 5 of this document. Unfortunately, disease issues often trump conservation interests, especially when the conservation actions are likely to come in direct conflict with powerful agricultural industries. This will necessitate the careful selection of source

stock, extensive testing and screening of source herds, health monitoring of herds, and regulatory involvement in the process of translocation (Table 8.2).

Successful restoration projects will need to navigate the animal health regulatory process necessary to permit translocation of bison and to accomplish the eventual establishment of healthy conservation herds in North America (see Chapter 5). The key disease categories that need to be considered in bison restoration are: Foreign Animal Disease (FAD) events, regulatory diseases (across international boundaries and within country jurisdictions), and diseases of significance to livestock, but not regulated. A foreign animal disease will cause significant impact to bison restoration and agricultural activities in any jurisdiction. A significant response network is already available to address FADs within countries, states, and provinces. This response network typically involves federal, state, and provincial agriculture, wildlife, and public health agencies. Any such event involving source bison, or on a restoration landscape, would halt a restoration project and stop movement of individuals from an infected source stock. A bison conservation effort is at risk when a bovine FAD arrives in any country, and a subsequent federal response is required to immediately stop movement of all affected animals. Regulatory diseases on the other hand are typically more manageable, with regulatory steps required to allow movement after health standards are met. Although they are significant, there are established protocols to test, manage, and even control many of these diseases. Each disease has its own characteristics and subsequently the challenges of disease testing, management and control vary. There have been many historic efforts, some successful and some not, to control and eliminate these types of diseases in bison. This historic record is a good place to go to see what works and what does not.

The science behind wildlife disease issues is improving, but more work is needed (Friend 2006). Considerable research is needed to establish quarantine and testing protocols required to ensure the safe movement of animals. To be certain that restoration projects will not introduce new diseases, or exacerbate existing diseases, it is important to accurately and reliably establish the health background of source herds and of the wild and domestic animals within restoration areas. There will be many agricultural interests examining bison restoration efforts, so during a restoration project, utmost attention should be given to communicating the health prevention measures taken, and testing information obtained. It is likely that agricultural conflicts will be one of the major impediments to restoration, but embracing modern approaches, with careful monitoring of population health and integrating regulatory health officials into the projects from the beginning, can mitigate most disease issues. Restoration efforts should establish and maintain regular communication with state, provincial, and federal animal health regulators and other appropriate public health agencies. General communications should also be established with key animal health organisations, such as the U.S. Animal Health Association or Wildlife Disease Association, to ensure that the best health information is being openly discussed and shared with affected groups and individuals.

Restoration projects that involve international transport of bison are subject to additional legal and policy considerations. For example, increased animal disease regulations due to any discovery and control of bovine spongiform encephalopathy (BSE) across the U.S.–Canadian or U.S.–Mexican borders will undoubtedly complicate trans-boundary movement of bison (APHIS, USDA 2007). Until these restrictions are eased there will be limited opportunity for international movement of bison despite any evidence that this disease actually exists in American bison. Restoration planning will need to include a thorough search of current international border restrictions related to disease control. Early discussions with animal health regulators will be essential to identify any disease regulations and specific testing requirements for transport of bison across an international boundary.

Table 8.2 *Some diseases that will or may have implications to bison restoration.*

Disease	Restoration is Prevented	Significant Impediment	Medium Impediment	Locally Significant
Any FAD*	X			
Anthrax	X			
Bovine Tuberculosis	X			
BSE**	X			
Brucellosis		X		
MCF***		X		
JD****			X	
Respiratory Diseases (e.g. BVD, IBR, BRSV, PI3, Bacterial)			X	X
Endoparasites				X
Ectoparasites				X
Other Bacterial/Viral infections				X

* Foreign animal disease ** Bovine spongiform encephalopathy
*** Malignant catarrhal fever ****Johne's disease.

8.4 Legal and Policy Obstacles Hindering Conservation of Bison

Bison conservation and restoration intersects directly with many laws, rules, and policies within a complex social-economic-ecological matrix. Isenberg (2000) detailed the historical relationships of social and economic change to preservation of the bison at the turn of the century. Bison were caught in a vortex of social, economic, and ecological change on the Great Plains, and were nearly exterminated (Isenberg 2000). These changes remain the central themes for an ongoing modern Great Plains drama. The continued expansion of the human population (except in rural areas of the Great Plains, where it is declining), the dominant use of prairie grazing lands for domestic livestock, and the conversion of native prairie to cropland, have led to persistent competition between wild bison and humans for primary use of grassland habitats. However, intermixed among these agricultural and urbanising landscapes are relatively intact islands of suitable prairie habitat with potential for bison restoration. These remaining intact landscapes are typically a mix of private and public land and are characterised by a mosaic of land ownership, land management regimes, socio-economic interests and land use policies. Excluding disease status of bison (see above section), we have identified six principle obstacles that are major impediments to conservation of bison within this social-economic-ecological landscape. Although there are many other minor obstacles, most of these are site specific in nature and can be addressed without efforts to shape law/policy or public attitudes in a range wide scale.

The most significant legal and policy obstacles to wild bison restoration are indirectly derived from socio-economic concerns and persistent historical paradigms of bison management. The greatest impediment is social intolerance for a large grazing bovid that is perceived to compete with other interests adjacent to, or within, prospective prairie landscapes suitable for bison restoration. As a species, the biology, behavioural plasticity, and wide ecological scope of bison provide unlimited opportunity for restoration efforts with a high probability of success in recolonising available grassland habitats.

8.4.1.1.1 Confusing legal classification and status

There are relatively few states and provinces where conservation bison herds are legally classified as wildlife (see Table 8.1). Other states/provinces have mixed status for bison and there is some confusion relative to the legal authority or policies of other bison herds. Many states/provinces within the original range of bison have classified bison as domestic livestock and management authority is vested within agricultural agencies. In addition, many conservation herds are managed by federal agencies, such as the National Park Service (NPS) or U.S. Fish and Wildlife Service (USFWS) Refuge System, adding a federal layer of laws and policies upon bison. This confusing legal classification and status increases the difficulties in conserving the species in a comprehensive manner.

Privately owned bison herds do not enjoy legal status as wildlife. Some bison owned by private producers may have conservation value (e.g., good genetics), but management is principally production oriented. Several privately owned bison herds managed by NGOs are managed in an ecologically relevant manner, but are also not legally classified as wildlife. In Alaska, wood bison were not considered native wildlife for many years by the USFWS, but plains bison herds were established by the State of Alaska and managed as wildlife. Federally owned bison herds are typically managed as wildlife, although behind high fences, but they are usually not recognised as native wildlife by state authorities. This confusion in the legal status of bison is probably the single most important obstacle impeding ecological restoration and hindering a nationwide conservation strategy for this species.

8.4.1.1.2 Historical management policies

Adding to the confused legal status of bison is the consistent policy of establishing and managing bison behind high fences by state and federal agencies. This management paradigm, established in the early 1900s to protect the species, has persisted, further confusing the management policy framework and public attitude toward bison as a wildlife species. This confusing management approach to bison is not consistent with other wildlife and has produced the second most significant obstacle to ecological restoration. Few agencies or members of the public identify bison as native wildlife deserving the same status as other free-ranging wildlife. A public recognition for the need to manage bison as wildlife, in an ecologically sensitive way, is essential to successful restoration. Ecological restoration of bison will be hindered until this management paradigm shifts and social tolerance is developed to allow free-ranging bison on native prairie habitats.

8.4.1.1.3 Complex partnerships needed to manage large landscapes

Bison populations managed on public lands are considered as the core of the wild herds being managed to conserve the species for the future (Boyd 2003; Knowles *et al.* 1997). However, few public land management agencies have a sufficient land base to manage bison populations in a manner that allows for natural selection processes. Bison need large landscapes to allow natural movements and express appropriate ecological function. Unfortunately, most wild bison are being managed as small populations on relatively small areas by single agencies or tribes. Forging the partnerships to manage populations across multiple jurisdictions on large landscapes seems to limit existing conservation efforts. Building partnerships to manage wild bison, as a public trust resource by a coalition of private and public interests, while theoretically feasible, has been limited in practice.

The problems of governance and scale have been well discussed in the literature (Westley and Miller 2003; Wilke *et al.* 2008). There typically is a wide range of actors associated with the conservation of large landscapes and species with large spatial needs such as bison. It is easy to underestimate the complexity of ownership patterns on large landscapes and to miss identifying key actors on this conservation stage. Furthermore, different kinds of actors will have different rights, interests, and capacities, and will need to be approached in different ways (Wilke *et al.* 2008). The challenge of forming complex partnerships at the appropriate scale is formidable and often discourages efforts to consider large-scale initiatives.

8.4.1.1.4 Defining the social and economic value of wild bison

Many legal and policy changes necessary for the ecological restoration of bison are linked to social and economic factors. Agencies and conservationists need to identify the economic, social, and ecological benefits of restoring wild free-ranging bison, while protecting existing cultural and economic interests (Geist 2006). The value of restoring wild bison must be expressed in a manner that does not necessarily diminish the economic value of existing livestock and commercial bison markets managed under an agricultural paradigm. This may take creative approaches involving policy adjustments and paradigm shifts among cooperating agencies/private sectors that optimise complimentary land use strategies and mitigate identified conflicts. This process could be supported by tax incentives, payment for environmental services, ecotourism, incentives for landowner cooperation (e.g., Colorado's Ranching for Wildlife Program), extension services, and training for a new generation of landowners and managers.

8.4.1.1.5 Coordination of policies, rules, and regulations by government

Coordination of management policies, rules, and regulations (or the lack thereof) by various governments has also hindered bison conservation efforts. Because no single government agency owns or manages sufficiently large blocks of land to sustain free-ranging bison, cooperation between agencies is needed for restoration and conservation planning and implementation. Many agencies' missions are not readily compatible with cooperative management strategies needed for conservation of bison at large scales. Furthermore, many land management agencies have directed missions and goals that may not immediately support the types of policy changes required to manage for the conservation of bison. In addition to coordination among government agencies there is often a compelling need to coordinate with and among Tribal and private lands influenced by other policies and management objectives.

8.4.1.1.6 Agricultural conflicts among mixed land ownership

The most significant conflicts associated with restoring wild free-ranging bison are likely to be with agricultural neighbours living near conservation reserves. Establishing free-ranging wild bison herds in North America will undoubtedly lead to conflicts from crop damage, forage competition with livestock, mixing with livestock, possible interbreeding with cattle, disease issues, and damaging private property. These agricultural conflicts are not entirely uncommon with other large herbivores.

These six policy obstacles are quite common across international, state/provincial, and public/private jurisdictional boundaries within the original range of bison. Bison restoration must occur at sufficiently large landscape scales that few, if any, individual agencies will be able to implement an effective management programme on their own. Coordination of agency missions to conserve wild bison must in the long run be a negotiated process to ensure joint conservation goals can be established and implemented within the legal framework. In addition, conservation goals must be established to encourage privately owned populations of wild bison (as defined elsewhere in this document) to be managed over the course of many years in a manner that allows ranchers to build new markets that provide economic benefits for conserving the characteristics of ancestral bison herds.

Other obstacles to restoration include: long time scales, institutional resistance, funding, and conservation mission creep. Most large-scale conservation projects for long-lived mammals need to play out across long time scales. It is easy for conservation partners to fatigue, and for shifting political and social climates to make extended time scales problematic. Institutional resistance is inevitable within and among the cooperating agencies and private sector partners involved in a bison restoration project. Within agencies and organisations there is likely to be some internal resistance to various aspects of the project, so care will be needed to build reasonable consensus. Although many agency or private groups may support the concept of restoration, there is a fundamental need for funding and contribution from all critical partners. Finally, with every conservation programme, the implementation can creep off target or move beyond intended goals. This has a tendency to dismantle social and political support for a project by creating a different type of management or objective than was originally identified and agreed upon by stakeholders. For example as landscapes become larger, and some measure of success is achieved, there may be a tendency to move the conservation focus. Conservation and restoration strategies and planning efforts need to clearly articulate the conservation goal and be able to measure progress and identify critical benchmarks for meeting those goals.

8.5 Overcoming Obstacles to the Ecological Restoration of Bison

8.5.1 Disease management considerations

Animal health and disease issues can present significant obstacles to bison restoration efforts. The presence of regulated diseases in bison can prevent the transport of bison across jurisdictional boundaries and limits access to sources of bison. Potentially important sources of genetically reputable bison for restoration from WBNP and YNP are deemed unsuitable because of their disease status. However, recent research efforts are exploring methods of quarantining bison from these sources to determine if disease free status can be established for animals passing through strict quarantine procedures (Nishi *et al.* 2002b; 2006). The use of effective quarantine to release these genetic sources of bison could be extremely helpful for enhancing access to a broader source gene pool for restoration.

Before animals can be translocated for restoration, each state or province and international border that would be crossed by bison will require specific health tests. When designing specific restoration projects, it is essential to contact State/Provincial or Federal Veterinarians so that required disease testing is a clearly articulated. Appropriate regulatory veterinarian(s) have the expertise to establish which disease(s) require screening, and which approved test protocols and diagnostic laboratories are acceptable/required for health clearance for specific jurisdictions. These health approvals need to be obtained *before* transporting any bison across jurisdictional lines. Good health monitoring of the source herd can provide important information to support the testing carried out prior to transport. A good health-monitoring programme will identify existing diseases circulating among the source herd, and include background information regarding the presence or absence of regulated diseases.

Infectious disease is an emerging threat that conservationists may be ill equipped to manage (Woodroffe 1999). Despite these limitations there are several disease management models across the globe that could help support disease management planning in bison (Osofsky *et al.* 2005). Through careful planning, and research of existing disease management models, this issue can be substantially reduced in scope and impact.

8.5.2 Legal status and policy considerations

In order to address obstacles to ecological restoration of bison, it is important to identify the strategic components of a continental conservation plan. The IUCN BSG has provided this strategic framework and associated technical guidelines for bison conservation to help agencies and the public accomplish ecologically relevant conservation projects. This framework can assist in resolving issues of international status and overcome legal/policy obstacles from a strategic perspective. While this continental wide strategy should be useful in advising some of the overarching legal and policy changes necessary to achieve conservation missions, federal state/provincial and local authorities will need to be involved, and supportive of significant local changes in policies, so that restoration projects can be accomplished.

For most bison restoration projects to advance, changes in laws and policy will be necessary, but they must be designed to encourage bison conservation in an ecologically relevant manner with due consideration of the potential socio-economic consequences to countries, state/provinces or local communities. Laws, rules, and policies of governments can impede conservation. However, they may be transformed into supportive frameworks if there is social acceptance and a high value associated with restoration goals. Comprehensive policies and laws need to be developed that promote ecosystem conservation, without being overly prescriptive. There will be a need for negotiation, compromise, and cooperation in the process of changing laws and policies. Such processes are interdisciplinary in nature, requiring integration of the disciplines of economics, law, ecology, and sociology to be successful (Wilkie *et al.* 2008).

8.5.2.1 Role of the non-governmental organisations

NGOs can play a key role advocating for the necessary changes to laws, rules, and policies that hinder restoration. NGOs can actively lobby for necessary legal/policy changes by federal, state or provincial governments to overcome identified obstacles. They can provide and secure or support government funding for conservation. Coalitions of NGOs and government agencies can be formed to advocate for specific conservation efforts. NGOs could also support the ecological, economic, cultural and spiritual interests of indigenous peoples with an interest in bison conservation. They can aid local community groups in negotiations and help these communities influence stewardship of natural resources in their area (Fraser *et al.* 2008). Finally, some NGOs could help to resolve international issues related to status and legal/policy obstacles associated with individual projects. While many agencies must operate within jurisdictional boundaries, NGOs can transcend these limitations and broker communication and cooperation among agencies.

The historic model of the American Bison Society (ABS), as a consortium of individuals and groups, is an example of how conservation organisations can play a powerful role in species restoration. The ABS advocated for the formation of bison preserves in the west and supported new wildlife policy and legislation to preserve a species at the brink of extinction. The Rocky Mountain Elk Foundation is an excellent example of a North American NGO employing land preservation and active advocacy to support conservation policies that create

suitable landscapes for wild elk. TNC is another conservation organisation that has worked effectively with private landowners and government to protect biodiversity and establish protected areas through the use of land purchase and easements. TNC has incorporated bison on several of these landscapes as a means of providing ecosystem services.

8.5.2.2 State/provincial and federal governance

It is vital that governments (both elected officials and government agencies) be engaged in policymaking and legislation that support bison conservation. Government agencies typically establish processes within their statutory authority to evaluate and approve appropriate policy changes, and recommend congressional and legislative changes, necessary to conduct conservation. It will be necessary to employ all of the instruments and processes of governments to modify policies or legal statutes affecting bison conservation at state, provincial, and federal levels. Government agencies can also direct public funding and staff resources to support implementation of a restoration project, and develop the necessary interagency agreements to achieve conservation goals. It is necessary that elected officials, as representatives of the people, approve relevant policies, and to develop a legislative framework that supports bison restoration, by empowering the appropriate agencies to implement management strategies for conserving bison as publicly owned wildlife. For example, opportunities for bison restoration could be increased by linking them to existing policies for land use planning for ecological integrity. This will require building public support for policy changes and acceptance by respective constituencies that these governments serve, by using, for example, extensive outreach, public advocacy and education. It will also require educating and influencing key politicians and government officials with critical decision making roles.

8.5.2.3 The private sector

There is substantial evidence of a massive change in land ownership and shifting economies taking place in the Great Plains and West, as well as some multiple-generation ranchers who are entrepreneurial and ready for change (Powers 2001). This shift in land ownership, economies, and visions brings opportunities to create a new paradigm for managing rangelands of high conservation value. Private landowners could have a strong voice influencing elected and agency officials of the need for policy changes that provide incentives for, and remove barriers to, bison conservation on private lands. Therefore, there is currently a substantial opportunity to engage landowners to petition government for change.

Privately owned bison managed on privately owned land typically present fewer regulatory obstacles than encountered in restoring wild bison. However, private herds are typically managed under a private property decision framework, which may not lead to a bison herd of conservation value. It is difficult to blend private property rights with the public trust framework for wildlife without negotiation and compromise. For effective cooperation, private owners of bison, or bison habitat, would have to be willing to sacrifice certain rights and submit to public review and scrutiny of operations. Government partners would also need to be sensitive to private property rights and the economic value of those rights for individuals or corporations willing to engage in bison conservation. Effective cooperation should include creative incentives, financial or other, to encourage the private entrepreneur to engage in bison conservation. For example, conservation easements compensate land-owners for transferring specific property rights. As noted earlier, a system for certifying producers who follow conservation guidelines in managing their bison herds may also provide an incentive.

To increase opportunities for large-scale conservation of bison, there is a need for federal and state policy programmes that foster the creation of private (for-profit or non-profit) protected areas (PPAs). PPAs are one of the fastest growing forms of land and biodiversity conservation in the world (Mitchell 2005). However, unlike Australia and many countries in southern Africa, the U.S. and Canadian federal governments and state and provincial governments do not generally have policies specifically supporting the creation of PPAs. The IUCN has developed guidelines for, and explored policies and programmes that support, the creation of PPAs (Dudley 2008). The danger is that private bison reserves may quickly shift away from a conservation mission and devolve to “private game farms” for privately owned wildlife, for which most states have policies and regulations. In addition, private nature reserves may be vulnerable to change of ownership and subsequent shifts in their mission unless clear legal instruments are in place to protect conservation values. Clear guidelines for management and accountability for the long-term security of private protected areas is essential (Dudley 2008).

8.5.2.4 Indigenous peoples

Many protected landscapes and seascapes would not exist without the deeply rooted cultural and spiritual values held by the people that originally inhabited these places and who often continue to care for them (Mallarach 2008). Mallarach (2008) points out that safeguarding the integrity of traditional cultural and spiritual interactions with nature is vital to the protection, maintenance, and evolution of protected areas. Hence, protected landscapes and seascapes are the tangible result of the interaction of people and nature over time. In recent years there have been many important developments in conservation and protection of important landscapes on

indigenous peoples' land (Dudley 2008). Within the original range of bison, there are extensive Native-owned grassland and mountain foothills landscapes suitable for bison restoration. These tribal lands present great opportunities to restore bison in a culturally sensitive way, protecting the rights and interests of traditional landowners. IUCN has identified basic principles of good governance as they relate to protected areas overlapping with indigenous peoples' traditional lands. In addition, there is one group, the ITBC, whose defining mission is restoration of bison. Cooperation of tribes and tribal organisations is essential to the conservation and restoration of bison in North America and should be encouraged. Governments and NGOs in North America should examine and then modify current policy and legislation to support the traditional and cultural interests of indigenous peoples relevant to bison restoration.

There is significant variation in jurisdictional powers over tribal landscapes, ranging from sovereignty over the land to co-management with other governments. It is important to understand indigenous peoples' rights and their level of authority over landscapes when designing restoration and conservation plans for bison. It is equally important to understand the cultural traditions and spiritual connections between indigenous people and bison. Some of this information is traditional knowledge that can only be acquired through conversation with elders and tribal leaders.

8.5.2.5 Local communities and economies

One key ingredient of successful bison conservation is active stakeholder participation in the development and implementation of conservation programmes. Stakeholders include all people or groups of people who are affected by, or can affect, the conservation programme. On public lands it is particularly important to have local support (individuals, adjacent landowners and communities) for policy changes and new legislation, and to avoid backlash from the types of regulatory protection that might be necessary for a successful conservation initiative (Merenlender *et al.* 2004). For landscapes with mixed jurisdiction (public and private), it will be necessary to engage stakeholders by developing critical relationships, building mutual understanding and designing an appropriate co-management framework.

Restoring bison to mixed-use landscapes will involve addressing conflicts with neighbouring landowners. These neighbours need some assurance that when conflicts arise they will be addressed as restoration projects are implemented. Comprehensive restoration and management plans will be required to clearly articulate population goals and to identify how agricultural conflicts are going to be resolved. Ranch land neighbours, living on agriculture lands near restoration projects, pose a great challenge, but may also provide a significant open-space buffer essential to the success of large-scale conservation efforts. Measures must be designed to appropriately manage the distribution of bison and address any trespass conflicts that arise. Other concepts to consider include the idea of wildlife damage insurance, economic incentives, and creative conservation-incentives to encourage and reward tolerance (Muchapondwa 2003).

Ecosystem services have been defined as *"the process by which the environment produces resources that we take for granted such as clean water, timber, pollination of plants, and habitat for fish and wildlife"* (Daly *et al.* 1997). Bison restoration and conservation programmes should consider assessing the value of ecosystem services associated with the development of a conservation strategy for bison. TNC has made significant investments in pursuing the valuation and marketing of ecosystem services as a conservation strategy and financing tool (Groves *et al.* 2008; Nelson *et al.* 2009). TNC, in collaboration with Stanford University and WWF, has developed a Natural Capital Project to better understand the economic values associated with natural systems (www.naturalcapitalproject.org). This project developed a tool known as InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) for quantifying ecosystem services for their inclusion in natural resource decision-making. They also established a "Swat Team" of ecosystem modellers and mappers who use InVEST to bring the valuation system into policy and decision-making for conservation projects (Groves *et al.* 2008). Approaches such as this may be useful in the valuation of ecosystem services associated with the conservation of large grassland landscapes and the role of bison as a keystone herbivore on those landscapes. We recommend further exploration of these emerging valuation tools and their application to the conservation and restoration of bison in North America.

In another novel programme, a coalition of NGOs, state and federal agencies, ranchers, and researchers has been developing a Pay-for-Environmental Services (PES) programme in Florida (Bohlen *et al.* 2009). This programme compensates cattle ranchers in Florida's northern everglades for providing water storage and nutrient retention on private lands. Key challenges to this programme include: identifying a buyer and defining the environmental service; agreeing upon approaches to quantify the service; reducing programme costs in light of current policies; and complex regulatory issues. Design of a PES programme requires navigating through a complex regulatory maze created by multiple state and federal agencies (Bohlen *et al.* 2009). This new model may provide an example for developing a PES on bison landscapes. In the case of bison restoration it will be challenging to meet the needs of multiple stakeholders, and to find the first entrepreneurial landowner willing start a new trend by participating.

Significant challenges lie ahead for the formulation of laws and policies about ecosystem services (Ruhl 2009). Some critical steps suggested by Ruhl (2009) include better definition of property rights, policies that prime the markets for ecosystem services, designing better governance institutions and instruments for these markets, and creative research to meet policy needs. Some governments are already engaged in this type of work, so interested readers are encouraged investigate programme and policy initiatives in their region (Freese et al. 2009). Furthermore, conservation organizations are encouraged to coordinate their activities with evolving government initiatives to more efficiently advance ecosystem-based conservation.

8.5.3 Coordination of agency missions, goals, regulations, and policies affecting bison conservation and restoration

There may be a need for new governance systems that will allow local communities, tribes, and governments to co-manage grassland reserves large enough to sustain bison. Political boundaries, agency policy, and legal jurisdictions need to be creatively blended to create a cooperative atmosphere for the successful establishment and co-management of new or expanded bison populations in the future. Accomplishing the coordination necessary to conduct effective conservation and ecological restoration will be formidable. However, the rewards for such effective coordination will go beyond the benefit of placing bison on the land, and could encourage much more opportunity to conserve other species associated with these landscapes.

It is likely that some type of standing co-management council or committee may be necessary to coordinate management of large landscapes with complex land ownership and affected local communities and economies. This committee should be structured and function to facilitate and maintain partnerships among the various government agencies, NGOs, landowners, and sportsmen or conservation groups that have interest in the project area. A co-management committee can encourage efficiencies in funding and coordinate restoration activities of the various stakeholders. A committee should include representatives from local stakeholders who are affected by the coordinated management effort. A recent announcement by the U.S. Department of the Interior (USDOI) of a new Bison Management Framework established a USDOI Bison Working Group to help coordinate bison management among the agencies. The working group provides an initial effort to coordinate many of the key federal agencies involved in bison conservation, but does not include non-government partners. This working group could become a new model for managing bison on multiple small-scale reserves as though it were one larger-scale population, creating an effective population of sufficient size to protect genetic and ecological integrity. In Montana (Northern Yellowstone Ecosystem) and Wyoming (Southern Yellowstone Ecosystem) interagency bison or bison/elk management plans were created that defined a co-management strategy transcending state and federal jurisdictional boundaries (See chapter 5). Public participation in these processes was achieved through numerous public meetings where stakeholders were provided opportunities to comment on and influence a proposed co-management design. Through this process, information was provided to the stakeholders, and some degree of acceptance for proposed decisions was negotiated. The establishment of the Sturgeon River Plains Bison Council in Saskatchewan is another co-management example developed by local stakeholders affected by bison management on neighbouring federal lands. These examples represent contrasting models of top down versus bottom up approaches to bison conservation. By combining local (bottom-up) and national (top-down) approaches, better forms of governance can evolve, natural resources may be more effectively managed, and livelihoods can be improved (Fraser et al. 2008).

Detailed project-specific planning for ecological restoration (see Chapter 10 of this document) should be completed by agencies, NGOs and private partners involved in the project area prior to implementing any bison conservation project. The successful completion of the environmental evaluations required under national, state or provincial environmental law will be critical to the advancement of any bison restoration project involving public land. These environmental evaluations will require a public involvement process and should gather input from all affected stakeholders in a meaningful process. In addition to public involvement significant public education and outreach should be developed and implemented during all phases of a restoration project.

Technical support from science groups, such as the IUCN Bison Specialist Group, can provide the necessary technical guidance for science based conservation strategies at the local, state/province and continental scale. Guidance from this technical group can identify best management practices, and recommend policy and legislative changes necessary to support sound conservation and restoration initiatives. Additional guidance for ecosystem restoration efforts can be found through other IUCN publications (Clewell *et al.* 2005; IUCN 1998; Chapter 10).

8.5.4 Recommendations

Some fundamental legal and policy changes recommended to enhance bison restoration include:

1) Where social acceptance for wild bison can be attained, establish the legal status of bison as a native wildlife species through working with state/provincial/federal jurisdictions.

2) Modify current policies that prevent partnerships and co-management among agencies, private sector, and tribes.

3) Develop outreach to state and federal land management agencies encouraging land management agencies to consider bison in agency planning and policy development.

4) Reform current policies governing suitable bison landscapes to protect the core habitat conservation values as defined in Sanderson *et al.* (2008) and this document. This is to protect the core value of these landscapes for future ecological restoration pending socio-economic shifts favourable to bison restoration.

5) Develop outreach materials identifying social and economic benefits and ecosystem services associated with restoration of bison and prairie conservation efforts for local communities, the private sector and governments.

6) Create a decision framework, suitable for private conservation efforts, that encourages restoration strategies with an ecological emphasis.

7) Create policies or economic and conservation incentives that reward private landowners who manage for biodiversity including bison.

8) Establish necessary state and federal regulations and legal instruments to support valuation and compensation for ecosystem services.

9) Work with animal health organisations (IUCN Wildlife Health Specialist Group) and regulatory agencies to encourage bison friendly health regulations.

10) Identify and support necessary research and monitoring to cultivate a science-based but adaptive process for ecological restoration of bison.

11) Encourage economic and power structures that support sustaining local communities and lifestyles.

12) Make efforts to reform policy and legislation that impede the interests and rights of indigenous people to manage bison in a culturally sensitive manner.

8.5.5 Recent initiatives to conserve and restore bison

Sanderson *et al.* (2008) present a collective vision for the ecological restoration of bison in North America. From a series of meetings with various conservation organisations, government agencies, indigenous groups, bison ranchers and private landowners a "Vermejo Statement" was jointly written that describes what ecological restoration of bison might look like. Five key attributes were identified in this statement that create both opportunities and challenges for bison restoration, such as large scale, long term, inclusive, fulfilling, and ambitious efforts. Sanderson *et al.* (2008) explored a shared vision for wild bison restoration with 20, 50, and 100-year timelines. Specific initiatives were not described, but a range-wide priority setting methodology resulted in a scorecard matrix with which to evaluate the conservation value of public and privately owned bison herds and a map of potential restoration areas. Significant changes in the landscape where bison once roamed are creating possibilities for bison restoration where few existed before (Freese *et al.* 2007; Sanderson *et al.* 2008).

8.5.5.1 United States

In the U.S., there are no specific federal efforts proposed to protect plains bison beyond the boundaries of existing national parks, monuments or wildlife refuges. The U.S. Forest Service (USFS) recently conducted an assessment of its management of national grasslands in Montana, North Dakota, Nebraska, South Dakota, and Wyoming and dismissed a proposed alternative to restore free-ranging bison (USDA Forest Service 2001).

The U.S. Secretary of the Interior recently announced a new management framework for improving the administration of the various bison herds on Federal Wildlife Refuges. The strategy will consider treating the various populations as a larger metapopulation, looking at ways to create and maintain gene flow, as well as protecting private alleles among these small populations by improving genetic management strategies. This framework also committed USDOI agencies to expanding herd size if possible, and building cooperation with partners for the conservation of bison. In addition, comprehensive refuge plans are being reviewed to consider the feasibility of attempting bison restoration on large refuge landscapes, such as the Charles M. Russell National Wildlife Refuge.

Utah just completed a reintroduction of bison into the Book Cliffs area of East Central Utah. This is a joint effort between the State of Utah Department of Wildlife Resources and the Ute Indian Tribe. Bison were moved onto this land from the Ute tribal bison herd and the Henry Mountains. These bison are legally classified as wildlife and will be managed as a valued wildlife resource in Utah. A herd management plan has been approved where hunting programmes will regulate bison population size and distribution.

Public interest in wood bison restoration in Alaska has grown, and there is widespread state, national, and international support for restoring one or more populations in the state. There is also support among local communities in the areas being considered for wood bison restoration. A Wood Bison Restoration Advisory Group comprised of representatives of various state and national interests has recommended that Alaska pursue the reintroduction of wood bison at the three sites, which include the Minto Flats, Yukon Flats, and lower Innoko/Yukon River areas in interior and western Alaska. These areas have sufficient habitat to support from 500 to 2,000 or more bison each, depending on the location. In 2008, wood bison were transported from Elk Island National Park (EINP) to a temporary holding facility in Alaska, where they are being quarantined for 2 years prior to release in the wild.

Alaska Department of Fish and Game and USFWS are developing a special rule that will designate wood bison in Alaska as a nonessential experimental population (NEP) under section 10(j) of the U.S. Endangered Species Act, which lists wood bison as endangered. The federal rule will remove many of the regulatory requirements that normally apply to endangered species, allowing a high degree of management flexibility and providing protection against possible regulatory burdens and effects on other land uses. NEP status will help maintain and enhance public support for wood bison restoration. An alternative proposal to delist bison from the ESA is being considered, which would obviate concerns by the oil and gas sector about impacts of a new listed species on development opportunities. Wood bison in Alaska will be legally classified as wildlife and, after populations reach levels that can support a sustainable harvest, their numbers will be regulated in part through a hunting programme as outlined in cooperative management plans that will be developed for each area prior to each reintroduction.

8.5.5.2 Canada

There have been several Canadian national park proposals and public discussions to include plains bison in their native species management plans. These include management plans for Banff, Waterton, and Grasslands national parks in Alberta and Saskatchewan (Boyd 2003; see also Chapter 7). Waterton park determined that there was insufficient landscape available for free-ranging bison within the park. Prince Albert and Grasslands national parks already have established plains bison herds. Bison in these herds are classified as federally managed wildlife and could be allowed to expand their range if coordinated management agreements can be negotiated with public and private landowners bordering these parks.

Canada has several large military reserves with suitable bison habitat. Restoration on military preserves is being discussed, but few detailed plans are currently available. Bison are protected on Department of National Defence Cold Lake/Primrose Air Weapons Range by virtue of prohibiting trespass, except for the Cold Lake First Nations, who can hunt with permission. Canadian Forces Base (CBF) Suffield is a 2,600 km^2 military reserve located in the Dry Mixed Grass Natural Sub-region of Alberta. It is used as a training area for military ground manoeuvres and it is a mostly intact native prairie landscape. CFB-Suffield has free-ranging populations of all indigenous large herbivores, except bison, for which the biological potential for restoration is highly favourable.

Canada's National Wood Bison Recovery Team was formed in 1973 and includes members from all relevant federal, provincial, and territorial governments, as well as academia. The draft national recovery strategy (H. Reynolds, personal communication, 1 March 2009) provides the following population and distribution objectives: 1) establish and maintain at least five genetically diverse populations of greater than 1,000 animals in each herd, 2) establish and maintain smaller free-ranging, disease-free herds where possible, and 3) establish and maintain at least two populations in each originally occupied ecological region.



8.5.5.3 Mexico

Since the original range of bison extended only a short distance in to the northern portion of Mexico, there are few suitable locations where they would be expected to successfully re-colonise available habitats in their former range. The large grasslands of the Janos-Casas Grande in north-western Mexico is the best location for bison conservation efforts, and a large biosphere reserve is proposed for this area to protect free-ranging plains bison.

A recent series of stakeholder and science workshops held in this boundary area have identified conservation needs and potential strategies for advancing bison recovery in this boundary area of Mexico, including reintroducing a plains bison conservation herd in Mexico. In November 2009, 23 plains bison were translocated from Wind Cave National Park in South Dakota to TNC's Rancho El Uno Ecological Reserve located in the Janos Biosphere Reserve in Chihuahua State. The project is part of a national programme for recovery of priority species in Mexico and an international collaboration on wildlife and habitat conservation in North America. The U.S. National Park Service donated the bison to The Working Group for Recovery of Bison in Mexico (El Grupo de Trabajo para la Recuperación del Bisonte en México), which is led by the National Commission of Protected Natural Areas (la Comisión Nacional de Áreas Naturales Protegidas). These bison are the foundation stock for a breeding herd that will be used to repopulate other areas, with the ultimate goal of restoring the ecological role of bison in the grasslands of northern Mexico. The bison will provide opportunities for ecological research and will serve as a focal species for educational outreach. Another potentially important area for the recovery of bison in Mexico is the Columbia Valley, in the State of Coahuila, where a privately owned herd moves over a very large area and is minimally managed. Bison were native to the state of Coahuila until the second half of the 19th Century.

8.5.5.4 Non-governmental organisations

TNC and NCC have played a lead role in North America in developing conservation programmes involving bison. TNC (eight herds) and NCC (one herd) already manage nine bison herds on grassland preserves in U.S. and Canada respectively. TNC is principally using bison as a native grazer and is considering adding bison to additional preserves in the U.S. and Canada. Specifically, the NCC is implementing a restoration strategy for the Old Man on His Back Conservation Area in Alberta, with a herd already established with bison from EINP (Freese *et al.* 2007).

In 2005, APF and WWF implemented a privately funded conservation effort restoring bison to the American Prairie Reserve in southern Phillips County, Montana. Plains bison were obtained from Wind Cave National Park. Under Montana regulations, they are currently classified as privately owned livestock, however, the Fish, Wildlife and Parks Commission has authority, under Montana law, to classify these bison as

Plate 8.1 Plains bison were reintroduced to the arid grasslands of the Janos Valley in northern Chihuahua State, Mexico in November 2009. The bison reside on Rancho El Uno Ecological Reserve, a property of The Nature Conservancy. Photo: Rurik List.



wildlife if APF agrees and if there is public support for such legal action. APF intends to purchase up to 405,000 hectares (one million acres) of land for a grassland preserve upon which wild bison would be allowed. In addition, the American Prairie Reserve leases adjacent BLM grazing allotments and recently modified these to change the class of livestock for these allotments from cattle to bison. Similarly, the USFWS has authority to establish bison on the Charles M. Russell Wildlife Refuge adjacent to the American Prairie Reserve. The combined efforts of these two agencies, and other conservation partners, could result in bison restoration on a very large native grassland habitat.

8.5.5.5 Tribal initiatives

Many tribal initiatives are also underway across North America. The ITBC was formed in 1990 and has 57 member tribes managing over 15,000 bison (http://www.itbcbison.com/index.php). Its stated goal is to restore bison to Indian Nations in a manner that is compatible with their spiritual and cultural beliefs and practices. Congress appropriated funding for tribal bison programmes in June of 1991, and has approved appropriations for ITBC annually since then. This action offered renewed hope that the sacred relationship between Indian people and the "Buffalo" might not only be saved, but would, in time, flourish.

Specific initiatives include the Cheyenne River Sioux Tribe, which has started an 8,900-hectare Tribal Wildlife Refuge. The Rosebud Sioux Tribe has officially endorsed "The Million Acre Project" developed by the Great Plains Restoration Council centred on the Pine Ridge Indian Reservation in South Dakota (Freese *et al.* 2007). Another potential initiative is identified in a strategic plan being developed by the Lower Brule Sioux Tribe in South Dakota (Lower Brule Sioux Tribe 10 year strategic plan; Lower Brule Sioux Department of Wildlife, Fish, and Recreation). The Wind River Reservation in Wyoming is working on a management plan that would restore wild free-ranging bison to available habitat on that tribal landscape. The Fort Belknap Reservation in Montana has requested Yellowstone bison from the state/federal quarantine facility. A comprehensive evaluation of the restoration potential of North American tribal/first nation's landscapes and continental conservation priority assessments for those landscapes has not been completed.

Chapter 9

Conservation Guidelines for Population, Genetic, and Disease Management

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9.1 Introduction and Principles

This chapter provides management and policy-relevant guidelines to foster bison conservation and full recovery. Conservation implies retaining desirable ecological, cultural, and genetic characteristics that currently exist, while full recovery implies a broader vision—bison populations inhabiting areas that permit full expression of natural behaviours and ecosystems functioning in ways similar to those of the past.

We focus on guidelines and principles that are broadly applicable, and we avoided highly specific, prescriptive recommendations. This approach requires managers and others to understand the basis for our guidelines, and to evaluate carefully how a guideline can best be implemented in a particular situation. We provide only brief reviews of the scientific basis for guidelines, and readers should refer to chapters four, five, and six in this volume for more comprehensive information on bison genetics, disease, and ecology.

A small set of overarching principles is the foundation for most of the guidelines in this chapter, and they provide a framework for developing and assessing conservation actions. These key principles are:

1) Maximize the number of bison in a population. Larger populations better retain natural variation, and are more resilient to 'surprises' or catastrophic events. Strive to achieve a 'maximum sustainable' rather than a 'minimum viable' population size.

2) Support and promote 'wild' conditions and behaviours. Where possible, provide an environment where bison are integral to community and ecosystem processes (Table 9.1). Behaviours and demographic processes should reflect natural selection, and active management interventions should be minimized. Wild bison herds use very large ranges.



Plate 9.1 *The bison is an interactive species. Here wolves are hunting and feeding on a plains bison they have killed and ravens are scavenging (middle photo). Top and middle photos: Douglas Smith, lower photo: Dwight Lutsey.*

Table 9.1 *Ecosystem processes that bison can strongly influence. See Hobbs (1996); Knapp et al. (1999); Larter and Allaire (2007); and Truett et al. (2001).*

Process	Description
Create patches	Grazing can produce a dynamic mosaic of vegetation patches that differ in seral stage and that differ due to variations in grazing intensity
Enhance nutrient cycling rates	Bison grazing can enhance nutrient turnover and change dominant system mode from detritus-decomposition to consumption-defecation
Enhance habitat quality	Bison grazing can increase habitat suitability for prairie dogs, pronghorn, and other species
Modify fire regimes	Bison consume fine fuels and create trails and trampled areas that reduce fire intensity and extent, and modify the effect of fire on vegetation heterogeneity
Create disturbances	Trampling and wallows create seedbeds for some species; localised tree stands that are not tightly clumped are susceptible to major damage by rubbing, horning, and thrashing of bison.
Stimulate primary production	Bison grazing removes senescent material from the sward and increases light penetration, nutrient availability, and growth
Disperse plant seeds	Bison transport seeds in leg fur and gut, and may enhance establishment (of native and exotic plants) via consumption, seed coat digestion, and defection in nutrient-rich media.
Maintain floral diversity	Bison grazing can result in greater grass and forb species diversity
Support carnivores and scavengers	Bison are prey to some large carnivores, and bison carcasses can contribute to supporting scavengers.

3) Preserve genetic integrity and health. Maintain bison lineages and carefully evaluate all movements of bison between populations. Consider potential genetic consequences of all management actions, especially for small herds.

4) Routine assessment is central to science-based conservation of bison. Routine monitoring and evaluation of demographic processes, herd composition, habitat, and associated ecological processes are central to evaluating herd health and management efficacy. Assessments are necessary to anticipate or respond to conservation needs and sound data is the basis for informed management.

The scientific basis and rational of principles for conserving bison is provided in the more detailed guidelines in this chapter and other chapters that review bison ecology, genetics, and ecological restoration.

9.2 Guidelines for Population and Genetic Management

The general goals for population and genetic management are to achieve and sustain a population with a healthy level of genetic variation and a sex and age composition typical of viable wild bison populations. Management actions needed to achieve these goals will vary with the size, history, and circumstances of each particular population. In this section, we articulate more specific management objectives, summarise background information relevant to our recommendations (see also Chapter 6), and provide both general and specific guidelines.

In bison, loss of genetic variation is a concern primarily when the number of actively breeding animals or the founding population size is small. Our best estimates are that bison populations can generally be considered “not small” (for genetic purposes) when they exceed about 1,000 animals, the population has approximately equal numbers of bulls and cows, and the size of the population is stable. For the purposes of this report, the genetic objective is to attain a 90% probability of retaining 90% of selectively neutral genetic variation for 200 years. This objective is less stringent than some published objectives, and thus our estimates for sustainable population sizes are smaller than those that result from estimates based on more conservative criteria (Reed *et al.* 2003; Soule *et al.* 1986). In all populations, the rate of loss of genetic diversity is directly related to how rapidly individuals in a population replace themselves (generation time) and to the size of the breeding population. Most guidelines for genetic management in this document can be understood in the context of just these two factors.

Most populations are not uniform, but have genetic variation related to the spatial substructure of the population (Manel *et al.* 2003). Demographic and genetic substructure occurs at a large geographical scale due to traditional use of particular parts of a range (e.g., breeding range fidelity, seasonal ranges, calving areas) by segments of a population (e.g., bison in YNP; Christianson *et al.* 2005; Gardipee 2007; Gogan *et al.* 2005; Halbert 2003; Olexa and Gogan 2007). Within herds, bison are thought to form family groups (i.e., matrilineal groups, mother cows with their preparturient daughters) and these family groups constitute fine-scale population structuring. These types of population structure are important because they increase the likelihood that animal removals without plans to explicitly accommodate substructures of cows could disproportionately impact a particular segment of the population and result in a greater loss of genetic diversity than necessary. Removal strategies should be designed to accommodate the potential spatial structure of herds, and institute procedures that ensure

animals are proportionately removed from different population segments. This could potentially be accomplished by removing animals from different parts of the range.

A variety of factors can lead to increased rates of genetic diversity loss. After accounting for population size, the most important factors are likely to be non-random mating (i.e., a few bulls are responsible for siring most calves), skewed sex ratios, and large variation in population size.

9.2.1 Guidelines that apply to most conservation herds

Very few conservation herds will persist without the need for some form of population control. Many guidelines in this chapter were included with the specific intent to support development of informed population management plans. Many of the following guidelines apply to most conservation herds, and are likely to be included in comprehensive management plans for conservation herds:

1) Maintain a sex ratio with neither sex constituting more than 60% of the population. Ideally, the adult sex ratio will be slightly female biased (e.g., 55 cows per 100 animals), reflecting observations that mortality rates of males tend to be slightly greater than those for females. Avoiding a high ratio of females to males helps ensure participation in mating and transfer of genetic diversity by a larger number of bulls. In large populations, mating competition will likely be sufficient when there are 20 or more mature bulls (six years old and older) per 100 cows. Maintaining mating behaviour, as noted above, calls for a more equal sex ratio.

2) Avoid removing a significant proportion of the population. For populations subjected to population control actions, culling should be on a yearly, or every other year, schedule, rather than periodically at longer intervals. We cannot offer a definitive definition of 'significant', as the effects of population fluctuations will be greater as population size diminishes and varies with other circumstances. As a general guideline, we suggest limiting removals of animals to less than 30% of the population;

3) Avoid disproportionate removal of matrilineal female groups (mother cows and their preparturient daughters). More specifically, attempt to retain the older cows matrilineal groups;

4) Remove animals from all spatial segments of the population;

5) Emulate natural mortality patterns—higher mortality/removal rates for juveniles and old age classes (more than 15 years);

6) In small populations, consider actions that reduce variation in the breeding success among individuals. This could be accomplished by reducing the opportunities for continued breeding by highly successful bulls.

7) Avoid human selection for market traits such as docility, carcass composition, body shape, or productivity, as such interventions contradict natural selection and conservation of genetic variability;

8) Routine supplemental feeding to increase productivity, or to support a population size that exceeds range carrying capacity, is discouraged for conservation herds;

9) Where practical, the full suite of natural limiting factors should be allowed to influence populations, including winter deprivation and predation. This will result in variable rates of reproduction and survival.

The need for active genetic management will vary with herd size, genetic composition, and management goals. In general, genetically diverse herds with more than 1,000 animals are unlikely to require active management to retain most of their genetic diversity for the next 200 years (Gross *et al.* 2006). Hedrick (2009) suggests a herd size of 2,000-3,000 to avoid inbreeding depression. In very small herds (fewer than about 250 animals), long-term genetic health will require occasional supplementation with genetic material from other herds. The exact number of animals needed to supplement a particular herd will vary with the genetic composition of the source and target herds, but a supplement of four to five breeding animals per decade should be sufficient for long-term herd genetic health (Wang 2004). In addition to the guidelines below, managers should follow the IUCN guidelines for translocation of wild animals between established herds, being especially careful about genetic purity (i.e., cattle genes and geographically appropriate sources of stock) and diseases (http://www.kew.org/conservation/RSGguidelines.html).

Active management to retain genetic variation (other than translocations) may be most important for intermediate-sized populations with about 250-750 animals because this is the size range where active management may prevent or greatly reduce the need for translocating animals to ensure long-term the genetic health of a herd (Gross *et al.* 2006). For conservation herds, the overall objective is to retain allelic diversity, which is the best indicator of the genetic resources available to the population. By contrast, genetic heterozygosity may be a better short-term indicator of the mating structure of the herd. In addition to the guidelines provided above, removal of young animals, prior to their first breeding, can significantly enhance the retention of genetic diversity (Gross *et al.* 2006). Removal of young animals to preserve genetic diversity may seem counterintuitive. Genetic material is lost only when animals in a population are replaced. Removal of young animals increases the length of the generation (replacement) interval, and this thereby prolongs the retention of genetic material.

9.2.2 Herd-level population and genetic management

For many conservation herds, the most frequent and contentious decisions will concern herd level management, especially population control. Key decisions address how many animals to maintain, which ones to remove, and how often to remove them, when to add animals, and where to source them. This section provides advice for active population management at the herd level—guidelines for establishing a new herd, maintaining the size of an existing herd, reducing the size of a herd that has become much too large, and how to deal with known genetic issues.

9.2.2.1 Soft release procedures

Bison may need to be moved to supplement an existing herd, or to establish a new herd. In such cases, the use of a "soft" release process should be considered in virtually all cases. Soft releases typically involve placing animals in a (usually large) holding facility prior to full release. Holding bison in a large pen may increase their tendency to remain in the area of release and establish some degree of site fidelity. American Prairie Foundation, for example, held bison for one month in a large corral prior to release on the American Prairie Reserve in Montana. An additional benefit of a soft release procedure is the effective quarantine and associated ability to monitor and more easily re-capture animals if any health issues become apparent.

9.2.3 Establishing a new herd

Establishing and maintaining related, isolated or semi-isolated herds (i.e., parental and one or more satellite herds) is critical to long-term species conservation in that multiple herds act to increase effective population size (N_e) and reduce the total loss of genetic variation over time (Lande and Barrowclough 1987). Furthermore, the maintenance of a unique genetic population in several small herds reduces the probability of accidental extinction, such as from a natural catastrophe by disease, and increases the opportunity for local adaptation (Franklin 1980; Lacy 1987). In theory, and under experimental conditions, several small groups (e.g., N_e about 50) may preserve more genetic diversity than a single herd with as many individuals as the smaller herds combined (Margan *et al.* 1998). Genetic drift within each related herd can be countered by the occasional movement of individuals between related herds (Mills and Allendorf 1996). Therefore, several moderately sized herds (i.e., more than 300 and fewer than 1,000 animals) of the same genetic stock can, if managed properly, act as a large metapopulation with an effective population size sufficient to impede genetic erosion (Lacy 1987). In this section, we articulate considerations for the establishment and maintenance of new bison herds from existing resources.

1. Source

Priority should be given to establishing satellite herds from extant conservation herds, within the respective original ranges for wood and plains bison, especially for those herds with unique genetic characteristics (Halbert 2003; Wilson and Strobeck 1999) and those which appear to be free of domestic cattle introgression (Ward *et al.* 1999; Halbert 2003; Halbert *et al.* 2005b). Beyond this, establishment of herds of mixed ancestry should be considered to maximise genetic diversity and the potential for adaptive response.

Although bison are likely to be more readily available from herds subjected to artificial selection and some level of domestication, we strongly recommend acquiring bison from "wild" herds not subjected to these influences.

2. Number of animals

Little specific information is available regarding appropriate foundation populations sizes. In general, a few (4-10) individuals should be sufficient to avoid very short-term inbreeding effects (Senner 1980). However, the loss of variation in such a small population will be substantial after the first few years (Nei *et al.* 1975) and additional bison should be imported over a period of several years to increase genetic variation. If the goal is to conserve or duplicate most of the genetic material in a source herd, many more animals are required. Shury *et al.* (2006) proposed a base of 200 "founder" animals to preserve most of the genetic variability in "re-established" wood bison herds.

3. Sex ratio

The initial imported bison should consist of approximately 50% of each sex, and the herd should be maintained with a balanced sex ratio to reduce inbreeding and maximise effective population size.

4. Breeding strategy

If a small number of bison are used to found a herd, and especially if additional bison are not brought into the new herd, breeding strategies to maximise the transfer of genetic diversity across generations should be considered (e.g., avoid excessive breeding by one or a few males). Appropriate genetic tools are available to accurately assign parentage in bison (Schnabel *et al.* 2000; Wilson *et al.* 2002), and these may be used to assist in captive breeding decisions by evaluating the breeding success of individual bulls and relatedness among calves.

5. Age composition and behaviour

Bison are social animals and the importance of social structure within a herd is critical to overall herd health and survival (McHugh 1958). We recommend establishing a new herd with both adult and sub-adult individuals to prevent disintegration of social structure and behavioural anomalies (e.g., foraging behaviour; Ralphs and Provenza 1999).

6. Maintenance number and growth rate

To minimise the loss of genetic variation and heterozygosity, and to maximise the probability of population survival, new herds should be allowed to grow as quickly as possible until the target herd size is attained (Nei *et al.* 1975). Bison herds can grow very quickly, doubling in size in as few as four years (see Chapter 6). Herds should then be maintained within an appropriate size range, which will likely be the maximum size possible within resource limits for herds with fewer than about 1,000 animals (Gross *et al.* 2006; Senner 1980). For small herds, fluctuations in population size can have a substantial negative impact on retention of genetic variation (Nei *et al.* 1975). Maintenance of population size is more important to population survival than is the founder population size and should, therefore, be given a high priority for small herds (Senner 1980).

7. Relationship between founders

Select unrelated individuals as founders for a new herd. Use appropriate genetic tools when available to establish relatedness between bison (Schnabel *et al.* 2000; Wilson *et al.* 2002).

8. Genetic variation and heterozygosity

Genetic evaluation should be carried out on the parental herd prior to establishment of a satellite herd, and repeated genetic evaluation of the satellite herd should be used to ensure that all the genetic variation from the parental herd are incorporated and maintained.

9. Disease

In general, do not use diseased bison to establish a new herd. Immune suppression in diseased individuals may lead to infection and spread of other diseases; further compromising herd establishment and health. One notable exception is the intentional creation of disease-free satellite herds from a diseased parental herd. In such cases, use extra precautions to prevent the spread of disease from bison to other wildlife during the initial disease elimination phase.

10. Monitoring success

Because it is expensive and time-consuming to establish bison herds, resources should be wisely invested to monitor bison herds and broader ecological effects of bison. Ideally, habitat characteristics should be monitored using a valid statistical process before bison are introduced. Herd composition, demographic parameters, and genetic structure, especially in the first few generations following herd establishment, should be monitored, along with ecosystem changes. Additional monitoring guidelines are provided below.

Trans-boundary transportation of bison to establish a new herd can introduce many administrative and regulatory considerations (Chapter 8). After an extended period of planning and negotiation, wood bison were transported from Canada to Alaska in 2008. Personnel with the relevant agencies may be consulted for advice on undertaking such an enterprise.

9.2.4 Maintaining or manipulating existing herd size

When a bison herd appears in need of intervention to restore or improve genetic health and population viability, the first and most important activity is to thoroughly evaluate the current condition of the herd to avoid premature, unnecessary, or even damaging management decisions. *There are no simple cookbook instructions that can be applied to any bison herd*. The following list of baseline evaluations will help ensure that decisions are well informed:

1. Determine the history of the herd to provide insight into current levels of genetic variation and population structure. Try to determine:

- Number and origin of herd founders;
- Number and origin of any bison introduced following herd foundation (transfers);
- Historic records on population size, especially with regard to substantial changes over time.

2. Evaluate current population parameters to establish baseline measurements for future comparison and to detect attributes that may lead to changes in social structure or genetic variation. Variables of interest include:

- Census population size
- Effective population size (N_e; will not be possible in all cases and requires knowledge of breeding structure)
- Rate and direction of population size changes (e.g., is the herd expanding or contracting)
- Sex ratio
- Age structure

3. Note any indications of inbreeding within the herd, such as:

- Unusual phenotypic characters within the herd, especially any that have recently appeared;
- Recent decrease in recruitment rates;
- High rates of morphologically abnormal or non-motile sperm among breeding-age bulls;
- Relatively low levels of heterozygosity as compared with previous measurements or other bison herds of similar size and history (e.g., Halbert 2003; Wilson and Strobeck 1999).

4. Assess potential health problems in the herd, including:

- Presence of transmissible diseases, especially those which may influence population dynamics (e.g., BTB, brucellosis, MCF);
- Presence of disease agents in livestock species on nearby (especially adjacent) properties (e.g., cattle with JD, sheep carrying MCF).

5. Evaluate the overall genetic constitution of the herd by measuring:

- Unique variation (rare or private alleles) and levels of heterozygosity in comparison to other bison herds (Halbert 2003; Halbert *et al.* 2004; Wilson and Strobeck 1999);
- Within-herd changes in heterozygosity and genetic variation between generations (Halbert *et al.* 2004);
- Current breeding structure of the herd (e.g. number of males contributing to calf crop each year, relatedness among calves, presence of genetic subpopulations);
- Existing levels of domestic cattle introgression in both the mitochondrial (Polziehn *et al.* 1995; Ward *et al.* 1999) and nuclear genomes (Halbert *et al.* 2005b).

Using the data collected from the above evaluations, informed and sensible management plans can be implemented to best fit the needs of the target herd. To further assist in this process, demographic and genetic data can be used to model the effects of various management alternatives prior to actually implementing a definitive management plan (Gross *et al.* 2006; Halbert *et al.* 2005a).

9.2.5 Transferring bison between herds

To maintain long-term herd health, it will be necessary in some cases to transfer bison between herds (Table 9.2). The decision to transfer bison between herds, however, must be made with extreme caution with the following considerations:

1. Necessity of movement

Is there actual evidence of loss of genetic diversity or inbreeding to necessitate the transfer? In bison and other mammalian species, well intended but uninformed management decisions to transfer individuals among isolated groups have resulted in detrimental and irreversible effects, especially related to genetic integrity and disease.

2. Domestic cattle introgression

As discussed in Chapter 4, few bison herds appear to be free from domestic cattle introgression (Halbert 2003; Halbert *et al.* 2005b; Polziehn *et al.* 1995; Ward *et al.* 1999). Therefore, it is essential to understand both the historic and genetic evidence of domestic cattle introgression in the recipient and potential donor herds before considering a transfer. If the two herds are related, and especially if one is a satellite of the other, the total effect on introgression levels due to transfer will be negligible. Care should be taken to prevent the introduction of bison of unknown origin, or questionable history, into conservation herds. Furthermore, given our current levels of understanding, bison should not be transferred into the few existing herds which appear to contain no domestic cattle introgression, with the possible exception of transfers between parental and satellite herds (Hedrick 2009).

Table 9.2 *Additional factors to be evaluated when considering transfers of bison between herds.*

Number	When possible, the number of imported bison should be based on prior modelling estimates to maximize improvements in heterozygosity and genetic diversity while minimizing dilution of the native bison germplasm.
Sex	Importing a few new males into a herd can have a large, positive and rapid genetic and demographic impact. The same overall effects can be obtained when importing females, although the process will be somewhat slower. In some cases, it may also be worthwhile to consider any known genetic uniqueness of the mitochondrial genome and Y chromosome. For instance, prior to importing bison into the Texas State bison herd, it was noted that this herd contained a unique bison mitochondrial haplotype not known to occur in other bison herds (Ward 2000; Ward et al. 1999). Therefore, importing males into this herd was favoured over importing females, in part to prevent dilution of the unique native bison mitochondrial haplotype (Halbert et al. 2005a).
Age	The most rapid infusion of germplasm will be obtained by importing breeding-age animals. It may be desirable to choose bison that have already produced offspring to avoid potential issues of sterility or offspring abnormalities. Despite planning, genetic incompatibilities between extant and imported bison may still influence contributions of the imported bison to the calf crop.
Quarantine	Consider a quarantine of newly imported bison prior to release, especially when the recipient herd is at a high risk of extinction. This allows for an easier adjustment of the imported bison to their new environment, as well as early detection and treatment/removal for latent diseases.
Mating regime	Decide whether imported bison should have exclusive mating privileges for one or more years or compete with other potential breeders for access to cows. "Exclusive" matings can be used to increase genetic and demographic impacts. A fully competitive mating regimen permits extant bison to contribute to the gene pool and provides some protection in case of genetic incompatibility between the donor and recipient herds.

3. Relationship between herds

Given the observed genetic distinctions among extant bison herds (Halbert 2003; Wilson and Strobeck 1999), dilution of unique genetic characters (alleles) within the recipient herd should be considered when evaluating potential donor herds (Halbert *et al.* 2005a). Ideally, bison should be transferred between satellite or related herds to reduce the loss of rare variants.

4. Health and disease

All attempts should be made to prevent the spread of disease between bison herds. Even if the recipient and donor herds host the same disease, transfers of bison should be discouraged since disease strain variants between herds can lead to differences in disease progression or effects. Potential donor herds should be thoroughly tested (see Chapter 5 and section above) to evaluate the presence of pathogens.

Once the above factors have been evaluated, there are various other features that may influence the demographic and genetic effects of the transfer, including the number, age, and sex of the imported bison as well as frequency (single or multiple introductions) and duration of the transfers (permanent vs. transient transfers, e.g., for short-term breeding). Each situation will differ and a comprehensive review is not possible here given the large number of potential management scenarios. However, the general guidelines in Table 9.3 should be considered.

Table 9.3 *Risk factors for disease.*

Disease Risk Factors	Disease Examples (not all-inclusive)
History of pathogen in the region	Anthrax, parasites
Proximity to potentially infected populations (wildlife or livestock)	MCF, Bovine tuberculosis, brucellosis, Johne's disease, bovine viral diarrhoea, foreign animal diseases (e.g., Foot-and-Mouth Disease)
Weather patterns and environmental suitability	Anthrax, parasites
Presence/abundance of mechanical or biological vector(s)	Anaplasmosis, bluetongue, pink eye
Population density (increased infectious contacts)	Most infectious diseases (e.g., brucellosis, tuberculosis)
Season	Diseases with unique transmission patterns (e.g., brucellosis, bluetongue)
Nutritional and other environmental stress	Infectious diseases which capitalise on depressed immunity (e.g., respiratory viruses)
Geographic location/ Climate	Hardy pathogens capable of surviving climate extremes

5. Number

The number of imported bison should be based on prior modelling estimates when possible, and should reflect the size of the population so that improvements in heterozygosity and genetic diversity are maximized with a minimum dilution of the native bison germplasm.

6. Sex

Importing a few males into a herd can have a large and rapid genetic and demographic impact. The same overall effects can be obtained when importing females, though the process will be somewhat slower. In some cases, it may also be worthwhile to consider any known genetic uniqueness of the mitochondrial genome and Y chromosome. For instance, prior to importing bison into the Texas State bison herd, it was noted that this herd contained a unique bison mitochondrial haplotype not known to occur in other bison herds (Ward et al 1999; Ward 2000). Therefore, importing males into this herd was favored over importing females, in part to prevent dilution of the unique native bison mitochondrial haplotype (Halbert et al. 2005a).

7. Age

Clearly the most rapid infusion of germplasm and improvement in herd viability will be obtained by importing breeding-age animals. In some cases, it may also be desirable to choose bison that have already produced offspring to avoid potential issues of sterility or offspring abnormalities. Even given the most well thought-out plans, however, genetic incompatibilities between native and imported bison may still influence the effectiveness of the imported bison in contributing to the calf crop.

8. Quarantine

A quarantine of newly imported bison should be considered prior to their release, especially when the recipient herd is at a high risk of extinction. Isolating the newly imported bison for some time will allow for an easier adjustment of the imported bison to their new environment and early detection and treatment/ removal of latent diseases.

9. Mating regime

Should the imported bison have exclusive mating privileges for one or more years or should they be included with all other potential breeders to compete for breeding rights? An "exclusive" mating regimen allows for larger potential genetic and demographic impacts. However, a "competitive" mating regimen permits native bison to continue to contribute to the gene pool each year and provides some protection in case of genetic incompatibility between the donor and recipient herds.

9.2.6 Recovering small or threatened herds

Small populations (N_e less than 50, or a census size of fewer than about 150 animals), or larger populations which have undergone a recent and significant decrease in population size, are especially vulnerable to a loss of genetic variation, decreased fitness, and, ultimately, extinction (Gilpin and Soulé 1986). Persistently small populations are additionally susceptible to inbreeding, which can lead to an overall loss of heterozygosity and increase in rare, and often detrimental, genetic traits.

If a large population has undergone a recent reduction (=population bottleneck) in a short period of time (e.g., fewer than three generations), and is allowed to subsequently increase in size rapidly and without culling, the resulting population will probably suffer only small reductions in allelic variation and heterozygosity (Nei *et al.* 1975). The same is not true of the bottleneck effect in small populations, where the loss of allelic variation and heterozygosity tends to be much higher; in this case, extra measures must be taken to maximise the transfer of genetic diversity and minimise the loss of heterozygosity across generations.

Several strategies can be used to alter the breeding strategy of a small herd to maximise recruitment rates and genetic diversity in the calf crops. For instance, attempts can be made to randomise breeding. Bison are naturally polygamous breeders, and it may be necessary or desirable to implement a controlled mating scheme to ensure that a maximum number of males are breeding with the available females, and to maximise the transmission of genetic variation across generations. If semen viability or other reproductive barriers are an issue, artificial insemination may also be considered.

In some cases, altering the breeding strategy of a herd may not be sufficient to reverse the effects of small population size (e.g., Halbert *et al.* 2005a). In these cases, it may be necessary to import bison from other herds to improve recruitment rates and increase genetic variation. As the effects of importing bison into a small herd can be irreversible and even detrimental, the ultimate decision to implement this strategy should be made only after careful consideration, and as a last resort (all issues discussed in section 9.6.2 should be considered). Furthermore, options to maximise demographic and genetic impact (e.g., importing several males vs. a few females) should be considered in threatened herds.

9.2.7 Recovering herds from germplasm introgression

If a bison herd has had an influx of germplasm (genetic material) from an outside source, including another bison herd or a related bovid species, the ability to recover the germplasm of the original herd depends on: 1) the ability to detect bison containing introgressed fragments, and 2) the number of generations since the original introgression event. For instance, if two distinct bison herds are accidentally mixed, parentage testing would allow for post-mating segregation of the two herds and their offspring provided that the bison from each herd are distinguishable (e.g., identification tags or sufficient genetic differences) and that a limited number of generations have passed (fewer than three). If more than a few generations have elapsed since the initial introgression event, the introgressed segments will become dispersed throughout the genome of the herd (hybrid swarm) and reconstitution of the original germplasm will not be possible (Allendorf *et al.* 2001). For example, low levels of domestic cattle introgression have been detected in many extant bison herds (Halbert 2003; Halbert *et al.* 2005b) and can be traced back to human-induced hybridisation of the two species over 100 years ago; in these cases, multiple domestic cattle fragments are dispersed so thoroughly throughout the genome that it is not possible to detect, much less remove, all introgressed fragments.

9.2.8 Herd size reduction

Bison have a high intrinsic reproductive rate and bison herds generally grow rapidly (see Chapter 6). Therefore, when resources are limited, bison herds often exceed the carrying capacity of their environment and begin to have negative impacts on other grazers and native plant species. As a result, most bison herds are subjected to some level of culling (=periodic removals) to maintain a suitable population size (Table 9.4). In extreme cases, it may be necessary to remove a large proportion of the population to meet management goals. For example, if bison have not been culled from a herd in several years, the herd may have nearly doubled in size, and it may threaten the survival of other species. In these cases, extreme caution should be taken to remove bison in a manner that will minimally influence herd and germplasm composition according to the following guidelines. Some discretion is needed in applying these guidelines. For example, it is important to avoid social disruption while simultaneously removing animals from all segments of the population. Managers must carefully evaluate their goals and the specific situation to achieve the best outcome (Table 9.4).

9.3 Behaviour: Mating System, Social Structure, and Movements

Bison behaviour is an index, or reflection, of the conditions experienced by individuals in a population, and behaviour is an emergent property of these conditions. For example, the intensity of competition for mates will be largely determined by population structure and density, and the ability of the herd to exploit environmental heterogeneity through foraging behaviours will be largely be determined by population density and habitat characteristics. Vertebrates exhibit a remarkable ability to modify behaviour, including territorial defence, mating system, or seasonal movement pattern, in response to environmental factors (Lott 1984). Here, we describe desirable behaviours related to social structure, mating, foraging, and movements. Unlike population or genetic composition, behaviours can only rarely be manipulated directly, and behavioural “adjustments” must be accomplished by modifying other factors.

Table 9.4 *Important considerations for culling bison herds. See section 9.2.8 for explanation.*

Genetic diversity	When removing a large proportion of a herd, the primary threat to long-term preservation of the herd is a loss of genetic diversity that can be very difficult, if not impossible, to restore. Therefore, thorough genetic evaluation (e.g., section 9.2.3), is necessary before, during, and after planned large-scale herd reductions. The primary genetic considerations should be the overall maintenance of mitochondrial and nuclear diversity, such that the genetic architecture of the herd is maintained during and after the reduction period. Routine examination of culled animals during the reduction period will allow for detection—and hopefully correction—of "biased" removals, such as removal of a sibship or multigenerational family groups. Preferential removal of related individuals can lead to losses in genetic diversity and effective population size and should be avoided (Frankham 1995).
Herd composition	If, prior to removals, the herd has the desired composition, bison should be removed proportionally from all age and sex classes to avoid disruption of social behaviours and demographic structure. If the current herd structure is substantially different from that desired (e.g. section 9.2), animals may be preferentially removed from certain classes. In the case of disproportional removals, particularly care should be taken to assess and mitigate the potential effects of removals on social structure and genetic diversity.
Population substructure	Population substructure is likely important in many bison populations (see section 9.2). The presence of distinct subpopulations should be carefully evaluated prior to large-scale herd reductions and accommodated in planned reductions.
Time scale	Bison should be removed at regular intervals (rather than large, occasional events) to minimise potentially irreversible impacts on social structure and genetic diversity The exact time period for removals will likely be different for each situation and will depend on such factors as total herd size, the total number of animals to be removed, and the resources available (e.g., facilities, manpower).
Assess effects of management actions	Before and after management actions are implemented, thorough genetic, health, and demographic monitoring is necessary to evaluate recovery efforts, and to detect the need for alternative management strategies. Small populations are especially sensitive to management changes, and comprehensive monitoring may be necessary for some time to ensure the recovery of such herds. Sections 9.2,1, 9.2.3, and 9.5.2 summarise information that should be monitored to detect changes in a timely manner. Especially for small herds, the overall health of the herd should be continuously monitored to detect and treat any heritable or transmissible diseases that may impede recovery efforts.

9.3.1 Social structure and spacing

Bison are inherently gregarious and there are many historical observations of huge bison herds roaming across North America. Despite the enormous size of some bison aggregations, astute observers consistently reported a definable population structure where cows, calves, and immature males formed mixed-sex groups, and where large bulls tended to form separate, much smaller groups throughout much of the year. Groups of bulls are typically smaller than cow-dominated or mixed groups, and bison bulls have frequently been observed alone (Allen 1876; Berger and Cunningham 1994; Meagher 1973; Melton *et al.* 1989). In winter, the general pattern is one of smaller mixed groups, with group size increasing to large aggregations that peak in size during the summer breeding season and then rapidly diminishing (Berger and Cunningham 1994; Hornaday 1889).

The fundamental social group in bison is thought to consist of matrilineal groups (Green *et al.* 1989), although the persistence of these groups in populations that differ in size and ecological circumstances is poorly documented (e.g., McHugh 1958). These general patterns provide a basis for social behavioural guidelines:

1) Bison herds should have the capacity to exhibit seasonal changes in group size;
2) Average herd sizes will usually be smaller in mountains or mixed terrain than in open prairie;
3) Old bulls will be observed alone or in small groups during much of the year;
4) Persistence of matrilineal groups should be facilitated and activities that divide matrilineal groups should be avoided;
5) Activities (roundups, harvest, visitor disruptions, and so on) that disrupt social groupings should be avoided. Where unavoidable, implement carefully to minimize disruptions.

9.3.2 Foraging and movements

Hornaday (1889) described a highly nomadic foraging strategy, where plains bison seemed to wander somewhat aimlessly until they located favourable grazing conditions. Bison then grazed until a need for water motivated further movement. More recent studies of bison foraging have shown that they actively select more nutritious forages, and forage in a highly efficient manner that satisfies their nutritional needs and that frequently compliments diet selection by sympatric herbivores (Coppock *et al.* 1983; Hudson and Frank 1987; Larter and Gates 1991; Singer and Norland 1994; Wallace *et al.* 1995). Spatial variation in forage is produced by natural gradients in soil moisture, soil nutrients, fire, other disturbances, including foraging by bison. After massive wildfires swept along the Alaska Highway in NE British Columbia and the SW Yukon Territory during the early 1980s, bison continued extensive use of recovering areas 15 years later (Larter *et al.* 2007). Bison serve as an ecosystem

engineer, both responding to, and creating, heterogeneity. Bison traditionally exploited broad- and fine-scale variation in forages, for example, sometimes migrating long distances in response to snowfall or drought.

Guidelines to help preserve desirable behavioural patterns are as follows:

1) Allow bison to respond to differences and changes in the distribution, quality, and quantity of forages by moving within, and between, ecosystems;

2) Provide herd ranges that include a broad variety of habitats so that bison can exploit short-term (seasonal) and long-term (annual, multi-year) heterogeneity in forages from patch to landscape scales;

3) Bison herds should have the ability to create and respond to spatial variation in forage quality, quantity, and distribution that is the result of underlying variation in resources necessary for plant growth, to variation resulting from herbivore foraging (by bison, prairie dogs, and other species), and to variation resulting from environmental disturbances such as fire and flood;

4) Balance the advantages of larger population size against a need to avoid permanent habitat damage.

These guidelines suggest that bison should have access to very large areas in which they can exploit natural heterogeneity in forage abundance and quality. Fences and other impediments to movement should be minimised.

9.3.3 Mating behaviour

Differential reproduction resulting from mate competition is an important evolutionary process and, as such, it is crucial to allow bison to express natural mating behaviours. The following guidelines for population management support this goal:

1) The sex ratio of a population should be nearly equal, and in no case should either sex constitute more than 60% of the population;

2) A population should include about 50 mature and reproductively active males for every 100 cows (Gates 1996, unpublished data; Gates *et al.* 2005; Komers *et al.* 1992);

3) Allow interaction and fighting between bulls.

The ratio of mature males to cows will generally be lower than the overall sex ratio because males (bulls) achieve sexual maturity at a greater age than females (cows) and the mortality rate of males is higher than for females.

9.3.4 Limiting factors and natural selection

Chapter 6 described factors that were historically responsible for seasonal and periodic fluctuations in the size and distribution of bison populations. These factors, and the population segments they tend to affect, are consistent with contemporary observations (Chapter 6; Gaillard *et al.* 1998).

General guidelines consistent with our understanding of "normal" demographic processes are:

1) Natural mortality rates should be highest for calves and the oldest age classes;

2) A "normal" range for calf survival is 40-90%, and calf survival should vary with winter severity, predation pressures, and forage availability;

3) Natural survival rates for prime-age adults will normally be about 95%;

4) Under good conditions (e.g., low density, mild winter, good forage production), pregnancy rates for three-year-old cows will be 70% or greater;

5) Under good conditions, pregnancy rates for prime-age cows (generally about 4-15 years old) will normally be 70-90% and some two-year-old cows (probably less than 5%) will produce calves;

6) Disease will generally lower reproductive performance.

9.4 Habitat and Biodiversity Management

Bison can, and usually will, significantly influence habitat and biological diversity, and bison are generally regarded as a foundation species and ecosystem engineers. This is especially true for ecosystems where bison are relatively abundant and range over large areas. Modern, small-horned bison have a long history as an integral part of two major ecosystems: the North American Great Plains (plains bison) and the sedge-meadow ecosystems of northern Canada and Alaska (wood bison).

Bison can profoundly affect ecosystem trophic structures, bio-geochemical cycling, species composition, and patterns of species diversity. Some major types of ecological processes that bison influence are summarised in Table 9.1, while a more detailed review is provided in Chapter 6.

Below we list guidelines for bison management that will help conserve biological diversity. Decisions on active bison management require knowledge of productivity, stocking rates, and movement patterns. Good sources of information for management of confined or semi-confined bison herds in western habitats are the USDA's Natural Resource Conservation Service (NRCS) and its Field Office Technical Guides (http://www.nrcs.usda.gov/technical/efotg/). These documents provide information on primary productivity, recommended stocking rates, animal conversion units, and other information relevant to range management. The NRCS guides, however, focus on obtaining the maximum sustained yield of livestock. There is no comparable resource for biologists managing northern bison. For

northern bison herds, managers should review relevant literature and consult with biologists in boreal regions that support wood or plains bison populations. To enhance and conserve regional biological diversity, bison managers will need to consider local and regional issues, cultural and economic issues, and land use patterns. For example, if the conservation of prairie dogs and other species associated with short vegetation structure is desired, plains bison stocking rates should be higher than those recommended by the NRCS field guides.

The following guidelines can help promote conservation of biodiversity to a higher degree than is achieved in most livestock production systems.

1) Promote the movement and distribution of bison across the landscape in as-natural-a-fashion as possible, including the existence of sub-herds;

2) Manage for a mosaic of seral conditions and grazing intensities across a landscape. If particular conditions or seral stages are regionally rare, they should be favoured through management. This may contrast with traditional livestock grazing management that attempts to impose relatively uniform grazing pressure across an entire management unit and avoid areas of "overgrazing";

3) Manage fire using the best available information on natural fire patterns for the region. Leave unburned areas as refugia for invertebrates and small mammals;

4) Restore and/or conserve prairie dogs and other grazers that interact with bison;

5) Where possible, restore or maintain native predators of bison, i.e., wolves and bears;

6) If mineral, food, or water supplements are necessary they should be provided in a way that creates habitat heterogeneity (as a point attractant rather than being distributed uniformly across the landscape);

7) Manage so that bison do not graze naturally inaccessible areas, for example isolated buttes and steep slopes, which increases landscape heterogeneity;

8) Leave carrion *in situ*.

9.5 Disease Guidelines: Considerations for Infected and Uninfected Herds

As all wildlife populations are hosts to a wide variety of natural pathogens, and these pathogens form an integral component of ecosystem health, we limit the focus of this section to:

- Pathogens that limit bison population recovery directly by reducing survival and/or reproduction, (demonstrating a bison population impact), and/or
- Pathogens that indirectly prevent bison recovery as they form threats to existing livestock and wildlife populations (e.g., so-called economic diseases).

In general, pathogens that fit the above categories are exotic (i.e., have spilled over from domestic livestock populations), such as bovine tuberculosis, brucellosis, bovine viral diarrhoea (BVD), and malignant catarrhal fever (MCF).

Wobeser (2002) outlined four general disease management philosophies: (1) prevention, (2) control, (3) eradication, and (4) the laissez-faire approach (do nothing). Preventative measures are those designed to inhibit the spread of disease to uninfected individuals or populations. For example, the Bison Control Area in the Northwest Territories is managed to prevent the movement of diseased bison from Wood Buffalo National Park (WBNP) to the Mackenzie Bison Sanctuary (Nishi *et al*. 2002c). Control measures reduce the frequency of occurrence or the effects of a disease within a population or contain the spread of the disease. Under this regime, a disease will normally persist indefinitely, requiring continued management. The Yellowstone National Park (YNP) cooperative bison management plan incorporates numerous control measures including test-and-slaughter of diseased bison, hazing of bison back into the park, vaccination, and radio telemetry of pregnant bison (NPS-USDOI 2000). Total eradication of a disease is difficult and, in some cases, may not be possible given current technology and resources. Test-and-slaughter programmes, in concert with vaccination, may eradicate a disease from a captive population (Nishi *et al.* 2002c); however, these techniques are difficult to apply to free-ranging wildlife (Wobeser 2002). In larger populations, or over larger areas, intensive management, emphasising treatment and vaccination, may be inappropriate, unsustainable, or simply impractical (Woodruff 1999). In these circumstances, managing population size, structure, area of occupancy, or the risk of contact between host species or adjacent populations, could offer alternatives to more intensive interventions. Depopulation (=eradication) of an infected herd is a potential option; however, there may be considerable logistical challenges and conservation and policy issues including genetic conservation or salvage, cascading ecological effects, and public opposition (Nishi *et al.* 2002c; Wobeser 2002). Selection of a disease management approach depends on the rationale for management, whether the disease is already present in a population, the availability of funding, and the likelihood of success (Wobeser 2002). Managers should also understand the ecology and pathology of the disease, the dynamics of the pathogen-host relationship (Bengis *et al.* 2002; Wobeser 2002) and the risk to adjacent uninfected host populations, including bison.

Our disease recommendations focus on four disease control strategies: prevention, surveillance, management, and research. We recommend development of a disease management plan under the umbrella of a restoration programme plan that is

consistent with conservation programme goals and incorporates the expert counsel of wildlife veterinarians, epidemiologists, and other disease specialists. Disease management plans should be developed in a local context and involve considerable stakeholder participation.

9.5.1 Prevention

Thorough efforts should be made to prevent the introduction of exotic diseases into existing and future free-ranging bison populations. Introduction of novel pathogens into bison populations could occur by contact with free-ranging wildlife or through contact with captive wildlife or livestock (herein referred to as "potential disease sources"). As a general strategy, managers should strive to maintain population attributes that reduce the likelihood of disease establishment, or an increase in disease prevalence should a pathogen be introduced (Table 9.5). For example, animal density may influence disease transmission and nutritional status of animals. Habitat conditions (e.g., marshy areas for bluetongue or dry conditions for anthrax) and the presence or absence of predators can influence disease establishment or prevalence.

A disease risk assessment should be conducted for existing and future free-ranging bison populations. This risk assessment should include components of disease surveillance (in both the potential disease source and the population at risk) to determine what potential pathogens are involved, contact potential (to determine risk of disease transmission), potential consequences of disease transmission, recommended strategies to mitigate disease risk, and collateral impacts of these actions. Preventive actions may include prevention of dispersal between infected and at risk populations, habitat modification, and maintaining optimal population density, as well as understanding the history of pertinent diseases within the region.

The development of a clinical infectious disease involves a complex interaction between the host (bison), the agent (pathogen), and the environment (habitat). Alterations to any one of these factors may influence the ability of a disease to be introduced or established within a given population. Therefore, a thorough understanding of the biology of the host, agent, and environment is necessary to minimise the risk of introducing or amplifying non-native diseases.

9.5.2 Surveillance

The first step in managing diseases in a population is to determine if a pathogen is present, and if no infected animals are detected, the probability that the disease is present, but at an undetectable level. Surveillance can also be used to determine the prevalence of a disease known to occur, and to monitor changes in its prevalence over time. Disease surveillance can be passive or active.

Passive, or opportunistic, surveillance would include disease testing of animals with clinical signs and/or those that are found dead or moribund. If a cause of death is not apparent, it may be prudent and informative to submit the entire carcass, where possible, for a full diagnostic necropsy to determine cause of death. Local management staff should be trained in basic necropsy techniques, and to correctly collect critical samples when it is not feasible to submit entire carcasses. Diagnostic evaluation is particularly important if human contact may have led to transmission of a zoonotic disease to an employee or a member of the public. If predators are present in the ecosystem, they may remove or compromise carcasses before they can be collected for investigation.

Active surveillance would include capturing animals and testing for diseases, or soliciting samples from hunters of hunted populations. Often, disease surveillance is performed by collecting serum from blood samples and testing these for antibodies to diseases of interest. It is important to remember that the presence of antibodies does not confirm disease in an animal, only exposure to the pathogen at some point in the past. However, one might infer that the pathogen of interest is present in a population based on positive serological results from individual animals. Additionally, most diagnostic tests have been developed for domestic livestock and their applicability in bison

Table 9.5 *Potential management techniques appropriate for management objectives to passively manage, control, or eradicate disease.*

Passive	Control	Eradication
Monitor herd for clinical signs of disease	All techniques under passive category	All techniques in passive and control categories
Implement movement restrictions from populations that are diseased or of unknown disease status	Manipulate population density to minimise spread of density-dependent diseases	Test and cull infected members of the population where scientifically founded and logistically feasible
Modify habitat to minimise congestion	Herd level treatment if feasible (rarely appropriate in free-ranging populations)	Combinations of vaccination, treatment or test and cull developed to rapidly eliminate disease
	Vaccination if available	Depopulation of host species followed by re-population with disease-free animals
	Implement temporal/ spatial separation between infected and susceptible populations (wildlife or livestock).	Elimination of bison from affected areas

may not have been validated. Testing faeces for parasites or pathogens, such as *Mycobacterium avium pseudotuberculosis* (Mptb), may also be beneficial. Active sampling allows estimation of the population-level prevalence of the disease (as it can have greater statistical value because it is likely to be more random than passive sampling), although passive surveillance as a disease detection strategy may be more suitable for protected populations. High priorities for disease surveillance, based on human, wildlife, and livestock health considerations could include anthrax, bovine tuberculosis, brucellosis, BVD, JD, and MCF, among others. Finally, while foreign animal diseases, such as foot-and-mouth (FMD) disease or heartwater, are not highly likely to affect American bison populations, they should be on the "watch" list of potential diseases, since introduction of diseases such as FMD to North America would have significant economic impacts.

Non-specific signs of disease should be monitored and investigated, even though diagnostics are required to determine cause (e.g., poor condition could be due to age or habitat condition, parasitism, or JD, among other causes; Table 9.6).

Table 9.6 *Non-specific clinical signs of disease.*

Loss of body condition	Abnormal behaviour
Abnormal exudates from body orifices	Isolation from the herd
Cloudy eyes	Abnormal loss of hair coat
Diarrhoea	Abortion
Abnormally poor hair coat	Lameness (multiple limb)
Somnolence	Abnormal interaction with humans
Unexpected/ abnormal mortality events	

9.5.3 Management

When a pathogen has been detected in a bison population, an evaluation should be made to determine if a disease management plan should be developed that is consistent with the goals for the bison population. Potential disease management objectives are: a) a passive approach where no actions, or at least no actions that manipulate animals, are taken to control the disease, b) a control strategy where actions are taken to limit disease prevalence, spread, or risk, or c) an eradication strategy where actions are taken to remove the disease from the population. All three strategies (Table 9.5) will likely involve monitoring disease prevalence (either actively or passively as defined above). Strategies used will also be influenced by the intensity of management within the herd. For example, management options, such as vaccination, would be more easily applied to a herd that is intensively managed with round-ups.

9.5.4 Research

Further research will be necessary to develop and implement tools for successful disease prevention, surveillance, and management. For example, many of the diagnostic tests commonly used in bison disease programmes were developed for use in the livestock industry and have not yet been validated in bison populations. Furthermore, key questions remain about the presence/absence and distribution of diseases in populations, and their potential effects on bison demography and genetics.

Research should be designed to meet the needs of local managers, so that results can be applied in more general contexts. A limited list of some of the key disease research themes include:

- Diagnostics (specific to bison, with high sensitivity and specificity to detect a disease);
- Vaccination/immunology;
- Role of genetics in disease resistance;
- Disease epidemiology (e.g., transmission, demography) and risk analysis (spread of disease among and between wild and domestic hosts);
- Identification of emerging disease threats to bison in North America;
- Pathology;
- Effect of disease on population growth and viability (both indirect and direct effects).

Where research is needed for a particular disease surveillance or management question, bison managers are encouraged to work with federal, state, university, and private researchers to meet this need. An adaptive management approach will be necessary, especially when information about a specific disease is scarce.

9.5.5 Stakeholder involvement

In summary, bison populations should be managed to prevent the introduction and spread of diseases that directly, or indirectly, impact bison recovery. However, bison disease management strategies have been, and continue to be, controversial because the apparent solution to the disease problems (or "cure") is often perceived to be worse than the disease itself. Extensive stakeholder involvement in disease management plans is absolutely critical to successful bison disease management; such management strategies have often failed without it. Typical stakeholders in bison disease



Plate 9.2 *Meeting of stakeholders at Vermejo Park Ranch, IUCN Bison Specialist Group. Photo: John Gross.*

management include state and federal agencies (animal health regulators, land management agencies, and wildlife agencies), landowners, livestock producers, conservation organisations, sportsmen's organisations, and native people groups and organisations.

9.6 Active Management: Handling, Herding, Infrastructure

Bison differ substantially from cattle and they often respond poorly to handling that would be routine for cattle. Bison should be treated as wildlife and handled infrequently or preferably, not at all. When handling is absolutely necessary, suitable precautions must be observed, for example, old bulls (and cows) can be very dangerous and difficult to handle. Handling facilities designed especially for bison are needed to ensure the safety of both the animals and people that work with them.

The overarching principle is that to preserve the true, wild nature of bison, active management, through herding or other interventions, should be minimised. Handling bison can result in changes to bison behaviour and lead to management-based selection that, over time, alters genetic composition of the herd (Lott 1998). These changes can be irreversible and detrimental to conserving or restoring a "wild" stock. The general guidelines on preserving normal bison behaviour below are only an introduction. An understanding of the concepts of bison behaviour, practical experience, and perhaps, special training is required to handle bison well. We recommend consulting known experts for advice. Bison handling presents a greater challenge than handling domestic stock and managing for "wild" behaviour is a relatively new concept.

9.6.1 Handling

"Sure, you can herd bison … anywhere they want to go."

When active management of bison is necessary, use "calm animal" techniques based on an approach that adjusts human behaviour to fit the natural response of the animal, rather than the other way around (Grandin and Johnson 2004; Roberts 1996). This approach simplifies handling "wild" animals, and it reduces the tendency for managers to inadvertently remove ecologically desirable traits over time by selective culling.

Guidelines for handling bison are predicated on exploiting their natural instincts (Lott 1991). Bison are strongly motivated by food, by threat of predation, and by the need to maintain social cohesion. Managers can exploit these tendencies: bison can be led with food, and lighter fencing is adequate if better foods are not detected across a fence. By appearing as a predator, managers can precipitate uncontrollable flight or even attack. Less aggressive techniques can be used to control bison movements while minimising risk and effort. Bison's herding "instincts" prevail and groups of bison can be motivated to move simply by motivating the lead cow. By the same token, disrupting the established "pecking order" or cow-calf bonds in a herd stresses bison and makes them harder to handle.

Social cohesion in bison has important implications for handling. In the wild, herds of bison found food and fended off predators better than lone animals, and social communication provides important clues when handling bison. Potential danger signals include postures such as tails up, intense staring, snorting and pawing, and "growling" (by bulls) (Lee 1990a). More subtle signals can advertise anxiety, intent to move away, or willingness to follow.

It is easier to lead than to drive bison (Lee 1990b). Once trained to come to vehicles for food, bison will readily follow a vehicle to different parts of their home range, or they can be gathered for processing. Food dispensed at corrals during annual processing can motivate bison to move on their own toward corrals at the appropriate time the next year.

Predator-related behaviours of bison that handlers can use to their benefit include:

1) A tendency to interpret a direct approach or staring as a threat;

2) A tendency to flee if approached too closely, too swiftly, or too directly;

3) A tendency to drift away if approached slowly and tangentially;

4) Reduced intensity of response with repeated harmless encounters.

Implications of bison being attracted by food include:

1) The difficulty of fencing them away from good-quality food;

2) A tendency for bison to seek out the highest-quality forages in their home ranges;

3) The power of food, when properly managed, to amplify desired behaviour and reduce undesired behaviour.

Ways in which social cohesion can affect handling include:

1) The strong tendency for social groups to follow the lead animal's response;

2) The difficulty of separating cows from their young calves during processing;

3) The stress and disorientation that accompany disruption of social groups;

4) The ease of translocating and moving animals if social groups remain intact.

9.6.2 Fencing

Motivated bison can easily cross or destroy fences generally effective at constraining cattle. Bison-proof fences can be expensive, and if not carefully designed, may hinder passage by other wildlife. Efforts to reduce a bison's motivation to breach fences can greatly reduce the costs of fencing required to contain animals, and reduce adverse effects on other species.

Appropriate fence designs vary with circumstance, and a detailed discussion is beyond the scope of this chapter. More detailed recommendations and evaluations should be consulted before any construction begins (e.g., Butterfield 1990a; 1990b; Gates 2006). In general, a three-strand barbed-wire fence can hold bison that have been trained to avoid fences and that are not strongly motivated to cross the fence. High-tensile wire is more commonly used to build new bison fences or to reinforce existing ones. Some prefer net-wire fences, but depending on design, they can be formidable barriers to other animals that need passage. Electric fences, high tensile or otherwise, greatly increase the barrier effect to bison, and also condition them to avoid fences in general.

The need to allow passage for other wildlife affects fence design where deer, pronghorn, elk, (or other large ungulates) are present. High tensile fences with the bottom wire at least 51 cm (20") off the ground and the top wire 107-132 cm (42"-52") off the ground will constrain bison under most circumstances, while still permitting deer and pronghorn to pass under the fence and most elk to jump over the fence (Karhu and Anderson 2003). A three-wire electric fence with the bottom and top wires 56 cm (22") and 107 cm (42") off the ground, respectively, offered better passage for deer, pronghorn, and elk than did two- or four-wire designs (Karhu and Anderson 2003). Gates (2006) provides additional details and recommendations that vary from those above (e.g., top wire 152 cm (60") above ground). Additional guidance should be obtained to ensure fencing meets the needs of any specific application.

Factors that can modify the effectiveness of fencing include:

1) Bison density; as density increases, more secure fencing may be required;

2) Deep snow-pack may require special design considerations;

3) Damage due to falling trees, big game, vandals, or bison;

4) Attractive food, or other objects, on the other side of a fence increases bison motivation to breach fences.

Factors that influence the effect of fences on deer, pronghorn, or elk include (Gates 2006):

1) Nutritional stress; adverse impacts increase during periods of nutritional stress;

2) Some fence designs (e.g., woven wire) have greater barrier effects than others;

3) Barrier effects that are only seasonal may not be evident when fences are built;

4) Poor designs may injure or kill animals or separate mothers from young;

5) Predators may kill big game more easily by chasing them against fences.

9.6.3 Corrals, pens, and chutes

Corrals and associated facilities for wild bison need to be more carefully designed and constructed than similar facilities for domestic livestock. Bison may not recognise standard fencing as a barrier. Young calves require special attention because they may run into solid gates or fences, although fences that are about 80% solid appear to prevent this (Lammers, personal communication). Fences and gates, with 30-40 cm (12"-16") planks spaced 10 cm (4") apart, effectively stop bison and can be easily climbed by wranglers. Open fences near the working chutes, even those that are very strong, often lead to injury and mortality. Totally solid fencing can be dangerous for people working animals from the ground if they need to escape crowded or charging animals.

Bison handling facilities must accommodate the strong social hierarchy and aggressive behaviours that bison exhibit.

Appropriate facilities usually include custom sized and constructed chutes and alleyways, crash gates, and chute crowding tubes. It is expensive to construct facilities safe for bison (and the people working with them), and we strongly recommend visiting facilities that have proven to be safe and effective. Highly credible facilities include those at YNP (Gardiner, Montana), the Baca Ranch (Colorado), Badlands National Park (South Dakota), and EINP (Alberta).

9.7 Modelling to Assess Bison Populations and Habitat

Computer models are routinely used to improve our understanding of bison population and disease dynamics, and to forecast probable genetic consequences resulting from particular management actions. In the future, we should expect even more widespread use of quantitative models, which can, and likely will, be used for a broad range of purposes. A detailed treatise on modelling is well beyond the scope of this plan. The main goals of this section are, therefore, to provide readers with the minimal background necessary to seriously consider the utility of using an existing model, or of constructing a new management-oriented model, and to provide sufficient insight to the modelling process, that they can reasonably evaluate the validity and usefulness of model results, or at least ask questions that will help resolve these issues.

For conservation purposes, population viability analysis (PVA) and population habitat viability assessment (PHVA) have become common, and important, approaches for assessing existing populations and for evaluating potential restoration or reintroduction projects. We restrict PVA and PHVA to analyses that employ quantitative modelling to assess the risk of extinction, or which attain a quantitative population threshold greater than extinction ("quasi-extinction", from Ginzburg *et al.* 1982; Burgman *et al.* 1992; Ralls *et al.* 2002). Other thresholds for evaluation could include attaining a specified level of inbreeding depression or allelic diversity, or estimating the likelihood that a proposed introduction plan will result in establishment. Conclusions drawn from expert panels, committees, and other source of opinions, in the absence of a quantitative model, do not constitute a PVA (Reed *et al.* 2002). PHVA is a much broader process than PVA, and includes evaluation of geographical, social, regulatory, and ecological considerations that may significantly affect a species. The PHVA process includes a broad range of stakeholders and leads to specific recommendations for conserving a species in the area considered (http://www.cbsg.org/cbsg/phva/index.asp). Viability analysis is important to bison conservation because so many bison populations are small and clearly at risk, and because we have a rich knowledge of factors necessary to conduct credible and insightful evaluations.

The small size of many bison herds has raised concerns about retention of genetic diversity, and these concerns motivated detailed simulations to evaluate effects of management actions on retention of genetic variation in bison herds (Gross *et al.* 2006; Halbert *et al.* 2005; Wilson and Zittlau 2004). Other modelling studies have focused on brucellosis dynamics and its control in bison (Dobson and Meagher 1996; Gross *et al.* 1998; 2002; Peterson *et al.* 1991; Treanor *et al*. 2007) and on illustrating population dynamics of bison (Brodie 2008). All wildlife models are ultimately limited by data availability, and model results can be misleading when forecasts are presented with an apparent precision that is not justified by the underlying model assumptions, structure, or the accuracy of model parameters (Ralls *et al.* 2002; Reed *et al.* 2002). In general, the most appropriate use of simulation model results is to evaluate the merits of alternative management actions, rather than to define an absolute threshold population size. In particular, minimum critical population sizes may be sensitive to small errors in parameter estimates, or to the functional structure of strong environmental perturbations.

9.7.1 Guidelines for using computer simulations

The first critical step is to clearly define the objectives of the modelling exercise. If the intent is to evaluate management actions, the best objectives are quantitative, specific, time-bound, and consist of "treatment" variables (e.g., number of founders, number or proportion removed) that can reasonably be simulated by a computer model. A good objective must include the likelihood of achieving the desired results, the quantitative value of a threshold, and a time horizon. For example, a bison PVA used the genetic objective to achieve a 90% probability of retaining 90% of currently observed selectively neutral genetic heterozygosity for 200 years (Gross *et al.* 2006).

Below, we list steps that will be required to construct a computer model to support bison conservation. A number of recent treatises provide more detailed information about this process (we especially recommend Burgman *et al.* 1993; Bessinger and Westphal 1998; Bessinger and McCullough 2002; Hilborn and Mangel 1997). Although we list steps sequentially, most modelling exercises are iterative and involve simultaneously working through a number of these tasks and revisiting them as more information or insight becomes available.

1. Clearly articulate the objectives of the modelling exercise. It is essential to clearly identify a small, discrete set of "treatments" and "responses".

- What management must be evaluated?
- What is the relevant time frame?
- What model outputs are to be evaluated?

2. Determine the required scope of model.

- Single or multiple species?
- Age or stage structured?
- One or more population units?
- Spatially homogeneous or with spatial structure?
- What is the geographical extent?
- Are animal-habitat feedbacks necessary?

3. Evaluate existing software and decide whether to use an existing programme or to construct a new model. Considerable time and money can be saved by using "off the shelf" software, such as RAMAS (http://www.ramas.com/software.htm), Vortex (Lacy 1993), ALEX (Possingham *et al.* 1992), or another modelling environment.

4. Collect necessary data and estimate model parameters. This can be a huge step. Data will be needed to estimate mean vital rates and realistic estimates of variance. Ecosystem or habitat models will require much additional information to determine carrying capacity and animal-ecosystem feedbacks. Most population-habitat models used for PVA will include catastrophes, estimates of variance in habitat carrying capacity, and specific assumptions on the form and process of density dependence.

5. Construct, calibrate, and run the model. Evaluate model results. Considerable effort may be required to understand and comprehensively evaluate model inputs, and to understand model results. Output from a simulation exercise usually includes huge quantities of data that will need to be reduced, summarised, and presented in an understandable form.

6. Package results in a digestible and understandable format. This is a vastly underappreciated problem, and it will be much easier if the model objectives were clear and concisely stated at the outset.

7. Ralls *et al.* (Table 25.4 in Ralls *et al.* 2002) provide a specific checklist for evaluating the quality of a PVA, and this checklist applies equally well to many additional conservation modelling exercises. They provide "yes-no" questions that focus on model objectives, model structure, data and parameter estimation, analysis of model outcomes, handling of model uncertainty, interpretation, and peer review. These criteria provide a sound framework for helping to ensure models are constructed and used in an appropriate fashion.

9.8 Conclusions

While many topics are addressed in this chapter, effective management of bison ultimately relies on the judicious application of common sense and good judgement. When bison have access to sufficient space and forage, and are left relatively undisturbed, they are more than fully capable of taking care of themselves. Nonetheless, most bison will not experience natural conditions that include wide-open spaces and intact predator communities, so we hope the guidelines provided will support science-based management programmes that lead to more effective conservation and restoration of bison. These guidelines focus on widespread common management issues—population management, disease, and genetic management. These guidelines and principles will ensure that key issues are addressed, and citations will help managers find more detailed information that may be necessary to accommodate specific situations.

Chapter 10 Guidelines for Ecological Restoration of Bison

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10.1 Introduction

During Pre-Columbia times, bison had the widest distribution of any large herbivore in North America, ranging from the arid grasslands of northern Mexico to the extensive meadow systems of Interior Alaska (Chapters 2 and 7). Following the arrival of Europeans, the species experienced unparalleled range contraction and collapse of populations in the wild, primarily during the late 19th Century (Isenberg 2000). Wild bison persisted in only two locations, south of Great Slave Lake in what is now Wood Buffalo National Park (about 300 individuals), and in the remote Pelican Valley in the Absaroka Mountains in the interior of Yellowstone National Park (YNP) (fewer than 30 individuals). The species was extirpated from the wild throughout the remainder of its original range. The American bison has achieved a remarkable numerical recovery, from approximately 500 at the end of the 19th Century to about half a million animals today, of which 93% now exist under captive commercial propagation (Chapter 7). However, Sanderson *et al.* (2008) estimate that bison occupy less than 1% of their original range.

Rarely do wildlife populations in North America achieve the full range of ecological interactions and social values existing prior to European settlement. The bison remains extirpated as wildlife and in the ecological sense from much of its original continental range. This is particularly true of the plains bison, for which few populations interact with the full suite of other native species and environmental limiting factors (Chapters 6 and 7). In the absence of committed action by governments (including aboriginal governments), conservation organisations, and perhaps the commercial bison industry, the conservation of bison as a wild species is far from secure. The main challenges were described in earlier chapters of this volume and are summarised by Freese *et al.* (2007). They include anthropogenic selection and other types of intensive management of captive herds, small population size effects, issues related to exotic diseases, introgression of cattle genes, management under simplified agricultural production systems, and associated with this, widespread ecological extinction as an interactive species.

Contemporary biological conservation is founded on the premise of maintaining the potential for ecological adaptation in viable populations in the wild (IUCN 2003; Secretariat of the Convention on Biological Diversity 1992; Soulé 1987), and maintaining interactive species (Soule *et al.* 2003). Viability relates to the capacity of a population to maintain itself without significant demographic or genetic manipulation by humans for the foreseeable future (Soulé 1987). For limiting factors, such as predation and seasonal resource limitation, adaptation requires interactions among species, between trophic levels, with physical elements of an ecosystem. These, and other interactions among individuals within a population (e.g., resource and mate competition), contribute to maintaining behavioural wildness, morphological and physiological adaptations, fitness, and genetic diversity. These factors enable a species to adapt, evolve, and persist in a natural setting without human support in the long term (Knowles *et al.* 1998).

Viable, wild populations of bison, subject to the full range of natural limiting factors, are of pre-eminent importance to the long-term conservation, global security, and continued evolution of the species as wildlife. However, the availability of extensive ecosystems capable of sustaining large, free-roaming, ecologically interactive bison populations is limited. This is particularly true in the original range of plains bison in the southern agriculture-dominated regions of the continent, given the historical post-European settlement patterns of industrial and post-industrial society. Social and political systems that provide space and environmental conditions where bison can continue to exist as wildlife and evolve as a species, are severely limited.

Innovative approaches need to be instigated in some locations to emulate, to the extent possible, the original ecological conditions, and to prevent domestication and small population-related deleterious effects such as those experienced by the European bison (Hartl and Pucek 1994; Prior 2005; Pucek *et al.* 2004). Currently, there is only one population of plains bison (YNP) and three populations of wood bison (Greater Wood Buffalo National Park, Mackenzie, and Nisling River) in North America that can be considered ecologically restored (thousands of individuals, large landscapes, all natural limiting factors present, minimal interference/management by humans).

The conservation of American bison as wildlife would be significantly enhanced by establishing additional large populations to achieve landscape scale ecological restoration. This will require effective collaboration among a variety of stakeholders, whereby local actions, based upon social and scientific information, are coordinated with wider goals for species and ecosystem conservation. The bison was an

ecologically dominant keystone species over much of its range. Thus the ecological integrity and diversity of ecosystems in which they occurred, whether defined historically or biologically, will depend on large-scale restoration of the bison.

10.2 Ecological Restoration

Ecological restoration provides a conceptual framework for bison restoration at medium to broad scales. It can be defined as the intentional process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed relative to a reference state or a trajectory through time (SERI and IUCN Commission on Ecosystem Management 2004). The goal of ecological restoration is an ecosystem that is resilient to perturbation, is self-sustaining with respect to structure, species composition and function, is integrated into large landscapes, and supporting sustainable human livelihoods. Many healthy ecosystems are a product of human endeavours over very long time periods. In many cases then, ecological restoration projects typically requires the participation of resource-dependant human communities, and have the potential to support ecologically sustainable economies in rural communities. Bison play important ecological roles (Chapter 6), as well as meaningful cultural and economic roles (Chapters 2 and 7). They are increasingly providing a viable alternative to grazing exotic domestic herbivores (Renecker *et al.* 1989).

Ecological restoration of bison: The re-establishment of a population of several thousand individuals of the appropriate sub-species, in an area of their original range, in which bison interact in ecologically significant ways with the fullest possible set of other native species and other biophysical elements of the landscape, and connect in meaningful ways with human communities, with minimal management interventions (adapted from Sanderson *et al.* 2008).

Sanderson *et al.* (2008) asserted that by sharing an inclusive, affirmative and specific vision and knowledge about bison and landscape conservation with a wide range of stakeholders, opportunities can be created to restore bison in ecologically effective herds roaming across extensive landscapes in all major habitats of their original range. Here we define the full, or ideal, ecological restoration of bison as the re-establishment of a population of several thousand individuals of the appropriate sub-species, in an area of original range, in which bison interact in ecologically significant ways with the fullest possible set of other native species and biophysical elements of the landscape, with minimal management interventions. This is not to say that populations smaller than several thousand bison do not contribute to bison conservation, or to restoration of ecological processes (e.g., grazing, soil disturbance, decomposition, nutrient cycling, predation, scavenging; Chapter 6). However, some processes, such as migration and natural selection, may be absent or not function as completely at smaller scales (Chapter 9). Sanderson *et al.* (2008) provide specific criteria for ranking the contribution of bison herds to ecological restoration.

10.2.1 Geographic potential for ecological restoration

The Wildlife Conservation Society hosted a workshop in May 2006 at Vermejo Park Ranch, New Mexico that involved 28 people, including bison specialists, indigenous groups, bison producers, conservation organisations, and government and private land managers, from throughout North America. Among other objectives, participants worked to draft a vision for ecological recovery of the American bison, to develop a consensus hypothesis on major habitat types within the original range that would be useful for representative conservation planning, and to map areas for potential ecological recovery over the next 20, 50, and 100 years (Sanderson *et al.* 2008; also see Chapter 7). The methods used to achieve these objectives were similar to those pioneered for jaguars (Sanderson *et al.* 2002) and subsequently applied to other species (e.g., Thorbjarnarson *et al.* 2006) under the title of "range-wide priority-setting".

A vision referred to as "The Vermejo Statement" was developed for the ecological future of the American bison (Sanderson *et al.* 2008):

"Over the next century, the ecological recovery of the North American bison will occur when multiple large herds move freely across extensive landscapes within all major habitats of their historic range, interacting in ecologically significant ways with the fullest possible set of other native species, and inspiring, sustaining and connecting human cultures.

This vision will be realised through a collaborative process engaging a broad range of public, private, and indigenous partners who contribute to bison recovery by:

- *Maintaining herds that meet the criteria for ecological recovery, as well as herds that contribute in some significant way to the overall vision, regardless of size,*
- *Managing herds for the long-term maintenance of health, genetic diversity, and integrity of the species,*
- *Restoring native ecosystems, ecological interactions, and species,*
- *Providing conservation incentives for bison producers, managers, and other stakeholders,*

"'Ecosystem' means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (Article 2 of the Convention on Biological Diversity).

- *Creating education, awareness and outreach programmes to public and policy-making constituencies,*
- *Building capacity among key stakeholder groups, and*
- *Working across international borders, where necessary."*

Participants in the Vermejo workshop were asked to map areas where "*ecological recovery might be possible*" over three time frames (20, 50, and 100 years), considering future trends in land use, economic development, demography, and climate. The resulting maps provide a subjective, visual hypothesis of the most promising places for ecological recovery (Sanderson *et al.* 2008). The maps illustrate that potential for ecological recovery exists throughout North America. Long-term opportunities are apparent across much of the original range of the plains bison, from private agricultural, state, and national grazing lands in northern Mexico and southern New Mexico, to the agriculture-dominated, mixed tenure landscapes of the Northern Great Plains. In northern regions of the continent, wood bison populations exceeding a thousand animals are already present in three large landscapes in Canada, and a new initiative will restore one or more populations in interior Alaska.

The kinds of large areas required to achieve ideal ecological restoration of bison are likely to be managed by several jurisdictions, and may also involve private landowners. Achieving agreement on restoring bison to such landscapes is challenging prospect, requiring principled, long-term development planning, soundly based on community-based conservation development praxis (see: Bopp and Bopp 2006, for practical guidelines for community development).

10.2.2 Principles for ecological restoration applicable to bison

Successful ecological restoration of bison as wildlife on multi-tenured landscapes requires careful assessment and collaborative planning. While some restoration projects will emerge from government and non-profit organisation initiatives, private landowners may initiate others. In many cases, assembling a sufficiently large landscape (tens or hundreds of thousands of hectares) for ecological restoration will require cooperation between public and private landowners.

The American Bison Specialist Group considered documents published by IUCN and the Society for Ecological Restoration Science and the Policy Working Group, and drew upon the professional and practical experiences of its members, and other participants, to develop the following guiding principles for agencies and non-profit conservation organisations interested in ecological restoration of bison:

1) Goals concerning the management of land, water, and living resources, including bison restoration, are a matter of societal choice.

2) Ecological restoration of bison is an interdisciplinary and inclusive undertaking requiring the involvement of all relevant sectors of society and scientific disciplines.

3) Planning and management of ecological restoration projects should be decentralised to the lowest appropriate level, as close as possible to the human community within a local ecosystem, and supported by the highest levels of government policy.

4) All forms of relevant information, including scientific, indigenous and local knowledge, and innovations and practices, should be considered in planning and implementing bison restoration.

5) Understanding and addressing economic drivers is imperative for successful ecological restoration of bison, including:
   a. Reducing market distortions that adversely affect conservation of bison as wildlife;
   b. Developing incentives to promote conservation of ecologically functioning bison populations and their sustainable uses; and
   c. To the extent possible, internalising the costs and benefits of managing bison as wildlife in an ecologically restored landscape.

6) Ecological restoration of bison should be undertaken at appropriate spatial and temporal scales, and should focus on restoring ecological structure, processes, functions, and interactions within a defined ecosystem.

"A functional conservation area maintains the focal species, communities, and/or systems, and their supporting ecological processes within their natural ranges of variability (i.e., the amount of fluctuation expected in biodiversity patterns and ecological processes under minimal or no influence from human activities)" (Poiani and Richter undated).

7) Restored bison populations should be managed, to the extent possible, as an integral component of, and within the ecological limits of, an ecosystem.

8) Conserving bison and conserving landscapes through restoration of ecologically functioning bison populations are inseparable.

9) Adopting a long-term perspective on ecological restoration of bison, and an inclusive process, will open up conversations and foster partnerships and political will that might not otherwise be possible.

10) Ecological restoration of bison should serve both biodiversity conservation and ecologically sustainable use, and involve fair and equitable sharing of benefits among stakeholders.

11) Ecological restoration of bison should be fully incorporated into national and state/provincial biodiversity conservation strategies.

12) Inter-sectoral and inter-jurisdictional communication at all levels (between nations, government ministries, management agencies, organisations, communities, etc.) improves awareness and multi-party cooperation.

The bison has been a utility species for many cultures and communities since people first arrived on the North American continent about 12,000 years ago, with the exception of a 100-year period between the great contraction of the species (*circa* 1880; Flores 1994) and recent commercialisation (*circa* 1980; Renecker *et al.* 1989). Its utility is reflected in the current predominance of animals managed for private commercial captive propagation (about 93%), and the fact that all large (more than 1,000 animals) free-roaming populations are hunted. The IUCN Policy on Sustainable Use of Wild Living Resources (http://cmsdata.iucn.org/downloads/2000_oct_sust_use_of_wild_living_resources.pdf) and the principles on sustainable use developed by the IUCN Sustainable Use Specialist Group (IUCN SUSG Technical Advisory Committee 2001) apply to the ecological restoration of bison. The IUCN Policy on Sustainable Use provides that conservation of biodiversity is central to the IUCN's mission, which is to influence, encourage, and assist societies to conserve the integrity and diversity of nature, and to ensure that any use of natural resources is equitable and ecologically sustainable. The Policy considers that both consumptive uses (harvesting of animals and plants) and non-consumptive uses (maintaining cultural and aesthetic values of biological diversity) are important components of a sustainable development agenda supporting human livelihoods, while, at the same time, contributing to conservation. In addition, the IUCN Re-introduction Specialist Group (1998) offered important considerations to ensure local stakeholder and agency support for wildlife restoration projects.

Principles for Sustainable Use of Living Resources (IUCN Sustainable Use Specialist Group 2001):

1. Sustainable use will most likely be achieved with consideration of socio-political, economic, biological and user factors at the community, sub-national, national, and international levels.

2. Sustainable use is enhanced by supportive incentives, policies, laws and institutions at all levels of governance, and by effective linkages between them.

3. Local communities, and other parties who have management responsibility for wild living natural resources, must be supported by recognised rights and the means to manage the resources.

4. The contribution and needs of those who manage wild living natural resources must be appropriately reflected in the allocation of the benefits from the use of those resources.

5. Adaptive management, relying on an iterative process of timely and transparent feedback from socio-economic, resource and ecological monitoring, is essential for sustainable use.

6. Sustainability of living wild resource use is enhanced if traditional/local knowledge is taken into account.

7. Sustainable use of wild living resources is enhanced if managerial jurisdictions match ecological and socio-economic scales.

8. Subsidies that distort markets, promote habitat alteration or destruction, and unsustainable use of natural resources should be eliminated.

10.3 The "Ecosystem Approach" for Designing Ecological Restoration of Bison

The Ecosystem Approach (Shepherd 2004) is a strategy for integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. It is the primary framework for action under the Convention on Biological Diversity. The Ecosystem Approach puts people, and their natural resource use practices, at the centre of decision-making. Because of this, it can be used to seek an appropriate balance between conservation and use of biological diversity in areas where there are many resource users combined with important natural values.

Planning and implementing ecological restoration of bison may involve multi-tenured landscapes and is a complex undertaking that requires assessing biophysical and social components, evaluating and engaging stakeholders, considering economic conditions, and cultivating long-term partnerships. Ecological restoration planning is a dynamic process, best achieved incrementally, with ample opportunities for iteration and feedback. The following elements provide guidance for agencies, organisations and individuals interested in designing ecological restoration projects.

10.3.1 Defining the biological landscape and objectives

Ecological restoration of bison considers the species as an interactive element of an ecologically functioning restoration area that provides the size and distribution of habitats necessary to support a restored bison population. Defining a biological landscape for this purpose involves determining the size and refining the boundary of the area, identifying the resource requirements of bison and other focal elements including their spatial needs, and mapping the distribution of habitat resources (Loucks *et al.* 2004). These tasks can be achieved by a variety of processes including expert-driven workshops and local working groups aided by technical experts. For example, the IUCN/SSC Conservation Breeding Specialist Group (CBSG) has extensive experience managing conservation planning workshops using its signature processes, the Conservation Action Management Plan and Population and Habitat Viability Assessment (PHVA), to assist groups in developing species level action plans (www.cbsg.org/cbsg). A Landscape Cumulative Effects Simulator (ALCES®; Forem Technologies; www.alces.ca) is another software tool that is rapidly gaining acceptance by industry, government, and the public as an effective simulation tool for exploring sustainable resource and landscape management alternatives.

Whatever the decision support system is used, common to each process is the need to have stakeholders (conservation groups, wildlife biologists, relevant government agencies, and local private and public land managers) involved. Agreements are typically required on the size and boundaries of the ecosystem and the potential biological capacity of the area to meet the needs of bison restoration and other conservation and community objectives.

"Conservation landscape" refers to a spatial plan for a priority area that meets fundamental conservation objectives while addressing other socio-economic needs (Loucks et al. 2004).

10.3.2 Defining the social landscape, the main stakeholders, and cultivating partnerships

Large-scale ecological restoration involves multiple levels of social complexity, and typically involves more than one jurisdiction. The geographic potential for ecological restoration of bison in North America is illustrated in a general sense by Sanderson *et al.* (2008). Priority areas may be considered as having the potential to become conservation landscapes (*sensu* Loucks *et al.* 2004) that have ecological and social potential for restoration of bison in the intermediate to long term. Careful assessment and understanding of social, economic, legal, and political conditions within candidate landscapes is an essential preparatory step for planning and implementing restoration projects (Loucks *et al.* 2004; The Nature Conservancy 2005), particularly where community support and involvement is required (Child and Lyman 2005).

The priority areas identified by Sanderson *et al.* (2008) represent, in the collective opinion of a group of experts, a hypothesis of where the most promising places for ecological recovery exist, considering future land use trends, economic forces, human demography, and climate. Understanding the regional social-ecological system in such target areas is an important feature of effective conservation planning (Driver *et al.* 2003). In addition to assessing the biophysical capability of a candidate area, detailed assessments are required to define the human community within the ecosystem boundaries. Social landscape analysis (Field *et al.* 2003) provides a tool for understanding and mapping the human landscape. It requires collecting, analysing and mapping human demographic and economic data, and information on land development and ownership patterns and trends. Social landscapes consist of the demographic patterns of people (location, density, age and gender structure, industry and employment patterns, and governance boundaries) in relation to land and resources.

The types of socioeconomic data relevant for ecological restoration planning will vary among locations across the continent. However, certain information is relevant for all landscapes. Detailed and current information on land use, including land use maps, is critical for assessing the impacts of habitat loss and trends. Development plans and targets for important resource sectors (agriculture, energy, and transportation) provide the basis for evaluating impacts of foreseeable change over time. Spatial information on land ownership and management authorities contribute to the identification of stakeholders and assessment of conservation potential.

Loucks *et al.* (2004) provided the following list of socioeconomic variables useful for conservation planning. The list should be reviewed and customised for each project in consultation with local managers:

1. **Current patterns of land and resource use:**
   - Major land and resource uses (including forest, water, wildlife use, agriculture, extraction);
   - Development plans and projected changes in land and resource use;
   - Existing zoning regulations;
   - Major existing and planned infrastructure (roads, dams, etc.);
   - Existing protected areas.
2. **Governance and land/resource ownership and management:**
   - Political boundaries (provinces, districts);
   - Land tenure (private, public, ancestral/communal areas);
   - Agencies responsible for management of land/ resource areas (e.g., forest, agriculture departments).
3. **Population data:**
   - Human population density and growth;
   - Population centres;
   - Migration patterns (in- and out-migration);
   - Social characteristics: income, ethnicity, indigenous areas;
   - Economic data;
   - Economic growth and loss areas;
   - Land prices;
   - Potential values and opportunities for ecological services;
   - Potential for incorporating natural assets into the local economy.
4. **Additional factors that affect biodiversity and potential for bison restoration:**
   - Access (e.g. roads, rivers, energy corridors, etc.);
   - Trends in habitat conversion.

Bison occupy a distinct iconic status as wildlife with both indigenous and non-indigenous North Americans. The cultural and historic significance of bison is particularly important to many Native North Americans (Stephenson *et al.* 2001; Wyckoff and Dalquest 1997). In recent decades, bison have increased in value as private property in the form of livestock (Chapter 7). In the grasslands of the continent, the cattle ranching culture and economy replaced a 10,000-year-old bison economy, and cattle ranching now occupies more than 95% of the Great Plains grasslands. The potential for restoration of plains bison at a meaningful ecological scale in this region therefore depends on support by people involved in this sector. Similarly, support from regulatory authorities, and harmonisation of policies and planning processes is necessary to ensure a feasible start, and sustainable outcomes of bison conservation projects.

> "Current conservation initiatives—parks, land conservation, regulatory programs—offer important contributions but provide solutions to only 10% of the problem. The remaining 90% exist at the interface of human populations and ecological systems" (Child and Lyman 2005).

To ignore or contradict cultural or local interests, or the authority of agencies, can generate unnecessary on-going resistance to conservation initiatives. An example of this is the concept of the "Buffalo Commons" or "re-bisoning" of the Great Plains proposed by Rutgers University geographers Frank and Deborah Popper (Popper and Popper 1987). The Popper's predicted economic and human population declines in the Great Plains, now borne out by current trends (Forrest *et al.* 2004). The idea of replacing the cattle ranching culture with a Buffalo Commons created a firestorm of protest among agriculture-based communities in the region, and continues to haunt discussions about bison conservation and ecological restoration. The general lesson learned from this case is that the ecological restoration of bison is not possible

> Stakeholders are people who will be impacted by the decisions; they have the knowledge to make the best decisions, and the power to implement or block decisions.

anywhere without engaging stakeholders, their interests, mandates and aspirations, and developing local community and agency capacity to engage in sustainable ecological restoration.

Managing social-ecological systems requires an explicit approach that can serve as a vision for stakeholders (Knight *et al.* 2006). Conservation planners should avoid perceiving themselves as empiricists that operate outside, rather than within, social-ecological systems (Sayer and Campbell 2004). Clewell and Aronson (2006) discuss the major motivations or rationales for the restoration of ecosystems and their associated species. These include technocratic, biotic, heuristic, idealistic, and pragmatic rationales that often result in social conflicts. Restoration of bison and their native ecosystems is no exception, as a diversity of socioeconomic factors, from local to regional to international levels, is involved. Organisers wishing to initiate large scale ecological restoration projects are encouraged to become familiar with the theories and practices of community-based resource management (Child and Lyman 2005) and community development (Bopp and Bopp 2006), but more importantly, to include an experienced practitioner on the core development team.

Although bison restoration presents many challenges, it is important to remember that bison have historically provided many benefits to human societies and continue to do so today. In collaborative planning for ecological restoration, it is important to emphasise economic and social benefits, as well as those related to biodiversity conservation and ecosystem health.

Re-introduction: an attempt to re-establish bison in an area that was once part of its original range, but from which it was extirpated.

Re-enforcement/Supplementation/ Augmentation: Addition of individuals to an existing population of conspecifics.

Substitution: the introduction of a closely related species or sub-species, for subspecies that have become extinct in the wild and in captivity. The introduction occurs in suitable habitat within the extinct species or subspecies historical range (Seddon and Soorae 1999).

Source: IUCN Re-introduction Guidelines (Re-introduction Specialist Group 1998)

10.4 Guidelines for Planning and Implementing Ecological Restoration Projects for Bison

The IUCN Re-Introduction Specialist Group (1998) defines the purpose of a re-introduction in the following manner:

"The principle aim of a re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management."

Ecological restoration adds additional values to species' reintroduction projects. It has as its goal, an ecosystem that is resilient and self-sustaining with respect to structure, species composition and function, as well as being integrated into the larger landscape and supporting sustainable human livelihoods (SERI and IUCN Commission on Ecosystem Management 2004). The following guidelines for planning and implementing an ecological restoration project for bison were adapted from the IUCN Re-introduction Guidelines (IUCN 1998). They are also informed by other key documents on conservation and restoration planning (Loucks *et al.* 2004; The Nature Conservancy 2005), community based natural resource management (Child and Lyman 2005), and community development planning (Bopp and Bopp 2006). They address biological and socio-economic needs for restoring bison as an interactive species within a restored ecosystem:

10.4.1.1 Feasibility assessment

- Sites for ecological restoration of bison should be within the original range of the appropriate sub-species of bison;
- For a re-introduction, there should be no remnant population of bison in order to prevent disease propagation, social disruption, introduction of alien genes, or disruptions to logistics;
- In some circumstances, a re-introduction or reinforcement may have to be made into an area that is fenced or otherwise delimited, but it should be within the sub-species' original range and habitat;
- Ecological restoration may take place where the annual habitat and landscape requirements of more than 1,000 bison can be satisfied normally, without the need for supplementation, and a population of at least this number is likely to be sustained for the foreseeable future with minimum management intervention.
- The possibility of natural habitat change should be considered (e.g. forest succession, climate change);
- The effects of interactions of bison with other species in the ecosystem should be defined and considered in planning the restoration project;

- Legal, policy, political, and cultural constraints need to be evaluated to determine if mitigation is needed or possible;
- Determine if the factors causing decline can be eliminated or mitigated (e.g., diseases, over-hunting, over-collection, pollution, poisoning, competition with, or predation by, introduced species, habitat loss, adverse effects of earlier research or management programmes, competition with domestic livestock);
- Where the release site has been substantial degraded by human activity, a habitat restoration programme should be initiated before the reintroduction is carried out;
- A Population and Habitat Viability Assessment will aid in identifying significant environmental and population variables, and assessing their potential interactions, which can guide long-term population management;
- *A priori* agreement is desirable on population objectives, monitoring, and methods that will be used to manage population growth as the target population size is approached;
- Similarly, *a priori* agreement on range health objectives and range monitoring and management methods is desirable;
- Determine the availability of suitable stock, including subspecies or locally adapted forms, genetics (e.g. cattle genes), and absence of specific diseases of concern to conservation;
- A feasibility assessment should include determining if adequate funding is available to successfully complete the project.

10.4.1.2 Suitable release stock

- It is preferable that source animals come from wild populations, or captive stock that have been subjected to minimum management, such as selection for or against specific morphological traits;
- The source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preferences) to the original sub-population;
- Use stock from a source population(s) that has tested negative for the presence of cattle gene markers, based on the best available technology;
- Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol;
- Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed and after it is certain that these effects will not be negative;
- If captive or artificially propagated stock is to be used, it must be from a population that has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology;
- Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock;
- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process for pathogens and exposure to pathogens before shipment from original source;
- If evidence of infection with any notable pathogen is found, the translocation should be stopped and a risk assessment conducted to determine the wisest action;
- Assess the presence of pathogens in wild and domestic species present in the re-introduction area;
- Minimise the risk of infection during transport by managing potential exposure to pathogens;
- Stock must meet all health regulations prescribed by the veterinary authorities of the recipient jurisdiction and adequate provisions must be made for quarantine if necessary;
- If vaccination is deemed appropriate prior to release this must be carried out allowing sufficient time for the required immunity to develop before the translocation.

10.4.1.3 Preparation and release

- Construct a multidisciplinary planning and management team(s) with access to expert technical advice for all phases of the programme;
- Establish short- and long-term goals and specific objectives, both for the bison population and for the habitat and biodiversity management, including success indicators and targets;
- Define monitoring programmes for evaluating how well goals and objectives are being met, and the adjustments that may be required. Each re-introduction should be a carefully designed experiment, with the capability to test methodology with scientifically collected data;
- Secure adequate funding for all phases of preparation and release;
- Monitor the health and survival of individuals;
- Secure appropriate veterinary expertise to ensure the health of released stock, including adequate quarantine arrangements, especially where stock is transported over long distances or crosses jurisdictional boundaries;
- Develop transport plans for delivery of stock to the site of reintroduction, with special emphasis on ways to minimise stress on the individuals during transport;
- Determine appropriate release strategies, including habituation of release stock to the project area, behavioural training, release techniques, and timing;
- Establish policies on interventions to manage parasites and pathogens;
- Establish, where necessary, a detailed containment programme that includes fence design and monitoring and protocols for dealing with escaped animals;

- Interventions (e.g., supplemental feeding, veterinary aid, horticultural aid) should only be undertaken if necessary to prevent catastrophic losses that risk extirpation, or a significant reduction in genetic diversity, particularly when the population is small;
- If fencing is required, use designs that allow for movement of other wildlife species (see Chapter 9 for specifications);
- Develop a conservation awareness programme for securing long-term support: professional training of individuals involved in the long-term programme, public relations through the mass media and in local community, and involvement, where possible, of local people in the programme.

10.4.1.4 Socio-economic and legal requirements

The IUCN Guidelines for Re-Introductions (IUCN 1998) also provide measures for addressing socio-economic and legal requirements of re-introduction programmes. They have been adapted here for ecological restoration projects involving bison. Considering that ecological restoration projects require long-term commitments of financial and political support:

- Socio-economic studies are needed to assess impacts, costs and benefits of the restoration programme to local human populations and governments;
- A thorough assessment of attitudes of local people towards the proposed project is necessary to develop and secure long-term conservation of the restored population;
- The restoration programme should be fully understood, accepted, and supported by local communities and affected government agencies;
- Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the programme area;
- The policies of affected government agencies (at all levels) on restoration and bison management should be assessed. This will include evaluating existing municipal, provincial, national, and international legislation and regulations, and if necessary negotiating new measures;
- Restoration projects must take place with the full permission and involvement of all relevant government agencies. This is particularly important in restoration programmes involving multi-tenure landscapes, such as in border areas, in areas involving more than one state, or where a re-introduced population can expand into other jurisdictions or onto adjacent private lands;
- As with other species of large herbivore (e.g. moose and elk), bison pose small, but manageable, risks of personal injury and property damage. These risks should be minimised and adequate provision made for awareness and, if necessary, compensation;
- If projects are situated adjacent to international or state boundaries, provisions should be made for monitoring or managing bison crossing the boundaries;
- Measures for managing escaped or emigrating bison should be agreed to *a priori* with owners of adjacent lands;
- Approval by relevant government agencies and landowners, and coordination with national and international conservation organisations are necessary.

10.4.1.5 Monitoring, evaluation, and adaptation

The implementation of an ecological restoration project does not guarantee its objectives will be attained or its goals achieved. Outcomes of restoration projects involving complex systems can be unpredictable. Restored ecosystems are dynamic and require evaluation over many years. In large landscapes, a bison population may not mature demographically for 30 years or more following release from management control or following reintroduction (Gates *et al.* 2005; Larter *et al.* 2000). Environmental factors, such as sporadic drought, severe winters or predation effects, contribute to uncertainty of outcomes. Maintaining support for an ecological restoration project in the long term requires continuous evaluation of performance measures (indicators) that represent the ecological infrastructure and functioning of the ecosystem, and others that represent human community needs about sustaining culture and economy. Respect for both local and science-based knowledge, coupled with participatory processes, ensures the full and equitable engagement of the communities, and that the indicators selected, data collected, and decisions made, meet the needs of agencies and local communities.

The following guidelines for monitoring, evaluation and adaptation are offered:

- Post-release monitoring of a significant sample of individual bison is necessary to evaluate individual survival, health, reproduction, and movements, and to assess the causes and significance of unanticipated losses (e.g., copper or selenium toxicity, behavioural naivety to predators) during the initial years of a project;
- Demographic, ecological and behavioural studies of the population should be undertaken over the long term to monitor changes in population and distribution patterns;
- Habitat protection or restoration may be necessary to support population and biodiversity restoration goals;
- Publicity and documentation should be incorporated into every restoration project because published accounts are important for maintaining long-term support of a project. Regular public information releases and publications in scientific and popular literature are useful instruments;
- Monitoring all the costs and a full range of benefits (monetary and non-monetary) to provide documentation that shows the impacts of the project and that funding support is justified;

- Implement adaptive management procedures as needed. Adaptive management, as a restoration strategy, is essential because what happens at one stage in restoration informs or dictates what needs to happen next;
- Capacity building should be informed by results of the monitoring programme and targeted toward the highest priorities and weakest aspects of management.

10.5 Summary

The next 10-20 years present opportunities for conserving American bison as a wild species and restoring it as an important ecological presence in many North American ecosystems. Taking an ecosystem approach, which puts people and their natural resource use practices at the centre of decision-making, offers a paradigm for balancing the sometimes competing demands of bison conservation, the use of bison and biological diversity by people, and sustaining human communities in areas where there are many resource users combined with important natural values. To achieve ecological restoration at broad scales (large herds roaming across vast landscapes, at numerous locations) will require flexible approaches that can be adapted to a variety of legal and socio-economic conditions. Assembling large landscapes for conservation herds will typically involve several land tenure holders, potentially including public agencies, tribal governments, non-profit private organisations, and for-profit corporations or individual entrepreneurs. Diverse mandates, interests, and incentives will influence how stakeholders choose to manage land and wildlife, including bison. Creative new approaches are needed for forging enduring partnerships among land tenure holders for cooperative undertakings. Strategies may range from top-down government programmes to bottom-up market-based or cultural-based initiatives. Progress towards large-scale restoration will require a much more supportive framework of government policies and significant investment by both public and private sectors. Awareness and substantial public support are necessary at both the local level where restoration occurs, and among national constituencies for whom the bison is an iconic component of North America's natural and cultural heritage. For ecological restoration of bison to be successful, careful assessment and understanding of biophysical, social, economic, legal, and political conditions are required for planning and implementation. This is particularly true where both community and agency support and involvement are required. This chapter provided guidelines for planning and implementing an ecological restoration project for bison, including feasibility assessment, selection of stock, preparation and release methods, assessing socio-economic and legal requirements, monitoring, evaluation, and adaptation.

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Appendix A North American conservation herds of bison and their managing authorities

Plains bison

State/Province	Site	Jurisdiction	Managing Authority
AB (Alberta)	Canadian Forces Base Wainwright	Federal-Canada	Department of National Defence
AB	Elk Island National Park	Federal-Canada	Parks Canada Agency
AB/SK (Saskatchewan)	Primrose Lake Air Weapons Range	Federal and Provincial	Department of National Defence; Saskatchewan Environment, Fish and Wildlife Branch
AB	Waterton Lakes National Park	Federal-Canada	Parks Canada Agency
AK (Alaska)	Wrangell-St. Elias National Park and Preserve-Chitina RIver	State	Alaska Department of Fish and Game
AK	Wrangell-St. Elias National Park and Preserve-Copper River	State	Alaska Department of Fish and Game
AK	Delta Junction State Bison Range	State	Alaska Department of Fish and Game
AK	Farewell Lake	State	Alaska Department of Fish and Game
AK	Popof Island	State	Alaska Department of Fish and Game; Shumagin Corporation
AZ (Arizona)	House Rock State Wildlife Area	State	Arizona Fish and Game Department
AZ	Raymond State Wildlife Area	State	Arizona Fish and Game Department
BC (British Columbia)	Pink Mountain Provincial Park	Provincial	British Columbia Ministry of Water, Land and Air Protection
CA (California)	U.S. Marine Corps Base Camp Pendleton	U.S. Military	U.S. Marine Corps
CA	Santa Catalina Island	NGO	Catalina Island Conservancy
CI (Chihuahua)	Rancho El Uno Ecological Reserve	Federal-Mexico	Comisión Nacional de Áreas Naturales Protegidas
CO (Colorado)	Daniels Park	Municipal	Denver Parks and Recreation
CO	Genesee Park	Municipal	Denver Parks and Recreation
CO	Medano-Zapata Ranch	NGO	The Nature Conservancy
CO	Rocky Mountain Arsenal	Federal-US	U.S. Fish and Wildlife Service
IA (Iowa)	Broken Kettle Grasslands	NGO	The Nature Conservancy
IA	Neal Smith National Wildlife Refuge	Federal-US	U.S. Fish and Wildlife Service
IL (Illinois)	Fermi National Accelerator Laboratory	Federal-US	U.S. Department of Energy

Plains bison *(continued)*

State/Province	Site	Jurisdiction	Managing Authority
KS (Kansas)	Konza Prairie Biological Station	State/NGO	Kansas State University, Division of Biology; The Nature Conservancy
KS	Maxwell Wildlife Refuge	State	Kansas Department of Wildlife and Parks
KS	Sandsage Bison Range & Wildlife Area	State	Kansas Department of Wildlife and Parks
KS	Smoky Valley Ranch	NGO	The Nature Conservancy
KY (Kentucky)	Land Between the Lakes National Recreation Area	Federal-US	USDA Forest Service
MB (Manitoba)	Riding Mountain National Park	Federal-Canada	Parks Canada Agency
MN (Minnesota)	Blue Mounds State Park	State	Minnesota Department of Natural Resources, Division of Parks and Recreation
MO (Missouri)	Prairie State Park	State	Missouri Department of Natural Resources
MT (Montana)	American Prairie Reserve	NGO	American Prairie Foundation
MT	National Bison Range	Federal-US	U.S. Fish and Wildlife Service
ND (North Dakota)	Cross Ranch Nature Preserve	NGO	The Nature Conservancy
ND	Sully's Hill National Game Preserve (new herd)	Federal-US	U.S. Fish and Wildlife Service
ND	Theodore Roosevelt National Park	Federal-US	U.S. National Parks Service
NE (Nebraska)	Fort Niobrara National Wildlife Refuge	Federal-US	U.S. Fish and Wildlife Service
NE	Fort Robinson State Park	State	Nebraska Game and Parks
NE	Niobrara Valley Preserve	NGO	The Nature Conservancy
NE	Sully's Hill herd at Ft. Niobrara (original herd)	Federal-US	U.S. Fish and Wildlife Service
NE	Wildcat Hills State Recreation Area	State	Nebraska Game and Parks
OK (Oklahoma)	Tallgrass Prairie Preserve	NGO	The Nature Conservancy
OK	Wichita Mountains National Wildlife Refuge	Federal-US	U.S. Fish and Wildlife Service
SD (South Dakota)	Badlands National Park	Federal-US	U.S. National Park Service
SD	Bear Butte State Park	State	South Dakota Game Fish and Parks Dept.
SD	Custer State Park	State	South Dakota Game Fish and Parks Dept.
SD	Ordway Prairie Preserve	NGO	The Nature Conservancy
SD	Lame Johnny Creek Ranch	NGO	The Nature Conservancy
SD	Wind Cave National Park	Federal-US	U.S. National Park Service
SK (Saskatchewan)	Buffalo Pound Provincial Park	Provincial	Saskatchewan Environment, Parks Branch
SK	Grasslands National Park	Federal-Canada	Parks Canada Agency

Plains bison *(continued)*

State/Province	Site	Jurisdiction	Managing Authority
SK	Old Man on His Back Conservation Area	NGO	Nature Conservancy of Canada
SK	Prince Albert National Park	Federal-Canada	Parks Canada Agency
TX (Texas)	Caprock Canyons State Park/ Texas State Bison Herd	State	Texas Parks and Wildlife Department
TX	Clymer Meadow Preserve	NGO / Private	The Nature Conservancy; Private rancher
UT (Utah)	Antelope Island State Park	State	Utah Division of Wildlife Resources, Division of Parks and Recreation
UT	Book Cliffs Recreation Area	State	Utah Division of Wildlife Resources
UT	Henry Mountains	State	Utah Division of Wildlife Resources
WI (Wisconsin)	Sandhill Wildlife Area	State	Wisconsin Department of Natural Resources
WY (Wyoming)	Bear River State Park	State	Wyoming State Parks and Historic Sites
WY	Grand Teton National Park/Nat. Elk Refuge	Federal/State	U.S. National Park Service; U.S. Fish & Wildlife Service; Wyoming Fish and Game Department
WY	Hot Springs State Park	State	Wyoming State Parks and Historic Sites
WY/MT	Yellowstone National Park	Federal/State	U.S. National Park Service; U.S. Forest Service, Montana Fish, Wildlife and Parks; Montana Department of Livestock

Wood bison

State/Province	Site	Jurisdiction	Managing Authority
AB (Alberta)	Elk Island National Park	Federal-Canada	Parks Canada Agency
AB	Hay-Zama Lakes Complex	Provincial	Government of Alberta, Fish and Wildlife Division
AB/ NWT (Northwest Territories)	Wood Buffalo National Park	Federal-Canada	Parks Canada Agency
AK (Alaska)	Portage Glacier	ENGO1	Alaskan Wildlife Conservation Center
BC (British Columbia)	Etthithun Lake	Provincial	British Columbia Department of Water, Lands and Air Protection
BC	Nordquist Flats	Provincial	British Columbia Department of Water, Lands and Air Protection
MB (Manitoba)	Chitek Lake	Provincial	Government of Manitoba, Department of Natural Resources; Waterhen First Nation
NWT	Mackenzie Bison Sanctuary	Territorial	Government of NW Territories, Resources, Wildlife and Economic Development
NWT	Nahanni	Territorial	Government of NW Territories, Resources, Wildlife and Economic Development
NWT	Slave River Lowlands	Territorial	Government of NW Territories, Resources, Wildlife and Economic Development
YT(Yukon Territories)	Aishihik	Territorial	Government of Yukon

Herds in the progress of establishment:

State/Province	Site	Jurisdiction	Managing Authority
AK (Alaska)	Minto Flats	State	Alaska Department of Fish and Game- currently held at Alaska Wildlife Conservation Center



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Conservation Genetics and North American Bison (*Bison bison*)

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The many millions of North American bison in the mid-19th century were reduced to near extinction by the middle 1880s. Plains bison, the subspecies found in the United States, were saved from extinction primarily by 5 private ranchers and the survival of a small herd in what is now Yellowstone National Park. This bottleneck resulted in the present-day plains bison population being descended from less than 100 founders. In addition, many conservation herds have cattle ancestry because of hybridization promoted by these ranchers in the late 1800s and early 1900s. Today, although there are around 500 000 plains bison in North America, only 4% (20 000) are in conservation herds. Only 1 conservation herd with no known ancestry from cattle has an effective population size of more than 1000. Here I review and evaluate this situation and provide recommendations for the reduction of cattle ancestry, avoidance of inbreeding depression, and maintenance of genetic variation in the conservation herds of bison.

Key words: *bison, effective population size, genetic variation, hybridization, inbreeding, mtDNA*

It is generally cited that 60 million North American bison (*Bison bison*), commonly known as buffalo, existed in the Great Plains until the early 1870s (Lott 2002). This estimate was based on the description of a large herd observed by Colonel R. I. Dodge in 1871 along the Arkansas River in Kansas. However, Shaw (1995), in evaluating the 3 approaches used to estimate the ancestral bison population size (direct observations, numbers killed, and environmental carrying capacity), concluded "one may assume with reasonable certainty that the bison population west of the Mississippi River at the close of the Civil War numbered in the millions, probably in the tens of millions. Any greater accuracy seems unlikely."

It is known from historical and other records that bison ranged from the Arctic Circle and into northern Mexico and nearly across the continent (List et al. 2007; Sanderson et al. 2008). The bison in all this distribution were generally considered the plains bison subspecies (*B. b. bison*) except for the populations in northern Alberta and the Northwest Territories, which had the wood bison subspecies (*B. b. athabascae*). Wood and plains bison have been described as morphologically different (COSEWIC 2004) although Geist (1991) suggested that this difference might be environmentally caused. However, van Zyll de Jong et al. (1995) found that plains bison raised in both plains and wood bison environments retained plains phenotypes and that wood bison raised in both plains and wood bison environments retained wood bison phenotypes, supporting a genetic basis for the morphological differences between the 2 subspecies.

In the early 1870s, very large numbers of bison were slaughtered, mainly for hides, but also for meat and sport. Further, this slaughter had negative effects on Indians living in buffalo country and was not generally discouraged by government officials. By the middle 1880s, bison were nearly extinct. Plains bison were saved from extinction in the late 1800s by 5 private herds established by ranchers and by a sixth herd at the New York Zoological Park. Altogether, these herds were established with less than 100 wild-caught founders (see below). In addition, a small remnant wild population survived in what is now Yellowstone National Park (NP). This population declined to an official estimate of 25 animals in 1902 (Meagher 1973). In other words, nearly all the present-day plains bison in the United States are descended from a founder population of 100 or less, and probably an effective founder number substantially less than 100, because of the small sizes of the herds in the initial generations (note: I will use the terms "population" and "herd" generally synonymously in this article).

In Canada, wild plains bison were extirpated around 1890 (Roe 1970). Plains bison herds were reestablished with animals from 4 of the 5 private herds that contributed to the recovery of plains bison in the United States (COSEWIC 2004). However, a preponderance of the ancestry in Canadian plains bison herds appears to be from the animals in the Pablo/Allard ranch herd that was shipped to Elk Island NP in 1907. A population of wood bison survived in the area that is now Wood Buffalo NP, Canada, and it reached a low of around 250 individuals by 1900 (Soper 1941). In 1963 and 1965, animals from Wood Buffalo NP were taken to Mackenzie Bison

Sanctuary and Elk Island NP to start new herds of wood bison. The Mackenzie and Elk Island herds were started with 16 and 11 animals, respectively (Wilson and Strobeck 1999)

A number of conservation issues face bison today. In 2002, it was estimated that there were approximately 500 000 plains bison but only 4% (20 000) were in herds managed for conservation, the remainder in herds used for commercial production (Freese et al. 2007). The number of plains bison in conservation herds has stayed relatively constant since the 1930s, whereas the number in commercial herds surpassed the number in conservation herds around 1980 and has grown exponentially since (Freese et al. 2007). There are around 10 700 wood bison today in Canada, both in free-ranging and captive conservation herds (Wilson G, personal communication). However, more than 6000 of these wood bison are in herds with either bovine tuberculosis or brucellosis and are isolated from disease-free conservation herds. In commercial herds, there is often artificial selection for domestication, particularly for ease of handling, and for meat production. In a number of the conservation herds, and nearly all the production herds, there is some cattle (*Bos taurus*) ancestry because of past artificial crossing of these 2 species. Freese et al. (2007) estimated that only 1.5% of the plains bison are free of domestic cattle ancestry. Much of the initial crossbreeding occurred on the private ranches that saved the bison because the ranchers wanted to improve cattle with commercially favorable traits found in bison. Finally, bison presently occupy less than 1% of their historical range, and because of this greatly reduced range and their greatly reduced number, Freese et al. (2007) and Sanderson et al. (2008) state that bison do not fulfill their previous ecological functions.

Although bison are an icon of conservation success, as indicated by their representation on the emblem of the US Department of Interior, their history and status are somewhat unusual for a conservation species. First, they are not listed as endangered or threatened, mainly because of their large overall numbers. The only exceptions are the wood bison, which are listed as threatened in Canada, and the Yellowstone herd of plains bison, which are under petition for listing as threatened. However, as stated above, only 20 000 bison are in conservation herds, and many of these have been affected by either interspecies hybridization with cattle or artificial selection. Second, in some jurisdictions, bison are not considered a wild animal but are treated as livestock (Freese et al. 2007). As a result, conservation of bison in the Yellowstone population and in Canadian populations have had additional management hurdles. Third, plains bison are the "only wild animal in the United States that is not allowed to live as a wild animal—live outside parks and refuges—anywhere in its original range" (Lott 2002). Finally, bison are the only conservation species (except for some fishes, such as salmon) that has been extensively selected for livestock-related traits, such as docility and meat production, which would be nonadaptive in a wild population. For example, 1 advertisement for bison ranchers promotes "bison people can get along with" and another promotes a bull with an unusually wide rump, "more rump and less hump," as breeding stock (Lott 2002). These bison provide a potential threat of introducing nonadaptive ancestry if they are ever crossed into conservation populations.

However, it is clear that bison need to be managed as a conservation species because of the potential effects of the low initial numbers of founders, past bottlenecks in various herds, cattle hybridization in a number of conservation herds, artificial selection for nonadaptive traits, isolation of most conservation herds, and the observation of severe inbreeding depression in 1 conservation herd. From a conservation genetics perspective, it is important for bison to keep cattle ancestry at a very low level, avoid detrimental effects of inbreeding and selection for livestock-related traits, and retain sufficient genetic variation for future adaptation. Unfortunately, some of these objectives may be in conflict with each other and may require tradeoffs to achieve the best possible outcome. Although I will present some general information about wood bison and plains bison in Canada, the main thrust of this perspective will be on plains bison in the United States.

Cattle Ancestry in Bison

The first molecular genetic assay of cattle ancestry in bison was by Polziehn et al. (1995) who found cattle mitochondrial DNA (mtDNA) in 2 bison from a sample of 30 from the Custer State Park (CSP) herd in South Dakota. They surveyed 239 other bison in 8 different herds and found only bison mtDNA. Although the founding bison for the CSP herd were purchased from rancher James Philip, who had removed obvious hybrids from his herd, a previous owner of this herd was known to have had cattle–bison hybrids. In the CSP herd and other contemporary conservation herds with low amounts of cattle ancestry, individual bison with cattle ancestry identified by molecular markers have not been reported to be phenotypically different from bison without cattle ancestry, although there are 2 unpublished reports (Halbert N, Derr J, personal communication; Hedgecock D, personal communication) that show an average smaller size for bison with cattle mtDNA (see below).

The *Journal of Heredity* in 1914 published 2 seminal articles by breeders who crossed bison with cattle in efforts to incorporate favorable agricultural traits from bison into cattle, such as meat quality and quantity, hardiness, feed efficiency, and disease resistance (Boyd 1914; Goodnight 1914). The cross between these 2 species was difficult, and they could only cross bison bulls to domestic cows; the reciprocal cross was not possible because bison cows would not mate with domestic bulls (however, see below). From molecular genetic studies, it is estimated that bison and the ancestor of domestic cattle diverged approximately 1 million years ago (Verkaar et al. 2004; Nijman et al. 2008),

suggesting that some reproductive isolation would be expected between these 2 species.

From this first cross, all the offspring were female and there were no male offspring (again, see below). This observation is consistent with Haldane's rule, "When if the F_1 of two different animal races one sex is absent, rare or sterile, that sex is the heterozygous sex" (Haldane 1922). Boyd (1914) suggested that the lack of F_1 males was in part because the large size of male F_1 calves prevented them from passing through the cow's pelvis. However, Charles Goodnight, one of the ranchers that saved bison from extinction, thought that this was mistaken speculation because F_1s, and even bison calves, were smaller than cattle calves, and they did not develop a hump until after birth (Dary 1974).

Figure 1a is a photograph of an F_1 cow from Boyd (1914), who stated that such F_1 cows, although often barren, were larger in size and produced more meat than cows from either parental species. From 1894 to 1915, Mossom Boyd had "102 successful impregnations of cows by buffalos; there were 63 abortions and 39 births. Of the 39 births, 6 were male, only 2 of which survived more than 24 h, and the one that became adult proved to be sterile" (Dary 1974). Starting initially with Boyd's animals, cattle–bison hybridization experiments were then carried out from 1916 to 1935 at an experimental station near Wainwright, Alberta. From 42 impregnations of domestic cows by bison bulls, 6 calves were born (2 males and 4 females), 20 calves were aborted or stillborn, and 16 cows died (Rorabacher 1970). Interestingly, bison cows and domestic bulls were also successfully crossed at Wainwright. From these crosses, there were 15 impregnations, resulting in 7 male births, 7 female births, and 1 stillbirth (Rorabacher 1970).

F_1 females could then be backcrossed to bison bulls, and nearly all these 75% bison ancestry offspring were females. Sometimes 75% bison ancestry bulls could be produced, but such offspring, although larger than the average bison bull, were often not fertile (Boyd 1914). Most of the backcrosses by these rancher–breeder were to domestic bulls so that commercially favorable bison characteristics could be introgressed into cattle. Figure 1b is a photograph of a bull that is 5/16 bison and 11/16 Hereford and that has a Hereford white face. Animals with a majority cattle ancestry were traditionally called cattlelo and are now often called beefalo, a term that refers to animals with $\geq$5/8 cattle ancestry. However, the development and history of the beefalo stock is complicated (Nichols 2007).

Genes with different modes of inheritance have different representations in the progeny of these crosses, and Table 1 gives the expected proportion of cattle ancestry for autosomes, mtDNA, and Y chromosomes. For the cross between bison bulls and domestic cows, the offspring have 50% autosomal cattle ancestry, 100% cattle mtDNA, and because there are generally no male offspring, 0% cattle Y ancestry. For the backcross progeny of a bison bull to F_1 cow, there is 25% autosomal cattle ancestry, again 100% mtDNA cattle, and 0% cattle Y ancestry. In other words, these first crosses result in a predicted excess of cattle mtDNA ancestry and a deficiency of cattle Y chromosomal ancestry compared with autosomal ancestry.

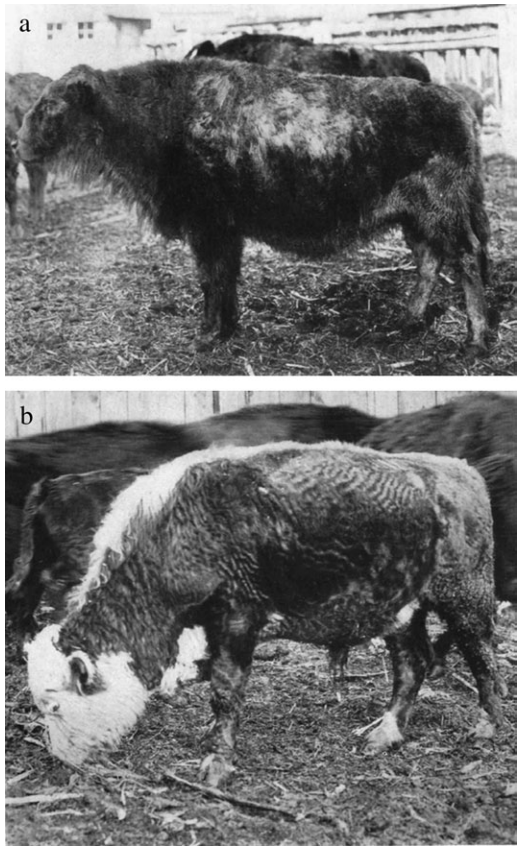


Figure 1. (**a**) F_1 hybrid cow offspring from a bison bull and a domestic polled Angus cow and (**b**) a bull that is 5/16 bison and 11/16 Hereford with a Hereford white face (Boyd 1914).

Table 2 summarizes the published estimates of cattle ancestry from 10 herds of plains bison and 3 herds of wood bison. As predicted, none of these herds, even those with cattle ancestry for autosomal genes and mtDNA, have any cattle ancestry from Y chromosome genes. Also, as predicted, the overall level of cattle mtDNA ancestry is higher than that for autosomal genes. As extreme examples, the herds from Santa Catalina Island (SCI) and Williams Ranch (WR) had mtDNA estimates of cattle ancestry of 44.9% (Vogel et al. 2007) and 100% (Ward et al. 1999), respectively, whereas estimates of cattle ancestry from autosomal genes for these 2 herds were 0.06% (SCI, Penedo C, personal communication) and 0% (WR, Halbert, Ward, et al. 2005), respectively.

The estimates for autosomal ancestry are the average of 14 independent, diagnostic loci for which cattle and bison have nonoverlapping sets of alleles (Halbert, Ward, et al. 2005). On the other hand, the estimate for mtDNA is for the D-loop and indicates ancestry of a single genetic unit, which as a result would be expected to have a much higher variance than the autosomal estimate. Although 5 of the 10

Table 1. The proportion of cattle ancestry from (a) interspecific crosses between bison and cattle and (b) for progeny of backcrosses to bison for genes on autosomes, mtDNA, and Y chromosomes

				Cattle ancestry		
Cross	Male	×	Female	Autosomal	mtDNA	Y
(a) Interspecies	Bison	×	Cattle	0.5	1.0	— (no male offspring)
	Cattle	×	Bison	—	— (no offspring)	—
(b) Backcross to bison	Bison	×	F_1	0.25	1.0	0.0 (few males)
	F_1 no males	×	Bison	—	— (no offspring)	—

plains bison herds have autosomal cattle ancestry, the average estimated ancestry is less than 1%.

Finally, the 3 wood bison herds do not appear to have any cattle ancestry, as would be expected if they are descended from the wild herd that survived. However, it appears that these wood bison populations hybridized with the large number of plains bison that were moved to Wood Buffalo NP from 1925 to 1928. In other words, it appears that these wood bison populations, and indeed all wood bison populations, are wood–plains hybrids and not pure wood bison (see discussion and data in Wilson and Strobeck 1999; COSEWIC 2004).

Understanding the difference in mtDNA and autosomal cattle ancestry and their modes of inheritance can be useful. If males are translocated from a herd with high mtDNA cattle ancestry and apparently low autosomal cattle ancestry, then the mtDNA ancestry would not be transmitted. For example, males from the Santa Catalina Island herd, if used in other herds, would not transmit cattle mtDNA.

Although conservation herds have been managed as pure bison, it has become clear in recent years that even conservation bison herds have some cattle ancestry resulting from the early experimental crosses. In a comprehensive survey of 11 federal conservation herds, Halbert and Derr (2007) used 14 diagnostic, nuclear microsatellite loci and mtDNA markers to estimate the amount of cattle ancestry (Table 3). Seven of these herds had evidence of low amounts of nuclear cattle ancestry (average of 0.84%).

This cattle ancestry appears to be the result of early crosses between cattle and bison in combination with more recent movement of animals that has spread this ancestry between populations. For example, 5 of these populations have the cattle microsatellite allele BM4307-197 in frequencies ranging from 0.115 to 0.163. However, 4 of these populations, Badlands NP, Neal Smith National Wildlife Refuge (NWR), Theodore Roosevelt NP-S, and Theodore Roosevelt NP-N, were founded entirely or in part with animals from Fort Niobrara NP, the only other federal conservation herd where this allele was detected. The Fort Niobrara population was established in 1913 in part by animals from a private ranch (Halbert and Derr 2007). A likely explanation is that this cattle microsatellite allele was by chance in high frequency on the private ranch because of small population size and that the similar high frequency in all the 5 descendant herds reflected this initial high frequency. Similarly, cattle microsatellite allele BM7145-166 was found both in the National Bison Range herd and the Neal Smith NWR herd, which was partially founded from animals from the National Bison Range.

Only 4 of these federal conservation herds do not have detectable cattle ancestry (Grand Teton NP, Sully's Hill NGP, Yellowstone NP, and Wind Cave NP). However,

Table 2. Estimated cattle ancestry for autosomal genes, mtDNA, and Y chromosome genes for 10 plains bison herds and 3 wood bison herds (summarized from Ward et al. 1999, 2001; Halbert et al. 2004; Halbert, Ward, et al. 2005; Vogel et al. 2007; Penedo C, personal communication)

			Cattle ancestry		
Subspecies	Herd name	Location	Autosomal	mtDNA	Y
Plains	Antelope Island SP	Utah	0	0.011	0
	Custer SP	South Dakota	0.015	0.206	0
	Elk Island NP	Canada	0	0	0
	Finney GR	Kansas	0.018	0.038	0
	Henry Mountains	Utah	0	0	0
	Maxwell GR	Kansas	0.011	0.180	0
	National Bison Range	Montana	0.003	0.018	0
	Santa Catalina Island	California	0.006	0.449	—
	TSBH	Texas	0	0.167	—
	Williams Ranch	Texas	0	1.000	0
Wood	Elk Island NP	Canada	0	0	0
	Mackenzie Bison Sanctuary	Canada	0	0	0
	Wood Buffalo NP	Canada	0	0	0

SP, State Park; GR, Game Refuge; —, not evaluated. Elk Island NP has both subspecies in separate areas.

Table 3. Eleven federal bison herds and the estimated proportion of autosomal cattle ancestry for mtDNA and 4 cattle alleles and overall estimated cattle ancestry found in these herds (Halbert and Derr 2007)

		Cattle mtDNA or allele					
Herd name	Location	mtDNA	BM314-157	BM4307-197	BM7145-166	BMS2270-94	Cattle ancestry
Badlands NP	S Dakota	0	0	0.136	0	0.032	0.011
Fort Niobrara NWR	Nebraska	0	0	0.135	0	0	0.009
Grand Teton NP	Wyoming	0	0	0	0	0	0
National Bison Range	Montana	0.018	0	0	0.038	0	0.004
Neal Smith NWR	Iowa	0	0	0.135	0.016	0	0.010
Sully's Hill NGP	N Dakota	0	0	0	0	0	0
Theodore Roosevelt NP-N	N Dakota	0	0	0.163	0	0	0.011
Theodore Roosevelt NP-S	N Dakota	0	0	0.115	0	0	0.008
Wichita Mountains NWR	Oklahoma	0	0.090	0	0	0	0.006
Wind Cave NP	S Dakota	0	0	0	0	0	0
Yellowstone NP	Wyoming	0	0	0	0	0	0

NGP, National Game Preserve; N, north unit; S, south unit.

given other historical evidence, Halbert and Derr (2007) suggested that they are reasonably confident that the herds are free of cattle ancestry only for Yellowstone NP and Wind Cave NP, due to the large samples examined and the known ancestry of these populations. Because the Grand Teton NP population was partially founded from the Theodore Roosevelt NP herd, which has cattle ancestry (the rest of the population was descended from Yellowstone animals), they suggested that a larger sample from Grand Teton NP (39 animals were surveyed) might potentially uncover cattle ancestry. Likewise, a substantial proportion of the founders of the Sully's Hill NGP population came from herds with known cattle ancestry, such as Fort Niobrara NP (note that the current census number in the Sully's Hill population is only 35 females). Only 1 of these 11 populations, National Bison Range, had cattle mtDNA ancestry (1.8%) even though these populations were exhaustively sampled (except in Grand Teton NP). Although Y chromosome cattle ancestry was not specifically evaluated in these populations (except for the National Bison Range where it was 0%), from the results discussed above, it is assumed to be 0%.

As mentioned above, there are 2 unpublished reports that bison with cattle mtDNA have smaller body size than bison with bison mtDNA (Halbert N, Derr J, personal communication; Hedgecock D, personal communication). From these data, the lack of known phenotypic differences between bison with cattle and bison ancestry at particular genes may be because there has not been detailed study of the appropriate comparisons. In other words, it is possible that cattle ancestry in bison may have important undesirable phenotypic effects.

Inbreeding Depression

Determining inbreeding levels, and inbreeding depression, for individuals in which specific pedigrees are not known is difficult. However, given a thorough population sampling, detailed genetic information, and known mother–offspring pairs, paternity can be inferred and accurate pedigrees from wild populations constructed (Pemberton 2008). To be confident of estimates of inbreeding and inbreeding depression, a detailed pedigree of at least several generations is generally required and reliable information on fitness measures, such as individual mortality, reproduction, and mating success, or of fitness surrogates, such as measurements of body size, is necessary.

The formerly large population size, and presumably large ancestral effective population size for bison, suggests that there was substantial detrimental genetic variation segregating in bison, assuming equilibrium. Further, the rapid reduction in population size from many millions to an effective founder number of less than 100 in plains bison suggests that some of these detrimental variants became fixed or increased in frequency by chance, resulting in a lowered population fitness (genetic load) and/or increased inbreeding depression (Hedrick 2005). In cattle, a longer time period of lower numbers during which they were domesticated and breeds developed may have allowed many detrimental variants to be purged. At this point, inbreeding depression has only been documented in the Goodnight herd (discussed below) and suggested for the population in Badlands NP (Berger and Cunningham 1994). However, this does not mean that it has not been present in other herds, only that it has not been demonstrated.

Charles Goodnight, one of the ranchers who worked to save bison from extinction in the late 1800s, began his herd with 5 wild-caught calves from Texas in the mid 1880s. Records indicate that his herd had 13 animals in 1887, 125 in 1910, and 200–250 in 1920s (Haley 1949). After Goodnight's death in 1929, the herd changed ownership several times, and in 1997, the remaining 36 animals were donated to Texas State Parks and Wildlife and moved to Caprock Canyons State Park (Halbert et al. 2004). These animals are now known as the Texas State Bison Herd (TSBH). The contemporary animals in this herd appear to be directly and exclusively descended from the bison herd originally assembled by Charles Goodnight. Six of the 36 bison

Table 4. The average age, natality (offspring per adult female), and early mortality from the first 6 years of the TSBH (Halbert, Grant, and Derr 2005) (*N* indicates sample size)

Year	Average age	Natality (*N*)	<1 Year mortality (*N*)
1997	3.56	0.19 (21)	0.75 (4)
1998	4.59	0.24 (17)	0.50 (4)
1999	5.35	0.73 (15)	0.64 (11)
2000	5.73	0.24 (17)	0.25 (4)
2001	6.23	0.62 (16)	0.30 (10)
2002	6.20	0.33 (15)	0.80 (5)
Average for TSBH		0.376 (101)	0.526 (38)
Other herds		0.560	0.042

donated in 1997 had cattle mtDNA, reflecting the crosses with cattle made by Goodnight (Halbert et al. 2004).

In 2002, the TSBH herd was still only 40 animals and had not shown any population growth. Other conservation herds have often had very rapid population growth, for example, the Badlands NP herd studied by Berger and Cunningham (1994) grew 10–20% per year. Table 4 gives the age, natality, and early mortality over the first 6 years of the TSBH (Halbert, Grant, and Derr 2005). Over this short time period, the average age in the herd increased by nearly 3 years, the natality rate (births per cow) was only 67% that in comparison herds, and the mortality in the first year was 12.5 times as high as other herds. This low natality and high early mortality explains the lack of growth of the population and its increasing age. In 2001, 15 of the 18 cows were pregnant but only 5 calves were born in 2002, and 4 of these died in the first year, so only 1 calf was produced for 15 cows. In addition, of 8 mature bulls (>3 years old) tested in 2000 for sperm motility and morphology, 4 had significant sperm abnormalities including low motility, bent tails, and detached heads (Halbert et al. 2004).

The TSBH was started from a small number of animals and is thought to have been through several bottlenecks during different owners and has had a small population size throughout most of its history. Although detailed records have been kept of this herd since 1997, there is no pedigree from earlier years from which to calculate inbreeding. As a general surrogate for these early records, we can compare the heterozygosity calculated by Halbert et al. (2004) for 54 microsatellite loci in 2001 in the TSBH (0.38) to the average in the Yellowstone and Theodore Roosevelt NP herds for the same loci (0.60). Using these estimates as the heterozygosity before and after genetic drift over a number of generations, a general estimate of the effect of small population size on heterozygosity in this population is

$$H_t = H_0 \prod_{i=1}^{t} \left(1 - \frac{1}{2N_{ei}}\right), \qquad (1a)$$

where H_t is the heterozygosity in the tth generation and N_{ei} is the effective population size in the ith generation (Hedrick 2005). We can then assume that the overall effect on reducing heterozygosity is approximately

$$1 - f \approx \prod_{i=1}^{t} \left(1 - \frac{1}{2N_{ei}}\right)$$

and

$$f \approx 1 - \frac{H_t}{H_0}, \qquad (1b)$$

where f is an estimate of the inbreeding coefficient. Therefore, assuming that $H_0 = 0.60$ and $H_t = 0.38$, the approximate level of inbreeding is $f \approx 0.367$. In other words, the reduced fitness observed in the TSBH appears to be equivalent to that expected from substantial inbreeding, on the order of 2 generations of full-sib mating (Hedrick 2005) although the loss of genetic variation probably took place unevenly over the last century (over 12 generations assuming a generation length of 8 years, see below).

In 2003, 3 bison bulls from Ted Turner's Vermejo Ranch in New Mexico were donated to the TSBH. The Vermejo Ranch herd is the only known private herd that does not appear to have cattle ancestry (Freese et al. 2007). Initial unpublished information suggests that the negative fitness effects in the TSBH have been overcome by this introduction (Swepston D, personal communication), a potential example of genetic rescue (Tallmon et al. 2004).

Genetic Variation

As general biological background related to understanding the amount of genetic variation in bison, we can use information on reproductive success from Berger and Cunningham (1994) and Wilson et al. (2002) in plains and wood bison, respectively. In plains bison, fecundity was highest for females aged 3–13 years, whereas the highest male success was for males aged 7–12 years (Berger and Cunningham 1994). Similarly, Wilson et al. (2002) found the highest success for females aged 3–12 years and the highest success for males aged 7–9 years. A general idea of generation length can be obtained as the average of these data on age of reproduction as approximately 8 years (or somewhat less if age-specific mortality is included). In addition, in both subspecies, the variance in reproductive success was significantly higher in males than females (Berger and Cunningham 1994; Wilson et al. 2002). Using the data from plains bison at Badlands NP, Berger and Cunningham (1994) estimated the ratio of effective populations size (N_e) to census population size (N), N_e/N, as between 0.3 and 0.45 over different years and estimation approaches.

Before the identification of cattle ancestry in bison, the major conservation genetic concern in bison was the potentially low genetic variation, mainly because of low initial founder numbers but also because of subsequent bottlenecks and genetic isolation. For example, the 5 original ranch herds were each founded by a very small number of individuals. From the historical literature (Dary 1974;

Wilson and Strobeck 1999; Halbert, Ward, et al. 2005), it appears that the Goodnight herd (Texas) was descended from 5 founders, the Alloway–McKay herd (Canada) from 5 founders, the Dupree–Philip herd (South Dakota) from 6 or 7 founders, and the Pablo–Allard herd (Montana) from 6 founders. Although the Jones herd (Kansas and Oklahoma) appears to have had a number of founders, it is known to have contributed only 1 animal to the New York Zoological Gardens population and a small number of founders to other private herds. In other words, the total number of independent founders that these 5 herds contributed to the present population appears to be less than 50 and may have been only 30.

Although the wild Yellowstone herd is thought to have had substantial population numbers in some years, it had official census estimates of only 25–50 for the 16 years from 1896 to 1912 (Meagher 1973), suggesting a 2-generation bottleneck for this population. Further, the official estimates were only 25 in 1901, 1902, and 1907 and in 1902 only 22 were observed in the main herd (1 other animal was also observed). Because of these low numbers in the wild Yellowstone herd, 18 cows from the Pablo–Allard herd and 3 bulls from the Goodnight herd were introduced into a fenced area in Yellowstone NP in 1902 (Meagher 1973). In 4 of the first 5 years, only 2 of these males were present (1 died after the first year), and in 3 of the first 5 years, only 17 of the 18 females were present. Using a standard formula for effective population size (Hedrick 2005), the effective number of founders for this group is unlikely to be more than $N_e = 4N_fN_m/(N_f + N_m) = (4)(17)(2)/(17 + 2) = 7.2$. This population was kept separate from the wild population until 1915–1920 and later Meagher (1973) suggested that it constituted 60–70% of the ancestry of the total Yellowstone population. Thus, it appears that a majority of the Yellowstone ancestry may be descended from a small effective founder number of animals from the Pablo–Allard and Goodnight herds, which may have reduced overall genetic variation in the Yellowstone herd.

Wilson and Strobeck (1999) examined variation at 11 microsatellite loci in a number of herds and looked for correlations of genetic variation with founder number and number of founder sources and found a positive correlation between the number of founders and the average number of alleles. Halbert and Derr (2008) examined variation at 51 microsatellite loci in the 11 federal herds; Table 5 summarizes their results and information about the founding of these herds (average number of alleles is given rather than the standardized allelic richness because a very high proportion of nearly all the populations were sampled). For example, 2 of the herds with the highest genetic variation, National Bison Range and Yellowstone NP, had many founders and multiple founder sources. The Neal Smith herd also had high genetic variation but was only established recently, and so has not experienced much genetic drift. On the other hand, the lowest variation was observed in the Theodore Roosevelt NP-N, which was founded from 20 animals from the Theodore Roosevelt NP-S in 1962. The Sully's Hill herd, which also has low variation, has a low census number and has been kept at a low number for many years.

Most of these federal herds have been managed separately except for the translocation of animals to establish new herds and infrequently to augment herds. In other words, many of them have independently undergone genetic drift over a number of generations so that some genetic differentiation between them would be expected. Halbert and Derr (2008) examined these herds for genetic differentiation using several different approaches and suggested that there are 5 different clusters (Table 5). Four of these clusters are single populations that show genetic differences from other herds, National Bison Range, Wichita Mountains, Wind Cave, and Yellowstone (average F_{ST} of 0.135). The other cluster (A) is composed of the 5 other populations that are connected by translocations and show lower differentiation between them (average F_{ST} of 0.065). The 2 other herds from Grand Teton and Neal Smith do not fit well into these categories, presumably because of their founding history from several sources.

Conservation Genetic Perspective and Recommendations

Cattle Ancestry in Bison

Much of the focus of conservation genetics in bison in recent years has been to identify herds with cattle ancestry (Halbert, Ward, et al. 2005; Halbert and Derr 2007). For example, Halbert and Derr (2007) suggested "the apparent success of the bison recovery efforts over the past 150 years is threatened by domestic cattle introgression. Hybrid species do not have taxonomic status and are not protected by the Endangered Species Act (ESA)." However, in Canada, only wood bison are listed as threatened, and the only petition for listing as threatened in the United States is for the Yellowstone herd of plains bison, and neither of these show evidence of cattle ancestry. Further, there does not appear at present to be an official policy to provide guidelines for dealing with hybrids under the US ESA (Allendorf et al. 2004), so how the ESA would be applied to bison with cattle ancestry is not clear.

As discussed above, in the federal herds that have cattle ancestry, the level appears quite low, less than 1%. Turning this around, it appears that more than 99% of the ancestry in these bison herds is from bison. Except for the 2 unpublished reports of the effect of cattle mtDNA on bison body size, animals with molecular evidence of cattle ancestry have not been identified as being morphologically, behaviorally, or in other phenotypic ways different than bison without identified cattle ancestry. Reducing cattle ancestry from $<1\%$ to 0% may not have a substantial positive impact on bison fitness. On the other hand, cattle ancestry could be different in kind than ancestry in most other hybridization situations because cattle were domesticated up to 10 000 years ago (Bruford et al. 2003). Since then, cattle have been selected for agricultural traits, making their ancestry potentially very detrimental in a wild species such as bison.

Table 5. Eleven federal bison herds (for abbreviations, see Table 3) and the number of founders, number of founder sources, and years of introduction for them (Halbert and Derr 2007)

	Founder						
Herd	Number	Sources	Years	Census	H_E	Number of alleles	Cluster
Badlands NP	73	3	1963, 1983	875	0.578	4.56	A
Fort Niobrara NWR	21	4	1913–1952	380	0.595	4.40	A
Grand Teton NP	32	2	1948, 1964	600	0.561	4.08	—
National Bison Range	50	7	1908–1984	350	0.647	5.00	6
Neal Smith NWR	33	3	1996–1998	63	0.639	4.96	—
Sully's Hill NGP	19	5	1919–1997	35	0.566	3.62	A
Theodore Roosevelt NP-N	20	1	1962	312	0.522	3.56	A
Theodore Roosevelt NP-S	29	1	1956	371	0.582	4.30	A
Wichita Mountains NWR	17	2	1907, 1940	600	0.652	4.85	2
Wind Cave NP	20	2	1913, 1916	350	0.591	4.16	1
Yellowstone NP	46[a]	3	1902	3000	0.625	4.84	7

Also given is the current census estimate (total number of individuals), level of heterozygosity (H_E), and average number of alleles for 51 microsatellite loci and cluster number from STRUCTURE analysis (Halbert and Derr 2008) (— not in cluster).

[a] About 25 from the surviving wild population.

In general, hybridization between endangered species and common related species is considered to be a potential threat to endangered species (Rhymer and Simberloff 1996; Allendorf et al. 2001). However, the greatest threat is thought to be from high levels of contemporary mating between an endangered species and a related nonendangered species. The cattle ancestry in conservation herds of bison is not the result of contemporary mating but is the result of artificial crosses, mostly made 100 or more years ago. Crossing cattle with bison is difficult, even in containment, and there is no evidence that crosses between these species occur naturally.

The low level of autosomal cattle ancestry in conservation herds of bison suggests that either the initial level when no more cattle ancestry was introduced was low or selection has resulted in a decline of cattle ancestry over time. There does not seem to be an imminent danger for the swamping of the bison gene pool by cattle ancestry. Although there are no temporal data on cattle ancestry in conservation herds of bison, it is entirely possible that the level of cattle ancestry is declining over time. If there is detrimental cattle ancestry, such as cattle mtDNA that appears to reduce body size, maintaining a large effective population size (so genetic drift is not important) would allow selection to reduce this detrimental ancestry without further human intervention.

For estimation of cattle ancestry, the microsatellite loci (and mtDNA D-loop) are appropriate and probably reflect neutral differences between the genomes of bison and cattle. However, it is important to put the estimate of $<1\%$ autosomal cattle ancestry from these markers in perspective. First, bison and cattle probably share more than 99% of their DNA sequence, as do other closely related species. In other words, the $<1\%$ cattle ancestry is probably $<1\%$ different from bison, or it results in $<0.01\%$ difference in the genomes of conservation herds with and without cattle ancestry.

Second, from the known cattle ancestry (Halbert, Ward, et al. 2005; Halbert and Derr 2007), there does not appear to be evidence that specific regions of the cattle genome have been positively selected in bison. In fact, the distribution of cattle regions in bison appears consistent with that expected by chance due to genetic drift (Halbert N, Derr J, personal communication). Even the very high cattle mtDNA ancestry in the Santa Catalina and Williams Ranch herds may be a chance effect of genetic drift.

How did the proportion of autosomal cattle ancestry become so low in bison herds with cattle ancestry? If backcrosses to bison occurred over multiple generations (as shown for 1 generation in Table 1), then the autosomal ancestry is reduced by half each generation. Or the expected cattle ancestry for t generations of backcrossing is $(\frac{1}{2})^t$. For 6 and 7 generations of backcrossing, the cattle ancestry would be reduced to 1.56% and 0.78%. This is not inconsistent with what has been observed. Or, if additional purebred bison were added to the herd, then this would decrease the level of cattle ancestry as well. Perhaps instead of this scenario, some of the cattle regions of the genome may have been selected against resulting in a decline in their frequency over time.

With these caveats, several recommendations about reduction of cattle ancestry in conservation bison herds seem reasonable.

(1) Bison from populations with evidence of cattle ancestry should not be introduced into populations with no evidence of cattle ancestry.
(2) Introduction of animals from herds with no evidence of cattle ancestry into herds with cattle ancestry is appropriate when surplus animals are available. This could, for example, result in a decrease of inbreeding depression, an increase of genetic variation, or even genetic swamping of cattle ancestry. In addition, excess animals from these herds without evidence of cattle

ancestry could be used to establish new conservation herds by public and private stakeholders.

(3) Translocation between herds with similar levels of cattle ancestry is potentially appropriate because this would not increase the overall level of cattle ancestry. However, to make sure that herds have similar levels of cattle ancestry, a more accurate estimate of cattle ancestry, based on more microsatellite loci or perhaps single nucleotide polymorphisms, is recommended. In addition, further detailed examination of the potential phenotypic effects of cattle ancestry in bison is recommended.

(4) Reduction of cattle ancestry by culling animals with known cattle mtDNA is generally appropriate and could eliminate cattle mtDNA from herds. However, such culling should not be assumed to reduce the nuclear cattle ancestry because the mtDNA and nuclear cattle ancestries are not expected to be associated, that is, to be in linkage disequilibrium. In herds with high cattle mtDNA levels, great care should be taken to retain bison variation at nuclear loci if there is selective culling to reduce cattle mtDNA.

(5) Reduction of the frequency of specific nuclear cattle alleles from a population by culling is also possible, but it is likely that cattle ancestry will remain at other unidentified genetic regions in these herds.

Avoiding Inbreeding Depression and Maintaining Genetic Variation

Although some population sizes of the conservation bison herds are not small, these numbers should be compared with the very high numbers present 150 years ago. When the total number for plains bison was in the many millions and there was generally gene flow throughout the subspecies, there presumably was high variation for genes having detrimental, neutral, and advantageous effects. It is not known whether the variation today reflects this historic variation. Examination of museum or historic samples before the great bison decline, from 1850 or earlier, could be used to compare the present-day variation with ancestral variation. For example, if the variation at neutral loci or sites is lower today than historically, this may indicate significant bottleneck effects and a consequent potential for increase in some detrimental variants.

As discussed above, the TSBH has substantially lowered fitness for several different traits. Although no other herds have as low genetic variation as the TSBH, the Neal Smith herd, for example, has relatively low heterozygosity. The amount of variation in other isolated conservation herds, besides the federal herds, may also potentially be low.

Although Halbert and Derr (2008) identified 5 different clusters with substantial differentiation between them, it is likely that these differences have been generated primarily by genetic drift since the founding of the herds. It is possible that some of the differences reflect ancestral differences present in bison herds before their near extinction, although the large ancestral population size and high amounts of ancestral gene flow make this unlikely.

Several general recommendations on inbreeding depression and genetic variation for the conservation bison herds seem reasonable if considered in balance with the previous recommendations on reducing cattle ancestry:

(1) In order to minimize inbreeding depression and maintain genetic variation in populations, regular exchange between bison populations is recommended. It appears that natural bison populations were composed of large, intermixing groups, and reestablishment of this situation is recommended. Of course, considerations beyond genetics, such as disease transfer, different state laws on bison, and success of translocated animals, must also be considered.

(2) Monitoring of fitness-related traits, such as mortality, natality, and mating success is recommended so that fitness levels (and adaptation) can be documented.

(3) Individual herds or clusters should have an effective population size of 1000 (census number of 2000–3000) to avoid inbreeding depression and maintain genetic variation. If it is not possible to have this primary herd in 1 location, then it could be in 2 or 3 locations with significant genetic exchange between them. Note that this is larger than any of the plains bison herds except for Yellowstone NP and any of the wood bison herds except for Wood Buffalo NP and Mackenzie Bison Sanctuary in Canada.

(4) Identified differentiated populations (clusters) should be replicated with at least one other physically separated population with an effective population size of 1000. If it is not possible to have this replicated population in 1 location, then it could be in 2 or 3 locations with significant genetic exchange between them.

(5) Pedigrees of the populations should be established. The molecular data already collected could form the basis of identifying paternity and potentially other relationships in these pedigrees. In addition, from these data, the contemporary effective population size N_e and the ratio of N_e to the census number, N_e/N, could be estimated.

(6) Estimation of effective population size in recent generations using analysis of linkage disequilibrium and variance in allele frequency, and past effective population size using sequence data, is recommended (Schwartz et al. 2007).

(7) Estimation of the ancestral level of genetic variation from museum samples or other historical samples is recommended. This should help identify genetic patterns over space that were present before the great reduction in bison numbers and large changes in allele frequency that may have occurred due to the changes in population numbers.

(8) There is no justification to select for preservation of specific rare bison microsatellite alleles in populations. Selection for the increase of the frequency of specific rare alleles has been shown to have a significantly greater cost than benefit because of the loss in genetic variation in the rest of the genome (Hedrick and Miller 1994).

Acknowledgments

I wish to acknowledge the attendees of the Bison Genetics Workshop at Nebraska City, Nebraska, in September 2008, for introducing me to many aspects of bison genetics. I particularly wish to acknowledge the research and publications of Jim Derr, Natalie Halbert, and their colleagues, who have contributed enormously to the understanding of bison genetics. Specific thanks to Natalie Halbert and Greg Wilson, who answered my questions about plains and wood bison, respectively. Thanks also to Scott Baker, Jim Derr, Rich Fredrickson, Natalie Halbert, Dennis Hedgecock, Robin Waples, Greg Wilson, and Jim Womack for comments on the manuscript.

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Corresponding Editor: C. Scott Baker

From: Stephen Torbit
To: Anna Munoz
Subject: More Bison Stuff
Date: Monday, February 29, 2016 1:33:00 PM

So, after looking at his emails, he has some good but very detailed questions for Lee and she has done a good job addressing his questions. I am sure we can expect more from him.

On the Bison Range Concept Issues.

1. The National Bison Range bison herd does contain some very valuable genetic material, material that is important to include in bison conservation planning at a regional or national scale. We have known and acknowledged for some time (Dratch and Gogan, 2010) of the important contribution that NBR bison can make to overall bison conservation. Accordingly, FWS has worked over the last several years to expand to numerous refuge locations (Rocky Mountain Arsenal, Ft. Niobrara and Sully's Hill) to expand both the numbers and enhance the conservation of NBR bison.
2. In this time of transition, we will continue to assess the status of our FWS bison meta-population and address appropriate opportunities to ensure genetic conservation of the NBR line of bison. We believe we have made considerable progress in ensuring the future of NBR bison and their genetic resources, but we will look to validate that progress over the next several months.

Stephen C. Torbit
Assistant Regional Director
Science Applications
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, Colorado 80228
303-236-4602 – Office
720-626-7504 – Cell

From: Cynthia Martinez
To: Tony A. Schoonen
Cc: Dan Ashe
Subject: Re: Bison Range
Date: Saturday, March 05, 2016 11:14:02 AM

Hi Tony,

Sure thing. I'll try to anticipate some of the questions you might get
and send it your way.

Cynthia

> On Mar 5, 2016, at 9:04 AM, Tony A. Schoonen <tony@boone-crockett.org> wrote:
>
> Thanks Dan!
>
> Hi Cynthia! Do you have a one pager or something that outlines the purpose of this transfer to BIA and why the USFWS would be supportive of that move?
>
> The Bison Range is in our backyard so to speak (the Club helped establish and pay for the refuge in 1908) so I am sure folks will be calling and I like to make sure we have our facts straight
>
> On the polar bear last I heard things are moving which is goo thanks for asking!
>
> Thanks
>
> Tony
>
> Sent from my iPhone
>
> On Mar 3, 2016, at 7:58 PM, Dan Ashe <d_m_ashe@fws.gov<mailto:d_m_ashe@fws.gov>> wrote:
>
> Hello Tony. No, we are not considering a "transfer" to the Confederated Salish-Kootenai Tribes (CSKT). We are in discussions, and do support, the concept of transferring the National Bison Range to the Bureau of Indian Affairs (BIA) to be held "in trust" for the CSKT people. It would be managed by the CSKT for the original purposes (bison conservation).
>
> Cynthia Martinez, National Wildlife Refuge System Chief, is a good contact and I've copied her with this message.
>
> Best.
>
> Dan.
>
> P.S. -- how's it going with the polar bear?
>
> Dan Ashe
> Director, U.S. Fish and Wildlife Service
>
>
>
> On Mar 3, 2016, at 12:05 PM, Tony A. Schoonen <tony@boone-crockett.org<mailto:tony@boone-crockett.org>> wrote:
>

> Hi Dan
>
> We are getting some calls about transferring the bison range to the Kootenai Salish. Is that in play? If so can you put me in touch with someone who can send me a brief summary of what is going on?
>
> Thanks
>
> Tony

HARRY REID
NEVADA

DEMOCRATIC LEADER

United States Senate

WASHINGTON, DC 20510–7020

March 8, 2016

Mr. Dan Ashe
Director
United States Fish and Wildlife Service
1849 C Street NW, Room 3331
Washington, DC 20240-0001

Dear Director Ashe:

Enclosed is a letter I have received from Marvin L. Plenert, former Regional Director of the Pacific Northwest Region for the Fish and Wildlife Service.

I would appreciate your reviewing this situation and providing answers to Mr. Plenert's concerns. Please send your reply directly to Mr. Plenert, and send a copy of your response to me.

Thank you for your cooperation and assistance.

My best wishes to you.

Sincerely,

Harry Reid

HARRY REID
United States Senator

March 1, 2016

Honorable Harry Reid

United States Senate
Washington, D C 20510
Dear Senator Reid;

I am writing to urge you to do everything within your power to prevent the Fish and Wildlife Service (FWS) from achieving an ill-conceived proposal to abandon its inherent responsibilities and objectives to the American People. The proposal I'm referring to, is a recently released document by the FWS, offering support for legislation to remove the 108 year old crown jewell refuge, the National Bison Range (NBR) in Montana from the National Wildlife Refuge System (NWRS) and place it "in trust" as an Indian Reserve. A copy of the announcement from the Mountain-Prairie States Regional Director Noreen Walsh is attached # (1).
By this proposed action there is no doubt that the FWS leadership in both Washington D C and Denver Colorado are shirking their inherent Federal responsibilities, thereby putting the entire NWRS under siege and in jeopardy. The passage of the National Wildlife Refuge System Administrative Act (NWRSAA) in 1966 and subsequent amendments by Congress provided the authority, guidelines and directions for the FWS to administer a network of lands and waters as a cohesive system. Congress also made it very clear that there should never be any attempt to establish a second refuge system by delegating its authorities or transferring units or responsibilities to any other entity.

The proposal to transfer the NBR out of the NWRS has exposed the lack of integrity and dishonesty of FWS Director Dan Ashe and disputes his earlier assurances as noted in the attached # (2) September 16, 2011 letter to former Assistant Secretary of the Interior Nathaniel Reed, in which Director Ashe states the Service will not "turn over" management of the NBR or any other refuge to the Confederated Salish-Kootenai Tribes (CSKT) or any other non-service entity. Under any future annual funding agreement (AFA), the NBR will remain a unit of the NWRS, managed by the Service under direct guidance of the Service on-site refuge manager. No inherently Federal functions will be contracted to the CSKT. Ashe also stated that before a new AFA is signed and reported to Congress that an environmental assessment (EA) laying out alternatives will be prepared in order to seek public review and comment on the draft document. The FWS did keep their word and an EA was released for review in September, 2014, marking the first time the public was given an opportunity to review and comment on the negotiated agreement with the CSKT. Despite Director Ashe's assurances reviewers of the latest negotiated AFA discovered it laden with inherent

Federal functions. Apparently the comments received by the FWS did not support their proposed alternative of ceding management to the CSKT. The entire process has been pigeonholed, with no follow up to those who commented on the EA, and hence 17 months later the transfer was proposed.

The FWS efforts to acquiesce to the CSKT's request for an AFA that would turn over management of the NBR to them has failed over a period now approaching 20 years at tremendous cost to the FWS and tax payers, as well as the enormous adverse impacts on dedicated professional refuge staff members. The primary reason for failure is that the CSKT has made no secret of their intentions and demands to take over complete control and full ownership of the NBR land. See attached CSKT mission statement # (3).

The impasse has apparently led to the current FWS proposed transfer of the NBR. It must also be noted that all negotiations and discussions on AFA's by the FWS and CSKT over the fate of the NBR have been conducted in secrecy behind closed doors, with not one iota of public input or involvement. If the American Public or true owners of the NWRS had been involved, the failed AFA attempts could have been avoided, as well as the lawsuits that were filed and lost by the FWS because of failure to follow or comply with legal mandates.

The NBR a hallmark refuge was established by President Theodore Roosevelt at the express order of congress. The legislation required the U S Government to purchase a reserve within the Flathead Indian Reservation with Federal monies at an appraised market value for the express purpose of preserving the nearly extinct population of American bison. In 1971 the initial payment to the Tribes was brought before the Indian claims court. That tribunal made a final judgement requiring the Government to make an additional payment of around $23 million for the land again. Certainly the public has paid for the acquisition of the NBR and for 108 years invested heavily in its infrastructure of roads, fences, corrals and buildings, including office-visitor center. Today the NBR draws over 220,000 visitors each year to view wildlife in natural settings. The economic effects of its presence and the recreation brought over $975,000 in local expenditures and more then $19,100.00 in non-resident spending in 2011. The economic effect of the NBR was calculated to be $13.89 for every dollar of budget expenditure by the NBR.

During my 32 years as a FWS employee and another 22 years in retirement I have personally been involved with the management, protection and enhancement of the NWRS, and worked diligently to ensure a strong and vital conservation system for all to enjoy, I therefore, strongly oppose this dangerous precedent setting action by the FWS, which is apparently being done to resolve the dilemma presented by intransigent positions of the FWS and CSKT. The NWRS today consists of nearly 600 units and totals more then 150 million acres, and represents the worlds largest most diverse collection of public lands set aside specifically for the conservation of fish, wildlife and plants, all managed by the FWS as a cohesive unit.

Senator, The refuge system needs your help and that of your colleagues to emphatically refuse to support any proposed legislation that would transfer the NBR or any other unit of the NWRS to the CSKT or any other non-service entity. This iconic 108 year old refuge or any other refuge should never be bargained away to appease the political or self-serving economic interests of non-service entities. Our collective efforts should be spent to preserve the integrity of the NWRS for all Americans from current and future threats.

With your help this ridiculous proposal can be put to bed. Thank you for your consideration on this request, and I look forword to hearing from you.

Sincerely,

Marvin L Plenert

[redacted]

Phone [redacted] Email [redacted]

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

SEP 16 2011

In Reply Refer To;
FWS/D/ 049519

Mr. Nathaniel P. Reed
P.O. Box 1213
Hobe Sound, Florida 33475

Nat

Dear Mr. Reed:

Thank you for our conversation today and your support and your interest in the National Bison Range (NBR). The U. S. Fish and Wildlife Service (Service) is currently negotiating with the Confederated Salish and Kootenai Tribes (CSKT) for a new Annual Funding Agreement (AFA) to involve the CSKT in the operations and maintenance of the National Bison Range and other units of the NBR Complex that lie within the Flathead Reservation. Before a new AFA is signed and reported to Congress, the Service will prepare an Environmental Assessment, and will seek public review and comment on the draft document.

The Service cannot and will not "turn over" management of NBR or any other Refuge to the CSKT or any other non-Service entity. Under any future AFA, NBR will remain a unit of the National Wildlife Refuge System, managed by the Service under direct guidance of the Service's on-site Refuge Manager. No inherently federal functions will be contracted to the CSKT. The CSKT has extremely strong cultural, historic, and geographic ties to the NBR and the NBR bison herd, and will work with us through its highly professional Natural Resources Department. Any future AFA will uphold both the letter and spirit of both the Refuge Administration Act, as amended, and the Tribal Self-Governance Act. These laws are not mutually exclusive. We are confident that a strong partnership, with Service and CSKT employees working together, under direction of the Refuge Manager, is the best way to continue managing the NBR to achieve the Refuge's purposes and the mission of the National Wildlife Refuge System.

Thanks again for your time today and continued interest in this issue. If you have any questions, please call me at 202-208-4545.

Sincerely,

Daniel M. Ashe
Director

Attachment NO. 1

THE CONFEDERATED SALISH AND KOOTENAI TRIBES, THE SOVEREIGN PEOPLE OF THE FLATHEAD INDIAN RESERVATION

VISION

The traditional principles and values that served our people in the past are imbedded in the many ways we serve and invest in our people and communities, in the ways we have regained and restored our homelands and natural resources, in the ways we have built a self-sufficient society and economy, in the ways we govern our Reservation and represent ourselves to the rest of the world and in the ways we continue to preserve our right to determine our own destiny.

MISSION

Our mission is to adopt traditional principles and values into all facets of tribal operations and service. We will invest in our people in a manner that ensures our ability to become a completely self-sufficient society and economy. We will strive to regain ownership and control of all lands within our reservation boundaries. And we will provide sound

enhance natural resources and ecosystems.

Developed by Strategic Planning Committee, March 1996

Adopted by Tribal Council, May 1996

Fwd: Discussion with the CSKT about the National Bison Range
Wednesday, March 2, 2016 5:56 PM Mark as Unread

From: "Marvin Plenert" <[redacted]>
To: [redacted]

--- On Fri, 2/5/16, Bill West <[redacted]> wrote:

> From: Bill West <[redacted]>
> Subject: Fwd: Discussion with the CSKT about the National Bison Range
> To: "Bill West" <[redacted]>
> Date: Friday, February 5, 2016, 5:46 PM
> FYI New
> direction----------
> Forwarded message ----------
> From: Noreen
> Walsh <noreen_walsh@fws.gov>
> Date: Fri, Feb 5, 2016 at 4:12 PM
> Subject: Discussion with the CSKT about the National Bison
> Range
> To:
>
> Dear
> Mountain-Prairie Region, I want to inform
> you of a discussion the Service started today with the
> Confederated Salish and Kootenai Tribes (CSKT) regarding the
> National Bison Range. Many of you know that we have been
> working with the CSKT for about 20 years on the idea of a
> partnership at the National Bison Range that would be
> outlined in an Annual Funding Agreement which would allow
> them to manage and implement some of the activities on the
> refuge. This process has required much time and effort on
> the part of many, and despite valiant efforts all around,
> the parties have been unable to come to terms on a
> mutually-acceptable agreement. In an effort to
> achieve the best, long-term solution for our many
> conservation priorities, the specific conservation goals of
> the National Bison Range, and to support the principles of
> Indian self-determination there was a discussion today with
> the CSKT about the potential for the Service to support
> legislation that would transfer the lands comprising the
> National Bison Range to be held in trust by the United
> States for the CSKT. I wanted you all
> to know why we entered into these discussions. The
> National Bison Range was established in 1908 within the
> boundaries of the Flathead Reservation, home of the CSKT,
> for the express purpose of conserving the American bison
> during a time when the species was on the verge of

> extinction. Since then, the Service as well as our
> federal, state, and tribal partners have made great strides
> in conserving bison and re-establishing herds throughout
> their historic range. Also, while we have desired a
> meaningful partnership with CSKT at the National Bison
> Range, a mutually-acceptable agreement has been elusive.
> Given that we are today in a much better place regarding the
> future of bison, that we have much work to do on
> landscape-scale conservation efforts, and that we want to
> strengthen our partnership with the CSKT, we believe that
> now is the right time to investigate the possibility of
> transferring the refuge, which was long ago carved out of
> tribal lands, into trust for the benefit of the CSKT.
> Such a proposal
> would require Congressional approval and therefore, at this
> point, we don't know if or when such a transfer would
> occur. Today was our first discussion with the CSKT about
> the idea. As we go forward, my pledge is to ensure that
> wherever the discussion leads us, the talented and
> committed staff of the National Bison Range are taken care
> of. To this end, Will Meeks, Mike Blenden, and I spent the
> afternoon at the Refuge where we talked about the ideas
> under discussion. In our conversations, I emphasized that
> they will all remain valued employees of the Service,
> regardless of the outcome of these discussions.
> I know that many
> of you will have thoughts and questions about this idea.
> This was not an easy decision to come by, nor one that was
> taken lightly, but in the end, I believe that this is a good
> path for the Service, the CSKT, and for the conservation of
> our fish and wildlife resources. As always, I value
> your feedback and questions. Noreen
>
> Noreen WalshRegional
> DirectorMountain-Prairie RegionU. S.
> Fish and Wildlife
> Service
>
>
>
>

From: Volesky, Mike
To: Noreen_Walsh@fws.gov
Date: Wednesday, March 09, 2016 1:46:43 PM

Hi Noreen,

Been meaning to send you a note letting you know, I think opening the door to transferring the NBR to CSKT is smart, bold, and the right thing to do. I'm sure you've heard from some who disagree. Keep up the good work.

Mike

From: Noreen Walsh
To: "Volesky, Mike"
Subject: RE:
Date: Wednesday, March 09, 2016 3:17:00 PM

Mike, hope all is well with you. You are right: we're hearing from some who disagree….. Thanks for your note – it really means a lot.

Best,
Noreen

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

From: Volesky, Mike [mailto:mvolesky@mt.gov]
Sent: Wednesday, March 09, 2016 1:46 PM
To: Noreen_Walsh@fws.gov
Subject:

Hi Noreen,

Been meaning to send you a note letting you know, I think opening the door to transferring the NBR to CSKT is smart, bold, and the right thing to do. I'm sure you've heard from some who disagree. Keep up the good work.

Mike

Conversation Contents

Fw: Mazzoni Letter to Ashe

Attachments:

/29. Fw: Mazzoni Letter to Ashe/1.1 Personal Correspondence - NBR Ashe 2016.docx

Marvin Plenert <marvplenert@yahoo.com>

From:	Marvin Plenert <marvplenert@yahoo.com>
Sent:	Wed Mar 09 2016 18:56:32 GMT-0700 (MST)
To:	Ralph Webber <ralphwebber@frontier.com>
Subject:	Fw: Mazzoni Letter to Ashe
Attachments:	Personal Correspondence - NBR Ashe 2016.docx

Here is letter to Ashe regarding the NBR from Mazzoni

b(6) [redacted]

[redacted]

February 26, 2016

Mr. Dan Ashe, Director

U.S. Fish and Wildlife Service

1849 C. Street

Washington, D.C. 20240

Dear Dan:

You may not remember me. I believe the last time we met was nearly eighteen years ago in Albuquerque, New Mexico, while I was serving as the Assistant Regional Director for Refuges and Wildlife in Region 2. As a retired, forty-year employee of the Fish and Wildlife Service (Service), dedicated to the management and protection of units of the National Wildlife Refuge System (NWRS), I was stunned recently to learn that the Service, under your leadership, supports legislation that would "transfer lands comprising the National Bison Range to be held in trust by the United States" for the Confederated Salish-

Kootenai Tribes (CSKT) in Montana…..as announced in Regional Director Noreen Walsh's memorandum to the refuge field folks in the Mountain-Prairie Region.

That decision contravenes your earlier assurances in a September 16, 2011 letter to former Assistant Secretary of the Interior Nathaniel Reed, in which you stated, "The Service cannot and will not 'turn over' management of NBR or any other refuge to CSKT or any other non-Service entity. Under any future AFA, NBR will remain a unit of the National Wildlife Refuge System under direct guidance of the Service's on-site Refuge Manager. You went on to say, "We are confident that a strong partnership, with the Service and CSKT employees, working together, under the direction of the Refuge Manager, is the best way to continue managing the NBR to achieve the Refuge's purposes, and the mission of the National Wildlife Refuge System."

That statement was a clear, unambiguous expression of your commitment to protect the NBR and other units of the NWRS and not allow it or other refuges to be bargained away to appease the political, economic, or other self-serving interests of non-Service entities. Refuge field folks and retirees felt re-assured and applauded this clear statement of your dedication

to preserving the ultimate integrity of the NWRS from such future threats.

The recent pronouncements by Service sources, notably Regional Director Walsh and Chief of Refuges Cynthia Martinez, to try to rationalize this radical departure from your earlier position are seen by many as contrived.

To suggest that the NBR should be relinquished because bison are no longer endangered, and, therefore, the refuge no longer serves its purpose, objectives and contribution to the NWRS, ignores its historical place in American history, the role this herd continues to play in the effort to preserve natural bison populations and the total values of the refuge, as clearly defined by Congress in the Refuge Improvement Act. We're talking about a viable, fully successful, fully functional national wildlife refuge that maintains a herd of genetically unique and diverse bison in carefully maintained and artfully managed natural habitat for the education and enjoyment of future generations of all Americans. And it has done so for 108 years!

The examples being given to suggest that this action is not precedent-setting are simply not comparable. Some are former

migratory waterfowl easement areas that permanently lost their water supply, another is the former Mescalero fish hatchery, which was closed for two years due to severe weather damages before being turned over to a tribe from among several tribes whose commercial and recreational fishing programs it was originally built to support! Please, don't insult our intelligence.

Your spoke persons have said that any proposed legislation to place the NBR in trust for the CSKT would be unique to that refuge, and not affect any other refuge. Yet, the Service has identified 37 or 38 refuges as available for tribal negotiations for Annual Funding Agreements (on a Federal Register List that may, at any time, be added to by tribal or Bureau of Indian Affairs request).

The Service's track record for successfully negotiating AFAs is not good. Its' efforts to respond to the CSKT's demands at NBR have repeatedly failed over a period now approaching 20 years, at tremendous cost to the Service (and, ultimately, the tax payers who fund its programs) and with enormous adverse impacts on professional refuge staff members. It failed quite simply because the Service couldn't acquiesce to the demands of the tribe to take over complete control and management of the refuge under existing law. In the absence of any apparent

resistance from the Secretary of the Interior, or the agency tasked with the responsibility for protecting and managing the refuge in trust for the American public, it now appears that a sympathetic Congress will likely do what the tribes couldn't. And we are to believe that this can't happen again on any of those 37 or 38 other refuges, including the sixteen refuges in Alaska? Theodore Roosevelt will roll over in his grave!

Also, I'm not at all clear on what you mean when you say that implementing landscape conservation strategies "…is how the day to day work of the agency needs to be done from now on….". You seem to be implying that traditional refuge establishment and management is no longer valid, and that that helps justify the disposal of the NBR and, presumably, other so-called "stand alone refuges". What ever happened to the NWRS objective of preserving a diversity of American wildlife and wildlife habitats, as we strive to fulfill our commitments under the several Migratory Bird Treaties, Cities, the Endangered Species Act, among many other National and International commitments?

Also, how does your newly discovered strategy fit the Desert, Kofa and Cabeza Prieta NWRs in the Southwest? Geographically they are not connected. Their Desert Bighorn Sheep populations are also not connected in any physical sense. Yet, collectively they helped and continue to help

preserve Desert Bighorn Sheep and the critical habitat they depend upon. Each of them is quite large, and their biota unique and diverse, although not fully achieving the "landscape scale" found in the Alaska refuges or the current expressed concepts of the Landscape Conservation program.

While I recognize that you are institutionalizing landscape conservation thinking in a way that hasn't been done in the past (and I applaud that), the concept is not new to the Service.

It's that kind of thinking that drove the Prairie Pothole protection efforts in the mid-West; it's what drove the Service from very early on to protect critical migratory waterfowl migration and wintering habitats within the context of their flyways; it's what led early pioneers of the agency to establish three, distinct bison herds on refuges in Oklahoma, Nebraska and Montana to help ensure the continued survival of natural bison populations; it's what influenced Ed Crozier and his refuge planning team in Region 3 during the 70's to broaden the scope of individual refuge planning to include what he called the "area of ecological concern". It's what influenced me when I initiated a refuge master planning effort at the Malheur refuge during that period, with the strategy to incorporate the entire Harney Basin in our planning considerations, since many of the migratory waterfowl and other water bird populations

we were dealing with on the refuge were and are highly dependent upon private lands adjacent to the refuge. (I never got to complete that planning effort due to my later move to Alaska, but I do understand that the current refuge manager, much to his credit, has actively and successfully pursued that concept with the local community).

It's a concept that would have helped make the Service's earlier Private Lands Initiative more successful (and refuges potentially more effective) had it been universally tied closely to refuges, as it was in Regions 1 and 3

My point is: recognize that the concept or strategies that you now promote has been at work and germinating for decades…perhaps nearly as long as the NBR and the other early conservation areas were established; and finally, as you look at the forest, don't overlook the fact that a fully functioning forest is made up of individual trees…all with a purpose, and all contributing to the whole.

When established in 1908, the NBR was one of 52 Theodore Roosevelt preserves that formed the precursor to what later evolved into the National Wildlife Refuge System, which, along

with lands preserved within the National Park and National Forest Systems, formed a national land conservation legacy that has been held in trust and managed by the federal government for the benefit of all Americans ever since. It is a wildlife habitat protection system unrivaled by any other Nation in the World, with its' over 560 refuges now representing and protecting the enormous range of wildlife and wildlife habitat diversity found in our fifty states and territorial areas.

Protecting that legacy challenges every generation, with the most serious being those schemes that would remove individual refuges or portions of refuges from federal stewardship and national public ownership. As a former Refuge Manager and refuge administrator at the Regional level, I am fully aware of the range of threats refuges have faced throughout their history. I also learned that the first line of defense against such threats is those responsible for protecting and managing the Refuge System. I always felt that responsibility very strongly while I served the Refuge System, and felt confident that that sense of responsibility was shared by my superiors within the Service and the Department.

The NBR was my first refuge as a manager. I put my heart and soul into this beautiful and highly productive area. I learned a lot in the process, including a full understanding of the multiple benefits it provided to the community, the region and, yes, to the Nation. I'm proud of my tenure there, and the efforts of one of the finest, most dedicated refuge staffs I've ever encountered. It will break my heart if this wonderful area is taken out of the Refuge System and reduced to serving the singular interests of only two Indian tribes – whatever they might choose those interests to mean, and whoever they might choose those interests to serve.

An author writing of natural area values in general recently said that what people come to love, they want protected. The American people love their National Park System, their National Forest System, and, yes, their National Wildlife Refuge System. The American public expects, and has a right to expect that their refuges will be protected within the Refuge System. If you doubt the veracity of that statement, then I suggest you place the question of whether any fully functioning unit of the Refuge System should be turned over to a non-Service entity before the American public.

I acknowledge that this letter is probably an exercise in futility…that the proposal to move the NBR out of the refuge system has likely moved far beyond your control…if you every had it. I'm convinced that if that transfer does occur, those who care about the future integrity of the Refuge System, and its history, will soon come to regret it.

Sincerely,

Joseph P. Mazzoni, Sr.

Cc: Sally Jewell, Secretary of the Interior

Jim Kurth, Deputy Director

Noreen Walsh, Regional Director

Cynthia Martinez, Chief, NWRS

From:	Munoz, Anna
To:	Noreen Walsh; Matt Hogan
Cc:	Will Meeks
Subject:	Fwd: DCN: 062622 - Former RD has asked Congressional help in stopping the Service transferring National Bison range to CKST
Date:	Wednesday, March 16, 2016 10:21:41 AM
Attachments:	20160316190230.pdf

FYI - Not sure if Cynthia or Jim have seen this letter given that they are at the North American but I wanted you to be aware of it in the event that it comes up.

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

---------- Forwarded message ----------
From: <denise_sanchez@fws.gov>
Date: Wed, Mar 16, 2016 at 10:13 AM
Subject: DCN: 062622 - Former RD has asked Congressional help in stopping the Service transferring National Bison range to CKST
To: anna_munoz@fws.gov

Note: Former Regional Director has written to his Senator asking for congressional intervention on the National Bison Range. Charisa has assigned to HQ ANRS and sent an FYI copy to Noreen and Matt in R6 and and looped in AEA-CLA .

HARRY REID
NEVADA

DEMOCRATIC LEADER

United States Senate

WASHINGTON, DC 20510–7020

March 8, 2016

Mr. Dan Ashe
Director
United States Fish and Wildlife Service
1849 C Street NW, Room 3331
Washington, DC 20240-0001

Dear Director Ashe:

Enclosed is a letter I have received from Marvin L. Plenert, former Regional Director of the Pacific Northwest Region for the Fish and Wildlife Service.

I would appreciate your reviewing this situation and providing answers to Mr. Plenert's concerns. Please send your reply directly to Mr. Plenert, and send a copy of your response to me.

Thank you for your cooperation and assistance.

My best wishes to you.

Sincerely,

Harry Reid

HARRY REID
United States Senator

March 1, 2016

Honorable Harry Reid

United States Senate
Washington, D C 20510
Dear Senator Reid;

I am writing to urge you to do everything within your power to prevent the Fish and Wildlife Service (FWS) from achieving an ill-conceived proposal to abandon its inherent responsibilities and objectives to the American People. The proposal I'm referring to, is a recently released document by the FWS, offering support for legislation to remove the 108 year old crown jewell refuge, the National Bison Range (NBR) in Montana from the National Wildlife Refuge System (NWRS) and place it "in trust" as an Indian Reserve. A copy of the announcement from the Mountain-Prairie States Regional Director Noreen Walsh is attached # (1).
By this proposed action there is no doubt that the FWS leadership in both Washington D C and Denver Colorado are shirking their inherent Federal responsibilities, thereby putting the entire NWRS under siege and in jeopardy. The passage of the National Wildlife Refuge System Administrative Act (NWRSAA) in 1966 and subsequent amendments by Congress provided the authority, guidelines and directions for the FWS to administer a network of lands and waters as a cohesive system. Congress also made it very clear that there should never be any attempt to establish a second refuge system by delegating its authorities or transferring units or responsibilities to any other entity.

The proposal to transfer the NBR out of the NWRS has exposed the lack of integrity and dishonesty of FWS Director Dan Ashe and disputes his earlier assurances as noted in the attached # (2) September 16, 2011 letter to former Assistant Secretary of the Interior Nathaniel Reed, in which Director Ashe states the Service will not "turn over" management of the NBR or any other refuge to the Confederated Salish-Kootenai Tribes (CSKT) or any other non-service entity. Under any future annual funding agreement (AFA), the NBR will remain a unit of the NWRS, managed by the Service under direct guidance of the Service on-site refuge manager. No inherently Federal functions will be contracted to the CSKT. Ashe also stated that before a new AFA is signed and reported to Congress that an environmental assessment (EA) laying out alternatives will be prepared in order to seek public review and comment on the draft document. The FWS did keep their word and an EA was released for review in September, 2014, marking the first time the public was given an opportunity to review and comment on the negotiated agreement with the CSKT. Despite Director Ashe's assurances reviewers of the latest negotiated AFA discovered it laden with inherent

Federal functions. Apparently the comments received by the FWS did not support their proposed alternative of ceding management to the CSKT. The entire process has been pigeonholed, with no follow up to those who commented on the EA, and hence 17 months later the transfer was proposed.

The FWS efforts to acquiesce to the CSKT's request for an AFA that would turn over management of the NBR to them has failed over a period now approaching 20 years at tremendous cost to the FWS and tax payers, as well as the enormous adverse impacts on dedicated professional refuge staff members. The primary reason for failure is that the CSKT has made no secret of their intentions and demands to take over complete control and full ownership of the NBR land. See attached CSKT mission statement # (3).

The impasse has apparently led to the current FWS proposed transfer of the NBR. It must also be noted that all negotiations and discussions on AFA's by the FWS and CSKT over the fate of the NBR have been conducted in secrecy behind closed doors, with not one iota of public input or involvement. If the American Public or true owners of the NWRS had been involved, the failed AFA attempts could have been avoided, as well as the lawsuits that were filed and lost by the FWS because of failure to follow or comply with legal mandates.

The NBR a hallmark refuge was established by President Theodore Roosevelt at the express order of congress. The legislation required the U S Government to purchase a reserve within the Flathead Indian Reservation with Federal monies at an appraised market value for the express purpose of preserving the nearly extinct population of American bison. In 1971 the initial payment to the Tribes was brought before the Indian claims court. That tribunal made a final judgement requiring the Government to make an additional payment of around $23 million for the land again. Certainly the public has paid for the acquisition of the NBR and for 108 years invested heavily in its infrastructure of roads, fences, corrals and buildings, including office-visitor center. Today the NBR draws over 220,000 visitors each year to view wildlife in natural settings. The economic effects of its presence and the recreation brought over $975,000 in local expenditures and more then $19,100.00 in non-resident spending in 2011. The economic effect of the NBR was calculated to be $13.89 for every dollar of budget expenditure by the NBR.

During my 32 years as a FWS employee and another 22 years in retirement I have personally been involved with the management, protection and enhancement of the NWRS, and worked diligently to ensure a strong and vital conservation system for all to enjoy, I therefore, strongly oppose this dangerous precedent setting action by the FWS, which is apparently being done to resolve the dilemma presented by intransigent positions of the FWS and CSKT. The NWRS today consists of nearly 600 units and totals more then 150 million acres, and represents the worlds largest most diverse collection of public lands set aside specifically for the conservation of fish, wildlife and plants, all managed by the FWS as a cohesive unit.

Senator, The refuge system needs your help and that of your colleagues to emphatically refuse to support any proposed legislation that would transfer the NBR or any other unit of the NWRS to the CSKT or any other non-service entity. This iconic 108 year old refuge or any other refuge should never be bargained away to appease the political or self-serving economic interests of non-service entities. Our collective efforts should be spent to preserve the integrity of the NWRS for all Americans from current and future threats.

With your help this ridiculous proposal can be put to bed. Thank you for your consideration on this request, and I look forword to hearing from you.

Sincerely,

Marvin L Plenert
b(6)
Phone b(6) Email b(6)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

SEP 16 2011

In Reply Refer To;
FWS/D/ 049519

Mr. Nathaniel P. Reed
P.O. Box 1213
Hobe Sound, Florida 33475

Nat

Dear Mr. Reed:

Thank you for our conversation today and your support and your interest in the National Bison Range (NBR). The U. S. Fish and Wildlife Service (Service) is currently negotiating with the Confederated Salish and Kootenai Tribes (CSKT) for a new Annual Funding Agreement (AFA) to involve the CSKT in the operations and maintenance of the National Bison Range and other units of the NBR Complex that lie within the Flathead Reservation. Before a new AFA is signed and reported to Congress, the Service will prepare an Environmental Assessment, and will seek public review and comment on the draft document.

The Service cannot and will not "turn over" management of NBR or any other Refuge to the CSKT or any other non-Service entity. Under any future AFA, NBR will remain a unit of the National Wildlife Refuge System, managed by the Service under direct guidance of the Service's on-site Refuge Manager. No inherently federal functions will be contracted to the CSKT. The CSKT has extremely strong cultural, historic, and geographic ties to the NBR and the NBR bison herd, and will work with us through its highly professional Natural Resources Department. Any future AFA will uphold both the letter and spirit of both the Refuge Administration Act, as amended, and the Tribal Self-Governance Act. These laws are not mutually exclusive. We are confident that a strong partnership, with Service and CSKT employees working together, under direction of the Refuge Manager, is the best way to continue managing the NBR to achieve the Refuge's purposes and the mission of the National Wildlife Refuge System.

Thanks again for your time today and continued interest in this issue. If you have any questions, please call me at 202-208-4545.

Sincerely,

Daniel M. Ashe
Director

Attachment NO. 1

THE CONFEDERATED SALISH AND KOOTENAI TRIBES, THE SOVEREIGN PEOPLE OF THE FLATHEAD INDIAN RESERVATION

VISION

The traditional principles and values that served our people in the past are imbedded in the many ways we serve and invest in our people and communities, in the ways we have regained and restored our homelands and natural resources, in the ways we have built a self-sufficient society and economy, in the ways we govern our Reservation and represent ourselves to the rest of the world and in the ways we continue to preserve our right to determine our own destiny.

MISSION

Our mission is to adopt traditional principles and values into all facets of tribal operations and service. We will invest in our people in a manner that ensures our ability to become a completely self-sufficient society and economy. We will strive to regain ownership and control of all lands within our reservation boundaries. And we will provide sound

enhance natural resources and ecosystems.

Developed by Strategic Planning Committee, March 1996

Adopted by Tribal Council, May 1996

Fwd: Discussion with the CSKT about the National Bison Range
Wednesday, March 2, 2016 5:56 PM Mark as Unread

From: "Marvin Plenert" <b(6)>
To: b(6)

--- On Fri, 2/5/16, Bill West <b(6)> wrote:

> From: Bill West <b(6)>
> Subject: Fwd: Discussion with the CSKT about the National Bison Range
> To: "Bill West" <b(6)>
> Date: Friday, February 5, 2016, 5:46 PM
> FYI New
> direction----------
> Forwarded message ----------
> From: Noreen
> Walsh <noreen_walsh@fws.gov>
> Date: Fri, Feb 5, 2016 at 4:12 PM
> Subject: Discussion with the CSKT about the National Bison
> Range
> To:
>
> Dear
> Mountain-Prairie Region, I want to inform
> you of a discussion the Service started today with the
> Confederated Salish and Kootenai Tribes (CSKT) regarding the
> National Bison Range. Many of you know that we have been
> working with the CSKT for about 20 years on the idea of a
> partnership at the National Bison Range that would be
> outlined in an Annual Funding Agreement which would allow
> them to manage and implement some of the activities on the
> refuge. This process has required much time and effort on
> the part of many, and despite valiant efforts all around,
> the parties have been unable to come to terms on a
> mutually-acceptable agreement. In an effort to
> achieve the best, long-term solution for our many
> conservation priorities, the specific conservation goals of
> the National Bison Range, and to support the principles of
> Indian self-determination there was a discussion today with
> the CSKT about the potential for the Service to support
> legislation that would transfer the lands comprising the
> National Bison Range to be held in trust by the United
> States for the CSKT. I wanted you all
> to know why we entered into these discussions. The
> National Bison Range was established in 1908 within the
> boundaries of the Flathead Reservation, home of the CSKT,
> for the express purpose of conserving the American bison
> during a time when the species was on the verge of

> extinction. Since then, the Service as well as our
> federal, state, and tribal partners have made great strides
> in conserving bison and re-establishing herds throughout
> their historic range. Also, while we have desired a
> meaningful partnership with CSKT at the National Bison
> Range, a mutually-acceptable agreement has been elusive.
> Given that we are today in a much better place regarding the
> future of bison, that we have much work to do on
> landscape-scale conservation efforts, and that we want to
> strengthen our partnership with the CSKT, we believe that
> now is the right time to investigate the possibility of
> transferring the refuge, which was long ago carved out of
> tribal lands, into trust for the benefit of the CSKT.
> Such a proposal
> would require Congressional approval and therefore, at this
> point, we don't know if or when such a transfer would
> occur. Today was our first discussion with the CSKT about
> the idea. As we go forward, my pledge is to ensure that
> wherever the discussion leads us, the talented and
> committed staff of the National Bison Range are taken care
> of. To this end, Will Meeks, Mike Blenden, and I spent the
> afternoon at the Refuge where we talked about the ideas
> under discussion. In our conversations, I emphasized that
> they will all remain valued employees of the Service,
> regardless of the outcome of these discussions.
> I know that many
> of you will have thoughts and questions about this idea.
> This was not an easy decision to come by, nor one that was
> taken lightly, but in the end, I believe that this is a good
> path for the Service, the CSKT, and for the conservation of
> our fish and wildlife resources. As always, I value
> your feedback and questions. Noreen
>
> Noreen WalshRegional
> DirectorMountain-Prairie RegionU. S.
> Fish and Wildlife
> Service
>
>
>
>

From:	Morris, Charisa
To:	Dan Ashe; Stephen Guertin; Jim Kurth
Subject:	Fwd: DCN: 062622 - Former RD has asked Congressional help in stopping the Service transferring National Bison range to CKST
Date:	Thursday, March 17, 2016 3:39:03 PM
Attachments:	20160316190230.pdf

FYI
---------- Forwarded message ----------
From: <Nikki_Randolph@fws.gov>
Date: Wed, Mar 16, 2016 at 10:59 AM
Subject: DCN: 062622 - Former RD has asked Congressional help in stopping the Service transferring National Bison range to CKST
To: charisa_morris@fws.gov

Former Regional Director has written to his Senator asking for congressional intervention on the National Bison Range. I have assigned yo HQ ANRS and sent an FYI copy to Noreen and Matt in R6 and and looped in AEA-CLA .

--
Charisa_Morris@fws.gov | Chief of Staff, Office of the Director | U.S. Fish & Wildlife Service | 1849 C Street NW, Room 3348 | Washington, DC 20240 | (202) 208-3843 | For urgent matters, please dial cell: 301-875-8937

HARRY REID
NEVADA

DEMOCRATIC LEADER

United States Senate

WASHINGTON, DC 20510–7020

March 8, 2016

Mr. Dan Ashe
Director
United States Fish and Wildlife Service
1849 C Street NW, Room 3331
Washington, DC 20240-0001

Dear Director Ashe:

Enclosed is a letter I have received from Marvin L. Plenert, former Regional Director of the Pacific Northwest Region for the Fish and Wildlife Service.

I would appreciate your reviewing this situation and providing answers to Mr. Plenert's concerns. Please send your reply directly to Mr. Plenert, and send a copy of your response to me.

Thank you for your cooperation and assistance.

My best wishes to you.

Sincerely,

Harry Reid

HARRY REID
United States Senator

March 1, 2016

Honorable Harry Reid

United States Senate
Washington, D C 20510
Dear Senator Reid;

I am writing to urge you to do everything within your power to prevent the Fish and Wildlife Service (FWS) from achieving an ill-conceived proposal to abandon its inherent responsibilities and objectives to the American People. The proposal I'm referring to, is a recently released document by the FWS, offering support for legislation to remove the 108 year old crown jewell refuge, the National Bison Range (NBR) in Montana from the National Wildlife Refuge System (NWRS) and place it "in trust" as an Indian Reserve. A copy of the announcement from the Mountain-Prairie States Regional Director Noreen Walsh is attached # (1).
By this proposed action there is no doubt that the FWS leadership in both Washington D C and Denver Colorado are shirking their inherent Federal responsibilities, thereby putting the entire NWRS under siege and in jeopardy. The passage of the National Wildlife Refuge System Administrative Act (NWRSAA) in 1966 and subsequent amendments by Congress provided the authority, guidelines and directions for the FWS to administer a network of lands and waters as a cohesive system. Congress also made it very clear that there should never be any attempt to establish a second refuge system by delegating its authorities or transferring units or responsibilities to any other entity.

The proposal to transfer the NBR out of the NWRS has exposed the lack of integrity and dishonesty of FWS Director Dan Ashe and disputes his earlier assurances as noted in the attached # (2) September 16, 2011 letter to former Assistant Secretary of the Interior Nathaniel Reed, in which Director Ashe states the Service will not "turn over" management of the NBR or any other refuge to the Confederated Salish-Kootenai Tribes (CSKT) or any other non-service entity. Under any future annual funding agreement (AFA), the NBR will remain a unit of the NWRS, managed by the Service under direct guidance of the Service on-site refuge manager. No inherently Federal functions will be contracted to the CSKT. Ashe also stated that before a new AFA is signed and reported to Congress that an environmental assessment (EA) laying out alternatives will be prepared in order to seek public review and comment on the draft document. The FWS did keep their word and an EA was released for review in September, 2014, marking the first time the public was given an opportunity to review and comment on the negotiated agreement with the CSKT. Despite Director Ashe's assurances reviewers of the latest negotiated AFA discovered it laden with inherent

Federal functions. Apparently the comments received by the FWS did not support their proposed alternative of ceding management to the CSKT. The entire process has been pigeonholed, with no follow up to those who commented on the EA, and hence 17 months later the transfer was proposed.

The FWS efforts to acquiesce to the CSKT's request for an AFA that would turn over management of the NBR to them has failed over a period now approaching 20 years at tremendous cost to the FWS and tax payers, as well as the enormous adverse impacts on dedicated professional refuge staff members. The primary reason for failure is that the CSKT has made no secret of their intentions and demands to take over complete control and full ownership of the NBR land. See attached CSKT mission statement # (3).

The impasse has apparently led to the current FWS proposed transfer of the NBR. It must also be noted that all negotiations and discussions on AFA's by the FWS and CSKT over the fate of the NBR have been conducted in secrecy behind closed doors, with not one iota of public input or involvement. If the American Public or true owners of the NWRS had been involved, the failed AFA attempts could have been avoided, as well as the lawsuits that were filed and lost by the FWS because of failure to follow or comply with legal mandates.

The NBR a hallmark refuge was established by President Theodore Roosevelt at the express order of congress. The legislation required the U S Government to purchase a reserve within the Flathead Indian Reservation with Federal monies at an appraised market value for the express purpose of preserving the nearly extinct population of American bison. In 1971 the initial payment to the Tribes was brought before the Indian claims court. That tribunal made a final judgement requiring the Government to make an additional payment of around $23 million for the land again. Certainly the public has paid for the acquisition of the NBR and for 108 years invested heavily in its infrastructure of roads, fences, corrals and buildings, including office-visitor center. Today the NBR draws over 220,000 visitors each year to view wildlife in natural settings. The economic effects of its presence and the recreation brought over $975,000 in local expenditures and more then $19,100.00 in non-resident spending in 2011. The economic effect of the NBR was calculated to be $13.89 for every dollar of budget expenditure by the NBR.

During my 32 years as a FWS employee and another 22 years in retirement I have personally been involved with the management, protection and enhancement of the NWRS, and worked diligently to ensure a strong and vital conservation system for all to enjoy, I therefore, strongly oppose this dangerous precedent setting action by the FWS, which is apparently being done to resolve the dilemma presented by intransigent positions of the FWS and CSKT. The NWRS today consists of nearly 600 units and totals more then 150 million acres, and represents the worlds largest most diverse collection of public lands set aside specifically for the conservation of fish, wildlife and plants, all managed by the FWS as a cohesive unit.

Senator, The refuge system needs your help and that of your colleagues to emphatically refuse to support any proposed legislation that would transfer the NBR or any other unit of the NWRS to the CSKT or any other non-service entity. This iconic 108 year old refuge or any other refuge should never be bargained away to appease the political or self-serving economic interests of non-service entities. Our collective efforts should be spent to preserve the integrity of the NWRS for all Americans from current and future threats.

With your help this ridiculous proposal can be put to bed. Thank you for your consideration on this request, and I look forword to hearing from you.

Sincerely,

Marvin L Plenert
b(6)

Phone b(6) Email b(6)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

SEP 16 2011

In Reply Refer To;
FWS/D/ 049519

Mr. Nathaniel P. Reed
P.O. Box 1213
Hobe Sound, Florida 33475

Nat

Dear Mr. Reed:

Thank you for our conversation today and your support and your interest in the National Bison Range (NBR). The U. S. Fish and Wildlife Service (Service) is currently negotiating with the Confederated Salish and Kootenai Tribes (CSKT) for a new Annual Funding Agreement (AFA) to involve the CSKT in the operations and maintenance of the National Bison Range and other units of the NBR Complex that lie within the Flathead Reservation. Before a new AFA is signed and reported to Congress, the Service will prepare an Environmental Assessment, and will seek public review and comment on the draft document.

The Service cannot and will not "turn over" management of NBR or any other Refuge to the CSKT or any other non-Service entity. Under any future AFA, NBR will remain a unit of the National Wildlife Refuge System, managed by the Service under direct guidance of the Service's on-site Refuge Manager. No inherently federal functions will be contracted to the CSKT. The CSKT has extremely strong cultural, historic, and geographic ties to the NBR and the NBR bison herd, and will work with us through its highly professional Natural Resources Department. Any future AFA will uphold both the letter and spirit of both the Refuge Administration Act, as amended, and the Tribal Self-Governance Act. These laws are not mutually exclusive. We are confident that a strong partnership, with Service and CSKT employees working together, under direction of the Refuge Manager, is the best way to continue managing the NBR to achieve the Refuge's purposes and the mission of the National Wildlife Refuge System.

Thanks again for your time today and continued interest in this issue. If you have any questions, please call me at 202-208-4545.

Sincerely,

Daniel M. Ashe
Director

Attachment NO. 1

THE CONFEDERATED SALISH AND KOOTENAI TRIBES, THE SOVEREIGN PEOPLE OF THE FLATHEAD INDIAN RESERVATION

VISION

The traditional principles and values that served our people in the past are imbedded in the many ways we serve and invest in our people and communities, in the ways we have regained and restored our homelands and natural resources, in the ways we have built a self-sufficient society and economy, in the ways we govern our Reservation and represent ourselves to the rest of the world and in the ways we continue to preserve our right to determine our own destiny.

MISSION

Our mission is to adopt traditional principles and values into all facets of tribal operations and service. We will invest in our people in a manner that ensures our ability to become a completely self-sufficient society and economy. We will strive to regain ownership and control of all lands within our reservation boundaries. And we will provide sound

enhance natural resources and ecosystems.

Developed by Strategic Planning Committee, March 1996

Adopted by Tribal Council, May 1996

Fwd: Discussion with the CSKT about the National Bison Range
Wednesday, March 2, 2016 5:56 PM Mark as Unread

From: "Marvin Plenert" <b(6)>
To: b(6)

--- On Fri, 2/5/16, Bill West <b(6)> wrote:

> From: Bill West <b(6)>
> Subject: Fwd: Discussion with the CSKT about the National Bison Range
> To: "Bill West" <b(6)>
> Date: Friday, February 5, 2016, 5:46 PM
> FYI New
> direction----------
> Forwarded message ----------
> From: Noreen
> Walsh <noreen_walsh@fws.gov>
> Date: Fri, Feb 5, 2016 at 4:12 PM
> Subject: Discussion with the CSKT about the National Bison
> Range
> To:
>
> Dear
> Mountain-Prairie Region, I want to inform
> you of a discussion the Service started today with the
> Confederated Salish and Kootenai Tribes (CSKT) regarding the
> National Bison Range. Many of you know that we have been
> working with the CSKT for about 20 years on the idea of a
> partnership at the National Bison Range that would be
> outlined in an Annual Funding Agreement which would allow
> them to manage and implement some of the activities on the
> refuge. This process has required much time and effort on
> the part of many, and despite valiant efforts all around,
> the parties have been unable to come to terms on a
> mutually-acceptable agreement. In an effort to
> achieve the best, long-term solution for our many
> conservation priorities, the specific conservation goals of
> the National Bison Range, and to support the principles of
> Indian self-determination there was a discussion today with
> the CSKT about the potential for the Service to support
> legislation that would transfer the lands comprising the
> National Bison Range to be held in trust by the United
> States for the CSKT. I wanted you all
> to know why we entered into these discussions. The
> National Bison Range was established in 1908 within the
> boundaries of the Flathead Reservation, home of the CSKT,
> for the express purpose of conserving the American bison
> during a time when the species was on the verge of

> extinction. Since then, the Service as well as our
> federal, state, and tribal partners have made great strides
> in conserving bison and re-establishing herds throughout
> their historic range. Also, while we have desired a
> meaningful partnership with CSKT at the National Bison
> Range, a mutually-acceptable agreement has been elusive.
> Given that we are today in a much better place regarding the
> future of bison, that we have much work to do on
> landscape-scale conservation efforts, and that we want to
> strengthen our partnership with the CSKT, we believe that
> now is the right time to investigate the possibility of
> transferring the refuge, which was long ago carved out of
> tribal lands, into trust for the benefit of the CSKT.
> Such a proposal
> would require Congressional approval and therefore, at this
> point, we don't know if or when such a transfer would
> occur. Today was our first discussion with the CSKT about
> the idea. As we go forward, my pledge is to ensure that
> wherever the discussion leads us, the talented and
> committed staff of the National Bison Range are taken care
> of. To this end, Will Meeks, Mike Blenden, and I spent the
> afternoon at the Refuge where we talked about the ideas
> under discussion. In our conversations, I emphasized that
> they will all remain valued employees of the Service,
> regardless of the outcome of these discussions.
> I know that many
> of you will have thoughts and questions about this idea.
> This was not an easy decision to come by, nor one that was
> taken lightly, but in the end, I believe that this is a good
> path for the Service, the CSKT, and for the conservation of
> our fish and wildlife resources. As always, I value
> your feedback and questions. Noreen
>
> Noreen WalshRegional
> DirectorMountain-Prairie RegionU. S.
> Fish and Wildlife
> Service
>
>
>
>

From:	Ralph
To:	jim_kurth@fws.gov
Cc:	cynthia_martinez@fws.gov; noreen_walsh@fws.gov
Subject:	Fwd: NBR Issue: Meet the NWR System
Date:	Sunday, March 20, 2016 12:51:11 PM

Jim,

It has been a long time. I believe our last meeting was on an eve just prior to going out on an excursion to Wapato Lake. That was a very good day! Note that I'm forwarding you a letter sent to Dan yesterday covering the National Bison Range issue. Refuge Chief Martinez and Regional Director Walsh have been cc on it as well. Please don't take the letter personally as it is very difficult for me to be at odds with leadership of an organization that over the years has defined the principles of resource stewardship and set the standard of excellence for others to follow. As important as the Service has been to me, I must confess that the National Wildlife Refuge System is my first love and will always be first and foremost in my heart. That being said, I and many other former colleagues feel the Refuge System is currently being threatened and is in need of support and protection. It is with that thought in mind that we must respectfully challenge the decisions being made by this current Directorate.

Please contact me if you would like to discuss the matter further.

Take Care,

Ralph

Begin forwarded message:

> **From:** Ralph <ralphwebber@frontier.com>
> **Date:** March 19, 2016 3:26:10 PM MDT
> **To:** Ralph Webber <ralphwebber@frontier.com>
> **Subject: NBR Issue: Meet the NWR System**
>
> Director Ashe,
>
> It has been several years now but you and I met either in Portland, at NCTC, or at Tualatin River National Wildlife Refuge, a station that I directed during its stages of development and one where I oversaw its management for 16 years as the Refuge Manager. Our meeting is foggy to me so I certainly don't expect you to remember the time or place of our meeting either, but I do recall it was prior to you becoming Director of the Service. That said, I assume it is okay to refer to you as Dan instead of Director Ashe? Dan, it was a difficult decision, but after 35 years of being an employee of the Service and managing stations of the Refuge System I found it time to hand over the reins and move to northwest Montana, not far from the National Bison Range. Be rest assured that my fire and passion for the National Wildlife Refuge System has not strayed and has stayed the course into retirement. This brings us to the primary purpose and reason for contacting you, that being the seeking of sponsorship legislation to transfer all lands and management of the National Bison Range to the Confederated Salish and Kootenai Tribes.

Over the last several weeks I've been in close contact with many former colleagues and friends to discuss and take action on the Bison Range issue. We are all deeply troubled and concerned, and quite frankly, finding it difficult to follow the thinking behind your leadership decisions and those of the directorate. How can a Director of the Service send a letter to Assistant Secretary Reed in 2011 stating that management of the Bison Range or any other refuge will not be turned over to the Tribes or any other non-Service entity, and 5 years later, seek congressional sponsorship for its removal from the System? How can the Service not prepare a Comprehensive Conservation Plan for the Bison Range with full public scoping and participation as mandated under the Refuge Improvement Act and the National Environmental Policy Act? As one of the alternatives, the significance of a transfer action alone would most certainly require a full blown Environment Impact Statement. Finally, how can the Service release a publication almost one year to the day that features its front and back covers with the National Bison Range as an iconic flagship of the Refuge System and historic symbol of the west, and one year later propose its removal from the Refuge System? Dan, take note of the final passage of that publication which states, "Providing a healthy and complete National Wildlife Refuge System, as envisioned by past generations of conservationists, would stand as a treasured testament to the nation's ability to pass on a lasting natural legacy to future generations." I think you will agree that the key words to this statement are "healthy and complete".

We are all aware of the failures encompassing the nearly 20 years of effort to partner with the Tribes under a functioning Annual Funding Agreement, but the surgical removal of a refuge unit of the System will do nothing more than instigate fragmentation, and thereby threaten the very integrity of that System. The seriousness of this entire matter is underscored by the fact that it will set precedent with profound implications to all of our federal Refuges and National Parks. To put it bluntly, what is being proposed is simply unethical and is not in the best interest of our nation. Please spare me the arguments that have been used for the Bison Range transfer as they insult the intelligence of current and former employees of the Service, especially those that are most knowledgable with the Refuge System.

I want you to know that I have the utmost respect for the men and woman who serve the fish and wildlife resources under the emblem of the greatest conservation agency in the world, that being the Fish and Wildlife Service. That is why I ask that you help me understand your leadership thinking on this issue. I can only hope you have some silver bullet strategy up your sleeve to keep the System whole and are not just playing out the role of a good soldier. Bring this issue full circle and provide us with a decision we can all be proud of and one that will demonstrate the importance of what the Refuge System means to you. We need to know you are in our corner with full intent of protecting and conserving the greatest network of lands and waters on the planet. Please don't disappoint the people you serve, especially the American people who truly own the National Wildlife Refuge System.

Thank you for your time and consideration of this matter. I look forward to

hearing from you.

Sincerely,

Ralph D. Webber
431 N Milnor Lake Road
Troy, Montana 59935
(406) 295-5952
ralphwebber@frontier.com

From: Noreen Walsh
To: Matt Hogan; Will Meeks; Anna Munoz
Subject: Fwd: NBR Issue: Meet the NWR System
Date: Sunday, March 20, 2016 1:06:41 PM

FYI

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

Begin forwarded message:

> **From:** Ralph <ralphwebber@frontier.com>
> **Date:** March 20, 2016 at 12:50:49 PM MDT
> **To:** <jim_kurth@fws.gov>
> **Cc:** <cynthia_martinez@fws.gov>, <noreen_walsh@fws.gov>
> **Subject: Fwd: NBR Issue: Meet the NWR System**
>
> Jim,
>
> It has been a long time. I believe our last meeting was on an eve just prior to going out on an excursion to Wapato Lake. That was a very good day! Note that I'm forwarding you a letter sent to Dan yesterday covering the National Bison Range issue. Refuge Chief Martinez and Regional Director Walsh have been cc on it as well. Please don't take the letter personally as it is very difficult for me to be at odds with leadership of an organization that over the years has defined the principles of resource stewardship and set the standard of excellence for others to follow. As important as the Service has been to me, I must confess that the National Wildlife Refuge System is my first love and will always be first and foremost in my heart. That being said, I and many other former colleagues feel the Refuge System is currently being threatened and is in need of support and protection. It is with that thought in mind that we must respectfully challenge the decisions being made by this current Directorate.
>
> Please contact me if you would like to discuss the matter further.
>
> Take Care,
>
> Ralph
>
> Begin forwarded message:
>
> > **From:** Ralph <ralphwebber@frontier.com>
> > **Date:** March 19, 2016 3:26:10 PM MDT
> > **To:** Ralph Webber <ralphwebber@frontier.com>
> > **Subject: NBR Issue: Meet the NWR System**

Director Ashe,

It has been several years now but you and I met either in Portland, at NCTC, or at Tualatin River National Wildlife Refuge, a station that I directed during its stages of development and one where I oversaw its management for 16 years as the Refuge Manager. Our meeting is foggy to me so I certainly don't expect you to remember the time or place of our meeting either, but I do recall it was prior to you becoming Director of the Service. That said, I assume it is okay to refer to you as Dan instead of Director Ashe? Dan, it was a difficult decision, but after 35 years of being an employee of the Service and managing stations of the Refuge System I found it time to hand over the reins and move to northwest Montana, not far from the National Bison Range. Be rest assured that my fire and passion for the National Wildlife Refuge System has not strayed and has stayed the course into retirement. This brings us to the primary purpose and reason for contacting you, that being the seeking of sponsorship legislation to transfer all lands and management of the National Bison Range to the Confederated Salish and Kootenai Tribes.

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I want you to know that I have the utmost respect for the men and woman who serve the fish and wildlife resources under the emblem of the greatest conservation agency in the world, that being the Fish and Wildlife Service. That is why I ask that you help me understand your leadership thinking on this issue. I can only hope you have some silver bullet strategy up your sleeve to keep the System whole and are not just playing out the role of a good soldier. Bring this issue full circle and provide us with a decision we can all be proud of and one that will demonstrate the importance of what the Refuge System means to you. We need to know you are in our corner with full intent of protecting and conserving the greatest network of lands and waters on the planet. Please don't disappoint the people you serve, especially the American people who truly own the National Wildlife Refuge System.

Thank you for your time and consideration of this matter. I look forward to hearing from you.

Sincerely,

Ralph D. Webber
431 N Milnor Lake Road
Troy, Montana 59935
(406) 295-5952
ralphwebber@frontier.com

From:	Will Meeks
To:	Jeff King
Subject:	Fwd: NBR LETTER
Date:	Monday, March 28, 2016 8:21:39 PM
Attachments:	Untitled attachment 00240.htm Final letter to Ashe National Bison Range March 2016-signed.pdf

---

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

From: bob streeter <rgstreeter@gmail.com>
Date: March 28, 2016 at 8:57:37 AM MDT
To: "Kurth, Jim" <jim_kurth@fws.gov>, <Cynthia_martinez@fws.gov>, Noreen Walsh <Noreen_Walsh@fws.gov>, <Will_meeks@fws.gov>, Mike Blenden <Mike_Blenden@fws.gov>
Subject: NBR LETTER
Reply-To: <rgstreeter@gmail.com>

Dear FWS Refuge Leadership,

Our Retirees Association Board, after more than a month of deliberating, fact-finding, reviewing our charter & more deliberating, decided unanimously to send an "Alert" to our membership (it is on our website) about what is happening with the NBR, and to express our opinion to the Director. I wanted you all to be aware of our actions.

We know that all of you have the best interests of the Service and the National Wildlife Refuge System in mind, as do we, the ol' geezers. We offer any assistance we may bring to the table as this issue moves on. Stay strong for our wildlife resources, stay strong for the "Outfit," & our folks!

Cheers, Bob Streeter, Association Chair

--
Sent from Gmail Mobile

Association of Retired U.S. Fish and Wildlife Service Employees
698 Conservation Way
Shepherdstown, WV 25443

http://fwsretirees.org/

March 25, 2016

Mr. Dan Ashe
U.S. Fish and Wildlife Service
Washington, D.C.

Dear Dan

The Board of Directors of the Association of U.S. Fish & Wildlife Service Retirees wishes to go on record as opposing the proposed Service action to remove the National Bison Range (NBR) from the National Wildlife Refuge System. It is our belief that such action would result in a 'slippery slope' that would likely impact other Fish and Wildlife facilities to the detriment of the Service as the World leader in the conservation and management of this Nation's natural resources.

We recognize that priorities must be set for allocation of scarce resources. We also recognize that the Service cannot manage all lands within the System to the fullest extent with limited financial and personnel resources. However, the NBR is part of a System, governed by the National Wildlife Refuge System Administrative Act of 1966 and various amendments including the National Wildlife Refuge System Improvement Act of 1997. It is part of the rich heritage of the Service. Each refuge has an intrinsic value as part of the System, and not just a commodity to be disposed of when it becomes difficult or of lesser priority to manage.

Besides its historical importance to the NWRS, the bison gene pool is unique. It is the reason the refuge was established, and it should be preserved. In addition, the refuge provides nearly pristine habitat for native bird populations, as well as outstanding visitation and educational opportunities for the public. It is part of the heritage that our Association has pledged to help preserve. The Service purchased these lands for all Americans to enjoy. The Board is gravely concerned that the proposed transfer is precedent-setting for future dealings with other tribal, state or even military organizations wishing to acquire and/or manage federal lands. This is a huge precedence for the NWRS, for wildlife conservation, for public use, and for the agency's heritage.

Our Association, with the accumulated depth of experience of our members, stands ready to assist in any way as this issue moves towards resolution. We are first and foremost members of the Service family and care deeply about our heritage and the resources we work to conserve.

Sincerely,

Robert G. Streeter, Ph.D.
Board Chair

cc: Secretary Jewel
Fish and Wildlife Service Directorate

Chairman, FWS Retirees Association
929 Coho Run, Fort Collins, CO 80524-8329
970-222-0383 or chair@fwsretirees.org

From:	Jeff King
To:	Mike Blenden; Will Meeks (will_meeks@fws.gov)
Cc:	Jeff King (Jeff_King@fws.gov)
Subject:	e copy of Ashe letter
Date:	Tuesday, April 19, 2016 3:42:00 PM
Attachments:	Ashe USFWS 4.5.16.pdf

Thanks,

jk

Jeff King, Project Leader
National Bison Range Complex
58355 Bison Range Road
Moiese, Montana 59824
(406) 644-2211 ext. 204

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Mailing Address: 600 Capitol Way N, Olympia, WA 98501-1091 • (360) 902-2200 • TDD (360) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

April 5, 2016

Mr. Dan Ashe
Director
U.S. Fish and Wildlife Service
1849 C Street NW, Room 3331
Washington, DC 20240-0001

Dear Director Ashe:

Last week, the National Bison Range (NBR) and the Washington Department of Fish and Wildlife (Department) participated in a translocation of bighorn sheep (*Ovis canadensis*) from NBR to two needy herds in eastern Washington. Bighorns in the NBR had become over-abundant at about the time we were searching for suitable animals to augment our herds. After a few weeks of hurried but productive planning, ground-based captures took place during March 29-31, and after the needed veterinary clearance, animals were moved on April 1.

I write to inform you of this, but also to express the gratitude WDFW has to the U.S. Fish and Wildlife staff involved, both in reaching out to the Department, and in their exemplary work during the process.

The welcome our staff received at NBR, and the help provided us in getting the bighorns, was simply beyond anything we could have imagined. Not only was the NBR field assistance absolutely top-notch, and the preparations they made for the animals innovative and creative, but the hospitality displayed toward Department folks was just outstanding. Worth noting was the work of Francis Cahoon and others in creating the transport boxes, of Darren Thomas and others in retrofitting the corral for bighorns (even though we didn't end up using it, it may yet come in handy at some point), of Amy Lisk in facilitating just about everything, and of Jeff King for supervising in his gentle, yet supportive way. Much of the credit for the good condition of the animals goes to NBR's transport staff, who got the animals off the hill and to our processing sites so quickly.

We often hear 'mom and apple pie' statements about inter-agency cooperation, but NBR staff really showed how it can be done. It felt to us that we were not so much cooperating with another agency, as simply working together on a team with a common objective. After about a day, it seemed that they had all known each other for years.

Please know that the NBR staff's hard work and collaborative attitude was very much appreciated. Simply put, these folks are tops, and have set what surely must be a new standard in inter-agency cooperation.

We plan to continue to be in touch with the NBR about the bighorns we now have, as well as if there are other ways we can work together toward mutual goals in the future.

Sincerely,

James Unsworth, Ph.D.
Director

cc: U.S. Fish and Wildlife Service:
Chief Cynthia Martinez
Director Robyn Thorson, Pacific Region
Director Noreen Walsh, Mountain-Prairie Region

From:	George Waters
To:	Sellars, Roslyn
Cc:	Dan Ashe; cynthia_martinez@fws.gov; robert_dreher@fws.gov; scott_aikin@fws.gov; hallison_putnam@fws.gov; betsy_hildebrandt@fws.gov; shaun_sanchez@fws.gov; noreen_walsh@fws.gov; will_meeks@fws.gov; anna_munoz@fws.gov; stephen_guertin@fws.gov; charisa_morris@fws.gov; Michael Black
Subject:	Requestd meeting for next week with Confederated Salish and Kootenai Tribes of the Flathead Reservation
Date:	Friday, April 29, 2016 5:18:47 PM

Roslyn and FWS Folks – I am following up on conversations that the Brian Upton from the Confederated Salish and Kootenai Tribes of the Flathead Reservation has had with some of you relative to where things stand on the introduction of the National Bison Range legislation. We have some congressional meetings next Thursday and were hoping to then update you all on Friday (May 6). Attending from CSKT will be Tribal Attorneys Brian Upton and Shane Morigeau as well as Chairman Vernon Finley and I. (I understand third hand that Scott Aiken would like to join in via speakerphone and that he is available either before 10:30am (EST) or after 1:30pm (EST) on Friday.) Can we find a time for next Friday that works for you all? Thanks

George

Ps – sorry to cast such a wide net on the cc list. Just using the names that were including in the cc list for the last meeting.

George Waters, President
George Waters Consulting Service
505 Capitol Court., NE
Suite 200
Washington, DC 20002
(202) 544-3044
(202) 544-3155 fax
george@georgewaters.com

Conversation Contents

Fwd: Google Alert - "Bison Range"

Will Meeks <will_meeks@fws.gov>

From:	Will Meeks <will_meeks@fws.gov>
Sent:	Wed May 04 2016 13:31:05 GMT-0600 (MDT)
To:	Mike Blenden <mike_blenden@fws.gov>
Subject:	Fwd: Google Alert - "Bison Range"

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

From: Anna Munoz <anna_munoz@fws.gov>
Date: May 4, 2016 at 12:50:10 PM MDT
To: Noreen Walsh <noreen_walsh@fws.gov>, will_meeks@fws.gov
Subject: Fwd: Google Alert - "Bison Range"

FYI

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, CO 80228
Office: 303-236-4510
Cell: 720-648-2542

Begin forwarded message:

From: Google Alerts <googlealerts-noreply@google.com>

Date: May 4, 2016 at 10:25:17 AM MDT
To: <anna_munoz@fws.gov>
Subject: Google Alert - "Bison Range"

"Bison Range"

As-it-happens update · May 4, 2016

NEWS

National **Bison Range**: An investment in Montana

Helena Independent Record

The National **Bison Range** has been investing in Montana for years while hosting 200,000 visitors per year, with 83 percent of those guests being ...

Helena Independent Record

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Send Feedback

From: Jones, Lee
To: Stephen Torbit
Subject: National Bison Range transfer in the news
Date: Thursday, May 05, 2016 2:46:10 PM

Just FYI,
Not sure if you've seen this yet, but this popped up yesterday. http://helenair.com/news/opinion/national-bison-range-an-investment-in-montana/article_1cda1cd8-ba53-53cb-98b7-73c4a3d857ee.html

Lee C. Jones
Wildlife Health office
USFWS-Natural Resource Program Center
10 E. Babcock, Rm 105
Bozeman, MT 59715
Office: 406.587.2169
Cell: 406.600.8405
Fax: 406.587.9098
lee_c_jones@fws.gov

Conversation Contents

Response to Mr. Plenert

Attachments:

/12. Response to Mr. Plenert/1.1 062622_Response to Mr. Plenert_NBR.pdf

"Matten, Betsy" <betsy_matten@fws.gov>

From:	"Matten, Betsy" <betsy_matten@fws.gov>
Sent:	Wed May 18 2016 14:44:25 GMT-0600 (MDT)
To:	Mike Blenden <mike_blenden@fws.gov>
Subject:	Response to Mr. Plenert
Attachments:	062622_Response to Mr. Plenert_NBR.pdf

I uploaded the response into DTS earlier this afternoon. The final letter may not look the same as HQ may still make changes. Who knows.
Betsy

--
Betsy M. Matten, Administrative Officer
U.S. Fish and Wildlife Service, Region 6
National Wildlife Refuge System
134 Union Blvd.
Lakewood, CO 80228
303-236-4307
Betsy_Matten@fws.gov

Marvin Plenert
20500 Tranquility Lane
Oregon City, Oregon 97045

Dear Mr. Plenert:

I am writing in response to your inquiry to Senator Harry Reid concerning the U.S. Fish and Wildlife Service's (Service) expression of support for potential legislation transferring the National Bison Range into trust for the benefit of the Confederated Salish and Kootenai Tribes (CSKT). The Service recognizes your concern and passion for the National Wildlife Refuge System (System) and offers the following observations.

While the National Bison Range has been around for over a century, the Service considers the proposed transfer as a very unique situation whereby a refuge was established wholly within a Reservation boundary for a narrowly defined purpose – conservation of bison at a time when they were on the verge of extinction. Since then, the Service along with our federal, state, and tribal partners have made great strides in conserving bison and we expect this conservation success story to continue under this proposal.

It is the Service's expectation that any legislation regarding the transfer of lands comprising the National Bison Range will include provisions to ensure these lands are managed in accordance with the original purpose of the refuge as well as provide public access. The Service considers the CSKT to be experienced land and resource managers that have a long-standing track record of successful wildlife conservation.

I take my responsibilities for the System to heart. You are well aware of my loyalty to that part of the Service. Although you may not agree with the Service on the National Bison Range, I hope you acknowledge that if we are to continue to successfully achieve the mission of the Service, we must make hard decisions to focus our energies and allocate our limited resources to meet our country's greatest conservation challenges.

Sincerely,

Director

cc: Senator Harry Reid

Approved: Deputy Regional Director Date

Conversation Contents

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134 Union Blvd.
Lakewood, CO 80228
303-236-4307
Betsy_Matten@fws.gov

Mr. Marvin Plenert
b(6)

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Sincerely,

Director

cc: Senator Harry Reid

5·18·16

Approved: Deputy Regional Director Date

Conversation Contents

FW: PRESS RELEASE: Lawsuit Tackles National Bison Range Giveaway

Ryan Moehring <ryan_moehring@fws.gov>

From:	Ryan Moehring <ryan_moehring@fws.gov>
Sent:	Mon May 23 2016 09:36:04 GMT-0600 (MDT)
To:	Will Meeks <will_meeks@fws.gov>, Anna Munoz <anna_munoz@fws.gov>, Maureen Gallagher <maureen_gallagher@fws.gov>, Mike Blenden <mike_blenden@fws.gov>
Subject:	FW: PRESS RELEASE: Lawsuit Tackles National Bison Range Giveaway

FYI

Thanks,

Ryan

Ryan Moehring

Public Affairs (ND, SD, WY, MT)

U.S. Fish and Wildlife Service

Mountain-Prairie Region

303-236-0345

---------- Forwarded message ----------
From: **Public Employees for Environmental Responsibility (PEER)** <info@peer.org>
Date: Mon, May 23, 2016 at 7:59 AM
Subject: PRESS RELEASE: Lawsuit Tackles National Bison Range Giveaway
To: Ryan Moehring

Having trouble with images or links? Click here and also try adding us

(info@peer.org) to your address book.

For Immediate Release: Monday, May 23, 2016
Contact: Kirsten Stade (240) 247-0296

LAWSUIT TACKLES NATIONAL BISON RANGE GIVE-AWAY LEGISLATION
Agency Failed to Conduct Mandatory Environmental Analysis when Submitting Bills

Washington, DC — The U.S. Fish & Wildlife Service has not done the environmental analysis required by law before sponsoring legislation to turn the National Bison Range over to local tribes, according to a federal lawsuit filed today by Public Employees for Environmental Responsibility (PEER). The suit aims to force FWS to ascertain potential impacts before proceeding any further with the first major surrender of a national wildlife refuge in American history.

In February, FWS announced that it was pursuing legislation to transfer Montana's National Bison Range, often called the Crown Jewel of the National Wildlife Refuge System, to the Confederated Salish and Kootenai Tribes (CSKT). As described in emails and other records PEER has obtained, the bill would –

- Give the entire refuge, its buildings (including a new $650,000 maintenance facility) and prized bison herd totaling nearly $100 million in value to the CSKT without any compensation. Ironically, federal taxpayers had previously paid twice to purchase the refuge's 18,000 acres;
- Contain no requirement that the CSKT maintain the Bison Range as a refuge or admit the public. The refuge attracts more than 200,000 visitors each year, the vast majority (83%) come from out-of-state or abroad and pump an estimated $12.5 million into the local economy; and
- Make no provision for the fate of the Range's unique bison herd, considered by many as vital to the future of the bison –now the nation's official mammal – as a healthy native species.

"The law requires federal agencies to think through the environmental consequences of proposals before launching them," stated PEER Senior Counsel Paula Dinerstein, who brought the litigation that struck down a joint management plan FWS developed with the CSKT in 2010 for its failure to comply with the same statute at the heart of the new suit. "The inability or unwillingness of the Service to do its homework on the Bison Range has kept this century-old refuge in political limbo for more than a decade."

The suit also takes the Service to task for failing to ever develop a conservation plan for the Bison Range despite a statutory mandate dating back to 1997 that it do so. Virtually every one of the other 560 national wildlife refuges has such a plan to guide their

operations to best accomplish their purpose.

Joining the PEER suit as co-plaintiffs are former refuge managers and employees of the Bison Range and top FWS officials with a combined over 280 years of experience, as well as a leading citizen activist.

“The Bison Range is a major ecological asset that is being tossed away without consideration,” Dinerstein added, noting that the National Bison Range is the 10th most visited refuge among the 563 NWRs nationwide, creating an estimated 169 jobs in Montana. “If we succeed, this lawsuit will not only keep the National Bison Range as a wildlife refuge but also restore its crown jewel luster.”

###

Read the PEER suit

Meet the co-plaintiffs

See Freedom of Information Act record summary

View legislative NEPA requirement

Look at National Bison Range transfer plan

* To unsubscribe from future emails, go to http://org.salsalabs.com/o/823/unsubscribe.jsp. To update your information (including action and donation history), log into your online PEER account https://org.salsalabs.com/o/823/profile/login.jsp

empowered by Salsa

From: Blenden, Mike
To: Jeff King
Subject: Fwd: DCN: FWSPM00143 - National Bison Range
Date: Wednesday, May 25, 2016 6:46:21 AM
Attachments: Incoming PM00143.pdf

Jeff - FYI - Mike

---------- Forwarded message ----------
From: <kandi_baaske@fws.gov>
Date: Tue, May 24, 2016 at 2:16 PM
Subject: DCN: FWSPM00143 - National Bison Range
To: Maureen_Gallagher@fws.gov, Mike_Blenden@fws.gov, Will_Meeks@fws.gov

Please respond or distribute as necessary.

--
Michael Blenden
Refuge Supervisor - Montana, Wyoming and Utah
134 Union Boulevard
Lakewood, CO 80228
303-236-4306
303-710-7934 cell

Too often we...enjoy the comfort of opinion without the discomfort of thought.
John F. Kennedy

NEW PM 00143

National Bison Range MAY 23 2016

RL AA

b(6) [redacted]

May 6, 2016

The Honorable Michael Bennet
United States Senate
Washington, D. C. 20510

Dan Ashe, Director FWS

Dear Senator Bennett:

Dear Director Ashe —

It has come to my attention that the U. S. Fish and Wildlife Service (Service) through Director Dan Ashe is proposing to transfer the National Bison Range National Wildlife Refuge (Range) located near Moiese, Montana in the Flathead Indian Reservation to the Confederated Salish and Kootenai Tribes (Tribes). This National Wildlife Refuge should remain under the management of the U. S. Fish and Wildlife Service. These lands should not be given to the Tribes not should they be managed my the Tribes under any circumstances.

The Range is located within the boundary of the Flathead Indian Reservation, but when established in 1908, the Tribes were payed for the Land. They were further paid again in 1971 when the U. S. Court of Claims awarded the Tribes over $22 million, some of which was payment again for the Range. The Range consists of about 18,800 acres all of which has been managed for the benefit of approximately 350 bison and other wildlife. The public is also welcome to visit the Range on a year around basis.

In 2005 and again in 2008, the Tribes and the Range entered into an "Annual Funding Agreement" where by the Tribes and Service had joint management of the area. This was proposed because of the passage of the Self-Governance Act. The Service cancelled the first and the courts cancelled the second. There was poor management, poor cooperation and out right hostility by the Tribes.

In 2014, the Service produced a Draft Environmental Assessment for another Annual Funding Agreement that was for a five year period. This draft EA was never completed. There was considerable opposition to the proposed action of having the Tribes manage the Range. This was based on the past history of the other AFAs, and the fact that a number of laws prohibited the Service from allowing others to manage the Range. (i. e. National Wildlife Refuge System Administrative Act of 1966 as well as the National Wildlife System Improvement

Act of 1997 and other laws relating to the operation of the National Wildlife Refuge System precludes such agreements.)

I do support working with the Tribes as directed under the Self-Determination Act of 1994 as well as the Self-Goverment Act. However, I strongly object to the Tribes managing or owning the lands of the National Bison Range.

What I do support is the following. There is great opportunity to assist the Tribes to develop another Bison Sanctuary within the Flathead Indian Reservation boundary. The Service could assist with the land purchase if needed, provide guidance for the development of this new operation, provide bison to stock the area, and serve as mentors as desired by the Tribes for all the operations as the Service personnel have unique knowledge for this type of operation. The Service could also provide assistance as needed to develop a visitor/ interpretative center concerning the bison and history related to native Americans.

Over the years, the National Bison Range has provide bison to Native Americans to start their own herds. These ventures have never been successful. It would be poor judgement to give the Bison Range to the Tribes, but it would be wise to assist them in development of their own.

It is my understanding the only Congress has the right to transfer the National Bison Range to the Tribes. It is my request that Congress ensures that the Bison Range remains under the ownership of the Federal Government and continues to be managed by the U. S. Fish and Wildlife Service.

While these lands are located in Montana, this is a National issue. Your support of Colorado as well as our nation is greatly appreciated. I look forward to hearing from your office concerning this issue.

Sincerely yours,

Thank you for reading this!

Barnet W. Schranck

Barnet W. Schranck

Copies of this letter provided to: Sec. of Interiior Sally Jewell, Mt. Senators Jon Tester and Steve Daines, Mt. Represenative Ryan Zinke, FWS Dirctor Dan Ashe and Region 6 Regional Director Noreen Walsh

From: New Breast, Ira
To: Stephen Torbit
Subject: NBR Conference Call
Date: Wednesday, May 25, 2016 7:58:12 AM

Hi Steve,

Cynthia Martinez, Megan Reed are putting together a call on June 6th regarding the Moeise Bison Range and CSKT.

Not sure if you are still the Chair for the Work Group. May be of interest to you.

IRA

From: New Breast, Ira
To: Stephen Torbit
Subject: Re: NBR Conference Call
Date: Thursday, May 26, 2016 11:17:33 AM

Will do.

IRA

On Thu, May 26, 2016 at 1:04 PM, Stephen Torbit <stephen_torbit@fws.gov> wrote:

> Let me know details please.
>
> Sent from my iPhone
>
> > On May 25, 2016, at 7:58 AM, New Breast, Ira <ira.newbreast@bia.gov> wrote:
> >
> > Hi Steve,
> >
> > Cynthia Martinez, Megan Reed are putting together a call on June 6th regarding the Moeise Bison Range and CSKT.
> >
> > Not sure if you are still the Chair for the Work Group. May be of interest to you.
> >
> > IRA

From: New Breast, Ira
To: Stephen Torbit
Subject: Re: NBR Conference Call
Date: Tuesday, June 07, 2016 6:01:33 AM

Touching base.

Our conference call has been cancelled. No re-schedule to date.

IRA

On Thu, May 26, 2016 at 1:17 PM, New Breast, Ira <ira.newbreast@bia.gov> wrote:

> Will do.
>
> IRA
>
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> > >
> > > IRA

From: New Breast, Ira
To: Stephen Torbit
Subject: Re: NBR Conference Call
Date: Tuesday, June 07, 2016 9:45:25 AM

I didn't plan on attending. The last train for WV leaves at 7 pm. I leave town about 5:30.

If I hear any more on the call I'll holler.

IRA

On Tue, Jun 7, 2016 at 10:28 AM, Stephen Torbit <Stephen_Torbit@fws.gov> wrote:

> OK thanks. Are you going to the National Mammal reception for bison on the 23rd?
>
> Stephen C. Torbit
>
> Assistant Regional Director
>
> Science Applications
>
> U.S. Fish and Wildlife Service
>
> 134 Union Blvd.
>
> Lakewood, Colorado 80228
>
> 303-236-4602 – Office
>
> 720-626-7504 – Cell
>
> **From:** New Breast, Ira [mailto:ira.newbreast@bia.gov]
> **Sent:** Tuesday, June 07, 2016 6:02 AM
> **To:** Stephen Torbit
> **Subject:** Re: NBR Conference Call
>
> Touching base.
>
> Our conference call has been cancelled. No re-schedule to date.
>
> IRA

On Thu, May 26, 2016 at 1:17 PM, New Breast, Ira <ira.newbreast@bia.gov> wrote:

Will do.

IRA

On Thu, May 26, 2016 at 1:04 PM, Stephen Torbit <stephen_torbit@fws.gov> wrote:

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> IRA

Conversation Contents

Fwd: Google Alert - cskt

Will Meeks <will_meeks@fws.gov>

From:	Will Meeks <will_meeks@fws.gov>
Sent:	Fri Jun 10 2016 13:51:41 GMT-0600 (MDT)
To:	Jeff King <jeff_king@fws.gov>, Mike Blenden <mike_blenden@fws.gov>
Subject:	Fwd: Google Alert - cskt

Just found this out. Hot off the press

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

> **From:** Anna Munoz <anna_munoz@fws.gov>
> **Date:** June 10, 2016 at 1:49:39 PM MDT
> **To:** Noreen Walsh <noreen_walsh@fws.gov>, Matt Hogan <matt_hogan@fws.gov>, will_meeks@fws.gov, Cynthia Martinez <cynthia_martinez@fws.gov>, Roya Mogadam <roya_mogadam@fws.gov>, Gavin Shire <gavin_shire@fws.gov>, seth_willey@fws.gov
> **Subject: Fwd: Google Alert - cskt**
>
> FYI - Looks like CSKT has released their draft legislation and announced their Bison Range Working Group.
>
> Sent from my iPad
>
> Begin forwarded message:
>
> > **From:** Google Alerts <googlealerts-noreply@google.com>
> > **Date:** June 10, 2016 at 1:05:47 PM MDT

To: <anna_munoz@fws.gov>
Subject: Google Alert - cskt

cskt

As-it-happens update · June 10, 2016

NEWS

CSKT announces formation of Bison Range Working Group

Missoula Independent (blog)

As the Indy wrote earlier this month, FWS surprised the tribes this spring when federal officials offered to pass the refuge into a trust and allow **CSKT** to ...

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Comment now on restoring Bison Range land to Tribes - Valleyjournal

Full Coverage

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Send Feedback

From: Google Calendar on behalf of Noreen Walsh
To: will_meeks@fws.gov; anna_munoz@fws.gov; matt_hogan@fws.gov; stephen_torbit@fws.gov
Subject: NBR Issues
Attachments: invite.ics

HYPERLINK "https://www.google.com/calendar/event?
action=VIEW&eid=ZnMxdW9sNjlvdG9ibmMyMnNydGs3bWxmZHMgd2lsbF9tZWVrc0Bmd3MuZ292&tok=MjAjbm9yZWVuX3dhbHNoQGZ3cy5nb3YzNGY0OGFiMWYyYmUxYjI3YmI5ZjEzOTEwOTM4ZDEzYzUxNjhhYmM4&ctz=America/Denver&hl=en"more details »

NBR Issues

When
Thu Jun 16, 2016 4pm – 5pm Mountain Time
Where
RD Conference Rm (HYPERLINK "https://maps.google.com/maps?q=RD+Conference+Rm&hl=en"map)
Video call
HYPERLINK "https://plus.google.com/hangouts/_/doi.gov/noreen-walsh?hceid=bm9yZWVuX3dhbHNoQGZ3cy5nb3Y.fs1uol69otobnc22srtk7mlfds"https://plus.google.com/hangouts/_/doi.gov/noreen-walsh
Calendar
will_meeks@fws.gov
Who
• noreen_walsh@fws.gov
- organizer
• stephanie_potter@fws.gov
- creator
• will_meeks@fws.gov
• anna_munoz@fws.gov
• matt_hogan@fws.gov
• stephen_torbit@fws.gov

Going?
HYPERLINK "https://www.google.com/calendar/event?
action=RESPOND&eid=ZnMxdW9sNjlvdG9ibmMyMnNydGs3bWxmZHMgd2lsbF9tZWVrc0Bmd3MuZ292&rst=1&tok=MjAjbm9yZWVuX3dhbHNoQGZ3cy5nb3YzNGY0OGFiMWYyYmUxYjI3YmI5ZjEzOTEwOTM4ZDEzYzUxNjhhYmM4&ctz=America/Denver&hl=en"Yes -
HYPERLINK "https://www.google.com/calendar/event?
action=RESPOND&eid=ZnMxdW9sNjlvdG9ibmMyMnNydGs3bWxmZHMgd2lsbF9tZWVrc0Bmd3MuZ292&rst=3&tok=MjAjbm9yZWVuX3dhbHNoQGZ3cy5nb3YzNGY0OGFiMWYyYmUxYjI3YmI5ZjEzOTEwOTM4ZDEzYzUxNjhhYmM4&ctz=America/Denver&hl=en"Maybe -
HYPERLINK "https://www.google.com/calendar/event?
action=RESPOND&eid=ZnMxdW9sNjlvdG9ibmMyMnNydGs3bWxmZHMgd2lsbF9tZWVrc0Bmd3MuZ292&rst=2&tok=MjAjbm9yZWVuX3dhbHNoQGZ3cy5nb3YzNGY0OGFiMWYyYmUxYjI3YmI5ZjEzOTEwOTM4ZDEzYzUxNjhhYmM4&ctz=America/Denver&hl=en"No HYPERLINK
"https://www.google.com/calendar/event?
action=VIEW&eid=ZnMxdW9sNjlvdG9ibmMyMnNydGs3bWxmZHMgd2lsbF9tZWVrc0Bmd3MuZ292&tok=MjAjbm9yZWVuX3dhbHNoQGZ3cy5nb3YzNGY0OGFiMWYyYmUxYjI3YmI5ZjEzOTEwOTM4ZDEzYzUxNjhhYmM4&ctz=America/Denver&hl=en"more options »

Invitation from HYPERLINK "https://www.google.com/calendar/"Google Calendar

You are receiving this email at the account will_meeks@fws.gov because you are subscribed for invitations on calendar will_meeks@fws.gov.

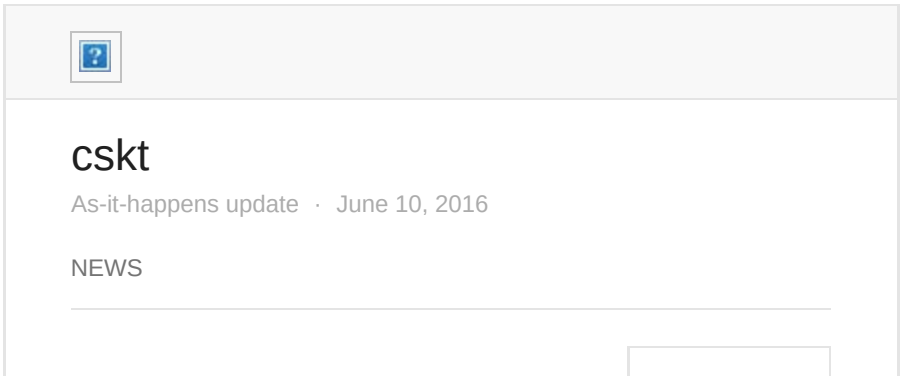
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From:	Will Meeks
To:	Stephen_Torbit@fws.gov
Subject:	Fwd: Google Alert - cskt
Date:	Thursday, June 16, 2016 9:08:37 AM

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

> **From:** Anna Munoz <anna_munoz@fws.gov>
> **Date:** June 10, 2016 at 1:49:39 PM MDT
> **To:** Noreen Walsh <noreen_walsh@fws.gov>, Matt Hogan <matt_hogan@fws.gov>, will_meeks@fws.gov, Cynthia Martinez <cynthia_martinez@fws.gov>, Roya Mogadam <roya_mogadam@fws.gov>, Gavin Shire <gavin_shire@fws.gov>, seth_willey@fws.gov
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> > **To:** <anna_munoz@fws.gov>
> > **Subject: Google Alert - cskt**
> >
> > 
> >

CSKT announces formation of Bison Range Working Group

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Comment now on restoring Bison Range land to Tribes - Valleyjournal

Full Coverage

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Send Feedback

From: Noreen Walsh
To: Dave Heffernan
Bcc: Dan Ashe
Subject: RE: National Bison Range transfer
Date: Thursday, June 16, 2016 1:43:40 PM

Hello Dave,

We never connected when you returned from vacation (or maybe you found Costa Rica to your liking and did not return??). I would still value the chance to talk with you. Is there a good time for you and a number at which I could give you a call?

Best regards,

Noreen

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

-----Original Message-----
From: Dave Heffernan [mailto:deheffer248@yahoo.com]
Sent: Friday, February 19, 2016 2:24 PM
To: Noreen Walsh
Subject: Re: National Bison Range transfer

Noreen, thanks for responding! We are vacationing in Costa Rica(:), I'll call you when we return the end of March. Hang in there!!! Dave :)

Sent from my iPad

> On Feb 19, 2016, at 10:49 AM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>
> Hello Dave,
>
> Thank you for your thoughtful note. I would value the opportunity to
> talk with you directly if you have the time. You can reach me at 303
> 236 7920, or I would be glad to call you.
>
> Best regards,
>
> Noreen
>
>
>
> Noreen Walsh
> Regional Director
> Mountain-Prairie Region
> U. S. Fish and Wildlife Service
>

>> On Feb 18, 2016, at 11:47 AM, Dave Heffernan <deheffer248@yahoo.com>
wrote:
>>
>> Hi Noreen. We worked together briefly in Atlanta before I transferred
>> to Denver-Refuges in 2000 and subsequently retired in 2003. My wife
>> Catherine and I still reside near Conifer just off of Hwy. 285. I was
>> glad when you were selected the RD for Region 6 as your reputation is
>> a good one. I received a copy of your all-employees memo (not
>> shocking in this day, is it :) concerning the issue of simply
>> transferring the National Bison Range to local CSK tribes since
>> previous efforts to "co-manage" were ineffective. I have no doubt you
>> are very familiar with that whole issue, and I for one do not envy
>> you the position you find yourself in. Careers have been greatly
>> impacted in several cases over this issue, and unfortunately politics
>> seems to oftentimes rule instead of good sound science as well as the
>> future of the Refuge System itself. I'm sure you are aware that I and
>> many others in my situation would be much opposed to the idea of
>> transferring the Bison Range, or any other unit of the NWRS, unless
>> it made sound biological and scientific sense, and would make the
>> Refuge System stronger in the long run. As I said, I do not envy you
>> the position you are in, these are potentially dangerous waters. I
>> would simply encourage you to continue doing what YOU believe is the
>> right thing to do on the part of our resources, and then do your best
>> to take each day as it unfolds. Thanks for listening, I wish you all
>> the best in your position, and pray to the Good Lord that He blesses
>> you with good and honest advisers. Sincerely, Dave Heffernan (retired
>> after 35 years of service with the Refuge System :)
>>
>> Sent from my iPad

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Response Reply to:
FWS/ANRS/062622

JUN 16 2016

The Honorable Debra Feinstein
United States Senate
Washington D.C. 20510

Dear Senator Feinstein:

Thank you for your letter of June 2, 2016, regarding your constituent, Mr. Joseph Mazzoni, concerns with the U.S. Fish and Wildlife Service's (Service) expression of support for potential legislation transferring the National Bison Range into trust for the benefit of the Confederated Salish and Kootenai Tribes (CSKT). The Service recognizes your concern and passion for the National Wildlife Refuge System (Refuge System) and offers the following observations.

President Theodore Roosevelt established the National Bison Range in 1908 within the boundaries of the Flathead Indian Reservation, home of the CSKT. The Service considers this potential transfer of administration a unique situation because the National Bison Range was established wholly within a Reservation boundary for a narrowly defined purpose, the conservation of bison at a time when they were on the verge of extinction. The Service, along with our federal, state and tribal partners, has made great strides in conserving bison, and we expect this conservation success story will continue under this proposal.

The Service would support legislation that included provisions to ensure these lands are managed in accordance with the original purpose of the National Bison Range as well as provide public access. The Service considers the CSKT to be experienced land and resource managers that have a long history of successful wildlife conservation. We have confidence the CSKT will maintain the high conservation standards that have been established at the National Bison Range, preserving its conservation legacy.

I take my responsibilities for the Refuge System seriously and although you may not agree with the Service's position, I hope you acknowledge that if the Service is to continue achieving our mission, we must make difficult decisions to focus our limited resources on our country's greatest conservation challenges.

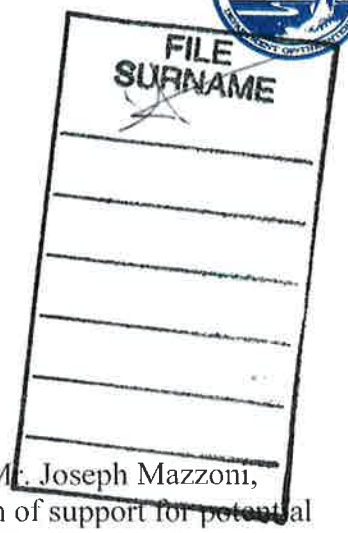
Sincerely,

Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

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Sincerely,

Director

DIANNE FEINSTEIN
CALIFORNIA

SELECT COMMITTEE ON INTELLIGENCE - VICE CHAIRMAN
COMMITTEE ON APPROPRIATIONS
COMMITTEE ON THE JUDICIARY
COMMITTEE ON RULES AND ADMINISTRATION

United States Senate
WASHINGTON, DC 20510-0504
http://feinstein.senate.gov

June 2, 2016

U.S. Fish and Wildlife Services
1849 C Street, NW
Washington, D.C. 20240

To whom it may concern:

I write to bring your attention to the enclosed constituent correspondence my office received from Mr. Jospeh Mazzoni, a former Refuge Manager of the National Bison Range, so that you may be aware of the concerns raised.

I ask that you send the Fish and Wildlife Services' response to my office so that we may forward it to the constituent. Please email a copy of this response to Tamara Gilden of my staff at tamara_gilden@feinstein.senate.gov.

If you need any further information or assistance from my staff, please contact Tamara Gilden at tamara_gilden@feinstein.senate.gov or (202) 224-3841.

Best Regards,

Dianne Feinstein
United States Senator

DF/tg

[redacted]

February 17, 2016

Senator Diane Feinstein

United States Senate

Washington, D.C. 20510-0504

Dear Senator Feinstein:

As a retired, forty-year employee of the U.S. Fish and Wildlife Service (FWS), dedicated to the management and protection of units of the National Wildlife Refuge System (NWRS), I was stunned recently to learn that my former agency is proposing to support legislation that would "transfer lands comprising the National Bison Range to be held in trust by the United States" for the Confederated Salish-Kootenai Tribes (CSKT) in Montana. A copy of that announcement from FWS Mountain-Prairie Region Regional Director Noreen Walsh is attached. The refuge is referenced later in this letter as the NBR.

This proposal contravenes earlier assurances from FWS Director Dan Ashe in a September 16, 2011 letter to former Assistant Secretary of the Interior Nathaniel Reed in which Director Ashe states, "The Service cannot and will not 'turn over' management of NBR or any other Refuge to CSKT or any other non-Service entity. Under any future AFA, NBR will remain a unit of the National Wildlife Refuge System, managed by the Service under direct guidance of the Service's on-site Refuge Manager. " He goes on in that letter to say, "We are confident that a strong partnership, with Service and CSKT employees working together, under the direction of the Refuge Manager, is the best way to continue managing the NBR to achieve the Refuge's purposes and the mission of the National Wildlife Refuge System." A copy of that letter is also enclosed.

I am writing to urge you to do everything within your power to prevent this proposal for legislating the removal of the NBR from the NWRS from becoming a reality. In so doing, you will be sending a strong message that this iconic 108 year old refuge, or any other fully successful, fully functional unit of the NWRS will not be bargained away to appease the political or self-serving economic interests of non-Service entities, but rather preserving the ultimate integrity of the NWRS from such future threats.

Established by Congress in 1908, the NBR was one 52 Theodore Roosevelt preserves that formed the precursor to what later evolved into the National Wildlife Refuge System, which, along with lands preserved within the National Park and National Forest Systems, formed a national land conservation legacy that has been held in trust and managed by the federal government for the benefit of all Americans ever since. It is a wildlife habitat protection system unrivaled by any other Nation in the World, with over 560 refuges now representing and protecting the enormous range of wildlife and wildlife habitat diversity found in our fifty States and territorial areas.

Protecting that legacy challenges every generation, with the most serious proposals those that would remove individual refuges or portions of refuges from federal stewardship and national public ownership. As a former Refuge Manager and refuge administrator at the regional level, I am fully aware of the range of threats refuges have faced throughout their history. I have also learned that the bulwark against those threats is ultimately the Congress and the various laws it enacts to ensure that the many values enshrined in the National Wildlife Refuge System are protected for future generations ...and its legacy preserved.

As a former Refuge Manager in charge of the National Bison Range, I'm also fully aware of its multiple public benefits. In addition to developing and managing one of the most diverse, natural herds of American Bison (whose genetics demonstrate valuable unique characters that are carefully managed in coordination with other FWS protected herds in Nebraska and Oklahoma), the refuge hosted over 100,000 visitors during my tenure...a figure that now exceeds 200,000. These are people and their families who come from all over the Nation and many other countries to see bison and other refuge wildlife in their natural habitats; a valuable and enjoyable learning experience for future leaders and other citizens of America.

It's also a mecca for outdoor photographers , who have the opportunity to pursue their hobby or profession in a proximity to wildlife rarely available elsewhere.

Throughout much of its history the refuge has enjoyed an extensive relationship with local and regional schools at all levels for research and environmental education opportunities, both on and off the refuge, with universities from as far away

as Western Washington bringing their classes for educational interactions with professionally trained refuge staff.

The refuge has also participated in cooperative environmental and wildlife health research programs associated with the University of Montana and other noted universities. Over the years it has provided surplus big game animals to the State of Montana for the re-establishment of native big game populations, including Rocky Mountain elk, big horn sheep and pronghorn antelope. Bison from the NBR have been used to improve genetic diversity in several other State and federally owned herds. They have also been used to begin limited new populations of bison in Colorado and Iowa, and have been donated to the CSKT Tribes on many occasions for food and other products (including two previous attempts by the Tribes to develop their own bison herd).

This refuge, along with many other units of the NWRS, has a long history of involving other groups and interests in assisting in the planning of and contributing to specific aspects of the management of individual refuges through the authority and use of cooperative agreements. They offer a very practical and legal opportunity to develop mutually beneficial partnerships

that contribute to the purpose of each refuge and the mission of the NWRS without abrogating the FWS's legal authorities and responsibilities under the law to manage units of the NWRS. The CSKT rejected this approach, and chose to pursue their interests through an Annual Funding Agreement (AFA), as provided for in the Indian Self Determination Act.

The FWS efforts to respond to the CSKT's request for an AFA that would involve them in the management of the NBR have repeatedly failed over a period now approaching 20 years, at tremendous cost to the Service and with enormous adverse impacts on professional refuge staff members. The fundamental reason is that 1) the tribe has made no secret of their desire to take over full ownership and control of the refuge (read their mission statement, also attached), and 2) Congressional law requires that refuges remain in the NWRS and be managed by the FWS. This impasse has now led to the current FWS incredible proposal to transfer the NBR out of the NWRS!

My hope is that, with your help and that of your colleagues, the Congress will emphatically refuse to support any proposed

legislation that would transfer the NBR or any other unit of the NWRS to the CSKT or any other non-Service entity.

Further, my hope is that the FWS will then decide to take a realistic approach to involving the CSKT in the management of the NBR by developing an annual cooperative agreement that clearly defines how the tribe can contribute to the objectives of the refuge and the mission of the NWRS, in a demonstrable manner, that is cost-effective for the FWS and maintains the authority and responsibility of the FWS for management of the refuge.

I enjoyed a good working relationship with the CSKT when I was the Refuge Manager at the NBR, and I see no reason why that kind of a mutually supportive relationship can't be continued...so long as each parties' expectations are truly realistic and consistent with applicable law.

Thank you for considering my request. I look forward to hearing from you.

Sincerely,

From: Mike Blenden
To: Will Meeks
Subject: NBR suggestion
Date: Friday, June 17, 2016 6:28:03 AM

Yesterday the staff brought up the problem of them being constantly asked about many aspects of the possible transfer. County commissioners, news media, community members, etc. are asking. I think it would be helpful to work with them and Anna to develop a list of talking points or responses to questions they frequently hear so they can provide local responses to at least some of the questions they hear. Maybe we can discuss with Jeff today.

Sent from my iPad

From: Will Meeks
To: Anna Munoz
Subject: Fwd: NBR suggestion
Date: Friday, June 17, 2016 6:42:08 AM

Thoughts

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

Begin forwarded message:

> **From:** Mike Blenden <mike_blenden@fws.gov>
> **Date:** June 17, 2016 at 6:28:00 AM MDT
> **To:** Will Meeks <will_meeks@fws.gov>
> **Subject: NBR suggestion**
>
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>
> Sent from my iPad

From: Munoz, Anna
To: Will Meeks
Subject: Re: NBR suggestion
Date: Friday, June 17, 2016 10:45:04 AM

Let's add this to our meeting this afternoon.

On Friday, June 17, 2016, Will Meeks <will_meeks@fws.gov> wrote:

> Thoughts
>
> Will Meeks
> U.S. Fish and Wildlife Service
> Mountain-Prairie Region
> Assistant Regional Director
> National Wildlife Refuge System
> 303-236-4303(w)
> 720-541-0310 (c)
>
> Begin forwarded message:
>
> > **From:** Mike Blenden <mike_blenden@fws.gov>
> > **Date:** June 17, 2016 at 6:28:00 AM MDT
> > **To:** Will Meeks <will_meeks@fws.gov>
> > **Subject: NBR suggestion**
> >
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> >
> > Sent from my iPad

--
Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

From: Will Meeks
To: Mike Blenden; Jeff King
Cc: Anna Munoz
Subject: Talking points
Date: Friday, June 17, 2016 12:20:05 PM

Spoke to Anna (cc'd) and she'd be happy to help with talking points for staff. Can you two send 5-6 common questions so she can craft the response for you?

Thanks.

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

From: Dave Heffernan
To: Noreen Walsh
Subject: Re: National Bison Range transfer
Date: Friday, June 17, 2016 1:46:53 PM

Hi Noreen, thanks for getting back to me! I'll contact you next week to try to set up a time that works for both of us, I promise!! Looking forward to it, Dave

Sent from Dave

> On Jun 16, 2016, at 1:43 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>
> Hello Dave,
>
> We never connected when you returned from vacation (or maybe you found
> Costa Rica to your liking and did not return??). I would still value the
> chance to talk with you. Is there a good time for you and a number at
> which I could give you a call?
>
> Best regards,
>
> Noreen
>
>
>
> Noreen Walsh
> Regional Director
> Mountain-Prairie Region
> U. S. Fish and Wildlife Service
> 303 236 7920
>
> -----Original Message-----
> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
> Sent: Friday, February 19, 2016 2:24 PM
> To: Noreen Walsh
> Subject: Re: National Bison Range transfer
>
> Noreen, thanks for responding! We are vacationing in Costa Rica(:), I'll
> call you when we return the end of March. Hang in there!!! Dave :)
>
> Sent from my iPad
>
>> On Feb 19, 2016, at 10:49 AM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>
>> Hello Dave,
>>
>> Thank you for your thoughtful note. I would value the opportunity to
>> talk with you directly if you have the time. You can reach me at 303
>> 236 7920, or I would be glad to call you.
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>>

>>
>> Noreen Walsh
>> Regional Director
>> Mountain-Prairie Region
>> U. S. Fish and Wildlife Service
>>
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>>> future of the Refuge System itself. I'm sure you are aware that I and
>>> many others in my situation would be much opposed to the idea of
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>>> the best in your position, and pray to the Good Lord that He blesses
>>> you with good and honest advisers. Sincerely, Dave Heffernan (retired
>>> after 35 years of service with the Refuge System :)
>>>
>>> Sent from my iPad

From: Noreen Walsh
To: Will Meeks
Subject: RE: NBR - all employee
Date: Friday, June 17, 2016 4:17:05 PM

Can you be on the phone from SLC? If so that is fine, no need to change any plans

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

From: Will Meeks [mailto:Will_Meeks@fws.gov]
Sent: Friday, June 17, 2016 4:15 PM
To: Noreen Walsh
Subject: NBR - all employee

Noreen,

It just dawned on me that I was going to arrive in Salt Lake City early to head out to Bear River on the 27th.

I'm happy to arrange if you preferred I did the presentation in person here in the RO. Any preference on your part?

Thanks.

Will Meeks
U.S. Fish and Wildlife Service
Mountain Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

From:	Munoz, Anna
To:	Noreen Walsh; Matt Hogan; Will Meeks
Subject:	Fwd: Bison Range story on MT Public Radio
Date:	Wednesday, June 22, 2016 11:14:27 AM
Attachments:	MtPR 6-13-16 NBR story (color).pdf

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

---------- Forwarded message ----------
From: **Brian Upton** <brianu@cskt.org>
Date: Wed, Jun 22, 2016 at 10:49 AM
Subject: Bison Range story on MT Public Radio
To: cynthia_martinez@fws.gov, shaun_sanchez@fws.gov, betsy_hildebrandt@fws.gov, anna_munoz@fws.gov, scott_aikin@fws.gov
Cc: mike.black@bia.gov, sharee.freeman@bia.gov

I know that you are probably getting copies of the Montana print stories concerning the Tribes' draft NBR restoration legislation, but I wasn't sure whether you are also getting things from media outlets such as Montana Public Radio. In case you haven't already seen it, here is a June 13th piece from MtPR that discusses the proposed restoration/transfer, as well as the litigation. The story addresses some different angles than most of the media we've seen thus far. It also includes notice that CSKT is accepting public comments on the Tribes' draft legislation, so that is good.

The audio is a bit hard to hear at times, so it's probably best to read the online print version of the story (which also includes a screenshot of one of the plaintiffs' Facebook page that is discussed in the news piece).

Here is a link: Fight Brewing Over Proposed Transfer Of National Bison Range | MTPR. I'm also attaching a PDF of the story in case that's easier.

I wasn't sure who all I should send this to, so please forward on as you see fit.

Thanks,

BU

Montana Public Radio (/)

Donate (http://mtpr.org/donate-mtpr)

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Morning Classics LOADING...

Fight Brewing Over Proposed Transfer Of National Bison Range

By AMY MARTIN • JUN 13, 2016

Twitter (http://twitter.com/intent/tweet?url=http%3A%2F%2Fwww.tinyurl.com%2Fjo79a5p&text=Fight%20Brewing%20Over%20(



(http://mediad.publicbroadcasting.net/p/kufm/files/styles/x_large/public/201606/National-Bison-Range-02_Amy-Martin.jpg)

After more than 100 years of federal control, the lands of the National Bison Range may be returned to the Confederated Salish and Kootenai Tribes.

AMY MARTIN

Listen
5:29

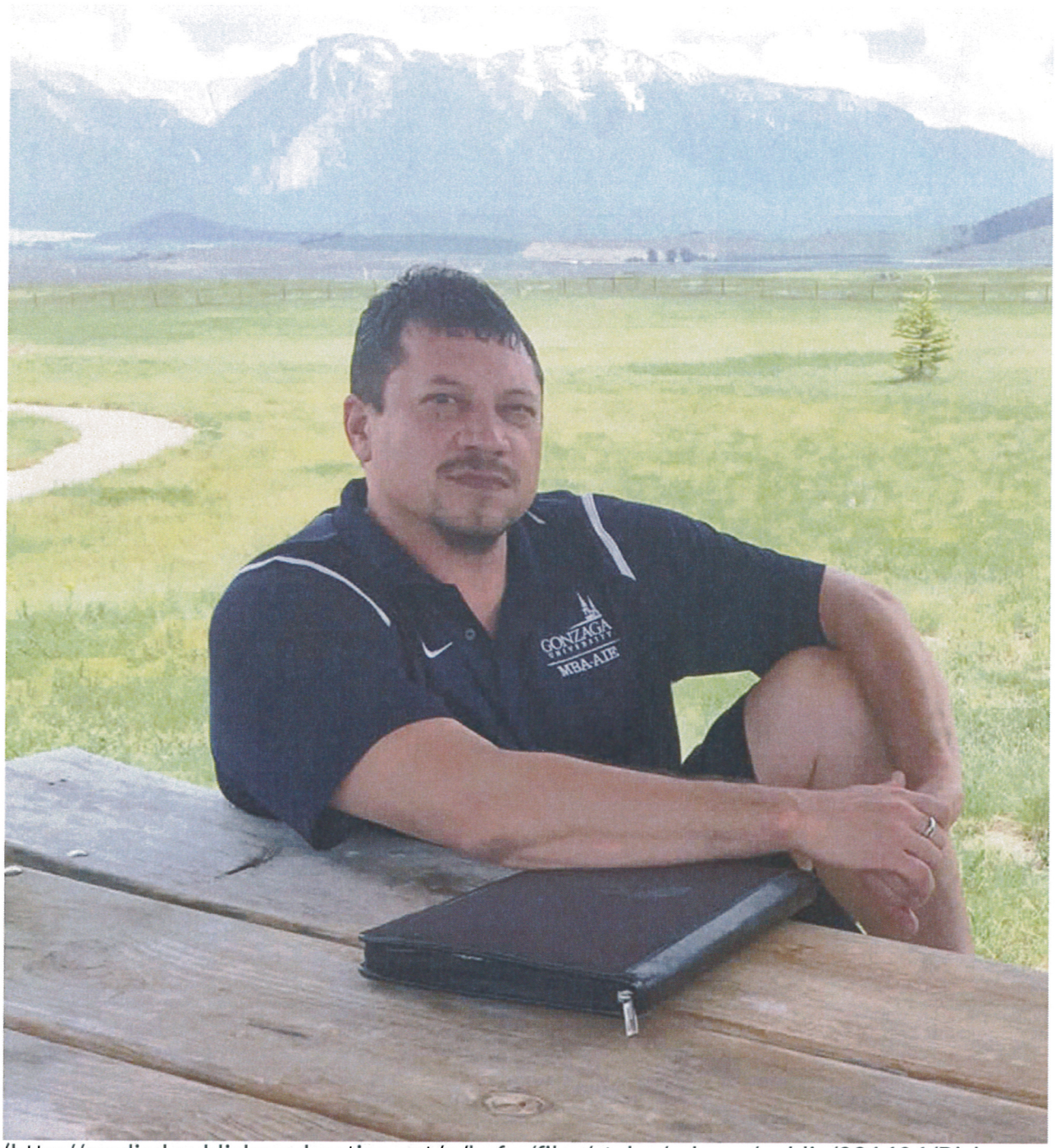
Fight Brewing Over Proposed Transfer Of National Bison Range



After more than 100 years of federal control, the lands of the National Bison Range may be returned to the Confederated Salish and Kootenai Tribes. Last week, the tribes released draft legislation that would transfer authority over the range (http://mtpr.org/post/draft-bill-would-transfer-bison-range-tribal-control) from the U.S. Fish and Wildlife Service to the CSKT.

At the top of Ravalli* Hill, about 40 miles north of Missoula, you can look right into the National Bison Range from an overlook on the side of Highway 93. You can't always see bison from that spot, but on the day I met Rich Janssen, head of the natural resources department for the Confederated Salish and Kootenai Tribes, we got lucky.

"..seeing the mighty bison, the American bison, commonly called buffalo by the Europeans, *Q'wey Q'way* in the Salish language."



(http://mediad.publicbroadcasting.net/p/kufm/files/styles/x_large/public/201606/Rich-Janssen-CSKT_Amy-Martin.jpg)

Rich Janssen is head of the Natural Resources Department for the Confederated Salish and Kootenai Tribes.

CREDIT AMY MARTIN

Tourists making the trek between Glacier National Park and Yellowstone were stopping to photograph the herd, including the red calves who hopped about while their moms grazed.

"Yeah, that's a prehistoric animal that thrives, and is very hearty, and obviously was not driven to extinction like they tried, and you can see how well they're doing right now," Janssen says. "It's pretty neat to see that animal walking along the side hills of the Bison Range, that you see them grazing, nonchalantly."

In the Hellgate Treaty of 1855, the United States promised the Flathead Reservation would be the permanent homeland for the Salish, Kootenai and Pend d'Oreille people. But in 1908, the federal government carved 18,000 acres out of the reservation to form the National Bison Range. Since the mid-1990s, the tribes have been seeking a larger role in the management of the range. And this past February, the U.S. Fish and Wildlife Service signaled their willingness to return control of the lands to the tribes.

"You know the time is now, it's a long time coming for this to happen and I'm pretty proud to say that I'm going to be part of history," says Janssen.

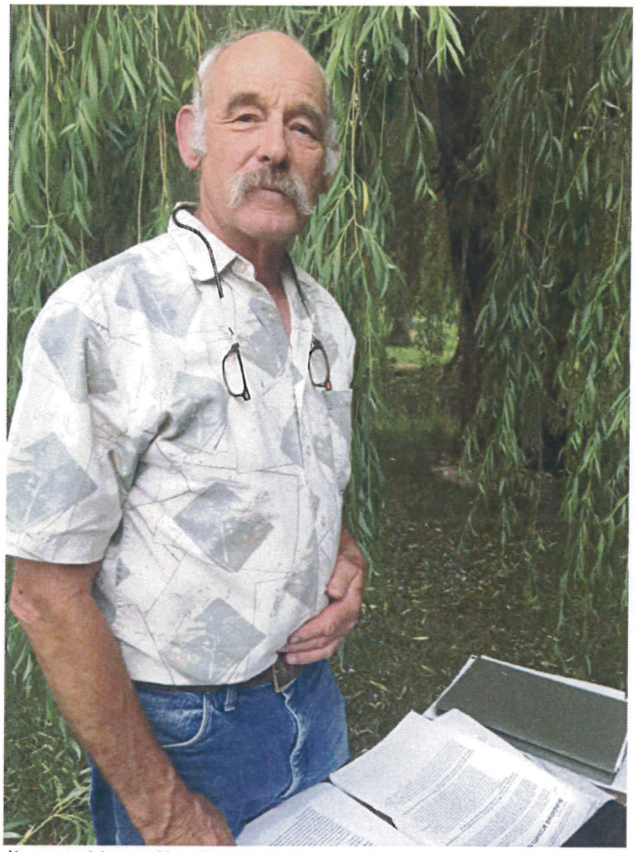
Last week, the CSKT released a draft of a bill which would return the range to its pre-1908 status as part of the reservation (http://bisonrangeworkinggroup.org/wp-content/uploads/2016/06/CSKT-Draft-NBR-Bill-6-6-16.pdf). The bill would continue bison conservation and public access, while giving the tribes management authority. Janssen says his department is more than ready.

"Our wildlife program is top-notch. I would put our wildlife program, our department, at any level of any other wildlife program within the state. Even nationally. We have the tools and the capabilities to manage this bison range in perpetuity, and I think when that occurs, this will undoubtedly improve what you see at the bison range at this time."

But not everyone supports the proposed transfer. Skip Palmer worked in the maintenance department at the National Bison Range for 16 years.

"Loved it. How could a person not love it? You know, you're working with wildlife. I spent 16 years basically, amongst other things, chasing bison on horseback. Round 'em up every year."

Palmer is one of 10 co-plaintiffs in a lawsuit filed by the group Public Employees for Environmental Responsibility, or PEER.



(http://mediad.publicbroadcasting.net/p/kufm/files/styles/x_large/public/201606/Skip-Palmer_Amy-Martin.jpg)

Skip Palmer worked in the maintenance department at the National Bison Range for 16 years. He's a plaintiff in the lawsuit seeking to prevent transfer of the Bison Range to CSKT management.

CREDIT AMY MARTIN

(http://www.peer.org/assets/docs/nwr/5_23_16_PEER-Bison_Range_Complaint.pdf) He says PEER (http://www.peer.org/) is opposed to transferring control to the tribes for several reasons, including his fear that the land will not remain a bison range.

"There's nothing out there at this point that tells the tribe we want a guarantee from you that you're going to keep it a bison range ... nope, no guarantee.

The draft legislation proposed by the tribes (http://bisonrangeworkinggroup.org/wp-content/uploads/2016/06/CSKT-Draft-NBR-Bill-6-6-16.pdf) states that the lands will be managed "solely for the bison, wildlife and other natural resources".

Palmer: "I don't care what they said."

Martin: "You don't believe them?"

Palmer: "No."

Palmer says he joined the PEER lawsuit because he believes legislation should not even be proposed unless a full environmental impact statement is completed first.

"They're introducing something that's illegal. It shouldn't go to Congress because it's illegal to even get that point."

The courts will decide whether or not an environmental impact statement is required: that question may come down to technicalities of who is proposing the legislation – the Fish and Wildlife Service, or the tribes.

Rachel Carrol-Rivas (http://mtpr.org/term/Rachel-Carrol-Rivas) of the Montana Human Rights Network (http://mhrn.org) says opposition to the transfer of the bison range did not begin with environmental concerns, but rather, with racial fear.

"There's a history of anti-Indian sentiment and active organizing in this community and on these issues."

Carrol-Rivas says the Montana Human Rights Network documented this history in a report from January 2000 called "Drumming Up Resentment." (http://www.mhrn.org/publications/specialresearchreports/DrummingUp.pdf)

"And a lot of it centered on the anti-Indian movement against the Confederated Salish and Kootenai tribe particularly. And touched on the early stages of the opposition to the National Bison Range and that continues to be a concern for us."

Carrol-Rivas says the anti-Indian movement in the Flathead Valley is not as strong as it once was, but that it tends to get re-ignited when the tribes make advancements like the Flathead water compact, or this proposed transfer.

Paula Dinerstein, lead counsel for PEER, doesn't buy it.

"I think groups are suggesting that because they don't want to deal with the merits of the case, they want to scream racism instead, and I don't think there's any basis for it," Dinerstein said.

Martin: "Well one of the plaintiffs in the lawsuit, Skip Palmer, on his Facebook page right now has a white power symbol."

Dinerstein: "Well, I don't know anything, I haven't seen his Facebook page, but I do know Mr. Palmer, and I know he has worked very closely with tribal people who are employed at the range."



(http://mediad.publicbroadcasting.net/p/kufm/files/styles/x_large/public/201606/Skip-Palmer-Facebook-Screen-Capture-06-09-16.jpg)

A screen capture from June 9, 2016 of a Facebook post shared by Skip Palmer, one of the plaintiffs in the lawsuit seeking to prevent the transfer of the National Bison Range to the Confederated Salish & Kootenai Tribes.

Palmer actually left the National Bison Range in part over employment disputes that stemmed from sharing management duties with the tribes.

The Montana Human Rights Network says other plaintiffs have ties to anti-Indian groups as well.

Back at the overlook, however, the visitors who have stopped to watch the bison seem to be less concerned with who is in charge of the land, and more interested in the animals themselves – and not only the bison.

"We're not used to seeing signs that say 'danger, rattlesnakes,'" Jane Heppell said. She and Bob Heppell are from Norfolk, England.

"People are always going to object about something anyway," Bob Heppell says, "but give them chance to have a go, and good luck to them, that's what I say."

The CSKT have formed a Bison Range Working Group (http://bisonrangeworkinggroup.org/) to support the proposed transfer. They are accepting comments on their draft legislation through June 24. The lawsuit by PEER is currently pending in federal court.

an earlier version of this story mis-identified the Bison Range overlook's location as atop Evaro hill. We regret the error.

TAGS: NATIONAL BISON RANGE (/TERM/NATIONAL-BISON-RANGE) BISON (/TERM/BISON)

CONFEDERATED SALISH AND KOOTENAI TRIBES (/TERM/CONFEDERATED-SALISH-AND-KOOTENAI-TRIBES)

U.S. FISH & WILDLIFE SERVICE (/TERM/US-FISH-WILDLIFE-SERVICE)

RICH JANSSEN (/TERM/RICH-JANSSEN) HELLGATE TREATY (/TERM/HELLGATE-TREATY)

From: Noreen Walsh
To: Dan Ashe (d_m_ashe@fws.gov)
Subject: FW: National Bison Range transfer
Date: Wednesday, June 22, 2016 3:03:00 PM

---

fyi
-----Original Message-----
From: Dave Heffernan [mailto:deheffer248@yahoo.com]
Sent: Friday, June 17, 2016 1:44 PM
To: Noreen Walsh
Subject: Re: National Bison Range transfer

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Date: Thursday, June 23, 2016 1:04:21 PM

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From: Noreen Walsh
To: "Dave Heffernan"
Subject: RE: National Bison Range transfer
Date: Thursday, June 23, 2016 5:27:00 PM

Thanks Dave, how does late Wednesday the 29th look for you? Say 4 pm?

Noreen Walsh
Regional Director
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From: Dave Heffernan
To: Noreen Walsh
Subject: Re: National Bison Range transfer
Date: Thursday, June 23, 2016 7:42:33 PM

We'll make it work. My home phone is b(6) cell is b(6). Look forward to talking with you!
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Sent from Dave

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From: Noreen Walsh
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Date: Friday, June 24, 2016 6:25:46 AM

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>>>>>> On Feb 19, 2016, at 10:49 AM, Noreen Walsh <noreen_walsh@fws.gov>
>>> wrote:
>>>>>>
>>>>>> Hello Dave,
>>>>>>
>>>>>> Thank you for your thoughtful note. I would value the opportunity
>>>>>> to talk with you directly if you have the time. You can reach me at
>>>>>> 303
>>>>>> 236 7920, or I would be glad to call you.
>>>>>>
>>>>>> Best regards,
>>>>>>
>>>>>> Noreen
>>>>>>
>>>>>>
>>>>>>
>>>>>> Noreen Walsh
>>>>>> Regional Director
>>>>>> Mountain-Prairie Region
>>>>>> U. S. Fish and Wildlife Service
>>>>>>
>>>>>>> On Feb 18, 2016, at 11:47 AM, Dave Heffernan
>>>>>>> <deheffer248@yahoo.com>
>>>>> wrote:
>>>>>>>

>>>>>>> Hi Noreen. We worked together briefly in Atlanta before I
>>>>>>> transferred to Denver-Refuges in 2000 and subsequently retired in
>>>>>>> 2003. My wife Catherine and I still reside near Conifer just off of
>>>>>>> Hwy. 285. I was glad when you were selected the RD for Region 6 as
>>>>>>> your reputation is a good one. I received a copy of your
>>>>>>> all-employees memo (not shocking in this day, is it :) concerning
>>>>>>> the issue of simply transferring the National Bison Range to local
>>>>>>> CSK tribes since previous efforts to "co-manage" were ineffective.
>>>>>>> I have no doubt you are very familiar with that whole issue, and I
>>>>>>> for one do not envy you the position you find yourself in. Careers
>>>>>>> have been greatly impacted in several cases over this issue, and
>>>>>>> unfortunately politics seems to oftentimes rule instead of good
>>>>>>> sound science as well as the future of the Refuge System itself.
>>>>>>> I'm sure you are aware that I and many others in my situation would
>>>>>>> be much opposed to the idea of transferring the Bison Range, or any
>>>>>>> other unit of the NWRS, unless it made sound biological and
>>>>>>> scientific sense, and would make the Refuge System stronger in the
>>>>>>> long run. As I said, I do not envy you the position you are in,
>>>>>>> these are potentially dangerous waters. I would simply encourage
>>>>>>> you to continue doing what YOU believe is the right thing to do on
>>>>>>> the part of our resources, and then do your best to take each day
>>>>>>> as it unfolds. Thanks for listening, I wish you all the best in
>>>>>>> your position, and pray to the Good Lord that He blesses you with
>>>>>>> good and honest advisers. Sincerely, Dave Heffernan (retired after
>>>>>>> 35 years of service with the Refuge System :)
>>>>>>>
>>>>>>> Sent from my iPad
>>

Conversation Contents

Fwd: laura_king@fws.gov has shared something with you

"King, Laura" <laura_king@fws.gov>

From:	"King, Laura" <laura_king@fws.gov>
Sent:	Fri Jun 24 2016 14:47:40 GMT-0600 (MDT)
To:	Anna Munoz <anna_munoz@fws.gov>, Will Meeks <will_meeks@fws.gov>, Mike Blenden <mike_blenden@fws.gov>, Jeff King <jeff_king@fws.gov>
Subject:	Fwd: laura_king@fws.gov has shared something with you

Here are some Op-eds that were published this week in our local newspaper, the Valley Journal. Gale Decker is one of our Lake County Commissioners. I'll forward these local articles about the NBR proposal when I see them.

Just an FYI.

Laura

Laura King, Refuge Program Specialist
U.S. Fish and Wildlife Service, Division of Refuge Planning
58355 Bison Range Rd.
Moiese, MT 59824
phone, 406-644-2211, ext. 210
fax, 406-644-2661

http://www.valleyjournal.net/Article/15614/Oppose-Bison-Range-transfer

http://www.valleyjournal.net/Article/15613/Draft-Bison-Range-bill-fails-to-address-county-impact#.V22Y9fa3CrU.email

From: Noreen Walsh
To: Will Meeks
Subject: Good morning...
Date: Monday, June 27, 2016 8:37:10 AM

Apologies if this topic never got to you.....if so, all my fault.....but I think we talked about it....

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Mountain-Prairie Region
U. S. Fish and Wildlife Service

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Regional Director
Mountain-Prairie Region
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From: Will Meeks
To: Noreen Walsh
Subject: Re: Good morning...
Date: Monday, June 27, 2016 9:10:35 AM

I will be and will add to your comments. I will go off of your cue.

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303(w)
720-541-0310 (c)

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From: Noreen Walsh
To: Will Meeks
Subject: RE: Good morning...
Date: Monday, June 27, 2016 9:15:34 AM

Awesome, thank you.

Barbara had a panicked look in her eye..... :)

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

-----Original Message-----
From: Will Meeks [mailto:will_meeks@fws.gov]
Sent: Monday, June 27, 2016 9:11 AM
To: Noreen Walsh
Subject: Re: Good morning...

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U.S. Fish and Wildlife Service
Mountain-Prairie Region
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From: Jeff King
To: Noreen Walsh; Will Meeks
Subject: Nbr update
Date: Monday, June 27, 2016 10:37:14 AM

Noreen and Will. Thanks for the nbr update during the all employee call today. I would like to request a call with the NBR staff to address more specific questions that they may have. Let me know a date and time that works for both of you.

Thanks

jk

Sent from my iPhone

From: Jeff King
To: Noreen Walsh; Will Meeks
Subject: Nbr update
Date: Monday, June 27, 2016 10:37:18 AM

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From: Noreen Walsh
To: Jeff King
Cc: Will Meeks; Stephanie Potter; Matt Hogan
Subject: Re: Nbr update
Date: Monday, June 27, 2016 2:17:06 PM

Thanks Jeff. I'm happy to do that as soon as it works for all. Will and I are at Bear River the next two days. We should be able to schedule something after that. I'm copying Stephanie Potter, our new executive assistant, who can help with scheduling.
Noreen

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Mountain-Prairie Region
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Subject: Re: Good morning...
Date: Monday, June 27, 2016 2:22:47 PM

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Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

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No problem being available. Yes, we had talked about it. :)

Thanks for the kind words. I was hopeful you thought it was "OK."

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From: stephanie_potter@fws.gov
To: Will Meeks; Jeff King
Subject: Conference call with NBR staff
Start: Monday, July 25, 2016 2:30:00 PM
End: Monday, July 25, 2016 3:00:00 PM
Location: RD office or 1-866-613-9547 passcode 92085018

> On Jun 27, 2016, at 10:37 AM, Jeff King <HYPERLINK "mailto:jeff_king@fws.gov"jeff_king@fws.gov> wrote:

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From: stephanie_potter@fws.gov
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Subject: Conference call with NBR staff

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> Thanks

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> jk

From: Dave Heffernan
To: Noreen Walsh
Subject: Re: National Bison Range transfer
Date: Wednesday, June 29, 2016 10:31:52 AM

Hi Noreen. Best bet for me today would be my cellphone at b(6) . Will look for your call around 4 if that still works for you. Dave

Sent from Dave

> On Jun 24, 2016, at 6:25 AM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>
> I will give you a call then - thanks Dave!
>
>> On Jun 23, 2016, at 7:42 PM, Dave Heffernan <deheffer248@yahoo.com> wrote:
>>
>> We'll make it work. My home phone is b(6) , cell is b(6) . Look forward to talking with you! Dave
>>
>> Sent from Dave
>>
>>> On Jun 23, 2016, at 5:27 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>>
>>> Thanks Dave, how does late Wednesday the 29th look for you? Say 4 pm?
>>>
>>>
>>>
>>>
>>> Noreen Walsh
>>> Regional Director
>>> Mountain-Prairie Region
>>> U. S. Fish and Wildlife Service
>>> 303 236 7920
>>>
>>> -----Original Message-----
>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>> Sent: Thursday, June 23, 2016 1:04 PM
>>> To: Noreen Walsh
>>> Subject: Re: National Bison Range transfer
>>>
>>> Hi again, Noreen. Is there a time next week when we can talk? This week is
>>> already shot with grandkids visits, etc, and we head to Alaska the week
>>> after for much of July. What do you think? Dave
>>>
>>> Sent from Dave
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>>>> On Jun 17, 2016, at 1:43 PM, Dave Heffernan <deheffer248@yahoo.com>
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>>>>
>>>> Hi Noreen, thanks for getting back to me! I'll contact you next week
>>>> to try to set up a time that works for both of us, I promise!! Looking
>>>> forward to it, Dave
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>>>> Sent from Dave
>>>>

>>>>> On Jun 16, 2016, at 1:43 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>>>>
>>>>> Hello Dave,
>>>>>
>>>>> We never connected when you returned from vacation (or maybe you
>>>>> found Costa Rica to your liking and did not return??). I would still
>>>>> value the chance to talk with you. Is there a good time for you and
>>>>> a number at which I could give you a call?
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>>>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>>>> Sent: Friday, February 19, 2016 2:24 PM
>>>>> To: Noreen Walsh
>>>>> Subject: Re: National Bison Range transfer
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>>>>> Noreen, thanks for responding! We are vacationing in Costa Rica(:),
>>>>> I'll call you when we return the end of March. Hang in there!!! Dave
>>>>> :)
>>>>>
>>>>> Sent from my iPad
>>>>>
>>>>>> On Feb 19, 2016, at 10:49 AM, Noreen Walsh <noreen_walsh@fws.gov>
>>> wrote:
>>>>>>
>>>>>> Hello Dave,
>>>>>>
>>>>>> Thank you for your thoughtful note. I would value the opportunity
>>>>>> to talk with you directly if you have the time. You can reach me at
>>>>>> 303
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>>>>>>
>>>>>> Best regards,
>>>>>>
>>>>>> Noreen
>>>>>>
>>>>>>
>>>>>>
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>>>>>> Regional Director
>>>>>> Mountain-Prairie Region
>>>>>> U. S. Fish and Wildlife Service
>>>>>>
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>>>>>>> your reputation is a good one. I received a copy of your
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>>>>>>> the issue of simply transferring the National Bison Range to local
>>>>>>> CSK tribes since previous efforts to "co-manage" were ineffective.
>>>>>>> I have no doubt you are very familiar with that whole issue, and I
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>>>>>>> unfortunately politics seems to oftentimes rule instead of good
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>>>>>>> your position, and pray to the Good Lord that He blesses you with
>>>>>>> good and honest advisers. Sincerely, Dave Heffernan (retired after
>>>>>>> 35 years of service with the Refuge System :)
>>>>>>>
>>>>>>> Sent from my iPad
>>

From:	Morris, Charisa
To:	Noreen Walsh; Matt Hogan; Cynthia Martinez; Shaun Sanchez; Scott Aikin
Subject:	Fwd: Tribal Bison Range Leaves Many Uncertainties
Date:	Wednesday, June 29, 2016 11:53:24 AM

FYI

---------- Forwarded message ----------
From: **Sellars, Roslyn** <roslyn_sellars@fws.gov>
Date: Wed, Jun 29, 2016 at 11:04 AM
Subject: Fwd: Tribal Bison Range Leaves Many Uncertainties
To: "Morris, Charisa" <Charisa_Morris@fws.gov>, Nikki Randolph <Nikki_Randolph@fws.gov>, "Hancock, Donnise L" <Donnise_Hancock@fws.gov>

FYI
Roslyn

---------- Forwarded message ----------
From: **Robert E. Rutkowski** <r_e_rutkowski@att.net>
Date: Wed, Jun 29, 2016 at 9:30 AM
Subject: Tribal Bison Range Leaves Many Uncertainties
To: Mitch McConnell <Elizabeth_Strimer@mcconnell.senate.gov>, Paul Ryan <connect@messages.speaker.gov>, Harry Reid <David_Krone@reid.senate.gov>
Cc: exsec@ios.doi.gov, Secretary_jewell@ios.doi.gov, Dan_Ashe@fws.gov

Senator Mitch McConnell
RUSSELL SENATE OFFICE BUILDING
WASHINGTON DC 20510
Phone: (202) 224-2541

Senator Harry Reid
Democratic Leader
RUSSELL SENATE OFFICE BUILDING
Washington, DC 20510

Speaker Paul Ryan
Office of the Speaker
H-204 The Capitol
Washington, DC 20515
Phone: (202) 225-4000
Fax: (202) 225-5117

The Hon. Nancy Pelosi
Democratic Leader
United States Capitol
Washington, DC 20515

Re: Tribal Bison Range Leaves Many Uncertainties

Dear Congressional Leadership:

A plan to take over the National Bison Range being circulated by local tribes raises more questions than it answers while digging big legal pitfalls. Once the refuge is handed over to the Confederated Salish and Kootenai Tribes (CSKT) there is no guarantee that the public will have access, that it will operate as a refuge or that its bison herd will remain.

The CSKT began circulating a mock-up of legislation earlier this month after the U.S. Fish & Wildlife Service indicated that it would sponsor or support legislation authorizing the first major surrender of a national wildlife refuge in American history. PEER has sued the Service because it ignored statutory requirements that it conduct an environmental analysis prior to making any such proposal.

Besides lacking enforceable assurances that the CSKT would operate National Bison Range as a refuge, admit the public or keep the bison, the CSKT draft would allow the land to be used for "other purposes," preclude any legal challenges about conflicting uses and preclude application of federal or state law.

Under the tribes' plan, the CSKT could turn the Bison Range into an auto race track, gravel mine or casino and there would be absolutely no recourse.

Montana's congressional delegation should press the Service to do a thorough analysis of what the loss of the refuge system's Crown Jewel would mean, including the loss of this unique and vital herd for the future of the national mammal.

Besides the large unresolved question marks, the CSKT draft would also –

• Leave U.S. taxpayers on the hook to make further payments, even after giving away properties valued at more than $100 million, to the CSKT;

• Cast a legal cloud over the title of 4,834 privately-held land parcels (consisting of nearly 500,000 acres) within the boundaries of the Flathead Indian Reservation by giving the CSKT a legal claim on all lands within the reservation; and

• Suspend application of the National Environmental Policy Act on any action taken affecting the Bison Range, thus precluding any further environmental analyses, while also precluding any legal actions against the government regarding management of the Bison Range, either pre- or post-transfer.

Why should American taxpayers owe more money to the Tribes after giving them the entire Bison Range and every asset on it? Note the fiscal strain on the already cash-starved National Wildlife Refuge System. The Montana delegation should take a very hard look at this incredibly one-sided proposal and demand that the Service provide a full accounting of its implications before taking another step.

Thank you for the opportunity to bring these remarks to your attention.

Yours sincerely,
Robert E. Rutkowski

cc:
Dan Ashe
Director, U.S. Fish and Wildlife Service
1849 C Street, N.W.
Washington, D.C. 20240
Dan_Ashe@fws.gov

Sally Jewell, Secretary
Department of the Interior
1849 C Street, N.W.
Washington, D.C. 20240
Email: exsec@ios.doi.gov, Secretary_jewell@ios.doi.gov

2527 Faxon Court
Topeka, Kansas 66605-2086
P/F: 1 785 379-9671
E-mail: r_e_rutkowski@att.net

Re: PEER letter:
http://www.peer.org/assets/docs/6_29_16_PEER_congress_ltr_CSKT_takeover_plan.pdf

--

Charisa_Morris@fws.gov | Chief of Staff, Office of the Director | U.S. Fish & Wildlife Service | 1849 C Street NW, Room 3348 | Washington, DC 20240 | (202) 208-3843 | For urgent matters, please dial cell: 301-875-8937

From: Noreen Walsh
To: Dave Heffernan
Subject: Re: National Bison Range transfer
Date: Wednesday, June 29, 2016 12:17:47 PM

Thanks Dave. I think I should be out of my last meeting by then. I
will call at the number you gave below.

> On Jun 29, 2016, at 10:31 AM, Dave Heffernan <deheffer248@yahoo.com> wrote:
>
> Hi Noreen. Best bet for me today would be my cellphone at b(6) . Will look for your call around 4 if that still works for you. Dave
>
> Sent from Dave
>
>> On Jun 24, 2016, at 6:25 AM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>
>> I will give you a call then - thanks Dave!
>>
>>> On Jun 23, 2016, at 7:42 PM, Dave Heffernan <deheffer248@yahoo.com> wrote:
>>>
>>> We'll make it work. My home phone is b(6) , cell is b(6) . Look forward to talking with you! Dave
>>>
>>> Sent from Dave
>>>
>>>> On Jun 23, 2016, at 5:27 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>>>
>>>> Thanks Dave, how does late Wednesday the 29th look for you? Say 4 pm?
>>>>
>>>>
>>>>
>>>>
>>>> Noreen Walsh
>>>> Regional Director
>>>> Mountain-Prairie Region
>>>> U. S. Fish and Wildlife Service
>>>> 303 236 7920
>>>>
>>>> -----Original Message-----
>>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>>> Sent: Thursday, June 23, 2016 1:04 PM
>>>> To: Noreen Walsh
>>>> Subject: Re: National Bison Range transfer
>>>>
>>>> Hi again, Noreen. Is there a time next week when we can talk? This week is
>>>> already shot with grandkids visits, etc, and we head to Alaska the week
>>>> after for much of July. What do you think? Dave
>>>>
>>>> Sent from Dave
>>>>
>>>>>> On Jun 17, 2016, at 1:43 PM, Dave Heffernan <deheffer248@yahoo.com>
>>>>> wrote:
>>>>>
>>>>> Hi Noreen, thanks for getting back to me! I'll contact you next week

>>>>> to try to set up a time that works for both of us, I promise!! Looking
>>>>> forward to it, Dave
>>>>>
>>>>> Sent from Dave
>>>>>
>>>>>> On Jun 16, 2016, at 1:43 PM, Noreen Walsh <noreen_walsh@fws.gov> wrote:
>>>>>>
>>>>>> Hello Dave,
>>>>>>
>>>>>> We never connected when you returned from vacation (or maybe you
>>>>>> found Costa Rica to your liking and did not return??). I would still
>>>>>> value the chance to talk with you. Is there a good time for you and
>>>>>> a number at which I could give you a call?
>>>>>>
>>>>>> Best regards,
>>>>>>
>>>>>> Noreen
>>>>>>
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>>>>>>
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>>>>>> Regional Director
>>>>>> Mountain-Prairie Region
>>>>>> U. S. Fish and Wildlife Service
>>>>>> 303 236 7920
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>>>>>> -----Original Message-----
>>>>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>>>>> Sent: Friday, February 19, 2016 2:24 PM
>>>>>> To: Noreen Walsh
>>>>>> Subject: Re: National Bison Range transfer
>>>>>>
>>>>>> Noreen, thanks for responding! We are vacationing in Costa Rica(:),
>>>>>> I'll call you when we return the end of March. Hang in there!!! Dave
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>>>>>>
>>>>>> Sent from my iPad
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>>>>>>>>
>>>>>>>> Sent from my iPad
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From:	Hagener, Jeff
To:	Noreen Walsh
Subject:	FW: National Bison Range comments
Date:	Wednesday, June 29, 2016 12:29:19 PM
Attachments:	Bison Range Comments with Letterhead.FINAL.pdf

FYI

From: Tom France [mailto:france@nwf.org]
Sent: Tuesday, June 28, 2016 2:56 PM
To: Tom France
Subject: National Bison Range comments

Over the years, the Confederated Salish and Kootenai Tribes have been a valued ally and a leading voice for conservation in Indian Country. For the last 20 years, the CSKT have been working for co-management of the 12,000 acre national bison range, which is wholly surrounded by the Flathead Indian Reservation. It has been a slow and difficult struggle.

Earlier this year, the U.S. Fish and Wildlife Service abruptly announced that they were no longer interested in co-management. Instead, FWS urged the tribes to seek legislation transferring the bison range from the national wildlife refuge system to the BIA to hold in trust for CSKT to manage. Since this announcement the tribes have been working with the Montana congressional delegation to introduce a bill to this end.

In an effort to move this process along, the tribes have posted a draft bill and invited public comment. http://bisonrangeworkinggroup.org/wp-content/uploads/2016/06/CSKT-Draft-NBR-Bill-6-6-16.pdf

Attached are comments on the draft that NWF has sent to the CSKT. While NWF supports a strong refuge system, we support transferring the NBR to the Salish and Kootenai for many reasons. We believe the Tribes will do a great job of managing the Bison Range and will strengthen the educational and interpretive programs around bison and their importance to Native American Tribes across the country.

Please let me know if you have questions or comments.

Tom France
Regional Executive Director
National Wildlife Federation
240 N. Higgins
Missoula, MT 59802
france@nwf.org
406-541-6706 (0)
406-396-5085 (C)

NATIONAL WILDLIFE FEDERATION®



June 24, 2016

Vernon Finley, Chairman
Confederated Salish and Kootenai Tribes
P.O. Box 278
Pablo, MT 59855

Comments on Draft Legislation to Restore the National Bison Range
To the Confederated Salish and Kootenai Tribes

Dear Chairman Finley:

The National Wildlife Federation (NWF) has reviewed the proposed legislation drafted by the Confederated Salish and Kootenai Tribes that would restore the lands of the National Bison Range to federal trust ownership of the Confederated Salish and Kootenai Tribes. http://bisonrangeworkinggroup.org/wp-content/uploads/2016/06/CSKT-Draft-NBR-Bill-6-6-16.pdf

NWF supports moving forward with introducing the draft bill in the Congress and endorses its adoption into federal law. Over the last forty years, NWF has been a close observer of the exceptional wildlife stewardship provided by CSKT on the Flathead Reservation. This extensive track record gives us confidence that CSKT will manage the bison and other wildlife of the National Bison Range in a highly professional manner.

Because of the Tribes' cultural and historical connection to bison, we believe CSKT has the background to do an even to a *better* job than current managers of the refuge. No one can tell the story of bison conservation with more passion or authenticity than Native Americans. This close bond with bison is what also gives us complete confidence that conservation of this herd will be a foremost consideration. Moreover, the transfer legislation clearly commits the Tribes to manage the bison and other wildlife for conservation purposes. We believe that providing the Tribes with the opportunity to tell the bison conservation story from their viewpoint is one of the most attractive aspects of this land transfer.

NWF offers its support for this important legislation with the understanding that it is a completely unique situation and should not in any way be construed as a precedent regarding other federal properties. We are pleased to see the proposed legislation makes that explicit. There

are several factors that make this situation one of a kind. In particular, it's important to understand that the National Bison Range lies completely within the Flathead Indian Reservation, on lands acquired from the tribe by the U.S. government with minimal compensation. In addition, Tribal members played a critical role in preserving the bison that made up the original herd.

We are also pleased to see that the legislation stipulates that public use of the Bison Range will continue. CSKT has a strong track record of allowing public access on nearly all tribal lands and conservation areas. It's plain to us that the Tribes look forward to the opportunity to showcase their longstanding relationship with bison to the public.

We believe it is helpful that CSKT has proposed a two-year "transition" period designed to ensure that change occurs in as seamless a manner as possible. This will ensure that management differences experienced by the public are minimal.

In sum, NWF has worked closely with CSKT land managers and biologists for several decades and we have complete confidence in their natural resource and wildlife management abilities. The fact that the location of the Bison Range is in the midst of a tribal reservation, coupled with the long tribal history associated with the creation and conservation of this bison herd, can only lead us to conclude that the tribe will be excellent stewards of these bison, as well as other wildlife.

With best regards,

Tom France
Regional Executive Director

Garrit Voggesser
Director, Tribal Lands Program

From: Noreen Walsh
To: Hagener, Jeff
Subject: Re: National Bison Range comments
Date: Wednesday, June 29, 2016 12:30:52 PM

Thanks for sharing Jeff.

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

On Jun 29, 2016, at 12:29 PM, Hagener, Jeff <JHagener@mt.gov> wrote:

> FYI
>
> ---
>
> **From:** Tom France [mailto:france@nwf.org]
> **Sent:** Tuesday, June 28, 2016 2:56 PM
> **To:** Tom France
> **Subject:** National Bison Range comments
>
> Over the years, the Confederated Salish and Kootenai Tribes have been a valued ally and a leading voice for conservation in Indian Country. For the last 20 years, the CSKT have been working for co-management of the 12,000 acre national bison range, which is wholly surrounded by the Flathead Indian Reservation. It has been a slow and difficult struggle.
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>
> Please let me know if you have questions or comments.
>
> **Tom France**
> Regional Executive Director

National Wildlife Federation
240 N. Higgins
Missoula, MT 59802
france@nwf.org
406-541-6706 (0)
406-396-5085 (C)

<Bison Range Comments with Letterhead.FINAL.pdf>

From:	Noreen Walsh
To:	Will Meeks; Anna Munoz; Cynthia Martinez; Jim Kurth; Dan Ashe; Matt Hogan; Stephen Torbit
Subject:	Fwd: National Bison Range comments
Date:	Wednesday, June 29, 2016 12:31:29 PM
Attachments:	Untitled attachment 00755.htm Bison Range Comments with Letterhead.FINAL.pdf

---

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

Begin forwarded message:

From: "Hagener, Jeff" <JHagener@mt.gov>
Date: June 29, 2016 at 12:28:41 PM MDT
To: Noreen Walsh <noreen_walsh@fws.gov>
Subject: FW: National Bison Range comments

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From: Tom France [mailto:france@nwf.org]
Sent: Tuesday, June 28, 2016 2:56 PM
To: Tom France
Subject: National Bison Range comments

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Tom France
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National Wildlife Federation
240 N. Higgins
Missoula, MT 59802
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406-541-6706 (0)
406-396-5085 (C)

NATIONAL WILDLIFE FEDERATION®



June 24, 2016

Vernon Finley, Chairman
Confederated Salish and Kootenai Tribes
P.O. Box 278
Pablo, MT 59855

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To the Confederated Salish and Kootenai Tribes

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Tom France
Regional Executive Director

Garrit Voggesser
Director, Tribal Lands Program

From:	Noreen Walsh
To:	Will Meeks; Anna Munoz; Cynthia Martinez; Jim Kurth; Dan Ashe; Matt Hogan; Stephen Torbit
Subject:	Fwd: National Bison Range comments
Date:	Wednesday, June 29, 2016 12:32:06 PM
Attachments:	Untitled attachment 02037.htm Bison Range Comments with Letterhead.FINAL.pdf

---

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

Begin forwarded message:

From: "Hagener, Jeff" <JHagener@mt.gov>
Date: June 29, 2016 at 12:28:41 PM MDT
To: Noreen Walsh <noreen_walsh@fws.gov>
Subject: FW: National Bison Range comments

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Sent: Tuesday, June 28, 2016 2:56 PM
To: Tom France
Subject: National Bison Range comments

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National Wildlife Federation
240 N. Higgins
Missoula, MT 59802
france@nwf.org
406-541-6706 (0)
406-396-5085 (C)

NATIONAL WILDLIFE FEDERATION®



June 24, 2016

Vernon Finley, Chairman
Confederated Salish and Kootenai Tribes
P.O. Box 278
Pablo, MT 59855

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NWF supports moving forward with introducing the draft bill in the Congress and endorses its adoption into federal law. Over the last forty years, NWF has been a close observer of the exceptional wildlife stewardship provided by CSKT on the Flathead Reservation. This extensive track record gives us confidence that CSKT will manage the bison and other wildlife of the National Bison Range in a highly professional manner.

Because of the Tribes' cultural and historical connection to bison, we believe CSKT has the background to do an even to a *better* job than current managers of the refuge. No one can tell the story of bison conservation with more passion or authenticity than Native Americans. This close bond with bison is what also gives us complete confidence that conservation of this herd will be a foremost consideration. Moreover, the transfer legislation clearly commits the Tribes to manage the bison and other wildlife for conservation purposes. We believe that providing the Tribes with the opportunity to tell the bison conservation story from their viewpoint is one of the most attractive aspects of this land transfer.

NWF offers its support for this important legislation with the understanding that it is a completely unique situation and should not in any way be construed as a precedent regarding other federal properties. We are pleased to see the proposed legislation makes that explicit. There

are several factors that make this situation one of a kind. In particular, it's important to understand that the National Bison Range lies completely within the Flathead Indian Reservation, on lands acquired from the tribe by the U.S. government with minimal compensation. In addition, Tribal members played a critical role in preserving the bison that made up the original herd.

We are also pleased to see that the legislation stipulates that public use of the Bison Range will continue. CSKT has a strong track record of allowing public access on nearly all tribal lands and conservation areas. It's plain to us that the Tribes look forward to the opportunity to showcase their longstanding relationship with bison to the public.

We believe it is helpful that CSKT has proposed a two-year "transition" period designed to ensure that change occurs in as seamless a manner as possible. This will ensure that management differences experienced by the public are minimal.

In sum, NWF has worked closely with CSKT land managers and biologists for several decades and we have complete confidence in their natural resource and wildlife management abilities. The fact that the location of the Bison Range is in the midst of a tribal reservation, coupled with the long tribal history associated with the creation and conservation of this bison herd, can only lead us to conclude that the tribe will be excellent stewards of these bison, as well as other wildlife.

With best regards,

Tom France
Regional Executive Director

Garrit Voggesser
Director, Tribal Lands Program

From: Noreen Walsh
To: Dave Heffernan
Subject: Re: National Bison Range transfer
Date: Wednesday, June 29, 2016 3:34:09 PM

Dave, 4 PM still works but I did get out of my meeting early so if you
want me to call earlier let me know

> On Jun 29, 2016, at 10:31 AM, Dave Heffernan <deheffer248@yahoo.com> wrote:
>
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>
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>>
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>>> On Jun 23, 2016, at 7:42 PM, Dave Heffernan <deheffer248@yahoo.com> wrote:
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>>>>
>>>> Noreen Walsh
>>>> Regional Director
>>>> Mountain-Prairie Region
>>>> U. S. Fish and Wildlife Service
>>>> 303 236 7920
>>>>
>>>> -----Original Message-----
>>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>>> Sent: Thursday, June 23, 2016 1:04 PM
>>>> To: Noreen Walsh
>>>> Subject: Re: National Bison Range transfer
>>>>
>>>> Hi again, Noreen. Is there a time next week when we can talk? This week is
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>>>>>> Regional Director
>>>>>> Mountain-Prairie Region
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>>>>>> 303 236 7920
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>>>>>> From: Dave Heffernan [mailto:deheffer248@yahoo.com]
>>>>>> Sent: Friday, February 19, 2016 2:24 PM
>>>>>> To: Noreen Walsh
>>>>>> Subject: Re: National Bison Range transfer
>>>>>>
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>>>>>>> Mountain-Prairie Region

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From: Dave Heffernan
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Subject: Re: National Bison Range transfer
Date: Wednesday, June 29, 2016 3:44:28 PM

Anytime is ok.

Sent from Dave

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>>>>>>>>> Sent from my iPad
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From: Dale Ferguson
To: Noreen Walsh
Subject: Re: The Bison Range
Date: Monday, July 04, 2016 10:18:48 PM

Hi, again, Noreen:

On February 9th, 2016, I sent you a copy of my letter to our Montana Congressmen reacting to your February 5th proposal about transferring the National Bison Range to the CSKT. I suggested moving the Bison Range off the Reservation (see below).

Your 4th paragraph said, "Such a proposal would require Congressional approval and therefore, at this point, we don't know if or when such a transfer would occur."

On 2-19-16, I got a call from Sophie Miller in Senator Daines' office acknowledging receipt of my proposal! He likes the idea.

On June 17th, I sent my comments to the Tribes "Bison Range Working Group" per their request for public input. It is a slightly edited version of my Feb. 9th letter. A cc also went to Daines' office. On June 19th Sophie replied with, "Thank you very much for sending this. Would greatly appreciate your remaining in touch on this topic with additional developments you believe our office should be aware of."

It appears that as long as the Bison Range is within the boundaries of the Flathead Indian Reservation, the Tribes will try to control it, PEER will continue to oppose them, and FWS will have to deal with both of them. Moving the Bison Range outside the Reservation, should resolve this conflict and force their lawyers to find another source of income. The present Range is really just a government-operated ranch.

Also, the bison would benefit by having another place where the species can be preserved.

Except for your "Thank you" reply and the call from Daines' office I haven't received any feedback from anyone else. One of my friends thought I may get some hate mail, but none so far.

What do YOU think? Would moving the Range make your job easier?

Dale Ferguson

From: Noreen Walsh
Sent: Tuesday, February 09, 2016 12:05 PM
To: Dale Ferguson
Subject: RE: The Bison Range

Dear Mr. Ferguson,

I received your email below. Thank you for sharing it with me.

Sincerely,

Noreen Walsh

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

From: Dale Ferguson [mailto:dalepf@montanasky.net]
Sent: Tuesday, February 09, 2016 11:57 AM
To: noreen_walsh@fws.gov
Subject: The Bison Range

Hi, Noreen,

You may be interested in the following, which I sent to all three of our Congressmen:

In today's Missoulian (Feb 9, 2016) is an article, "Bison Range could move to tribes." This is a proposal that is long overdue. About ten years ago, or more, someone suggested in a letter to the editor that we move the National Bison Range off the Flathead Reservation, split the herd and give the present facilities to the Tribes.

Surely, somewhere in Montana, are a few square miles of Federal land that would make a suitable bison range. Then we maybe could have a real wildlife refuge. By no stretch of the imagination could the present Range be called a wildlife refuge. The bison are herded, fenced, and even have their own Medicare program.

The Tribes claim that their heritage qualifies them to manage Bison. OK, let them demonstrate it! They could also use the additional jobs.

Public Employees for Environmental Responsibility (PEER) has strongly opposed any tribal involvement at the Bison Range. In my opinion, based on some of their past comments, they are really concerned about their jobs. Splitting the herd should solve that problem, and maybe PEER and the Tribes could compete to see who is more environmentally responsible.

Because this proposal requires the approval of Congress, I'm asking you to do whatever is necessary to make it happen.

When this idea was first proposed, I wrote to your predecessor, but never received a response. May I have one from you?

Dale P. Ferguson
376 Mission View Drive

Polson, MT 59860
dalepf@montanasky.net

From:	Munoz, Anna
To:	Will Meeks
Subject:	Fwd: FYI: House Natural Resources Minority Staff Trip to NBR
Date:	Tuesday, July 05, 2016 6:36:12 PM

FYI - Matt is a staffer with HNR.

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

---------- Forwarded message ----------
From: **Mogadam, Roya** <roya_mogadam@fws.gov>
Date: Thu, Jun 30, 2016 at 12:48 PM
Subject: FYI: House Natural Resources Minority Staff Trip to NBR
To: Anna Munoz <anna_munoz@fws.gov>

Hey Anna-

Matt Strickler reached out to me this morning about planning a trip to NBR over the summer. I am waiting for him to give me a call to get some additional details but wanted to flag for you all.

-Roya

--
Roya Mogadam
Division of Congressional and Legislative Affairs
U.S. Fish and Wildlife Service
5275 Leesburg Pike
Falls Church, VA 22041-3803

Roya_Mogadam@fws.gov
703-358-2128

From:	Brian Upton
To:	cynthia_martinez@fws.gov; will_meeks@fws.gov; anna_munoz@fws.gov; Jeff_King@fws.gov
Cc:	shane.morigeau@cskt.org; george@georgewaters.com
Subject:	CSKT public meeting on draft NBR restoration legislation
Date:	Monday, July 11, 2016 10:03:56 AM
Attachments:	Public Meeting 7-12-16 Agenda.pdf Public Meeting 7-12-16 comment form(front&back).pdf

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Hi Cynthia, Will, Anna, and Jeff,

I'm attaching copies of the agenda and comment form for CSKT's public meeting on the Tribes' draft NBR restoration legislation tomorrow. We have hired a great facilitator with decades of experience (Virginia Tribe), and I think she will do a really good job.

I thought you all may be interested in seeing the attached documents, but I didn't want to clutter others' email boxes unnecessarily so please forward this on to others as you see fit.

Thanks,
BU

Confederated Salish & Kootenai Tribes

PUBLIC MEETING on
DRAFT NATIONAL BISON RANGE RESTORATION LEGISLATION
Salish Kootenai College – Johnny Arlee and Victor Charlo Theater
July 12, 2016 7:00 - 9:00 PM

AGENDA

- Welcome and introductions – Virginia Tribe (meeting facilitator)

- How the workshop is structured – Virginia Tribe
  - Session objectives
  - Presentation and discussion stations
  - Roles and "ground rules" for productive conversation
  - Web streaming of the session
  - Timeline tonight

- Presentation on CSKT's Draft Legislation - Shane Morigeau and Brian Upton, CSKT Legal Department

- Discussion stations with Tribal officials and staff:
  - Information available
  - Comment forms – how/where to submit your comments

Thanks for your time and comments tonight!

Confederated Salish & Kootenai Tribes

Draft National Bison Range Restoration Legislation
July 12, 2016 Public Meeting

Comment Form

Name (*please print*) _____

Email or Mailing Address (*optional*) _____

Representation (*if any*) _____

It would be helpful to have your responses to the following:

1. **What is most important to you about management of the Bison Range?**

2. **What new opportunities do you see for the Bison Range?**

3. **What changes would you propose for the draft legislation?**

4. **Additional comments and/or questions:**

Please submit this comment in designated boxes located throughout the meeting facility. If you have additional comments after this meeting, or if you would like to submit your comment later, please go to the following CSKT website, where you can submit a comment: bisonrangeworkinggroup.org. You can also email comments directly to BisonRangeWorkingGroup@gmail.com. The draft legislation can also be found on the CSKT website.

You may submit this comment form to any Tribal staff, or leave in any of the designated boxes, at the July 12th public meeting held by the Confederated Salish and Kootenai Tribes.

To submit a comment on the Confederated Salish and Kootenai Tribes' draft National Bison Range restoration legislation after the July 12th meeting, you can go to the website established by CSKT: www.bisonrangeworkinggroup.org and fill out/submit a comment on the form provided there. Or you can simply email a comment to: BisonRangeWorkingGroup@gmail.com. **The comment period closes on Friday, July 15, 2016.**

Please note: Any comments submitted for this record become property of the Confederated Salish and Kootenai Tribes and may be shared with others, including, but not limited to, governmental officials or conservation groups. Please be aware of this when submitting your comment.

This public meeting is being held by the Confederated Salish and Kootenai Tribes, who will review and summarize the comments. The Montana Congressional delegation offices are not sponsors of the July 12th meeting, nor is the U.S. Fish & Wildlife Service. For anyone who may wish to contact Montana Congressional delegation offices, they may be reached as follows:

Congressman Ryan Zinke
U.S. House of Representatives
Washington, D.C. 20515
phone: (202) 225-3211
website (*includes email contact information*): https://zinke.house.gov/

Senator Jon Tester
United States Senate
Washington, D.C. 20510
phone: (202) 224-2644
website (*includes email contact information*): http://www.tester.senate.gov/

Senator Steve Daines
United States Senate
Washington, D.C. 20510
phone: (202) 224-2651
website (*includes email contact information*): https://www.daines.senate.gov/

From:	Munoz, Anna
To:	Noreen Walsh; Matt Hogan
Cc:	Will Meeks
Subject:	Fwd: CSKT public meeting on draft NBR restoration legislation
Date:	Monday, July 11, 2016 10:05:47 AM
Attachments:	Public Meeting 7-12-16 Agenda.pdf Public Meeting 7-12-16 comment form(front&back).pdf

---

FYI

---------- Forwarded message ----------
From: **Brian Upton** <brianu@cskt.org>
Date: Monday, July 11, 2016
Subject: CSKT public meeting on draft NBR restoration legislation
To: cynthia_martinez@fws.gov, will_meeks@fws.gov, anna_munoz@fws.gov, Jeff_King@fws.gov
Cc: shane.morigeau@cskt.org, george@georgewaters.com

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Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

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DRAFT NATIONAL BISON RANGE RESTORATION LEGISLATION
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Confederated Salish & Kootenai Tribes

Draft National Bison Range Restoration Legislation
July 12, 2016 Public Meeting

Comment Form

Name (*please print*) _____

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U.S. House of Representatives
Washington, D.C. 20515
phone: (202) 225-3211
website (*includes email contact information*): https://zinke.house.gov/

Senator Jon Tester
United States Senate
Washington, D.C. 20510
phone: (202) 224-2644
website (*includes email contact information*): http://www.tester.senate.gov/

Senator Steve Daines
United States Senate
Washington, D.C. 20510
phone: (202) 224-2651
website (*includes email contact information*): https://www.daines.senate.gov/

From:	Will Meeks
To:	Mike Blenden; Jeff King
Subject:	Fwd: CSKT public meeting on draft NBR restoration legislation
Date:	Monday, July 11, 2016 12:20:20 PM
Attachments:	Untitled attachment 01004.htm Public Meeting 7-12-16 Agenda.pdf Public Meeting 7-12-16 comment form(front&back).pdf Untitled attachment 01007.htm

---

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

Begin forwarded message:

From: Brian Upton <brianu@cskt.org>
Date: July 11, 2016 at 10:03:00 AM MDT
To: <cynthia_martinez@fws.gov>, <will_meeks@fws.gov>, <anna_munoz@fws.gov>, <Jeff_King@fws.gov>
Cc: <shane.morigeau@cskt.org>, <george@georgewaters.com>
Subject: CSKT public meeting on draft NBR restoration legislation

Hi Cynthia, Will, Anna, and Jeff,

I'm attaching copies of the agenda and comment form for CSKT's public meeting on the Tribes' draft NBR restoration legislation tomorrow. We have hired a great facilitator with decades of experience (Virginia Tribe), and I think she will do a really good job.

I thought you all may be interested in seeing the attached documents, but I didn't want to clutter others' email boxes unnecessarily so please forward this on to others as you see fit.

Thanks,
BU

Confederated Salish & Kootenai Tribes

PUBLIC MEETING on
DRAFT NATIONAL BISON RANGE RESTORATION LEGISLATION
Salish Kootenai College – Johnny Arlee and Victor Charlo Theater
July 12, 2016 7:00 - 9:00 PM

AGENDA

- Welcome and introductions – Virginia Tribe (meeting facilitator)

- How the workshop is structured – Virginia Tribe
  - Session objectives
  - Presentation and discussion stations
  - Roles and "ground rules" for productive conversation
  - Web streaming of the session
  - Timeline tonight

- Presentation on CSKT's Draft Legislation - Shane Morigeau and Brian Upton, CSKT Legal Department

- Discussion stations with Tribal officials and staff:
  - Information available
  - Comment forms – how/where to submit your comments

Thanks for your time and comments tonight!

Confederated Salish & Kootenai Tribes

Draft National Bison Range Restoration Legislation
July 12, 2016 Public Meeting

Comment Form

Name (*please print*) _____

Email or Mailing Address (*optional*) _____

Representation (*if any*) _____

It would be helpful to have your responses to the following:

1. **What is most important to you about management of the Bison Range?**

2. **What new opportunities do you see for the Bison Range?**

3. **What changes would you propose for the draft legislation?**

4. **Additional comments and/or questions:**

Please submit this comment in designated boxes located throughout the meeting facility. If you have additional comments after this meeting, or if you would like to submit your comment later, please go to the following CSKT website, where you can submit a comment: bisonrangeworkinggroup.org. You can also email comments directly to BisonRangeWorkingGroup@gmail.com. The draft legislation can also be found on the CSKT website.

You may submit this comment form to any Tribal staff, or leave in any of the designated boxes, at the July 12th public meeting held by the Confederated Salish and Kootenai Tribes.

To submit a comment on the Confederated Salish and Kootenai Tribes' draft National Bison Range restoration legislation after the July 12th meeting, you can go to the website established by CSKT: www.bisonrangeworkinggroup.org and fill out/submit a comment on the form provided there. Or you can simply email a comment to: BisonRangeWorkingGroup@gmail.com. **The comment period closes on Friday, July 15, 2016.**

Please note: Any comments submitted for this record become property of the Confederated Salish and Kootenai Tribes and may be shared with others, including, but not limited to, governmental officials or conservation groups. Please be aware of this when submitting your comment.

This public meeting is being held by the Confederated Salish and Kootenai Tribes, who will review and summarize the comments. The Montana Congressional delegation offices are not sponsors of the July 12th meeting, nor is the U.S. Fish & Wildlife Service. For anyone who may wish to contact Montana Congressional delegation offices, they may be reached as follows:

Congressman Ryan Zinke
U.S. House of Representatives
Washington, D.C. 20515
phone: (202) 225-3211
website (*includes email contact information*): https://zinke.house.gov/

Senator Jon Tester
United States Senate
Washington, D.C. 20510
phone: (202) 224-2644
website (*includes email contact information*): http://www.tester.senate.gov/

Senator Steve Daines
United States Senate
Washington, D.C. 20510
phone: (202) 224-2651
website (*includes email contact information*): https://www.daines.senate.gov/

From:	Anna Munoz
To:	Noreen Walsh; Matt Hogan; will_meeks@fws.gov; Cynthia Martinez; Shaun Sanchez; Roya Mogadam; stephen_torbit@fws.gov
Subject:	Fwd: Google Alert - "Bison Range"
Date:	Wednesday, July 13, 2016 5:20:15 AM

FYI - info on last night's NBR mtg. I found the Tom McDonald quote to be a bit confusing both in terms of composition and content. Will try to follow up w/ CSKT today.

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, CO 80228
Office: 303-236-4510
Cell: 720-648-2542

Begin forwarded message:

From: Google Alerts <googlealerts-noreply@google.com>
Date: July 13, 2016 at 2:38:26 AM MDT
To: <anna_munoz@fws.gov>
Subject: Google Alert - "Bison Range"

"Bison Range"

As-it-happens update · July 13, 2016

NEWS

Dozens attend meeting on National **Bison Range** transfer plan

The Missoulian

Legal attorneys Shane Morigeau and Brian Upton presented a brief outline of the draft bill, which would restore the management of the **bison range** to ...

CSKT holds public meeting to discuss **bison range** transfer - NBC Montana

National **Bison Range** legislation receives public input - ABC FOX Montana News

Full Coverage

Flag as irrelevant

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Send Feedback

From: Noreen Walsh
To: Anna Munoz
Subject: RE: Google Alert - "Bison Range"
Date: Wednesday, July 13, 2016 7:33:00 AM

Thanks Anna. You are right; that comment is curious.

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service
303 236 7920

From: Anna Munoz [mailto:anna_munoz@fws.gov]
Sent: Wednesday, July 13, 2016 5:20 AM
To: Noreen Walsh; Matt Hogan; will_meeks@fws.gov; Cynthia Martinez; Shaun Sanchez; Roya Mogadam; stephen_torbit@fws.gov
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Full Coverage

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Send Feedback

From:	Anna Munoz
To:	Noreen Walsh; Matt Hogan; will_meeks@fws.gov; stephen_torbit@fws.gov; Cynthia Martinez; Shaun Sanchez; Roya Mogadam
Subject:	Fwd: Google Alert - "Bison Range"
Date:	Wednesday, July 13, 2016 8:29:21 PM

Both are worth a read but the second link provides specific quotes from the Congressional delegation.

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, CO 80228
Office: 303-236-4510
Cell: 720-648-2542

Begin forwarded message:

From: Google Alerts <googlealerts-noreply@google.com>
Date: July 13, 2016 at 6:38:27 PM MDT
To: <anna_munoz@fws.gov>
Subject: Google Alert - "Bison Range"

"Bison Range"

As-it-happens update · July 14, 2016

NEWS

Tribal leaders say **Bison Range** management change won't set a precedent

KBZK Bozeman News

Attorneys drafting legislation to switch management of the National **Bison Range** to the Confederated Salish and Kootenai Tribes say they've written ...

Flag as irrelevant

Montana Delegation Reserving Judgement On Proposed **Bison Range** Transfer

MTPR

"I look forward to reviewing the comments and better understanding the impacts of transferring the management of

the **bison range** to the CSKT.".

Flag as irrelevant

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Receive this alert as RSS feed

Send Feedback

From: Munoz, Anna
To: Will Meeks
Subject: Re: FYI: House Natural Resources Minority Staff Trip to NBR
Date: Thursday, July 14, 2016 10:42:31 AM

Spoke to Roya this morning. The staffer would like to visit NBR sometime in August. How would you like to proceed?

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

On Tue, Jul 5, 2016 at 6:35 PM, Munoz, Anna <anna_munoz@fws.gov> wrote:

> FYI - Matt is a staffer with HNR.
>
> Anna
>
> Anna Muñoz
> Assistant Regional Director - External Affairs
> U.S. Fish and Wildlife Service, Mountain-Prairie Region
> Office: 303-236-4510
> Cell: 720-648-2542
>
> ---------- Forwarded message ----------
> From: **Mogadam, Roya** <roya_mogadam@fws.gov>
> Date: Thu, Jun 30, 2016 at 12:48 PM
> Subject: FYI: House Natural Resources Minority Staff Trip to NBR
> To: Anna Munoz <anna_munoz@fws.gov>
>
> Hey Anna-
>
> Matt Strickler reached out to me this morning about planning a trip to NBR over the summer. I am waiting for him to give me a call to get some additional details but wanted to flag for you all.
>
> -Roya
>
> --
> Roya Mogadam
> Division of Congressional and Legislative Affairs
> U.S. Fish and Wildlife Service
> 5275 Leesburg Pike
> Falls Church, VA 22041-3803
>
> Roya_Mogadam@fws.gov
> 703-358-2128

From: Will Meeks
To: Munoz, Anna
Subject: Re: FYI: House Natural Resources Minority Staff Trip to NBR
Date: Thursday, July 14, 2016 10:57:38 AM

I say to have me help schedule it. I'd like, at the very least, Mike Blenden to go. Maybe you want to attend?? Roya??

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

On Jul 14, 2016, at 11:42 AM, Munoz, Anna <anna_munoz@fws.gov> wrote:

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>
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-Roya

--
Roya Mogadam
Division of Congressional and Legislative Affairs
U.S. Fish and Wildlife Service
5275 Leesburg Pike
Falls Church, VA 22041-3803

Roya_Mogadam@fws.gov
703-358-2128

From: Munoz, Anna
To: Will Meeks
Subject: Re: FYI: House Natural Resources Minority Staff Trip to NBR
Date: Thursday, July 14, 2016 11:09:40 AM

I have to travel somewhere (SD, DC, UT) during the first 3 weeks of August, so I'm out. I'll see if Roya might be able to swing it. She's scheduled to start driving out here on 8/22 but she might be available prior to that. Marty is going to kill me. I'll have to buy him a couple of drinks in AK before I ask. Are you going to try to go?

Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

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> U.S. Fish and Wildlife Service
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Roya Mogadam
Division of Congressional and Legislative Affairs
U.S. Fish and Wildlife Service
5275 Leesburg Pike
Falls Church, VA 22041-3803

Roya_Mogadam@fws.gov
703-358-2128

From: Will Meeks
To: Munoz, Anna
Subject: Re: FYI: House Natural Resources Minority Staff Trip to NBR
Date: Thursday, July 14, 2016 11:17:48 AM

Only if I have to.

Traveling three weeks in Aug. Sports and school starts. Cindy will kill me.

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

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U.S. Fish and Wildlife Service, Mountain-Prairie Region
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Cell: 720-648-2542

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> Anna Muñoz
> Assistant Regional Director - External Affairs
> U.S. Fish and Wildlife Service, Mountain-Prairie Region
> Office: 303-236-4510
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> U.S. Fish and Wildlife Service
> 5275 Leesburg Pike
> Falls Church, VA 22041-3803
>
> Roya_Mogadam@fws.gov
> 703-358-2128

From:	b(6)
To:	Noreen_walsh@fws.gov
Cc:	will_meeks@fws.gov; matt_hogan@fws.gov; anna_munoz@fws.gov; mountainprairie@fws.gov; dan_ashe@fws.gov; sally_jewel@doi.gov; jeff_king@fws.gov; Laura_king@fws.gov
Date:	Friday, July 15, 2016 1:20:02 PM

Dear Ms. Walsh,

I want to express my great disappointment in your conduct as a public servant.

I commented on the National Bison Range Draft Environmental Assessment for the AFA between the USFWS and the Confederated Salish and Kootenai Tribes (CSKT). I have come to realize that those comments are now irrelevant because of the memo of February 5, 2016 regarding the "start of discussions with Indian Affairs and the CSKT about the potential for the Service to support legislation that would transfer the lands comprising the National Bison Range in Montana to be held in trust by the U.S. for the benefit of the CSKT".

Recently, a draft proposal for legislation was made available by the CSKT for comment and the CSKT held a public meeting on the issue. I realize that this is being done by the CSKT and not organized by the USFWS. However, since I assume you would think I was concerned about the Bison Range as I made the effort to make comments on the draft EA, and since I have yet to receive any feedback on my comments, I am quite displeased that you did not contact me about the comment period for the draft legislation. I know my contact information is on file with your office due to my comments on the draft EA.

I feel this is a breach of my public trust in my public servants. Please make an effort in the future to be responsible to all whom you serve.

Pat Jamieson
b(6)

From:	Blenden, Mike
To:	Steve Kallin; Jeff King; Bill West
Subject:	Fwd: FW: HNR staffer to visit MT and WY in August
Date:	Friday, July 15, 2016 4:00:21 PM
Attachments:	Untitled attachment 00749.htm Western Recess Trip Proposal_D2.docx

---

Gentlemen,

I will be working with you (I'm alerting Bill, just in case.) and External Affairs to coordinate this venture. Stay tuned for more.

Mike

---------- Forwarded message ----------
From: **Will Meeks** <Will_Meeks@fws.gov>
Date: Fri, Jul 15, 2016 at 12:18 PM
Subject: FW: HNR staffer to visit MT and WY in August
To: Mike Blenden <mike_blenden@fws.gov>
Cc: Maureen Gallagher <maureen_gallagher@fws.gov>

Mike,

As discussed, I will be unable to accompany him. Please plan on it.

Contact Anna/Roya for specifics.

Will Meeks

U.S. Fish and Wildlife Service

Mountain Prairie Region

Assistant Regional Director

National Wildlife Refuge System

303-236-4303 (w)

720-541-0310 (c)

From: Anna Munoz [mailto:anna_munoz@fws.gov]
Sent: Friday, July 15, 2016 9:02 AM
To: Noreen Walsh; Matt Hogan; will_meeks@fws.gov; michael_thabault@fws.gov
Cc: Nicole Alt; Roya Mogadam; matt_kales@fws.gov
Subject: HNR staffer to visit MT and WY in August

Good Morning!

Matt Strickler, House Natural Resources Committee Staffer, is planning a trip to MT and WY during the last week of August and would like to visit some of our refuges and meet with Service staff (and others) regarding National Bison Range, GRSG, wolves, and grizzly bear.

Please see the attached itinerary and start thinking about who you would like to have meet with Matt at his various stops/proposed meetings.

As luck would have it, this visit falls during Roya's first week and she has already offered to help staff this visit.

We can discuss specifics when I return from AK, but I wanted to get this on your radar now so we can start planning.

Thanks,

Anna

Anna Muñoz

Assistant Regional Director - External Affairs

U.S. Fish and Wildlife Service

134 Union Blvd.

Lakewood, CO 80228

Office: 303-236-4510

Cell: 720-648-2542

Begin forwarded message:

From: "Mogadam, Roya" <roya_mogadam@fws.gov>
Date: July 15, 2016 at 7:17:21 AM MDT
To: Anna Munoz <anna_munoz@fws.gov>
Subject: Fwd: trip draft

Lets talk about this more...

-Roya

---------- Forwarded message ----------
From: **Strickler, Matt** <Matt.Strickler@mail.house.gov>
Date: Fri, Jul 15, 2016 at 9:06 AM
Subject: trip draft
To: "Mogadam, Roya" <roya_mogadam@fws.gov>

--

Matthew J. Strickler

Senior Policy Advisor

US House of Representatives

Committee on Natural Resources

H2-186 Ford HOB

Washington, DC 20515

(202) 225-6065

--

Roya Mogadam

Division of Congressional and Legislative Affairs

U.S. Fish and Wildlife Service

5275 Leesburg Pike
Falls Church, VA 22041-3803

Roya_Mogadam@fws.gov

703-358-2128

--
Michael Blenden
Refuge Supervisor - Montana, Wyoming and Utah
134 Union Boulevard
Lakewood, CO 80228
303-236-4306
303-710-7934 cell

Too often we...enjoy the comfort of opinion without the discomfort of thought.
John F. Kennedy

Western Recess Trip Proposal

Matt Strickler

Monday, August 29: Depart DCA, arrive MSO. Meet with USFWS staff and Confederated Salish-Kootenai Tribes at National Bison Range, St. Ignatius, MT. Overnight with friends in St. Ignatius.

Tuesday, August 30: Depart St. Ignatius, meet in AM with USFWS/BLM/USDA staff, Bozeman, MT– Topic: greater sage grouse. Depart Bozeman. Meet in PM with NPS/USFWS staff, Yellowstone National Park – Topic: GYE. Overnight in Gardiner, MT/Yellowstone NP.

Wednesday, August 31: Tour Yellowstone NP with NPS/USFWS staff. Topic: gray wolves, etc. Overnight in West Yellowstone/Yellowstone, NP.

Thursday, September 1: Depart Yellowstone NP, meet in AM with NPS/USFWS staff in Grand Teton NP – Topic: grizzly bears, etc. Field trip in PM with Tom Mangelsen. Overnight with family in Jackson, WY.

Friday, September 2: Meet in AM with USFWS staff at National Elk Refuge, Jackson, WY. Overnight with family in Jackson, WY.

Saturday -Sunday, September 3-4: Personal travel.

Monday, September 5: Depart JAC, arrive DCA.

Conversation Contents

NBR Op-Ed

Ryan Moehring <ryan_moehring@fws.gov>

From:	Ryan Moehring <ryan_moehring@fws.gov>
Sent:	Sat Jul 16 2016 15:33:49 GMT-0600 (MDT)
To:	Anna Munoz <anna_munoz@fws.gov>, Will Meeks <will_meeks@fws.gov>
CC:	Mike Blenden <mike_blenden@fws.gov>
Subject:	NBR Op-Ed

http://billingsgazette.com/news/opinion/guest/guest-opinion-keep-bison-range-under-public-management/article_71135367-e84d-5bef-be16-c319aa517898.html

Thanks,

Ryan

Ryan Moehring

Public Affairs

U.S. Fish and Wildlife Service

Mountain-Prairie Region

303-236-0345

Web |Facebook | Twitter | Flickr | YouTube

From: Will Meeks
To: Mike Blenden; Jeff King
Subject: 7/25 call with RD
Date: Tuesday, July 19, 2016 12:21:50 PM

Mike/Jeff,

Are there any specific topics you would like Noreen to address on the scheduled call for next Monday? Outside an update, of course.

Thanks.

Will Meeks
U.S. Fish and Wildlife Service
Mountain Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

From:	Bulletin Intelligence
To:	Interior@BulletinIntelligence.com
Subject:	U.S. Department of the Interior News Briefing for Monday, July 25, 2016
Date:	Monday, July 25, 2016 5:01:03 AM

U.S. DEPARTMENT OF THE INTERIOR NEWS BRIEFING

Mobile version and searchable archives available at interior.bulletinintelligence.com. Please contact Public Affairs with subscription requests, questions or comments.

DATE: MONDAY, JULY 25, 2016 7:00 AM EDT

TODAY'S TABLE OF CONTENTS

DOI IN THE NEWS:
+ Heatwave Stokes California Wildfire.
+ Conservationists Push Back Against Attempts To Sell Public Lands.
+ U.S. Files Complaint To Recover Acoma War Shield.
+ Philadelphia Mayor Intervenes In Peebles Tax Credit Matter.
+ Land Transfers Benefit River Raisin National Battlefield Park, Detroit River International Wildlife Refuge.
+ Reward Offered In Connection With Owl's Shooting Death Near Santa Fe.
+ Additional Coverage Of Secretary Jewell's Utah Visit.
+ Additional Coverage: Wildlife Refuge Renamed To Honor Billy Frank Jr.
+ Additional Coverage Of Interior-EPA Spending Bill.
+ Additional Coverage: Wright Building Placed On World Heritage Waiting List.

AMERICA'S GREAT OUTDOORS:

National Park Service:
+ NPS Director Jarvis Discusses Challenges Facing NPS As It Celebrates Centennial.
+ NPS Director Jarvis Honored With SAFE Water Award.
+ Rising Visitorship Puts Strain On National Parks.
+ NPS Adapting To Climate Change At Assateague Island National Seashore.
+ Washington Monument Closed Due To Elevator Problems.
+ NPS, Delaware North Look To Resolve Yosemite National Park Trademarks Dispute.
+ Ranchers Want To Intervene In Lawsuit Over Cattle At Point Reyes National Seashore.
+ Dunes Pavilion Work Halted.
+ Dog Helping To Protect Wildlife In Glacier National Park.
+ Fossil Cycad National Monument Was Lost To Exploitation, Neglect.
+ Acting Superintendent To Join Olympic National Park.
+ Additional Coverage: Public Lands Welcome Pokémon Go Players.
+ Additional Coverage: Report Says Badlands Park Employee Took Sick Buffalo Calf.
+ Additional Coverage Of Bear Cam.
+ Westenberg: Voyageurs National Park Is Minnesota's Crown Jewel.
+ NPS' Funding For LGBT Artist Dishonors Legacy Of Art Environment Founder.

Fish and Wildlife Service:
+ New Water Rules Announced To Protect Endangered South Florida Sparrow.
+ Native American Group Opposes Removal Of Grizzlies From Endangered Species List.
+ Public Input Sought On Plans For Michigan Shooting Range.
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+ Berkshire National Fish Hatchery Celebrating 100th Anniversary.
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+ Confusion, Disappointment After NYSERDA Postpones Offshore Wind Farm Vote.
+ Wind Opponents Criticized As "Willfully" Promoting Disinformation.
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EMPOWERING NATIVE AMERICAN COMMUNITIES:
+ Anglers To Protest Tribal Closure Of Lower Skokomish River.
+ Seneca-Cayuga Election Delayed Again.
+ Additional Coverage: Judge Rejects Challenge To Mechoopda Indian Tribe Casino.

TACKLING AMERICA'S WATER CHALLENGES:
+ Delta Tunnels Plan Enters Critical Phase.
+ Klamath River Dam Removal Could Begin In Less Than Four Years.
+ Flathead Water Compact Survives Challenge.
+ Padre Dam Water District Awarded Funding For Water Recycling.
+ Drinking Water Temporarily Unavailable At Little Wood Campground.
+ Funding Bill For Colorado Conduit Advances In Senate.
+ Additional Coverage: Federal Agencies Threatened With Lawsuit Over Fish Parasites.
+ Additional Coverage: Youth Protesters March To Raise Awareness About Klamath River Water Quality.
+ O'Toole: DoA, DoI Collaboration Just One Step To Sustaining The Colorado River.

TOP NATIONAL NEWS:
+ Obama Makes Case Against Trump In CBS Interview.
+ Wasserman Schultz Out At DNC In Wake Of Email Leak.
+ CBS News Battleground Tracker Poll: Trump Now Leads Clinton 42%-41%.

EDITORIAL WRAP-UP:
+ New York Times.
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+ Headlines From Today's Front Pages.

WASHINGTON SCHEDULE:
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DOI in the News:

HEATWAVE STOKES CALIFORNIA WILDFIRE. ABC World News Tonight (7/23, story 5, 1:25, Llamas, 14.63M) reported hundreds of been forced to evacuate their homes given a fast-moving wildfire that has broken out north of Los Angeles, which has burned eleven thousand acres and is only 10 percent contained at the moment. ABC's Phillip Mena stated that "45,000 homes could be in the danger zone" and that "Three hundred firefighters on the ground and choppers attacking this blaze from above," with massive flames "producing plumes of smoke, cloaking much of the city."

The CBS Evening News (7/23, story 5, 1:20, Ninan, 11.17M) added the fire broke out at the "height of the heatwave," which is also blamed for fueling it.

In addition, NBC Nightly News (7/23, story 4, 2:00, Snow, 16.61M) reported the fire doubled in size today and that it's "glowing ridges [could be] seen up to 50 miles away," raining smoke and ask "for miles in every direction."

A more than 1,100-word Los Angeles Times (7/23, Stevens, Nelson, 4.09M) analysis also reports that officials have indicated 1,500 homes are currently under threat from the fire, which is being fueled by what officials say is "excessive heat, low humidity, extreme dry fuels that have not burned for several decades, and very rugged terrain." The Times also indicates the fire continues to be fanned by "gusts of up to 40 mph." Los Angeles County Fire Department public information officer Richard Lincon said, "There's a great possibility that the fire will increase in size."

In separate coverage, Los Angeles Times (7/23, Funke, 4.09M) indicated the fire had burned one structure, while the AP (7/25, Antczak) reports that fires are "out of control," also threatening homes on the scenic coast and "a sanctuary for exotic animals." According to the AP, the South Coast Air Quality Management District has warned of unhealthy air quality levels.

Meanwhile, Reuters (7/23, Whitcomb) reports fire crews are struggling to contain the fire given the terrain and that shelters have been set up for evacuated residents.

The Christian Science Monitor (7/23, Beck, 459K) also reports experts are saying the fire is showing unusual behavior, growing rapidly because of the dry conditions. UC Berkeley fire ecology and management expert Max Moritz said, "We're going to have a critically dry and flammable situation late in the season this year ... This is not even close to the peak of the season."

Additional coverage of wildfires was provided by the Los Angeles (CA) Times (7/24, Evans, 4.09M).

Crews Fighting Fire In Dinosaur National Monument. The Denver Post (7/24, 956K) reports that "fire crews from Dinosaur National Monument and various other agencies are responding to a fire just north of the Yampa Bench Road, about 2 miles west of Haystack Rock, according a news release from the National Park Service." According to the article, "the fire, called the Bench fire, was first spotted by a lookout in the Road Top Fire Tower after a storm moved through the eastern part of the monument Friday."

CONSERVATIONISTS PUSH BACK AGAINST ATTEMPTS TO SELL PUBLIC LANDS. The Milwaukee Journal Sentinel (7/23, 696K) reports that "as the U.S. political process heats up this summer with national conventions for the major parties, a coalition of conservation groups is pushing back against attempts to sell public lands." According to the article, "more than 30 national and state-level sportsmen organizations, representing millions of hunters and anglers, sent letters to the Republican and Democratic Platform Committees last week encouraging them to support America's public lands." The letter stated, "We do not believe it would be constructive to include broad directives to transfer federal lands to state or

local control, sell federal lands to private interests, or otherwise liquidate the national interest in federal land management. These kinds of directives do a disservice to the American people and especially to America's hunters and anglers. These proposals do not advance the goal of finding meaningful ways to balance competing interests and preserve our national public land heritage for future generations."

Additional coverage of the Republican party platform was provided by the Denver (CO) Post (7/23, 956K) and Outside (7/22, 2.5M).

U.S. FILES COMPLAINT TO RECOVER ACOMA WAR SHIELD. The Santa Fe New Mexican (7/23, 39K) reports that "the U.S. is seeking to recover an Acoma Pueblo war shield that came up for sale earlier this year in Paris." According to the article, "the EVE auction house withdrew the shield from the May 30 sale after lobbying by the tribe and U.S. government officials, including Interior Secretary Sally Jewell." The U.S. attorney for New Mexico has "filed a complaint for forfeiture, a civil action to condemn the shield to the benefit of the U.S."

PHILADELPHIA MAYOR INTERVENES IN PEEBLES TAX CREDIT MATTER. Real Deal (FL) (7/23) reports that "the mayor of Philadelphia interceded to help Coral Gables-based developer Peebles Corp. win a national historic designation for a city-owned property and an associated tax credit for redeveloping it." The NPS has "rejected an application by Peebles Corp. for national historic designation of the building, a former courthouse, because the company's proposed redevelopment would alter too much of the building's interior." Philadelphia Mayor Jim Kenney has sent "a letter to Interior Secretary Sally Jewell to request a meeting with her."

LAND TRANSFERS BENEFIT RIVER RAISIN NATIONAL BATTLEFIELD PARK, DETROIT RIVER INTERNATIONAL WILDLIFE REFUGE. The Monroe (MI) Evening News (7/24, 50K) reports that "nearly 70 acres of land north of the Port of Monroe has been transferred to two entities to support the City of Monroe's master plan." In 2013, "the Port of Monroe transferred 33 acres of land to the National Parks Service to expand the River Raisin National Battlefield Park, which was the site of the Battle of the River Raisin during the War of 1812." The NPS "just recently accepted the transfer." Also, "35 acres of land was transferred to the U.S. Fish and Wildlife Service to expand the Detroit River International Wildlife Refuge."

REWARD OFFERED IN CONNECTION WITH OWL'S SHOOTING DEATH NEAR SANTA FE. The AP (7/22, 2.13M) reports that "a reward of up to $5,000 is being offered for information leading to the arrest and conviction of those responsible for the fatal shooting of a burrowing owl near Santa Fe." The BLM and FWS are "investigating the case." The Humane Society and Humane Society Wildlife Land Trust are offering the reward.

Additional coverage was provided by the Albuquerque (NM) Journal (7/22, 234K), the Washington (DC) Times (7/22, 257K), and the Humane Society of the United States (7/22, 52K).

ADDITIONAL COVERAGE OF SECRETARY JEWELL'S UTAH VISIT. Additional coverage of Interior Secretary Sally Jewell's visit to Utah was provided by the St. George & Southern Utah Independent (7/24).

ADDITIONAL COVERAGE: WILDLIFE REFUGE RENAMED TO HONOR BILLY FRANK JR. Additional coverage that Interior Secretary Sally Jewell attended the celebration at the renamed Billy Frank Jr. Nisqually National Wildlife Refuge was provided by the Nisqually Valley (WA) News (7/22, 60K).

ADDITIONAL COVERAGE OF INTERIOR-EPA SPENDING BILL. Additional coverage of the Interior-EPA spending bill was provided by the Silver City (NM) Daily Press (7/23).

ADDITIONAL COVERAGE: WRIGHT BUILDING PLACED ON WORLD HERITAGE WAITING LIST. Additional coverage of the consideration of ten Frank Lloyd Wright-buildings by the U.N.'s World Heritage Committee was provided by the Pittsburgh Post-Gazette (7/23, Hopey, 533K).

America's Great Outdoors:

National Park Service:

NPS DIRECTOR JARVIS DISCUSSES CHALLENGES FACING NPS AS IT CELEBRATES CENTENNIAL. Voice of America (7/22, 74K) reports that as the NPS celebrates its centennial, NPS Director Jonathan Jarvis talked about "his time with the service" in an interview. He said, "For the last 100 years, the National Park Service has been charged by the U.S. government to manage the very best of America; the very best places that represent both our natural and cultural heritage. So, to be part of this organization and to be in the directorship is really a lifelong dream for me." Looking forward to the future, Jarvis also talked about the challenges that the park service faces, including climate change and financial support.

Additional coverage of the Centennial was provided by USA Today 10best (7/19, 149K), the Great Falls (MT) Tribune (7/24, 92K), the Baltimore (MD) Sun (7/24, 1.01M), the Deseret (UT) News (7/23, 543K), the Detroit Free Press (7/23, 1.02M), the Marin (CA) Independent Journal (7/22, 52K), the Augusta (VA) Free Press (7/23, 280), the Oregonian (7/23, 823K), the Greene County (PA) Observer-Reporter (7/23, 88K), the Florence (SC) Morning News (7/23, 93K), the Parsippany (NJ) Patch (7/22, 424), the New Richmond (WI) News (7/22, 15K), The Madison County (NY) Courier (7/23), Uexpress (7/25, 62K), and the Christian Science Monitor (7/24, 459K).

NPS DIRECTOR JARVIS HONORED WITH SAFE WATER AWARD. The Chadds Ford (PA) Live (7/22) reports that "the 2016 Stroud Award for Freshwater Excellence (the SAFE Water Award) will be presented to the National Park Service and its director, Jonathan B. Jarvis." Jarvis will "receive the award during the annual Water's Edge gala to be held on Nov. 3 at Longwood Gardens in Kennett Square, according to a Stroud Water Research Center press release."

RISING VISITORSHIP PUTS STRAIN ON NATIONAL PARKS. Christian Science Monitor (7/24, Wilkinson, 459K) reports that visitor traffic has increased in America's national parks, and that Yellowstone National Park had more than 4 million visits for the first time in 2015, with 2016 poised to break that record. Yellowstone park superintendent Dan Wenk said, "The question many are asking, is can Yellowstone escape from being loved to death? My answer is yes, I believe it can. But Yellowstone won't be saved if we stay on the same course." The Christian Science Monitor also reports on Latino representation among visitors, the rise of foreign visitors, and the role of parks in local economies.

NPS ADAPTING TO CLIMATE CHANGE AT ASSATEAGUE ISLAND NATIONAL SEASHORE. NBC Nightly News (7/23, story 9, 2:15, Snow, 16.61M) reported climate change is affecting the Assateague Island National Seashore off the coast of Maryland, as "storms, winds, and currents" have been "pushing the island westward," forcing the US National Parks Service (NPS) to rethink its management plant to adapt for the next 50 years.

WASHINGTON MONUMENT CLOSED DUE TO ELEVATOR PROBLEMS. The AP (7/23, 2.13M) reports that "officials say the Washington Monument will be closed until at least Tuesday due to elevator problems." The NPS "says in a statement that a mechanical failure occurred Saturday morning before the monument opened." The park service "says that no visitors were in the monument at the time and no staff members were affected."

Additional coverage was provided by the Washington (DC) Post (7/23, Schmelzer, Smith, Cox, 9.18M), the Washington (DC) Post (7/23, Press, 9.18M), the Washington (DC) Times (7/23, 257K), the Minneapolis (MN) Star Tribune (7/23, 1.27M), Philly (PA) (7/23, 731K), the Daily Mail (7/23, Press, 4.57M), and WTTG-TV Washington (DC) Washington (7/23, 19K).

NPS, DELAWARE NORTH LOOK TO RESOLVE YOSEMITE NATIONAL PARK TRADEMARKS DISPUTE. National Parks Traveler (7/23, 989) reports that "talks between the National Park Service and DNC Parks and Resorts at Yosemite are under way to see if a resolution might be possible over who holds trademarks to The Ahwahnee Hotel, Curry Village, and other iconic properties in Yosemite National Park." According to the article, "a federal judge presiding over the trademark battle has given the two sides until August 4 to deliver a status update on their progress." The article says that "initially, the

lawyers thought an agreement on guidelines for mediation could be reached by July 21, but then sought another extension, until August 4, and the judge approved that new date on Thursday."

RANCHERS WANT TO INTERVENE IN LAWSUIT OVER CATTLE AT POINT REYES NATIONAL SEASHORE. National Parks Traveler (7/24, 989) reports that "ten ranchers whose livelihoods are tied to grazing lands on Point Reyes National Seashore in California have asked to be allowed to intervene in a lawsuit seeking to force the National Park Service to conduct rigorous environmental impact studies on how cattle affect the seashore's natural resources." According to the article, "among the ranchers is Kevin Lunny, who had run an oyster farm at Drakes Estero in the national seashore until the National Park Service refused to extend his lease beyond 2012." The article says that "in asking to intervene in the matter, the ranchers maintain, in part, that the Park Service can't adequately represent their interests in the case because 'the NPS is charged with representing the public interest.'"

DUNES PAVILION WORK HALTED. The Merrillville (IN) Post-Tribune (7/24, 74K) reports that "the Indiana Department of Natural Resource's plans to have Pavilion Partners begin renovation work on the interior of the pavilion at Indiana Dunes State Park this fall appears to be in jeopardy because the project has not yet been approved by the National Park Service." According to the article, "the state park has received grant money through the federal Land and Water Conservation Fund Act, which stipulates that land in the program be open for public use in perpetuity, and any changes in that land use require review by the National Park Service." Dan Bortner, director of the DNR's Division of State Parks and Reservoirs, said that "DNR officials are working with the National Park Service and expect to move forward with plans for renovation of the pavilion and construction of an adjacent banquet center."

DOG HELPING TO PROTECT WILDLIFE IN GLACIER NATIONAL PARK. The AP (7/24, 2.13M) reports that "the dog bark patrol is on the job at Glacier National Park, notifying wildlife managers and herding mountain goats and bighorn sheep to keep them away from strangers." According to the article, "Glacier natural resource program manager Mark Biel says a dog named Gracie has been trained not to come in contact with the wild animals and to avoid hazing or harassing the wildlife."

FOSSIL CYCAD NATIONAL MONUMENT WAS LOST TO EXPLOITATION, NEGLECT. The Washington Times (7/23, Tupper, 257K) reports on the former Fossil Cycad National Monument in South Dakota, which was closed after being "spoiled by fossil collectors who exploited it and federal bureaucrats who neglected it." The Times says the "story of the monument's birth and death" is an "important lesson" for those who care about the areas under the care of the National Park Service. Archeologist George Wieland, who had played a major role in the park's founding, himself took more than 1,000 cycadeoid fossils from the site for the Yale Peabody Museum of Natural History. In 1929, a visiting National Park Service employee found that all above-ground fossils had been taken "and there was little to justify the site's continued status as a national monument." In 1957, Fossil Cycad National Monument was abolished by an act of Congress and the land was turned over to the Bureau of Land Management.

ACTING SUPERINTENDENT TO JOIN OLYMPIC NATIONAL PARK. The Peninsula (WA) Daily News (7/24, 41K) reports that "a Department of the Interior attorney will serve as acting superintendent of Olympic National Park beginning Monday." Rachel Spector will "serve for four months while park Superintendent Sarah Creachbaum is on special assignment." Creachbaum is "serving in with the U.S. Fish and Wildlife Service in Alaska as part of her year-long participation in the National Park Service's Senior Executive Service (SEC) candidate development program."

ADDITIONAL COVERAGE: PUBLIC LANDS WELCOME POKÉMON GO PLAYERS. Additional coverage that the NPS is welcoming Pokémon Go players was provided by The Guardian (UK) (7/22, Perry, 3.74M) and CTV News (CAN) (7/22, 74K).

ADDITIONAL COVERAGE: REPORT SAYS BADLANDS PARK EMPLOYEE TOOK SICK BUFFALO CALF. Additional coverage of the investigation into the death of a bison calf at Badlands National Park was provided by the Washington (DC) Post (7/22, Rein, 9.18M) and the Huffington Post (7/22, D'angelo, 367K).

ADDITIONAL COVERAGE OF BEAR CAM. Additional coverage of the bear cam was provided by

WKRN-TV Nashville, TN (7/22, 174K) and WLOX-TV Biloxi, MS (7/22, 52K).

WESTENBERG: VOYAGEURS NATIONAL PARK IS MINNESOTA'S CROWN JEWEL. In a Minneapolis Star Tribune (7/24, 1.27M) feature, Kerri Westenberg writes on her experience at Minnesota's Voyageurs National Park, which got its name from the French Canadian voyageurs "who paddled birchbark canoes through the area's maze of lakes and streams in the late 1700s and early 1800s." Westenberg says that Voyageurs National Park, "with its sweep of history, pristine forests and abundant waters, is the crown jewel in the Park Service's Minnesota treasure trove, the largest and most prestigious of the lands we share with the rest of America."

NPS' FUNDING FOR LGBT ARTIST DISHONORS LEGACY OF ART ENVIRONMENT FOUNDER. In a Life Site News (7/22, 12K) op-ed, Rev. Thomas Littleton says the trust Americans place in the National Parks Service "now be misplaced due to an activist culture within all federal agencies," citing the creation of Stonewall Inn as the first National Monument to LGBT rights as evidence NPS has been "quietly transformed from within by activist appointees and a pro-LGBT hiring policy drafted for federal agencies." Littleton discusses the NPS' funding of Paradise Gardens Park and Museum partly due to interest in a Georgian artist named Martin, and says, "Unknown to us, the NPS had been interested in Martin's work BECAUSE of his homosexual history and not in spite of it," and says the use of Paradise Gardens "as a platform for celebrating LGBT heritage" actually dishonors the Christian legacy of Rev. Howard Finster, creator of the Paradise Gardens art environment.

Fish and Wildlife Service:

NEW WATER RULES ANNOUNCED TO PROTECT ENDANGERED SOUTH FLORIDA SPARROW. The Miami Herald (7/22, 762K) reports that "facing one of the worst nesting years on record, federal wildlife and water managers Friday announced new measures to protect the Cape Sable seaside sparrow and hasten Everglades restoration." According to the article, "under the new guidelines, the 915-square-mile area just north of the Tamiami Trail could hold more water during wet years, like the one that just left the state saturated, caused the number of sparrow nests to plummet and led to toxic algae blooms along the Treasure Coast." The article says that "the plan also speeds up the schedule for moving more water down the L-29 canal into Everglades National Park and Florida Bay — which suffered a massive summer seagrass die-off — as federal regulators try to strike a balance between restoration and conservation."

Additional coverage was provided by the Lakeland (FL) Ledger (7/22, 159K) and the Sunshine State (FL) News (7/23, 3K).

NATIVE AMERICAN GROUP OPPOSES REMOVAL OF GRIZZLIES FROM ENDANGERED SPECIES LIST. Wyoming Public Radio (7/22) reports that "a national Native American conservation group says grizzly bears shouldn't be removed from the Endangered Species List, but instead should expand the bear's range onto tribal lands." Ben Nuvamsa, a spokesman for Guardians of Our Ancestor's Legacy or GOAL, "said the grizzly plays an intricate role in the belief systems of many tribes." Nuvamsa recently met with FWS Director Dan Ashe "to express tribal frustration with the delisting plan." However, "he added that neither the feds nor Wyoming Game and Fish have given much consideration to the group's proposal to expand the bear's range onto tribal lands."

PUBLIC INPUT SOUGHT ON PLANS FOR MICHIGAN SHOOTING RANGE. The AP (7/22, 2.13M) reports that "officials are seeking public comment on a plan for a new shooting range in Michigan's northern Lower Peninsula." The FWS "says an environmental assessment of the proposed range in Grand Traverse County's Union Township is available for public comment through July 30." The Michigan Department of Natural Resources has "proposed the range with funding from the Fish and Wildlife Service's Wildlife Restoration Act."

FWS RECOGNIZES EFFORT TO RESTORE LOUISIANA BLACK BEAR. The Monroe (LA) News Star (7/24, 130K) reports that "Maria Davidson, Large Carnivore Program Manager for the Louisiana Department of Wildlife and Fisheries (LDWF), has been recognized by the U.S. Fish and Wildlife Service (USFWS) for her work in the recovery of the Louisiana Black Bear." Davidson, "along with Deborah Fuller and David Soileau of USFWS, have been named 2015 Recovery Champions for the USFWS's Region 4."

According to the article, “the trio earned the distinction because of their efforts in restoring the species and having it removed from the Endangered Species list in April of this year.”

BERKSHIRE NATIONAL FISH HATCHERY CELEBRATING 100TH ANNIVERSARY. The Pittsfield (MA) Berkshire Eagle (7/23, 57K) reports that “the Berkshire National Fish Hatchery in Hartsville-New Marlborough is celebrating its 100th anniversary this year.”

ADDITIONAL COVERAGE: FWS TO OPEN MORE WILDLIFE REFUGES TO HUNTERS. Additional coverage that the FWS “plans to expand hunting and fishing opportunities at 13 national wildlife refuges across nine states” was provided by Take Part (7/23, 167K).

ADDITIONAL COVERAGE: LESSER PRAIRIE CHICKEN REMOVED FROM LIST. Additional coverage of the removal of the lesser prairie chicken was provided by the Tri-State Livestock News (SD) (7/22) and the Topeka (KS) Capital-Journal (7/23, 107K).

BAUM: FWS’ SERVHEEN IS “MANIACAL CZAR” AGAINST GRIZZLIES. In a Daily Inter Lake (MT) (7/17, 51K) op-ed, former aerospace engineer Bill Baum says that he took an early retirement and moved to Denver, Colorado “in order to help save the grizzly bear from the likes of Dr. Chris Servheen of US Fish and Wildlife.” Baum criticizes Servheen’s support for delisting the grizzly Endangered Species Act, and criticizes wildlife biologists who also disagreed with Servheen, but would not stand against him, according to Baum. Baum was “appalled to learn their careers come first in importance to them and they would not stand up to this maniacal czar of grizzly bear monitoring, controls and recovery.” Baum also says Servheen was “too established with his cohorts/superiors like current USFW Director Dan Ashe and Secretary of the Interior Sally Jewell in Washington, D.C., or their predecessors on the staff of Presidents George H.W. Bush, Bill Clinton, George W. Bush and, currently, Barack Obama,” to successfully oppose.

Bureau of Land Management:

WILKS RANCH SETTLES FENCE TRESPASS DISPUTE WITH BLM. The AP (7/23, 2.13M) reports that “a dispute between the owners of a Montana ranch company and the federal government has been settled, but some people are still not happy about it.” Wilks Ranch Montana Ltd. has “agreed to repair damage caused when fences were put up on federal land that destroyed trees and vegetation.” The company said “it will also reimburse the Bureau of Land Management about $70,000 to cover costs for the inquiry and a survey.” However, “Doug Krings, of Central Montana Outdoors, said someone should have been cited for trespass on the ranch in the Durfee Hills area, and the landowners should have been treated the same as hunters who cross boundaries and trespass on other peoples’ land.”

Additional coverage was provided by the Bozeman (MT) Daily Chronicle (7/23, 54K), the Washington (DC) Times (7/23, 257K), and KECI-TV Missoula (MT) Missoula, MT (7/24, 1K).

US Geological Survey:

SCIENTIFIC INTEGRITY INCIDENTS RATTLE USGS. eos.org (7/22) reports that “scientific integrity incidents” at a USGS lab have “rattled the agency,” following a DoI OIG report last month that found “the full extent of the impacts are not yet known but, nevertheless, that they will be serious and far ranging.” According to the report, employees at the inorganic section of the survey’s Energy Geochemistry Laboratory in Colorado “improperly manipulated mass spectrometer data.” Projects potentially affected include toxic metals analysis the Everglades ecosystem and in Alaska, and an analysis of uranium in Grand Canyon National Park. USGS Deputy Director Bill Werkheiser said the damage from misconduct “is relatively well contained,” but that the issue threatens the agency’s reputation for producing “high-quality defensible science” and “goes counter to [USGS] standards.”

Securing America’s Energy Future:

Offshore Energy Development:

OBAMA ADMINISTRATION TO HOLD OFFSHORE DRILLING LEASE SALE ONLINE. The Hill (7/22, Cama, 884K) reports that "the Obama administration is banning environmental activist protesters from an offshore drilling lease sale next month." According to the article, "the auction, scheduled for Aug. 24 in New Orleans, will be webcast, and the public will not be allowed in the venue, a change from the tradition of the Bureau of Ocean Energy Management (BOEM) and its predecessors." The article says that "the decision came after a boisterous lease sale in March, in which hundreds of protesters at the Mercedes-Benz Superdome yelled over announcements, stormed the stage and tried unsuccessfully to shut down the event, according to the New Orleans Times-Picayune."

Additional coverage was provided by the Fuel Fix (TX) (7/22, 7K), the Washington (DC) Examiner (7/25, 378K), Wired (7/22, 3.31M), Offshore Magazine (7/22, 129K), ETF Daily News (7/24, 2K), Rigzone (7/22, 11K), Oil Price (7/22, 10K), Splash 24/7 (SGP) (7/24), and PennEnergy (7/22, 128).

NEW JERSEY FISHERMEN OPPOSE LOSS OF UNDERSEA SAND HILL. The Asbury Park (NJ) Press (7/22, Radel, 356K) reports on controversy over Army Corps of Engineers (ACE) plans to take sand from an underwater sand hill for a sand replenishment project on the Jersey beach, which is opposed by fishermen, who say that "Tampering with these sand beds, which are long-established fishing areas, could reshape the fishing communities at the Shore." Boat captain Capt. Dale Steinart said, "It's always a bad idea to destroy a ridge. You know, the government is worried about overfishing but they have no problem destroying a fishing habitat." ACE would need to request permission from the Bureau of Ocean Energy Management before taking the sand. Department of Environmental Protection (DEP) is "adamant" the sand is needed to repair damage from hurricane sandy. A DEP spokesperson said, "What's at stake is protection of lives, homes, businesses and infrastructure, as well as many thousands of jobs and billions of dollars in tourism revenues."

NEW ORLEANS MAN PLEADS GUILTY TO FALSELY CLAIMING $26,000 IN BP OIL SPILL. The AP (7/23) reported US Attorney Kenneth Polite "says in a Friday news release that 26-year-old Kevin Richard fraudulently claimed he was a cook for New Orleans Paddlewheels Inc. at the time of the 2010 BP oil spill, which disrupted many Gulf Coast businesses and caused job losses." But, Polite "says, Richard was not a cook for New Orleans Paddlewheels," and "his false claim led to him illegally getting $26,000 in settlement money." Polite pleaded guilty Thursday with sentencing set for October 27.

ADDITIONAL COVERAGE OF BOEM'S NEW FINANCIAL AND RISK MANAGEMENT REQUIREMENTS. Additional coverage of BOEM's new financial assurance and risk management requirements was provided by Law360 (7/22, 41K) and JD Supra (7/22, 3K).

Onshore Energy Development:

DISPUTE OVER DRILLING IN LANDS SCARED TO TRIBE. In an over 3,300-word article, E&E Publishing (7/22, Gilmer, Subscription Publication, 705) reported on the dispute over drilling in the Badger-Two Medicine region, which "holds the headwaters of Badger Creek and the South Fork of the Two Medicine River and is central to" the Blackfeet Nation's creation story. The area was heavily leased 30 years ago, but the tribe and environmentalists argue "government officials failed to consult with the Blackfeet Nation or fully consider the impacts to the mostly untrammeled area." While Interior Secretary Sally Jewell previously "announced that the most contentious oil and gas lease was canceled, setting the stage for permanent protection of the Badger-Two Medicine," driller Solenex LLC is challenging Jewell's decision. "Solenex sees itself as an innocent party being punished for government officials' own mistakes" and argues "that Interior does not have authority to cancel leases if the lessee has done nothing wrong."

JUDGE APPROVES PEABODY SELF-BONDING CHALLENGES. Law360 (7/22, 41K) reports that "a Missouri bankruptcy judge has allowed environmental groups to resume their efforts to prove that bankrupt Peabody Energy Corp. cannot continue to self-bond for mining operation cleanups." U.S. Bankruptcy Judge Barry S. Schermer has "granted the Environmental Law & Policy Center and the Western Organization of Resource Councils' motion asking that he lift the automatic bankruptcy stay and allow them to file amended citizen complaints with the Office of Surface Mining Reclamation and Enforcement regarding Peabody's self-bonding capabilities in Illinois, Indiana and Wyoming."

ADDITIONAL COVERAGE OF COAL LEASING MORATORIUM. Additional coverage of the coal leasing moratorium was provided by CleanTechnica (7/22, 16K).

ADDITIONAL COVERAGE OF MOAB MASTER LEASING PLAN. Additional coverage of the Moab Master Leasing Plan was provided by Natural Gas Intelligence (7/22, Subscription Publication).

REFORM OF COAL LEASING POLICIES URGED. In an op-ed for the Deseret (UT) News (7/25, 543K), Julian Carr, CEO of Discrete, argues that "our federal coal leasing system is broken and outdated." According to Carr, "coal companies tear up our lands, put up no trespassing signs and then pay us pennies on the dollar for the coal they sell." Carr writes that "instead of subsidizing coal extraction that pollutes our air, water and land and tweaks our climate, we should invest that money in renewable energies — wind, solar and geothermal and efficiency technologies — and also spend it retraining laid off coal workers so we can employ them in the smart energy economy of the future."

Renewable Energy:

CONFUSION, DISAPPOINTMENT AFTER NYSERDA POSTPONES OFFSHORE WIND FARM VOTE. Newsday (NY) (7/23, Harrington, 1.25M) reports that a "late-night decision" by the New York State Energy Research and Development Authority (NYSERDA) to cancel last Wednesday's scheduled Long Island Power Authority trustee meeting when a vote "on a 90-megawatt wind-farm proposal by developer Deepwater Wind in the federal Rhode Island wind-energy area 30 miles from Montauk Point" was to take place has "prompted confusion and rancor" from offshore wind farm proponents. The "unprecedented" decision to delay the vote "disappointed Long Island environmentalists and at least one East End official."

WIND OPPONENTS CRITICIZED AS "WILLFULLY" PROMOTING DISINFORMATION. Katharine Kollins writes in her column for the Knoxville (TN) News Sentinel (7/24, 216K) that the rise in wind energy "has also been accompanied by a growth of misinformation around the wind industry" that "willfully ignore[s] the best available information in an effort to create fear around projects." Kollins goes on to debunk such claims about the costs, use of space, and avian impacts of wind.

MASSACHUSETTS URGED TO TAKE THE LEAD IN OFFSHORE WIND. George Bachrach, president of the Environmental League of Massachusetts, and Louis J. Antonellis, president of IBEW Local 103 write in an op-ed in the Boston Globe (7/23, 1.14M) that Boston hosting the US-China Climate Summit in 2017 "presents an extraordinary international opportunity for the city and Massachusetts to show the world our leadership on climate." Bachrach and Antonellis highlight leadership in building efficiency but urge lawmakers to "pass an energy bill that provides 2,000 megawatts of offshore wind power," which would "make Boston the center of a new national industry."

Empowering Native American Communities:

ANGLERS TO PROTEST TRIBAL CLOSURE OF LOWER SKOKOMISH RIVER. The Olympian (WA) (7/24, 74K) reports that "recreational anglers are planning a protest Saturday near the Skokomish River, angry over the tribe opting to close a section of the river to non-tribal anglers." Earlier this year, the Interior Department "issued a legal opinion that the portion of the river running along the Skokomish Tribe's reservation is part of the reservation and is under control of the tribe."

Additional coverage was provided by the Kitsap (WA) Sun (7/24, 59K).

SENECA-CAYUGA ELECTION DELAYED AGAIN. The Native American Times (7/22, 337) reports that "a Bureau of Indian Affairs court is delaying an already rescheduled Seneca-Cayuga election." On Wednesday, Magistrate Tom Walker "ruled to postpone a reconvened General Council meeting of the Seneca-Cayuga Nation."

ADDITIONAL COVERAGE: JUDGE REJECTS CHALLENGE TO MECHOOPDA INDIAN TRIBE CASINO. Additional coverage of Justice Frederick J. Scullin fuling "against a request made by Butte County, California, to block a proposed casino for the Mechoopda Indian Tribe of Chico Rancheria on a

parcel of land somewhere near the City of Chico" was provided by the Indian Country Today Media Network (7/22, 42K).

Tackling America's Water Challenges:

DELTA TUNNELS PLAN ENTERS CRITICAL PHASE. The Sacramento (CA) Bee (7/24, Kasler and Sabalow, 481K) reports that California Gov. Jerry Brown's "proposed $15.5 billion re-engineering of the troubled Sacramento-San Joaquin Delta is heading into a critical phase over the next year that could well decide if the project comes to fruition." On Tuesday, the State Water Resources Control Board "begins months of grueling public hearings on the details of Brown's plan to burrow a pair of massive tunnels beneath the heart of the Delta." And "as the hearings plow forward, project planners will be scrambling to surpass another major milestone: securing a declaration from two U.S. regulatory agencies that the tunnels could operate without violating the Endangered Species Act."

Additional Coverage: Court Rules In California's Favor On Delta Property Rights. Additional coverage that "California officials don't have to pay property owners to access their land to conduct preliminary testing before deciding whether to move forward with a $15.7 billion plan to build two giant water tunnels that would supply drinking water for cities and irrigation for famers" was provided by the Oroville (CA) Mercury-Register (7/21, 1K), the Los Angeles (CA) Times (7/22, Walton, Grad, 4.09M), and KQED-FM San Francisco (CA) San Francisco (7/21, 40K).

KLAMATH RIVER DAM REMOVAL COULD BEGIN IN LESS THAN FOUR YEARS. KOBI-TV Medford, OR (7/22) reports that "the clock is ticking on the future of four dams on the Klamath River." According to the article, "efforts to take it out could begin in less than 4 years." Pacific Power's Tim Hemstreet said, "People are hopeful that can happen by 2020. But it's a process that will take, frankly, whatever time it needs to take."

FLATHEAD WATER COMPACT SURVIVES CHALLENGE. The Flathead (MT) Beacon (7/22, 15K) reports that "the proposed Flathead water compact can proceed toward settlement with the U.S. government, while Montana employees and board members can be held liable for possible damages under the contentious water rights agreement, according to a Lake County district court judge." Judge James Manley "issued partial summary judgments July 18 that sided with the State of Montana and Confederated Salish and Kootenai Tribes on the Flathead Indian Reservation, while also ruling in favor of opponents regarding one aspect of the water compact." According to the article, "Manley agreed with a group of irrigators who said a provision in the compact violated the Montana Constitution because it provided immunity to the state, or its agents or employees, without a two-thirds vote in the 2015 Montana Legislature." But "the judge also determined that the provision can be removed from the water compact without voiding the entire agreement, which aims to permanently settle the tribes' water rights and is currently seeking congressional approval in Washington, D.C."

PADRE DAM WATER DISTRICT AWARDED FUNDING FOR WATER RECYCLING. The San Diego Union-Tribune (7/22, 523K) reports that "Padre Dam Municipal Water District has been awarded $4.5 million from a federal agency to use toward its water recycling efforts." According to the article, "the money is part of more than $30 million in funding through the United States Department of the Interior's Bureau of Reclamation for seven projects in California that will provide clean water and promote both water and energy efficiency."

DRINKING WATER TEMPORARILY UNAVAILABLE AT LITTLE WOOD CAMPGROUND. The Twin Falls (ID) Times-News (7/23, 73K) reports that the BOR "closed the well that supplies drinking water to Little Wood Campground due to health concerns." According to the article, "during a recent inspection, a water sample tested positive for coliform bacteria," and "further testing is necessary to confirm the well is safe." Ryan Newman, manager of Reclamation's Upper Snake Field Office, said, "Public safety is our primary concern. We are working to assure all health concerns are addressed in a timely manner."

FUNDING BILL FOR COLORADO CONDUIT ADVANCES IN SENATE. In an editorial, the Pueblo (CO) Chieftain (7/23, 72K) reports legislation offering funding options for a drinking water pipeline from Lake

Pueblo advanced in the Senate last week, and commends sponsoring Sen. Cory Gardner and co-sponsor Sen. Michael Bennet for advancing the bill. The proposed 130-mile conduuit would take fresh water east to Lamar, serving 40 communities along its route. The Chieftain says, “We share in the optimism for the long-awaited pipeline project and express our appreciation to Sens. Gardner and Bennet for helping to move the conduit, estimated to cost up to $400 million, forward.”

ADDITIONAL COVERAGE: FEDERAL AGENCIES THREATENED WITH LAWSUIT OVER FISH PARASITES. Additional coverage that “commercial fishing and conservation groups announced Thursday they may file a lawsuit to compel federal agencies to do more to protect juvenile coho salmon in the Klamath River” was provided by the Klamath Falls (OR) Herald And News (7/22, 45K).

ADDITIONAL COVERAGE: YOUTH PROTESTERS MARCH TO RAISE AWARENESS ABOUT KLAMATH RIVER WATER QUALITY. Additional coverage that “on July 18, a group of over two dozen youth, including teens from the Yurok and Hoopa Valley Tribes, organized three protests demanding a thorough clean up of the polluted Klamath Strait Drain in Klamath County, Oregon” was provided by Bay Area (CA) Indymedia (7/22, 2K).

O’TOOLE: DOA, DOI COLLABORATION JUST ONE STEP TO SUSTAINING THE COLORADO RIVER. In a Montrose (CO) Press (7/24, 17K) op-ed, Pat O’Toole reports that closer collaboration between Department of Agriculture and DoI drought resiliency programs “was welcomed” by those who depending on the Colorado River, and says the Colorado “is the lifeblood of the Southwest.” O’Toole says a successful water strategy should include “a ‘portfolio’ of water supply enhancements and improvements,” such as “water reuse, recycling, conservation, water-sensitive land use planning, and water system improvements.” O’Toole praises USDA Secretary Tom Vilsack and Interior Secretary Sally Jewell for their collaboration, but says it is “just one of many critical steps required” to develop lasting solutions.

Top National News:

OBAMA MAKES CASE AGAINST TRUMP IN CBS INTERVIEW. In an interview which aired on CBS’ Face The Nation on Sunday, the President made a case against Donald Trump and expressed confidence in Hillary Clinton. The President argued that Trump’s campaign rhetoric undermines American values, and that his suggestion that he might not defend a NATO ally that was attacked by Russia shows that he is not prepared for the presidency. On the other hand, Obama called Clinton “supremely capable” of taking over the job in January. Media coverage of the President’s comments is very light, however, with relatively little print and online coverage and only one network news broadcast – the CBS Evening News – covering the interview Sunday evening.

The New York Times (7/24, Davis, Subscription Publication, 14.18M) says the CBS interview was the first in a series of appearances this week during which the President will seek to counter Trump, “unite Democrats around Hillary Clinton’s candidacy and persuade independent voters to back her as well.” According to aides, in “media interviews and a prime-time televised speech scheduled for Wednesday...the president will defend his economic and foreign policy record, arguing that the nation is safer and more prosperous because of them – and that Mrs. Clinton is best positioned to protect them.”

In the interview with CBS’ Face The Nation (7/24, Dickerson, 4.61M), the President argued that Trump’s “divisive rhetoric” on Muslims and terrorism is “ultimately helping do ISIL’s work,” Politico (7/24, Herb, 1.96M) reported. The President told CBS, “If we start engaging in the kinds of proposals that we’ve heard from Mr. Trump or some of his surrogates like Mr. [Newt] Gingrich, where we start suggesting that we would apply religious tests to who could come in here, that we are screening Muslim Americans differently than we would others, then we are betraying that very thing that makes America exceptional.” In “another dig at Trump,” the President said, “One of the best ways of preventing it is making sure that we don’t divide our own country, that we don’t succumb to fear, that we don’t sacrifice our values and that we send a very strong signal to the world and to every American citizen that we’re in this together.” The Huffington Post (7/24, Nelson, 367K) reported that the President said Trump is “undermining America’s values with his campaign rhetoric.”

The President also said on CBS' Face The Nation (7/24, Dickerson, 4.61M) that Trump's claim that he "wouldn't necessarily come to the aid of a NATO ally attacked by Russia shows the Republican isn't ready for the Oval Office," Bloomberg Politics (7/24, Dorning, 529K) reports. The President argued that "Trump's willingness to cast doubt on the US's 'solemn commitment' while allies are anxious over Putin's posture 'is an indication of the lack of preparedness that he has been displaying when it comes to foreign policy.'" The AP (7/24, Taylor) quotes the President as saying, "There is a big difference between challenging our European allies to keep up their defense spending, particularly at a time when Russia's been more aggressive, and saying to them, 'You know what? We might not abide by the central tenant of the most important alliance in the history of the world.'"

According to the Washington Times (7/24, Richardson, 257K), the President argued that "recent terrorist attacks" do not "confirm the bleak outlook painted by Republican presidential nominee Donald Trump." The President also said (7/24, Dickerson, 4.61M) that "the American people are significantly more safe now than they were before all the work that we've done since 9/11. So, maintaining that perspective I think is absolutely critical, and trying to fan fears simply to score political points I think is not in the best interest of the American people." Asked (7/24, Dickerson, 4.61M) why he stopped using the phrase "radical Islam" after the 2008 presidential race, the President said, "This is an interesting example of where something that shouldn't be an issue gets magnified. ... The reason that I haven't used the particular phrase 'radical Islam' on a regular basis is because in talking to Muslim allies, in talking to the Muslim-American community here, that was being heard as if we were ascribing to crazy groups like ISIL or Al Qaeda the mantle of Islam."

The President also told CBS' Face The Nation (7/24, Dickerson, 4.61M) that Trump's nomination "says something about what's happened to the Republican Party over the course of the last eight, 10, 15 years. If you think about what a Bob Dole or a Jim Baker or a Howard Baker or a Dick Lugar or a Colin Powell stood for, they were conservative. They were concerned about limited government and balancing budgets and making sure we had a strong defense. But they also understood that our system of government requires compromise, that Democrats weren't the enemy, that the way our government works requires us to listen to each other."

In its report on the interview, the CBS Evening News (7/24, story 3, 1:25, Pelley, 11.17M) showed the Face The Nation host John Dickerson asking the President about his supporters claims in 2008 that if he "runs the presidency like his campaign, he's going to be in good shape," and why that is not true for Trump, "who has run a pretty remarkable campaign beating 16 other politicians." The President was shown saying, "In 2008 I don't think they were referring merely to the fact that I had won. We were really, really organized. We had a great culture that-- there wasn't a whiff of scandal to how we approached getting elected. We told the truth. I do think that the body of work of a person matters."

The AP (7/24, Taylor) reported that the President also argued that Hillary Clinton "is supremely capable of taking over the reins of power in January," adding that "he believes there has never been candidate better prepared for the presidency." Politico (7/24, Herb, 1.96M) quoted the President as saying, "She's not always flashy. And there are better speechmakers. ... But she knows her stuff. And more than anything, that is what is ultimately required to do a good job in this office." Asked on CBS' Face The Nation (7/24, Dickerson, 4.61M) how Clinton compared to Presidents Eisenhower or George H.W. Bush, Obama said, "I said 'more prepared.' I didn't say they were, you know, chopped liver. I mean, you know, heading up the Allied Forces is pretty good training for the presidency, and I'm huge admirers of both Eisenhower and Herbert Walker Bush. In fact, I think that George H. W. Bush is one of the most underrated presidents we've had and I think he is a really good man. But the skill sets that Hillary has are similar to many of the skill sets that they had – experience in government, experience in working with a wide range of people, solving big, difficult problems, familiarity with the world."

The President also discussed Clinton's use of a private email server while she was secretary of state, saying, "I think she would acknowledge she made a mistake, but what I also think is true is that if you've been in the public eye for decades at if highest levels of scrutiny, folks are going the find some mistakes you make. I've made mistakes." The President added that "the consistency with which she has devoted her life to trying to make sure that kids get health care and a good education and that families are getting

a fair break if they're working hard and that America upholds its best traditions of foreign policy, on the big stuff, she's gotten it right."

The Washington Times (7/24, Richardson, 257K) reports that in the interview, the President also "painted an optimistic picture about the state of the country, saying his team is 'operating at peak level.'" The President told CBS, "I feel as if I'm a better president than I've ever been. ... That the experience has made me sharper, clearer about how to get stuff done." In addition, the President told CBS' Face The Nation (7/24, Dickerson, 4.61M) that he is "'more hopeful' today about the state of race relations in the country than he was growing up, pointing to outrage over videos of police shootings." The President said, "So in a lot of ways, I would feel more hopeful. ... Ironically, I think precisely because things have gotten better, what I've heard from younger Africans Americans is more shock about these images and the videos from Minnesota or Baton Rouge."

Trump campaign manger Paul Manafort responded to the President's comments on ABC's This Week (7/24, Stephanopoulos, 6.61M), arguing that the President "should be the one to be ashamed of what's going on in the world. The growth of ISIS occurred as a direct result of the policies that he and Secretary Clinton established when they took office in 2009. The world is an unsafe place today because of his failed leadership, not because of anything Donald Trump has done." Donald Trump Jr. also took issue with the President's criticism, telling CNN's State Of The Union (7/24, 420K), "If you look at what's going on in this country it's a disaster. ... If President Obama wants to go on the air and say look at the America we live in, it's so phenomenal today versus eight years ago, I don't think I know an American that believes that to be the case. We are in a mess and we have to finally acknowledge that."

WASSERMAN SCHULTZ OUT AT DNC IN WAKE OF EMAIL LEAK. All three broadcast networks opened Sunday evening with the news that Rep. Debbie Wasserman Schultz (D-FL) will step down as Democratic National Committee chair effective at the end of this week's convention – an event where her role had already been significantly sidelined in the wake of leaked emails indicating DNC support for Hillary Clinton over Sen. Bernie Sanders in the presidential race. While the networks cast the resignation in very negative terms, print and online reports are more nuanced, with some stating that by getting the controversial Wasserman Schultz out of the way, the Clinton campaign is more likely to have the smooth convention it hopes for. Donna Brazile will become interim DNC chair.

ABC World News (7/24, lead story, 3:45, Muir, 14.63M) reported, "The Democratic National Convention hasn't even started, and we already have our first major controversy." ABC (Vega) added, "This is supposed to be about party unity. Instead, this is the exact opposite. On the eve of the Democratic convention, tonight, a bombshell" resignation intended to "blunt the controversy hanging over Clinton's convention." NBC Nightly News (7/24, lead story, 3:00, Holt, 16.61M) also said that "on the eve of their big convention, the Democratic party has been rocked by a bombshell. ... The turmoil is rapidly eroding the unity that Democrats were hoping to project this week."

The CBS Evening News (7/24, lead story, 3:20, Pelley, 11.17M) said, "There's breaking news here tonight, and not the kind that Hillary Clinton wants. A new email scandal" that "has cost the chairman of the DNC her job." CBS (Cordes) added, "Wasserman Schultz was already a lightning rod for Bernie Sanders supporters even before these hacked emails were made public. And so now, with Democratic officials desperate" to bring them "into the fold and unify the party in advance of the convention, the decision was made that she had to go. Wasserman Schultz announced her resignation just one day after introducing Clinton and her new running mate in Miami."

USA Today (7/24, Przybyla, 6.31M) says the announcement came in the wake of "the growing controversy" over the leaked emails "that at times depicted staffers favoring" Clinton over Sanders. The New York Times (7/24, Martin, Rappeport, Subscription Publication, 14.18M) reports that Wasserman Schultz "was meeting with advisers behind closed doors at a hotel here, a day before the party's convention was set to begin, and had faced growing calls for her resignation over the weekend." In a statement, she said, "I know that electing Hillary Clinton as our next president is critical for America's future. I look forward to serving as a surrogate for her campaign in Florida and across the country to ensure her victory."

Bloomberg Politics (7/24, Epstein, 529K) says the resignation "capped several hours of fast-moving developments as thousands of Democrats streamed into Philadelphia" and "comes days comes after Democrats delighted in watching Republican infighting disrupt the GOP's convention in Cleveland," and the Miami Herald (7/24, Mazzei, 762K) called the resignation "a stunning development that capped a whirlwind 48 hours for party leaders."

The Washington Post (7/24, Gearan, Phillip, 9.18M) says Clinton campaign officials "argued that she had become a lightning rod because of the hacked emails," according to a source. The AP (7/24, Thomas, Lucey) similarly says Wasserman Schultz "has been a lightning rod throughout the presidential campaign for criticism from the party's more liberal wing." The Los Angeles Times (7/24, Memoli, 4.09M) says the resignation "culminated a series of steps by the Clinton campaign to sideline her – first by appointing a new party executive last month to run the party's operations, then by taking away her speaking role at the convention and removing even the simple task of gaveling the convention in and out of session."

Politico (7/24, Strauss, Caputo, 1.96M) reports President Obama said in a statement, "For the last eight years, Chairwoman Debbie Wasserman Schultz has had my back. This afternoon, I called her to let her know that I am grateful." Clinton said, "I am grateful to Debbie for getting the Democratic Party to this year's historic convention in Philadelphia, and I know that this week's events will be a success thanks to her hard work and leadership. There's simply no one better at taking the fight to the Republicans than Debbie."

E.J. Dionne writes in his Washington Post (7/24, 9.18M) column that "before the controversy...could dominate the early part of the convention, Clinton's campaign moved quickly" to obtain Wasserman Schultz's resignation. The Washington Times (7/24, Morton, 257K) reports Clinton gave Wasserman Schultz "a soft landing by announcing that she would join the Clinton campaign."

The New York Times (7/24, Alcindor, Subscription Publication, 14.18M) reports that Sanders supporters were "energized" by the resignation. Sanders said, "Debbie Wasserman Schultz has made the right decision for the future of the Democratic Party. While she deserves thanks for her years of service, the party now needs new leadership that will open the doors of the party and welcome in working people and young people. The party leadership must also always remain impartial in the presidential nominating process, something which did not occur in the 2016 race." Reuters (7/24, Whitesides) says "lingering bitterness from the heated primary campaign" between Clinton and Sanders "erupted" following the email leak.

Politico (7/24, Herb, 1.96M) reports Sanders had called on Wasserman Schultz to resign earlier Sunday. On NBC's Meet The Press (7/24, Todd, 5.27M), Sanders said, "This really does not come as a shock to me or my supporters. There is no question but the DNC was on Secretary Clinton 's side since day one. The time is now Debbie Wasserman Schultz to step aside." Sanders added he would not reconsider his support for Clinton in the wake of the report: "No, no, no. We're going to do everything we can to protect working families in this country."

On ABC's This Week (7/24, Stephanopoulos, 6.61M), Sanders said, "I think I told you a long time ago that the DNC was not running a fair operation. That they were supporting Secretary Clinton." Sanders added that Wasserman Schultz "should resign. Period." On NBC Nightly News (7/24, story 3, 1:25, Holt, 16.61M), Chuck Todd said, "Talking with Sanders' campaign manager earlier today, he said the best way to unify the party has just happened: the Debbie Wasserman Schultz resignation. They finally got some retribution. They got her resignation."

Dan Balz writes in the Washington Post (7/24, 9.18M) that the DNC's covert support for Clinton "is not totally surprising, because Clinton is the institutional choice of the Democrats and because DNC members are the party's establishment. But the national committee's role is to maintain strict neutrality during the primaries, and the emails indicate that did not happen."

The Washington Times (7/24, Dinan, 257K), The Hill (7/24, Hellmann, 884K), Roll Call (7/24, 61K), and the Huffington Post (7/24, Fang, 367K) are among the other outlets reporting on the resignation.

CNN Suspends Agreement With Brazile; Granholm In Mix To Be Permanent Successor. Politico (7/24, Gold, 1.96M) reports that CNN has suspended Brazile's contributor agreement as she prepares to become interim chair. The Detroit Free Press (7/24, Spangler, 1.02M) reports that former Michigan governor Jennifer Granholm is said to be in the running as a permanent replacement for Wasserman Schultz. However, the Detroit News (7/24, 434K) reports Granholm said Sunday that she was not pursuing the job.

Clinton Campaign: "Russian State Actors" Orchestrated Hack To Aid Trump. The Wall Street Journal (7/24, Torry, Meckler, Subscription Publication, 6.27M) reports Clinton campaign manager Robby Mook faulted "Russian state actors" for hacking and leaking the emails. He told CNN, "I don't think it's coincidental that the emails were released on the eve of our convention." The Washington Post (7/24, Hamburger, Nakashima, 9.18M) says Mook "accused the Russian government of orchestrating the release of damaging Democratic Party records in order to help" Trump, an "extraordinary charge came as some national security officials have been growing increasingly concerned about possible efforts by Russia to meddle in the election."

The New York Times (7/24, A1, Sanger, Subscription Publication, 14.18M) says in a report headlined "As Democrats Gather, A Russian Subplot Raises Intrigue" that while "roving the source of a cyberattack is difficult...all the forensic evidence points toward Russian intelligence agencies as the perpetrators of the theft of the national committee emails."

On CNN's State Of The Union (7/24, Tapper, 420K), Mook said, "What's disturbing to us is that…experts are telling us that Russian state actors broke into the DNC, stole these emails, and other experts are now saying that the Russians are releasing these emails for the purpose of actually helping Donald Trump. I don't think it's coincidental that these e-mails were released on the eve of our convention here. And that's disturbing." On ABC's This Week (7/24, Stephanopoulos, 6.61M), Mook repeated his claim and added, "It was concerning that Donald Trump changed the Republican platform last week to what some would regard as pro-Russian. ... I think what is troubling is how he's praised Putin." On Fox News Sunday (7/24, Wallace), Clinton campaign chief strategist Joel Benenson similarly said, "Most experts on cyber security say this is a hack by bad actors in concert with Russia."

However, the Trump campaign was quick to discount these claims. Campaign chief Paul Manafort said on ABC's This Week, "It's pure obfuscation on the part of the Clinton campaign. What they don't want to talk about is what's in those emails. And what's in those emails show that it was a clearly rigged system." On CNN's State Of The Union (7/24, Tapper, 2.4M), Donald Trump Jr. said, "That exactly goes to show you what the DNC and what the Clinton camp will do. They will lie and do anything to win."

ABC World News (7/24, story 2, 1:10, Muir, 14.63M) said that the allegation, if true, "would make the Watergate scandal look minor by comparison." The CBS Evening News (7/24, story 9, 1:50, Pelley, 11.17M) also briefly reported that the Clinton campaign says "they're hearing from experts" that Russians may have conducted the hacks "to help Donald Trump."

Brazile Says "Insensitivity" And "Stupidity" Must Be Addressed, More Leaks To Come. On ABC's This Week (7/24, Stephanopoulos, 6.61M), Brazile said, "As vice chair, I went over yesterday to see the Sanders campaign. I apologized. I think the allegations, the emails, the insensitivity, the stupidity needs to be addressed. And we are going the address it." Brazile added, "This is not just a one-day leak. There will be a substantial number of emails that I understand will be leaked over the next couple of days, weeks, months. Because it was not a one-month breach or a two-month breach."

Emails Show DNC's Use Of Obama To Woo Big Fundraisers. The Washington Post (7/24, Gold, 9.18M) looks at how the emails "show how the party has tried to leverage its greatest weapon – the president – as it entices wealthy backers to bankroll the convention and other needs. At times, DNC staffers used language in their pitches to donors that went beyond what lawyers said was permissible under White House policy designed to curtail the perception that special interests have access." White House officials said President Obama's "attendance at DNC events is well within the law and the administration's own ethics policies."

More Than 1,000 Sanders Supporters March In Philadelphia. The New York Times (7/24, Gabriel, Subscription Publication, 14.18M) reports that "a large, impassioned crowd" of Sanders supporters, "chanting 'Hell, no, D.N.C., we won't vote for Hillary,'" marched on the convention site Sunday, "promising a week in which the party's divisions will be on vivid display in the streets." The Times says more than 1,000 demonstrators turned out for "the first of what are expected to be many Sanders rallies during the convention." The Chicago Sun-Times (7/24, Sfondeles, 877K) quotes some Illinois Sanders delegates about the leak. One said, "It's similar to Watergate. The break in and playing games, that's wrong. And the whole idea is very Donald Trump-ish."

CBS NEWS BATTLEGROUND TRACKER POLL: TRUMP NOW LEADS CLINTON 42%-41%. On its website, CBS News (7/24, Salvanto, 3.67M) reported that a CBS News Battleground Tracker Poll of 2,131 combined voters in eleven states – Colorado, Florida, Iowa, Michigan, North Carolina, New Hampshire, Nevada, Ohio, Pennsylvania, Virginia, and Wisconsin – taken July 22-23, shows Donald Trump received "a small boost in support across the battleground states coming out of his convention. he is at 42 percent support now, up from 40 percent heading in, and it now pushes him slightly ahead of Hillary Clinton, who remains unchanged at 41 percent."

The Hill (7/24, Savransky, 884K) reported that in the poll, "55 percent of Republicans said Trump's message at the convention made them feel hopeful, and about 40 percent said it made them feel enthusiastic. Among independents, 32 percent said it made them feel hopeful, and 25 percent said it made them feel enthusiastic," while "another 32 percent of independents said they felt scared. Among Democrats, 63 percent said what they saw and heard from the GOP nominee at the convention made them feel scared."

Clinton Camp Confident Trump Bid To Expand Map Is Futile. Asked on ABC's This Week (7/24, Stephanopoulos, 6.61M) about Donald Trump's campaign's plans to expand the battleground map from 12 to 20 states to include traditionally Democratic states like Connecticut, Michigan, Nevada, New Mexico, Oregon and Wisconsin, Hillary Clinton's campaign manager, Robby Mook, said, "I welcome Donald Trump to spend time in states like Connecticut. I think families there understand what a threat he is not only to our community, the fabric of our American community, but also to our national security and our economy. The voters in those states are going to resoundingly reject Donald Trump. So, I welcome him to spend his time there. We're focused on the states that we think are the real battleground. We're very confident in states like Pennsylvania, Ohio, and Florida we have a competitive operation."

Editorial Wrap-Up:

NEW YORK TIMES. ***"When Health Insurers Merge Consumers Often Lose."*** The New York Times (7/25, Subscription Publication, 14.18M) editorializes, "A wave of mergers in many sectors of the economy over the last several decades has significantly reduced competition and hurt consumers," which is why lawsuits filed last week by the Justice Department "and state attorneys general in federal court challenging two big heath insurance mergers were so important." The proposed Aetna/Humana and Anthem/Cigna mergers "are the culmination of a series of deals in the health care industry that have reduced the number of insurers and caused the consolidation of hospitals and doctors' practices everywhere."

"New York City Policing Reform, Derailed." The New York Times (7/25, Subscription Publication, 14.18M) editorializes in favor of two proposed New York City bills "to protect civilians from being harassed and unlawfully searched." The bills "require officers to identify and explain themselves when they stop people, and to make sure people know when they can refuse to be searched." But City Council Speaker Melissa Mark-Viverito "essentially derailed" them, saying "she had quietly struck a compromise with the Police Department to adopt some, but not all," of the components. The Times says the measures need to have the force of law.

"Nursing Home Residents Still Vulnerable To Abuse." The New York Times (7/25, Subscription Publication, 14.18M) says in an editorial that pending federal rules on nursing home standards "fail to hold nursing homes truly accountable to patients, their families or the law." The Times says the proposed

rule “should have banned pre-dispute arbitration clauses in nursing home contracts. Instead, they basically condone them as long as these homes take some legalistic steps to explain and disclose the clauses and do not make signing them a condition of admission.”

WASHINGTON POST. ***“Clinton Should Offer A Stark Contrast From The GOP’s Dystopian Vision.”*** The Washington Post (7/24, 9.18M) says in an editorial that this week, Democrats must present “facts that belie Mr. Trump’s fear-mongering rhetoric.” And Hillary Clinton “should recognize in her convention speech the very real pain some Americans are suffering” and “offer actual, substantive proposals to help spur growth and alleviate economic and social inequality.”

“The Wrong Way To Fight Disease.” The Washington Post (7/24, 9.18M) says in an editorial that congressional inaction has led to federal, state, and local public health agencies scrambling to find resources to mount an adequate response to the Zika virus. The Post says Congress acted irresponsibly by recessing without appropriating money to fight Zika. The Post adds the current system for financing public health emergencies is flawed, because politicians do not respond as rapidly to health threats as they do to natural disasters. The Post endorses a proposal by Rep. Rosa DeLauro (D-CT) to create a $5 billion public health emergency fund that would be ready for rapid and flexible response when epidemics break out.

“The Fairfax County School Board’s Failure On Transgender Protections.” The Washington Post (7/24, 9.18M) editorializes that the Fairfax County, Virginia school board “took a step backward last Tuesday by refusing to review regulations that would have helped enforce its policy protecting transgender students and staff.” Although the school board has had a nondiscrimination policy protecting transgender students and staff for more than a year, it has tabled discussion of amending its school handbook to add a clear enforcement clause for the rule. The Post says that by moving away from its previously expressed standard, “Fairfax is failing to live up to its own example.”

WALL STREET JOURNAL. ***“ObamaCare And Big Insurance.”*** The Wall Street Journal (7/24, Subscription Publication, 6.27M) editorializes that it is odd that the Justice Department is filing a lawsuit to block the Anthem-Cigna and Humana-Aetna mergers because increased consolidation in the health insurance industry is a direct result of the Affordable Care Act. The Journal argues that the ACA is predicated on the notion that larger entities in the insurance industry are more effective than a system with smaller players, and that the DOJ antitrust lawsuit is thus a classic example of politicians being most enraged by the problems they themselves have caused.

“International Olympic Dopes.” In an editorial, the Wall Street Journal (7/24, Subscription Publication, 6.27M) says the IOC’s decision not to ban the entire Russian Olympic team from the games in Rio was likely the result of intimidation by Russian President Vladimir Putin.

Big Picture:

HEADLINES FROM TODAY’S FRONT PAGES.

Wall Street Journal:
Democrats Seek Unity With Ouster Of Party Official
Clinton To Take Command Of A Changed Democratic Party
As China Lets Yuan Depreciate, Other Nations Take Note
How Much Oil Is In Storage? Take A Guess

New York Times:
Debbie Wasserman Schultz To Resign DNC Post
As Democrats Gather, A Russian Subplot Raises Intrigue
IOC Forces Russians To Prove They Have A Drug-Free Past
Yahoo Cuts $4.8 Billion Deal To Sell Core Business To Verizon
Years Before Truck Rampage In Nice, Attacker Wasn’t ‘Living In The Real World’
Kabul Bombing Adds New Layers Of Agony For Afghanistan’s Hazaras

Tesla's Chief Sticks To Mission Despite A Series Of Setbacks

Washington Post:
Turkish Lawyers Allege Detainee Abuse
DNC Chair Pushed Out Over Email Leak
IOC Decides Not To Ban Full Russian Team From Rio Olympics
Planning Care For Zika Babies Challenges US Health Officials
Clinton Campaign Says Russians Are Behind DNC Document Leak
DNC's Plight Began Long Before Leak

Financial Times:
Goldman Blamed For Role In BHS Deal
Italy Finance Minister Rejects Banks Bail-In

Washington Times:
Democrats Line Up Insiders As Speakers
Democrats Lose Chair On Eve Of Convention
Battle Of Mosul Seen As Ploy For US Elections
Two Female Officers Advance In Bid To Join Green Berets
Northwest Passge: A New Frontier

Story Lineup From Last Night's Network News:
ABC: DNC-Chair Resignation; DNC-Emails; DNC Chair Resignation-Trump; West Coast Wildfires; Severe Weather; Weather Forecast; Connecticut Plane Crash; Russian Olympians-Doping; Germany-Refugee Attack; Dallas Airport-Security Breach; College Football Player Deaths.
CBS: DNC-Chair Resignation; DNC-Hillary Clinton; DNC-President Obama; DNC-Trump; Political Polls; West Coast Wildfires; Germany-Shooting Rampage; Russian Olympians-Doping; DNC-Coverage.
NBC: DNC-Chair Resignation; DNC-Trump; DNC-Analysis; DNC-Security; West Coast Wildfires; Russian Olympians-Doping; Alzheimer's Developments; Verizon-Yahoo Purchase; Hacking Threats.

Network TV At A Glance:
2016 Politics – 29 minutes, 05 minutes
West Coast Wildfires – 6 minutes, 00 seconds
Russian Olympians-Doping – 3 minutes, 00 seconds

Story Lineup From This Morning's Radio News Broadcasts:
CBS: DNC-Chair Resignation; DNC-Email Investigation Comments; Hillary Clinton-RNC Comments; Severe Weather-Excessive Heat Warnings; West Coast Wildfires; Texas-Hot Car Child Death; Dallas Cowboys Bus-Accident Deaths; Germany Music Festival Explosion.
NPR: DNC-Chair Resignation; California Wildfires; Russian Olympians-Doping; Severe Weather-Excessive Heat Warnings; US Coast Guard Search-Fake Distress Calls; China-G20 Finance Meeting; Verizon-Yahoo Purchase.
FOX: Germany Music Festival Explosion; Germany Shooting Rampage-Questioning; DNC-Chair Resignation; DNC-Republican Chair Response; Severe Weather-Heat Warnings.

Washington Schedule:

TODAY'S EVENTS IN WASHINGTON.
White House:

PRESIDENT OBAMA — No public scheduled events.

VICE PRESIDENT BIDEN — No public scheduled events.
US Senate: Senate on recess from 15 Jul – 6 Sep
US House: 1:30 PM GOP Rep. Mac Thornberry off camera press roundtable on trip to Iraq and Afghanistan – House Armed Services Committee Chairman Republican Rep. Mac Thornberry hosts off-

camera press roundtable to discuss his recent trip to Afghanistan and Iraq and the readiness issues facing the military Location: Rm 2212 Rayburn House Office Bldg., Washington, DC armedservices.house.gov https://twitter.com/HASCRepublicans
Other: 9:15 AM Foundation for Defense of Democracies discussion on 'The Third Lebanon War' – 'The Third Lebanon War: The Coming Clash Between Hezbollah and Israel in the Shadow of the Iran Nuclear Deal' Foundation for Defense of Democracies discussion, with Carnegie Endowment for Middle East Peace Visiting Scholar Joseph Bahout, and FDD Vice President for Research Jonathan Schanzer, Senior Fellow Tony Badran, and Senior Advisor Brig. Gen. Yakov Shaharabani Location: FDD, 1800 M St NW, Washington, DC www.defenddemocracy.org https://twitter.com/FollowFDD

3:00 PM IACHR Executive Secretary finalists speak at Open Society Foundations – Open Society Foundations roundtable with the five finalist for Executive Secretary of the Inter-American Commission on Human Rights – Renzo Pomi (Uruguay), Elizabeth Abi-Mershed (U.S.), Paulo Abrao (Brazil), Michael Reed-Hurtdao (Colombia), and Lisa Shoman (Belize) Location: Open Society Foundations, 1730 Pennsylvania Ave., Washington, DC http://www.opensocietyfoundations.org/ https://twitter.com/OpenSociety

6:00 PM Young America's Foundation Annual National Conservative Student Conference – Young America's Foundation Annual National Conservative Student Conference. Speakers include former House Speaker Newt Gingrich, former Reps. Rick Santorum and Allen West, former U.S. Treasurer Bay Buchanan, Lt. Col. (Ret.) Oliver North, Heritage Foundation President Jim DeMint, Clare Boothe Luce Policy Institute Program Director Laurel Conrad, Princeton University Professor Robert George, Family Research Council Senior Fellow Cathy Ruse, Libre Initiative spokeswoman Rachel Campos-Duffy, talk show host Ben Shapiro, bloggers Matthew Walsh and Robert Spencer, and authors Dinesh D'Souza, David French, Kate Obenshain, Dr Burt Folsom, Katie Pavlich, and Jared Meyer Location: George Washington University, Washington, DC www.yaf.org https://twitter.com/yaf

Last Laughs:

LATE NIGHT POLITICAL HUMOR.

Jimmy Fallon: "Of course, last night was the end of the Republican National Convention, and now it's the time for the Republicans to sit back, reflect and say, 'Well, that was weird.'"

Jimmy Fallon: "The Republican National Convention came to a close last night, as Donald Trump formally accepted his nomination for president. Although I thought it was a little much that they did it by Paul Ryan giving him a rose."

Jimmy Fallon: "Donald Trump released some of his remarks ahead of his big speech last night and presented himself as the champion of the forgotten men and women of our country. Then he said, 'And if you don't believe me, just look at all the has-beens that appeared on 'Celebrity Apprentice.'"

Jimmy Fallon: "And earlier this week, Trump's son, Eric, gave a big speech of his own, where he told the crowd to vote for his dad, because he's the candidate who doesn't need the job. Then he said, 'Speaking of people who don't need jobs, how about another round of applause for me and my brother Don Jr.'"

Jimmy Fallon: "I saw that 'Earth, Wind and Fire' tweeted that the convention's use of their song 'September' was unauthorized. Not because they disagree with the Republican Party's policies – they disagree with the Republican Party's dancing."

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terms of use. Services that include Factiva content are governed by Factiva's terms of use. The Department of the Interior News Briefing is published five days a week by Bulletin Intelligence, which creates custom briefings for government and corporate leaders. We can be found on the Web at BulletinIntelligence.com, or called at (703) 483-6100.

From:	Will Meeks
To:	Mike Blenden; Jeff King
Subject:	FW: NWRA position on National Bison Range (NWR) proposed legislation
Date:	Monday, July 25, 2016 8:09:15 AM

Will Meeks
U.S. Fish and Wildlife Service
Mountain Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

From: Viker, David [mailto:david_viker@fws.gov]
Sent: Monday, July 25, 2016 7:54 AM
To: Polly Wheeler; Scott Kahan; Mitch Ellis; Aaron Archibeque; Charles Blair; Sharon Marino; Will Meeks; Kim Trust; Kevin Foerster; Brett Hunter; Maureen Gallagher; Thomas Harvey; Tom Worthington; Sarena Selbo
Subject: NWRA position on National Bison Range (NWR) proposed legislation

I just saw this morning for the first time ...http://refugeassociation.org/2016/07/national-bison-range/ ... pasted below

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July 20, 2016

Dear Supporters,

On June 10, 2016, the Confederated Salish and Kootenai Tribes (CSKT) released draft legislation that would transfer the National Bison Range in Montana from the U.S. Fish and Wildlife Service to the Secretary of the Interior to be held in trust for the tribe.

As the only nonprofit organization with a mission that includes “protecting, enhancing and expanding the National Wildlife Refuge System,” we cannot support the removal of a wildlife refuge from the System without a specific companion action that adds habitat of equal or greater value into the System. We believe that a transfer of the National Bison Range without such compensatory additions to the Refuge System would have the effect of creating an unintended precedent that would threaten the integrity of our nation’s only system of federal lands devoted specifically to wildlife. For these reasons, the National Wildlife Refuge Association cannot support the draft legislation as written.

If the proposed legislation were changed to ensure no net loss of habitat to the Refuge System, we would be willing to re-evaluate our position.

In addition, the Refuge Association remains supportive of the use of Annual Funding Agreements (AFAs) as an instrument for collaborative management by Department of the Interior bureaus and tribes. If the proposal is not amended to include the addition of lands to the System, we urge the Service and the tribe to return to an AFA and to pursue any further proposals for management changes through established public processes.

The tribe has requested comments on the draft legislation, which we will provide; however, until the fundamental issue of the impact of the proposed transfer without compensatory additions on the integrity of the Refuge System is addressed and reconciled, all other concerns — including funding implications to the Refuge System, future public access, and transfers of property — are secondary.

Meanwhile, we would like to share with our supporters our core beliefs with regard to this proposal:

We believe that historically the CSKT has played an essential role in the conservation and recovery of the American bison, and that the tribe has a vital role to play in the future management of the National Bison Range. The refuge was purchased from the Flathead Indian Reservation, and these lands hold special significance to the CSKT. When President Theodore Roosevelt worked with Congress to create the refuge in 1908, the iconic American bison had been nearly eradicated from the planet. Since 1908, the Service's investment in the National Bison Range has been instrumental in the species recovery, and this success holds a special significance both as an outstanding achievement and as a point of pride in the Refuge System's key role in recovering our newly designated national mammal. As a result, both the tribe and the Service have special connection to this place.

We believe that any proposal to transfer the National Bison Range must not be used as an open door to other divestments. Other legislative proposals to transfer parts of the Vieques National Wildlife Refuge in Puerto Rico to the territory for development, and to transfer management authority of lands at the Desert National Wildlife Refuge in Nevada to the Department of Defense, have occurred in the past several months.

We believe that strong science and public dialogue bring about the best solutions to the complex issues facing wildlife today, and that any proposal to transfer land out of the Refuge System must include a public process that includes sufficient analysis and review, consistent with the National Wildlife Refuge System Administration Act.

We believe that collaborative relationships between the Service and tribes are not only legally mandated but also essential to conservation success. There are many examples of successful collaboration, and in this context AFAs have been shown to be a demonstrated and fundamental tool for defining roles and creating a collaborative framework. Landscape-scale conservation to support wide-ranging wildlife like bison can only be successful through collaborative partnerships that engage many voices and interests to achieve common goals, and AFAs support these partnerships in achieving their common goals.

We believe that the genetics of the National Bison Range herd should continue to play an important role in the Department of the Interior's overall bison management plan.

The issues raised by a potential transfer of the National Bison Range are complex. Ultimately, we must all come together to address the needs of the Refuge System, the CSKT and our national mammal, the American bison.

Our goal is always to protect the integrity of the National Wildlife Refuge System and ensure that any action is in the best interest of America's wildlife. The National Wildlife Refuge Association has long been committed to collaborative conservation strategies, and we believe our role is to help find the path forward that unites seemingly disparate points of view towards shared efforts to conserve wildlife and the habitat on which they depend. We look forward to continued dialogue on this topic and to working with both the Department of the Interior and the tribe.

From: Noreen Walsh
To: Dan Ashe; Jim Kurth
Subject: Fwd: NWRA position on National Bison Range (NWR) proposed legislation
Date: Monday, July 25, 2016 8:43:11 AM

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

Begin forwarded message:

> **From:** Will Meeks <will_meeks@fws.gov>
> **Date:** July 25, 2016 at 7:59:45 AM MDT
> **To:** Noreen Walsh <noreen_walsh@fws.gov>, Matt Hogan <Matt_Hogan@fws.gov>, Anna Munoz <anna_munoz@fws.gov>
> **Subject: Fwd: NWRA position on National Bison Range (NWR) proposed legislation**
>
> Will Meeks
> U.S. Fish and Wildlife Service
> Mountain-Prairie Region
> Assistant Regional Director
> National Wildlife Refuge System
> 303-236-4303(w)
> 720-541-0310 (c)
>
> Begin forwarded message:
>
> > **From:** "Viker, David" <david_viker@fws.gov>
> > **Date:** July 25, 2016 at 7:53:58 AM MDT
> > **To:** Polly Wheeler <polly_wheeler@fws.gov>, Scott Kahan <scott_kahan@fws.gov>, Mitch Ellis <Mitch_Ellis@fws.gov>, Aaron Archibeque <aaron_archibeque@fws.gov>, Charles Blair <charles_blair@fws.gov>, Sharon Marino <Sharon_Marino@fws.gov>, Will Meeks <Will_Meeks@fws.gov>, Kim Trust <kim_trust@fws.gov>, Kevin Foerster <kevin_foerster@fws.gov>, Brett Hunter <brett_hunter@fws.gov>, Maureen Gallagher <maureen_gallagher@fws.gov>, Thomas Harvey <thomas_harvey@fws.gov>, Tom Worthington <tom_worthington@fws.gov>, Sarena Selbo <sarena_selbo@fws.gov>
> > **Subject: NWRA position on National Bison Range (NWR) proposed legislation**

I just saw this morning for the first time
...http://refugeassociation.org/2016/07/national-bison-range/ ... pasted below

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recovery, and this success holds a special significance both as an outstanding achievement and as a point of pride in the Refuge System's key role in recovering our newly designated national mammal. As a result, both the tribe and the Service have special connection to this place.

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From:	Will Meeks
To:	Noreen Walsh
Cc:	Matt Hogan; nanette_seto@fws.gov; Anna Munoz; stephen_torbit@fws.gov
Subject:	Fwd: Bison Range comments
Date:	Wednesday, July 27, 2016 1:17:11 PM
Attachments:	Untitled attachment 00166.htm Public-Comment-Responses-July-2016.pdf

---

I have not reviewed these yet.

Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

Begin forwarded message:

> **From:** "Hogan, Kelly" <kelly_hogan@fws.gov>
> **To:** Will Meeks <will_meeks@fws.gov>, Maureen Gallagher <maureen_gallagher@fws.gov>, Mike Blenden <mike_blenden@fws.gov>
> **Subject: Bison Range comments**
>
> Just FYI if you haven't seen the CSKT's response to comments.
> K

Responses of the Confederated Salish and Kootenai Tribes to Public Comments on the Tribes' Draft "National Bison Range Transfer and Restoration Act of 2016"

The Confederated Salish and Kootenai Tribes have collected over 150 comments on the Tribes' draft "National Bison Range Transfer and Restoration Act of 2016". These comments were solicited through the Bison Range Working Group website, which was established by the Tribes to notify the public of the draft legislation and to collect public comments, as well as through a public meeting held in Pablo, Montana on July 12, 2016. The comment period opened on June 10, 2016, was extended beyond its original closing date of June 24th, and closed on July 15, 2016.

The total number of comments received during that period was 153. Several individuals submitted more than one comment; the number of unique individuals/organizations that submitted comments is 145. Of those, approximately 76 commenters supported the Tribes' draft legislation, approximately 55 commenters opposed it, and 14 commenters presented questions or concerns without supporting or opposing the proposed legislation.

All of these comments have been posted on the Bison Range Working Group website (www.bisonrangeworkinggroup.org). To respect commenters' privacy, their email addresses, physical addresses (other than city/state), and phone numbers have been redacted from the comments prior to posting.

Below are a number of comments, concerns and questions that were raised in the public comments, along with responses from the Tribes. In the responses, the Confederated Salish and Kootenai Tribes are referred to as "Tribes", the draft National Bison Range Transfer and Restoration Act of 2016 is referred to as the "Act", the National Bison Range is referred to as "Bison Range", the Flathead Indian Reservation is referred to as "Reservation", and the U.S. Fish & Wildlife Service is referred to as "FWS" or the "Service".

1) **Precedent**

Comment: Some commenters expressed concern that passage of the Act would set a precedent for conveyance of other federal lands or facilities. One commenter asserted that "[g]iving ownership of the NBR to the CSK Tribe would by definition set a precedent of giving a federal wildlife refuge to a non-governmental entity." Other commenters pointed out that the Bison Range "is a completely unique situation and should not in any way be construed as a precedent regarding other federal properties."

Response: The Act directly addresses the issue of precedent. As a matter of law, Section 4(i) of the Act would prohibit the interpretation of the Act as a precedent. This section reads as follows:

> The provisions of this Act are uniquely suited to address the distinct circumstances, facts, history, and relationships involved with the subject bison, lands and Tribes. These provisions are not intended, and shall not be interpreted, as precedent for any other situation regarding federal properties or facilities.

As a practical matter, the facts surrounding the history of the National Bison Range do not lend themselves to creating a precedent for other situations. Unlike most federal properties, the Range is located in the center of an Indian Reservation that was reserved by Treaty, on lands which the Tribes never consented to convey. Underscoring this uniqueness is the fact that the lands were the subject of a federal judicial decision holding that the lands had been unconstitutionally taken within the meaning of the Fifth Amendment of the U.S. Constitution (see *Confederated Salish and Kootenai Tribes of the Flathead Reservation, Montana v. United States*, 437 F.2d 458, 485 (1971)). The history of how Tribal members had initially brought the ancestors of the Range's bison herd to the Flathead Indian Reservation makes the Bison Range situation even more unique and unlike that of any other federal property or facility. Further distinguishing this situation are the Tribes' two prior Tribal Self-Governance agreements, under which they had assisted with National Bison Range operations in 2005-06 and 2008-2010.

While one commenter expressed concern that the Act would create a precedent for "giving" a federal wildlife refuge to a "non-governmental entity", the Confederated Salish and Kootenai Tribes are a federally-recognized tribal government and so the Act could create no precedent for a transfer to a non-governmental entity.

2) **Access**

Comment: Several commenters asked about public access. One commenter asked whether the Tribes might impede access through "exorbitant entry fees". Another commenter asked whether fishing access would continue. At least one individual asked whether a person would be required to have a Tribal recreation permit in order to access the Bison Range.

Response: The Tribes have always agreed that public access must be required under the draft legislation, and this has been a key factor in FWS' support for the Bison Range restoration concept. Continued public access would be required by Section 4(d) of the Act. Fishing access would also continue under the Tribes' management. As a practical matter, the Tribes already provide public access to most Tribal lands on the Flathead Indian Reservation, so continued access at the National Bison Range would be consistent with the Tribes' current and past practices. This existing public access to Tribal lands includes fishing access. Public access at the Bison Range would continue to be guided by conservation and public safety considerations.

Maintaining reasonable entry fees would support the Tribes' interests in public education and visitor experiences at the Bison Range, whereas exorbitant fees would undermine those priorities.

The Bison Range would continue to be subject to its own fee structure. Access would therefore not depend on whether a person had a Tribal recreation permit.

3) **Additional access points**

Comment: Some commenters inquired about additional access points to the National Bison Range, and several individuals suggested an entrance off Highway 93 and/or at the top of Ravalli Hill.

Response: The Tribes do not currently have plans for new points of access to the National Bison Range. However, the Tribes may consider such access points if there was reason to believe that they would improve the visitor experience while still protecting the Range's natural resources.

The Tribes have developed, and currently maintain, the existing Ravalli Hill scenic turnout interpretive area on Highway 93, on Tribally-owned land adjacent to the Bison Range. The public generally considers, and uses, this site as a public access Bison Range viewing area. The U.S. Fish & Wildlife Service considers the public access viewing from this site when it estimates annual overall public uses and visitation of the National Bison Range. Use of this Tribally-owned and managed site will not change in the future, but may be considered for expanded visitor experiences and interpretation.

4) **Interpretive opportunity**

Comment: Some commenters said that the proposed Bison Range restoration would allow for improved interpretive opportunities through greater incorporation of the Tribes' cultural and historical ties to the land, bison, and other natural resources found at the Range.

Response: The Tribes agree that the proposed Bison Range restoration would greatly expand the Tribes' ability to incorporate aspects of Tribal historical and cultural connections to the Range's land, bison and other natural resources. Based upon comments, as well as past feedback from the public, the Tribes believe that many people would welcome such interpretive additions.

5) **Funding**

Comment: Several commenters asked how the Tribes would fund operation of the Bison Range, and a couple of commenters questioned whether the Tribes may charge higher admittance fees.

Response: Under the Act, after the two-year transition period provided for in Section 4(e) of the Act (and addressed in item #7 of these responses), the Tribes would fund annual operations of the Bison Range – the federal government would no longer fund them. The Tribal Council is committed to funding the Bison Range at a degree that will maintain or exceed its current level of operation. Some portions of Bison Range operations may be able to be performed or addressed through existing staff in the Tribes' Natural Resources, Lands, or Maintenance departments. The Tribes would likely assess the current bookstore concession at the Bison Range visitor center to evaluate for expanded opportunities related to visitor needs and expectations, which could also assist with meeting annual funding needs.

Maintaining or increasing the current level of visitation would be one part of the budget planning process, and would dovetail with planning for public education opportunities, which are a priority for the Tribes. As stated above, maintaining reasonable entry fees would be essential to supporting the Tribes' interests in public education and visitor experiences at the Bison Range, whereas exorbitant fees would undermine those priorities.

6) **Past compensation**

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Response: Although hunting is allowed on some National Wildlife Refuges, public hunting is not currently allowed on the National Bison Range, although there are periodic "management hunts" used for population control of certain animals. The Tribes do not envision changes to this.

16) **Ninepipe and Pablo Refuges**

Comment: One commenter asked who would manage the Ninepipe and Pablo National Wildlife Refuges.

Response: The Ninepipe and Pablo Refuges are both located on land held in trust by the federal government for the Confederated Salish and Kootenai Tribes, and are both currently administered by FWS as part of the National Bison Range Complex. The Act would not affect management of either the Ninepipe or Pablo Refuges. FWS would continue to manage both, although they would likely be administered out of another refuge, such as Lost Trail or Benton Lake Refuges. Changing administrative headquarters for a refuge is not a new concept. The Lost Trail National Wildlife Refuge has been removed and added to the National Bison Range Complex in the past.

The Ninepipe and Pablo Refuges were both originally established as refuges after years of Tribal requests for the federal government to designate them as bird conservation areas. In 1921, the federal government finally agreed and President Warren Harding issued Executive Orders designating both Ninepipe and Pablo as refuges. In 1948,

Congress approved the purchase by the federal government from the Tribes of perpetual easements for use of Ninepipe and Pablo for refuge purposes.

17) **Cooperative opportunities**

Comment: One commenter saw opportunity in the draft legislation for Tribal cooperation with state & federal programs such as Montana Conservation Corps (MCC).

Response: The Tribes appreciate this suggestion and note that nothing in the draft legislation would preclude or hinder such cooperation. The Tribes have a long and extensive history of cooperating with other governments and entities in the pursuit of conservation management, including at the National Bison Range.

18) **Shared management track record**

Comment: One commenter asserted that past shared management at the National Bison Range had "failed".

Response: The last Tribal Self-Governance agreement at the National Bison Range was very successful. Both the Tribes and the U.S. Fish & Wildlife Service were pleased with the constructive relationship that they jointly built at the Bison Range under their 2008-2010 partnership. However, unlike past Tribal Self-Governance agreements, under the Act the Tribes would be the sole manager of the Range – there would not be shared management between Tribal and federal governments. This would not, however, preclude continued cooperation between the two governments.

19) **Tribal preference in hiring**

Comment: One commenter expressed concern about the Tribes' "preferential hiring practices".

Response: Under Tribal law, the Tribes have adopted hiring preferences for Tribal members and other members of federally-recognized Indian tribes. This is consistent with federal law. However, the Tribes also hire many non-Indian and non-Tribal member employees. Under the Tribes' last partnership agreement at the National Bison Range, the Tribes hired and employed some non-Indian staff, including the manager of the Tribes' Bison Range staff.

20) **Separate bison herd**

Comment: One commenter suggested that the Tribes start a bison herd of their own, on Tribal land, while leaving the National Bison Range a National Wildlife Refuge.

Response: Starting its own herd elsewhere on the Reservation would not reunite the Tribes with either the land that had been taken from its Reservation or the bison herd which Tribal members had helped make possible. Nor would this approach of separate herds address the issue of how the Tribes could partner with the U.S. Fish & Wildlife Service at the National Bison Range. This partnership question has consumed a great deal of Tribal and federal resources over the last 22 years, since the passage of the Tribal

Self-Governance Act. The Act would resolve that question by restoring the Bison Range to federal trust ownership for the Tribes.

21) **Revising financial assistance to Counties**

Comment: One commenter suggested that the Tribes' draft legislation could either lengthen the time period for phasing out the Refuge Revenue Sharing payments to Sanders and Lake Counties, or increase the amount of such payments to those Counties.

Response: The Tribes appreciate this suggestion, and share the concern of easing any transition in the Counties' budgets. The Tribes have considered alternatives to the provisions in Section 4(f) of the draft Act, and have discussed alternatives with both Sanders and Lake Counties. Those discussions may result in changes to this part of the draft legislation.

22) **U.S. Fish & Wildlife Service motives**

Comment: One commenter questioned the motives of the U.S. Fish & Wildlife Service in supporting the proposed Bison Range restoration, and asserted disbelief that the FWS support arose from either concern for tribal self-governance or conserving limited federal resources.

Response: The Tribes cannot speculate as to the reasoning behind FWS support for the Tribes' proposed legislation. However, FWS Director Dan Ashe has stated in correspondence that

> [t]he plain fact is, the Salish-Kootenai are very capable managers. They can manage [the National Bison Range] and this herd. They very much want to do this. The land will be held in trust, by the BIA, on behalf of the CSKT, for the original purposes, so it will be protected, in perpetuity.
>
> . . . There is only one reason that I am supporting this: It is the right thing to do! And sometimes, doing the right thing is scary. But as Martin Luther King taught us, "It is never the wrong time to do the right thing."

Director Ashe's statement above finds support in the recently-revised FWS Native American Policy, which talks about furthering "the United States' and the Department of the Interior's trust responsibility to federally recognized tribes to protect, conserve, and use tribal reserved, treaty guaranteed, or statutorily identified resources."

23) **Bison Range Working Group**

Comment: One commenter asked which parties constituted the Bison Range Working Group.

Response: The Working Group currently consists informally of the comments submitted on the Working Group website established by the Tribes. The Tribes have met with conservation group representatives to discuss our draft legislation, and the Tribes expect to continue this discussion now that public comments have been received and posted.

The Tribes have also met with the Lake and Sanders County Commissions, and expect to continue that dialogue as well. Depending on future discussions/participation, the Working Group may become a more formalized body.

24) **Herd Capacity**

Comment: Some commenters asked about bison population management and culled bison.

Response: Surplus wildlife and removal of bison or other wildlife are addressed in the National Bison Range's existing management plan. Bison would continue to be culled as necessary to maintain the genetic diversity of the herd and the carrying capacity of the range. The Tribes would manage the culled bison via auction, similar to the current program. The Tribes are always open to suggestions and idea regarding disposition of culled bison and may consider other options in the future.

From:	Stephen Torbit
To:	Lee Jones
Subject:	FW: Bison Range comments
Date:	Thursday, July 28, 2016 9:20:29 AM
Attachments:	Untitled attachment 00088.htm Public-Comment-Responses-July-2016.pdf

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FYI, I have not even looked at these yet.

Stephen Torbit Ph.D.
ARD - Science Applications
Region 6
Fish and Wildlife Service
Office: 303-236-4602
Cell: 720-626-7504
stephen_torbit@fws.gov

From: Will Meeks [mailto:will_meeks@fws.gov]
Sent: Wednesday, July 27, 2016 1:17 PM
To: Noreen Walsh
Cc: Matt Hogan; nanette_seto@fws.gov; Anna Munoz; stephen_torbit@fws.gov
Subject: Fwd: Bison Range comments

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Will Meeks
U.S. Fish and Wildlife Service
Mountain-Prairie Region
Assistant Regional Director
National Wildlife Refuge System
303-236-4303 (w)
720-541-0310 (c)

Begin forwarded message:

> **From:** "Hogan, Kelly" <kelly_hogan@fws.gov>
> **To:** Will Meeks <will_meeks@fws.gov>, Maureen Gallagher <maureen_gallagher@fws.gov>, Mike Blenden <mike_blenden@fws.gov>
> **Subject: Bison Range comments**
>
> Just FYI if you haven't seen the CSKT's response to comments.
> K

Responses of the Confederated Salish and Kootenai Tribes to Public Comments on the Tribes' Draft "National Bison Range Transfer and Restoration Act of 2016"

The Confederated Salish and Kootenai Tribes have collected over 150 comments on the Tribes' draft "National Bison Range Transfer and Restoration Act of 2016". These comments were solicited through the Bison Range Working Group website, which was established by the Tribes to notify the public of the draft legislation and to collect public comments, as well as through a public meeting held in Pablo, Montana on July 12, 2016. The comment period opened on June 10, 2016, was extended beyond its original closing date of June 24th, and closed on July 15, 2016.

The total number of comments received during that period was 153. Several individuals submitted more than one comment; the number of unique individuals/organizations that submitted comments is 145. Of those, approximately 76 commenters supported the Tribes' draft legislation, approximately 55 commenters opposed it, and 14 commenters presented questions or concerns without supporting or opposing the proposed legislation.

All of these comments have been posted on the Bison Range Working Group website (www.bisonrangeworkinggroup.org). To respect commenters' privacy, their email addresses, physical addresses (other than city/state), and phone numbers have been redacted from the comments prior to posting.

Below are a number of comments, concerns and questions that were raised in the public comments, along with responses from the Tribes. In the responses, the Confederated Salish and Kootenai Tribes are referred to as "Tribes", the draft National Bison Range Transfer and Restoration Act of 2016 is referred to as the "Act", the National Bison Range is referred to as "Bison Range", the Flathead Indian Reservation is referred to as "Reservation", and the U.S. Fish & Wildlife Service is referred to as "FWS" or the "Service".

1) **Precedent**

Comment: Some commenters expressed concern that passage of the Act would set a precedent for conveyance of other federal lands or facilities. One commenter asserted that "[g]iving ownership of the NBR to the CSK Tribe would by definition set a precedent of giving a federal wildlife refuge to a non-governmental entity." Other commenters pointed out that the Bison Range "is a completely unique situation and should not in any way be construed as a precedent regarding other federal properties."

Response: The Act directly addresses the issue of precedent. As a matter of law, Section 4(i) of the Act would prohibit the interpretation of the Act as a precedent. This section reads as follows:

> The provisions of this Act are uniquely suited to address the distinct circumstances, facts, history, and relationships involved with the subject bison, lands and Tribes. These provisions are not intended, and shall not be interpreted, as precedent for any other situation regarding federal properties or facilities.

As a practical matter, the facts surrounding the history of the National Bison Range do not lend themselves to creating a precedent for other situations. Unlike most federal properties, the Range is located in the center of an Indian Reservation that was reserved by Treaty, on lands which the Tribes never consented to convey. Underscoring this uniqueness is the fact that the lands were the subject of a federal judicial decision holding that the lands had been unconstitutionally taken within the meaning of the Fifth Amendment of the U.S. Constitution (see *Confederated Salish and Kootenai Tribes of the Flathead Reservation, Montana v. United States*, 437 F.2d 458, 485 (1971)). The history of how Tribal members had initially brought the ancestors of the Range's bison herd to the Flathead Indian Reservation makes the Bison Range situation even more unique and unlike that of any other federal property or facility. Further distinguishing this situation are the Tribes' two prior Tribal Self-Governance agreements, under which they had assisted with National Bison Range operations in 2005-06 and 2008-2010.

While one commenter expressed concern that the Act would create a precedent for "giving" a federal wildlife refuge to a "non-governmental entity", the Confederated Salish and Kootenai Tribes are a federally-recognized tribal government and so the Act could create no precedent for a transfer to a non-governmental entity.

2) **Access**

Comment: Several commenters asked about public access. One commenter asked whether the Tribes might impede access through "exorbitant entry fees". Another commenter asked whether fishing access would continue. At least one individual asked whether a person would be required to have a Tribal recreation permit in order to access the Bison Range.

Response: The Tribes have always agreed that public access must be required under the draft legislation, and this has been a key factor in FWS' support for the Bison Range restoration concept. Continued public access would be required by Section 4(d) of the Act. Fishing access would also continue under the Tribes' management. As a practical matter, the Tribes already provide public access to most Tribal lands on the Flathead Indian Reservation, so continued access at the National Bison Range would be consistent with the Tribes' current and past practices. This existing public access to Tribal lands includes fishing access. Public access at the Bison Range would continue to be guided by conservation and public safety considerations.

Maintaining reasonable entry fees would support the Tribes' interests in public education and visitor experiences at the Bison Range, whereas exorbitant fees would undermine those priorities.

The Bison Range would continue to be subject to its own fee structure. Access would therefore not depend on whether a person had a Tribal recreation permit.

3) **Additional access points**

Comment: Some commenters inquired about additional access points to the National Bison Range, and several individuals suggested an entrance off Highway 93 and/or at the top of Ravalli Hill.

Response: The Tribes do not currently have plans for new points of access to the National Bison Range. However, the Tribes may consider such access points if there was reason to believe that they would improve the visitor experience while still protecting the Range's natural resources.

The Tribes have developed, and currently maintain, the existing Ravalli Hill scenic turnout interpretive area on Highway 93, on Tribally-owned land adjacent to the Bison Range. The public generally considers, and uses, this site as a public access Bison Range viewing area. The U.S. Fish & Wildlife Service considers the public access viewing from this site when it estimates annual overall public uses and visitation of the National Bison Range. Use of this Tribally-owned and managed site will not change in the future, but may be considered for expanded visitor experiences and interpretation.

4) **Interpretive opportunity**

Comment: Some commenters said that the proposed Bison Range restoration would allow for improved interpretive opportunities through greater incorporation of the Tribes' cultural and historical ties to the land, bison, and other natural resources found at the Range.

Response: The Tribes agree that the proposed Bison Range restoration would greatly expand the Tribes' ability to incorporate aspects of Tribal historical and cultural connections to the Range's land, bison and other natural resources. Based upon comments, as well as past feedback from the public, the Tribes believe that many people would welcome such interpretive additions.

5) **Funding**

Comment: Several commenters asked how the Tribes would fund operation of the Bison Range, and a couple of commenters questioned whether the Tribes may charge higher admittance fees.

Response: Under the Act, after the two-year transition period provided for in Section 4(e) of the Act (and addressed in item #7 of these responses), the Tribes would fund annual operations of the Bison Range – the federal government would no longer fund them. The Tribal Council is committed to funding the Bison Range at a degree that will maintain or exceed its current level of operation. Some portions of Bison Range operations may be able to be performed or addressed through existing staff in the Tribes' Natural Resources, Lands, or Maintenance departments. The Tribes would likely assess the current bookstore concession at the Bison Range visitor center to evaluate for expanded opportunities related to visitor needs and expectations, which could also assist with meeting annual funding needs.

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Comment: One commenter asked whether hunting would be allowed on the Bison Range.

Response: Although hunting is allowed on some National Wildlife Refuges, public hunting is not currently allowed on the National Bison Range, although there are periodic "management hunts" used for population control of certain animals. The Tribes do not envision changes to this.

16) **Ninepipe and Pablo Refuges**

Comment: One commenter asked who would manage the Ninepipe and Pablo National Wildlife Refuges.

Response: The Ninepipe and Pablo Refuges are both located on land held in trust by the federal government for the Confederated Salish and Kootenai Tribes, and are both currently administered by FWS as part of the National Bison Range Complex. The Act would not affect management of either the Ninepipe or Pablo Refuges. FWS would continue to manage both, although they would likely be administered out of another refuge, such as Lost Trail or Benton Lake Refuges. Changing administrative headquarters for a refuge is not a new concept. The Lost Trail National Wildlife Refuge has been removed and added to the National Bison Range Complex in the past.

The Ninepipe and Pablo Refuges were both originally established as refuges after years of Tribal requests for the federal government to designate them as bird conservation areas. In 1921, the federal government finally agreed and President Warren Harding issued Executive Orders designating both Ninepipe and Pablo as refuges. In 1948,

Congress approved the purchase by the federal government from the Tribes of perpetual easements for use of Ninepipe and Pablo for refuge purposes.

17) **Cooperative opportunities**

Comment: One commenter saw opportunity in the draft legislation for Tribal cooperation with state & federal programs such as Montana Conservation Corps (MCC).

Response: The Tribes appreciate this suggestion and note that nothing in the draft legislation would preclude or hinder such cooperation. The Tribes have a long and extensive history of cooperating with other governments and entities in the pursuit of conservation management, including at the National Bison Range.

18) **Shared management track record**

Comment: One commenter asserted that past shared management at the National Bison Range had "failed".

Response: The last Tribal Self-Governance agreement at the National Bison Range was very successful. Both the Tribes and the U.S. Fish & Wildlife Service were pleased with the constructive relationship that they jointly built at the Bison Range under their 2008-2010 partnership. However, unlike past Tribal Self-Governance agreements, under the Act the Tribes would be the sole manager of the Range – there would not be shared management between Tribal and federal governments. This would not, however, preclude continued cooperation between the two governments.

19) **Tribal preference in hiring**

Comment: One commenter expressed concern about the Tribes' "preferential hiring practices".

Response: Under Tribal law, the Tribes have adopted hiring preferences for Tribal members and other members of federally-recognized Indian tribes. This is consistent with federal law. However, the Tribes also hire many non-Indian and non-Tribal member employees. Under the Tribes' last partnership agreement at the National Bison Range, the Tribes hired and employed some non-Indian staff, including the manager of the Tribes' Bison Range staff.

20) **Separate bison herd**

Comment: One commenter suggested that the Tribes start a bison herd of their own, on Tribal land, while leaving the National Bison Range a National Wildlife Refuge.

Response: Starting its own herd elsewhere on the Reservation would not reunite the Tribes with either the land that had been taken from its Reservation or the bison herd which Tribal members had helped make possible. Nor would this approach of separate herds address the issue of how the Tribes could partner with the U.S. Fish & Wildlife Service at the National Bison Range. This partnership question has consumed a great deal of Tribal and federal resources over the last 22 years, since the passage of the Tribal

Self-Governance Act. The Act would resolve that question by restoring the Bison Range to federal trust ownership for the Tribes.

21) **Revising financial assistance to Counties**

Comment: One commenter suggested that the Tribes' draft legislation could either lengthen the time period for phasing out the Refuge Revenue Sharing payments to Sanders and Lake Counties, or increase the amount of such payments to those Counties.

Response: The Tribes appreciate this suggestion, and share the concern of easing any transition in the Counties' budgets. The Tribes have considered alternatives to the provisions in Section 4(f) of the draft Act, and have discussed alternatives with both Sanders and Lake Counties. Those discussions may result in changes to this part of the draft legislation.

22) **U.S. Fish & Wildlife Service motives**

Comment: One commenter questioned the motives of the U.S. Fish & Wildlife Service in supporting the proposed Bison Range restoration, and asserted disbelief that the FWS support arose from either concern for tribal self-governance or conserving limited federal resources.

Response: The Tribes cannot speculate as to the reasoning behind FWS support for the Tribes' proposed legislation. However, FWS Director Dan Ashe has stated in correspondence that

> [t]he plain fact is, the Salish-Kootenai are very capable managers. They can manage [the National Bison Range] and this herd. They very much want to do this. The land will be held in trust, by the BIA, on behalf of the CSKT, for the original purposes, so it will be protected, in perpetuity.
>
> . . . There is only one reason that I am supporting this: It is the right thing to do! And sometimes, doing the right thing is scary. But as Martin Luther King taught us, "It is never the wrong time to do the right thing."

Director Ashe's statement above finds support in the recently-revised FWS Native American Policy, which talks about furthering "the United States' and the Department of the Interior's trust responsibility to federally recognized tribes to protect, conserve, and use tribal reserved, treaty guaranteed, or statutorily identified resources."

23) **Bison Range Working Group**

Comment: One commenter asked which parties constituted the Bison Range Working Group.

Response: The Working Group currently consists informally of the comments submitted on the Working Group website established by the Tribes. The Tribes have met with conservation group representatives to discuss our draft legislation, and the Tribes expect to continue this discussion now that public comments have been received and posted.

The Tribes have also met with the Lake and Sanders County Commissions, and expect to continue that dialogue as well. Depending on future discussions/participation, the Working Group may become a more formalized body.

24) **Herd Capacity**

Comment: Some commenters asked about bison population management and culled bison.

Response: Surplus wildlife and removal of bison or other wildlife are addressed in the National Bison Range's existing management plan. Bison would continue to be culled as necessary to maintain the genetic diversity of the herd and the carrying capacity of the range. The Tribes would manage the culled bison via auction, similar to the current program. The Tribes are always open to suggestions and idea regarding disposition of culled bison and may consider other options in the future.

Conversation Contents

Discussion with the CSKT about the National Bison Range

Noreen Walsh <noreen_walsh@fws.gov>

From:	Noreen Walsh <noreen_walsh@fws.gov>
Sent:	Fri Feb 05 2016 16:12:44 GMT-0700 (MST)
To:	FW6 All Employees <fw6_all_employees@fws.gov>
Subject:	Discussion with the CSKT about the National Bison Range

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Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

Serena Baker <serena_baker@fws.gov>

From:	Serena Baker <serena_baker@fws.gov>
Sent:	Fri Feb 05 2016 16:20:49 GMT-0700 (MST)
To:	Noreen Walsh <noreen_walsh@fws.gov>, Will Meeks <will_meeks@fws.gov>, Mike Blenden <mike_blenden@fws.gov>
Subject:	FW: Discussion with the CSKT about the National Bison Range

Hello Noreen, Will, and Mike,

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which we may not yet have answers, and that can stir emotions even higher. What I do know about each of you, is that you will do what you absolutely believe is the right thing for everyone involved, and that the Refuge, employees, and resources involved are in the very best of hands.

Hang in there! We're behind you 100%!

Serena Baker

From: Noreen Walsh [mailto:noreen_walsh@fws.gov]
Sent: Friday, February 05, 2016 4:13 PM
To: FW6 All Employees
Subject: Discussion with the CSKT about the National Bison Range

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Noreen Walsh

Regional Director

Mountain-Prairie Region

U. S. Fish and Wildlife Service

Mike Blenden <mike_blenden@fws.gov>

From:	Mike Blenden <mike_blenden@fws.gov>
Sent:	Fri Feb 05 2016 17:34:49 GMT-0700 (MST)
To:	Serena Baker <serena_baker@fws.gov>
Subject:	Re: Discussion with the CSKT about the National Bison Range

Thank you Serena! Very kind and thoughtful. Will and Noreen made me proud. The staff

took it well and as expected but it was a hard day.

Sent from my iPhone

On Feb 5, 2016, at 4:20 PM, Serena Baker <serena_baker@fws.gov> wrote:

> Hello Noreen, Will, and Mike,
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Noreen Walsh

Regional Director

Mountain-Prairie Region

U. S. Fish and Wildlife Service

"Shinn, Kevin" <kevin_shinn@fws.gov>

From:	"Shinn, Kevin" <kevin_shinn@fws.gov>
Sent:	Sat Feb 06 2016 14:08:47 GMT-0700 (MST)
To:	Mike Blenden <mike_blenden@fws.gov>
Subject:	Fwd: Discussion with the CSKT about the National Bison Range

Mike,

So what is going to happen to Lost Trail and the WMD in all this? Can you give me some insight so I can fill Beverly and Bob in.

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Kevin J. Shinn

Manager/Federal Wildlife Officer
Lost Trail NWR/NW Montana WMD
406-858-2216 Office
406-260-5192 cell

Mike Blenden <mike_blenden@fws.gov>

From:	Mike Blenden <mike_blenden@fws.gov>
Sent:	Sat Feb 06 2016 15:23:45 GMT-0700 (MST)
To:	"Shinn, Kevin" <kevin_shinn@fws.gov>
Subject:	Re: Discussion with the CSKT about the National Bison Range

Kevin,

The discussion with CSKT only involves the National Bison Range. It does not even include Nipepipes or Pablo. Lost Trail and the WMD are not directly effected. But the National Bison Range Complex will definitely be changed with successful legislation. We will be working with Jeff and the entire NBR staff to develop a transition plan. My initial thought is that Lost Trail/WMD may be part of a different complex that may include easements and other refuge lands to the south or even broader. This is pretty much brainstorming on my part without talking to anyone, but we have time to consider all options.

Please understand this is substantial proposal that has to go through the legislative process. Even if legislation proceeded relatively quickly (no guarantee of that) we still need to allow an orderly transition.

I would go in to more detail but details are limited at this early stage of the proposal.

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Thanks for asking.

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Sent from my iPad

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Kevin J. Shinn
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406-858-2216 Office
406-260-5192 cell

Mike Blenden <mike_blenden@fws.gov>

From:	Mike Blenden <mike_blenden@fws.gov>
Sent:	Sat Feb 06 2016 15:24:20 GMT-0700 (MST)
To:	Jeff King <jeff_king@fws.gov>
	Fwd: Discussion with the CSKT about the National Bison

Subject: Range

FYI - Mike

Sent from my iPad

Begin forwarded message:

> **From:** Mike Blenden <mike_blenden@fws.gov>
> **Date:** February 6, 2016 at 3:23:45 PM MST
> **To:** "Shinn, Kevin" <kevin_shinn@fws.gov>
> **Subject: Re: Discussion with the CSKT about the National Bison Range**
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To:	Mike Blenden <mike_blenden@fws.gov>
CC:	Kevin Shinn <Kevin_Shinn@fws.gov>
Subject:	Re: Discussion with the CSKT about the National Bison Range

Mike. Please call me about this email string.

Thanks

jk

Sent from my iPhone

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> Begin forwarded message:
>
> **From:** Mike Blenden <mike_blenden@fws.gov>
> **Date:** February 6, 2016 at 3:23:45 PM MST
> **To:** "Shinn, Kevin" <kevin_shinn@fws.gov>
> **Subject: Re: Discussion with the CSKT about the National Bison Range**
>
> Kevin,
>
> The discussion with CSKT only involves the National Bison Range. It does not even include Nipepipes or Pablo. Lost Trail and the WMD are not directly effected. But the National Bison Range Complex will definitely be changed with successful legislation. We will be working with Jeff and the entire NBR staff to develop a transition plan. My initial thought is that Lost Trail/WMD may be part of a different complex that may include easements and other refuge lands to the south or even broader. This is pretty much brainstorming on my part without talking to anyone, but we have time to consider all options.
>
> Please understand this is substantial proposal that has to go through the legislative process. Even if legislation proceeded

relatively quickly (no guarantee of that) we still need to allow an orderly transition.

I would go in to more detail but details are limited at this early stage of the proposal.

Please give me your thoughts and concerns as well as Bob's and Bev's. You and all of your staff are encouraged to call me and, of course, Jeff.

Thanks for asking.

Mike

Sent from my iPad

On Feb 6, 2016, at 2:08 PM, Shinn, Kevin <kevin_shinn@fws.gov> wrote:

> Mike,
>
> So what is going to happen to Lost Trail and the WMD in all this? Can you give me some insight so I can fill Beverly and Bob in.
>
> Thanks
>
> ---------- Forwarded message ----------
> From: **Noreen Walsh** <noreen_walsh@fws.gov>
> Date: Fri, Feb 5, 2016 at 4:12 PM
> Subject: Discussion with the CSKT about the National Bison Range
> To: FW6 All Employees <fw6_all_employees@fws.gov>
>
> Dear Mountain-Prairie Region,
>
> I want to inform you of a discussion the Service started today with the Confederated Salish and Kootenai Tribes (CSKT) regarding the National Bison Range. Many of you know that we have been working with the CSKT for about 20 years on the idea of a partnership at the National Bison Range that would be outlined in an Annual Funding Agreement which would allow them to manage and implement some of the activities on the

refuge. This process has required much time and effort on the part of many, and despite valiant efforts all around, the parties have been unable to come to terms on a mutually-acceptable agreement.

In an effort to achieve the best, long-term solution for our many conservation priorities, the specific conservation goals of the National Bison Range, and to support the principles of Indian self-determination there was a discussion today with the CSKT about the potential for the Service to support legislation that would transfer the lands comprising the National Bison Range to be held in trust by the United States for the CSKT.

I wanted you all to know why we entered into these discussions. The National Bison Range was established in 1908 within the boundaries of the Flathead Reservation, home of the CSKT, for the express purpose of conserving the American bison during a time when the species was on the verge of extinction. Since then, the Service as well as our federal, state, and tribal partners have made great strides in conserving bison and re-establishing herds throughout their historic range. Also, while we have desired a meaningful partnership with CSKT at the National Bison Range, a mutually-acceptable agreement has been elusive. Given that we are today in a much better place regarding the future of bison, that we have much work to do on landscape-scale conservation efforts, and that we want to strengthen our partnership with the CSKT, we believe that now is the right time to investigate the possibility of transferring the refuge, which was long ago carved out of tribal lands, into trust for the benefit of the CSKT.

Such a proposal would require Congressional approval and therefore, at this point, we don't know if or when such a transfer would occur. Today was our first discussion with the CSKT about the idea. As we go forward, my pledge is to ensure that wherever the discussion leads us, the talented and committed staff of the National Bison Range are taken care of. To this end, Will Meeks, Mike Blenden, and I spent the afternoon at the Refuge where we talked about the

ideas under discussion. In our conversations, I emphasized that they will all remain valued employees of the Service, regardless of the outcome of these discussions.

I know that many of you will have thoughts and questions about this idea. This was not an easy decision to come by, nor one that was taken lightly, but in the end, I believe that this is a good path for the Service, the CSKT, and for the conservation of our fish and wildlife resources.

As always, I value your feedback and questions.

Noreen

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

--
Kevin J. Shinn
Manager/Federal Wildlife Officer
Lost Trail NWR/NW Montana WMD
406-858-2216 Office
406-260-5192 cell

"Blenden, Mike" <mike_blenden@fws.gov>

From:	"Blenden, Mike" <mike_blenden@fws.gov>
Sent:	Wed Aug 24 2016 15:43:14 GMT-0600 (MDT)
To:	Barney Email b(6)
Subject:	Fwd: Discussion with the CSKT about the National Bison Range

---------- Forwarded message ----------
From: **Noreen Walsh** <noreen_walsh@fws.gov>

Date: Fri, Feb 5, 2016 at 4:12 PM
Subject: Discussion with the CSKT about the National Bison Range
To: FW6 All Employees <fw6_all_employees@fws.gov>

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As always, I value your feedback and questions.

Noreen

Noreen Walsh
Regional Director
Mountain-Prairie Region
U. S. Fish and Wildlife Service

--
Michael Blenden
Refuge Supervisor - Montana, Wyoming and Utah
134 Union Boulevard
Lakewood, CO 80228
303-236-4306
303-710-7934 cell

Too often we...enjoy the comfort of opinion without the discomfort of thought.
John F. Kennedy

From: Caramanian, Lori
To: Will Meeks
Cc: Munoz, Anna; Reed, Megan; Cynthia Martinez; Stephen Torbit; Dana Jacobsen
Subject: Re: National Bison Range Team Call
Date: Monday, June 27, 2016 9:54:28 AM

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b(5) Attorney-client

On Mon, Jun 27, 2016 at 9:22 AM, Will Meeks <will_meeks@fws.gov> wrote:

> b(5) Attorney-client
>
> Will Meeks
> U.S. Fish and Wildlife Service
> Mountain-Prairie Region
> Assistant Regional Director
> National Wildlife Refuge System
> 303-236-4303(w)
> 720-541-0310 (c)
>
> On Jun 27, 2016, at 9:21 AM, Munoz, Anna <anna_munoz@fws.gov> wrote:
>
> > b(5) Attorney-client
> >
> > Anna
> >
> > Anna Muñoz
> > Assistant Regional Director - External Affairs
> > U.S. Fish and Wildlife Service, Mountain-Prairie Region
> > Office: 303-236-4510
> > Cell: 720-648-2542
> >
> > On Mon, Jun 27, 2016 at 8:48 AM, Caramanian, Lori
> > <lori.caramanian@sol.doi.gov> wrote:
> >
> > > b(5) Attorney-client
> > >
> > > On Mon, Jun 27, 2016 at 7:21 AM, Will Meeks <will_meeks@fws.gov>
> > > wrote:
> > >
> > > > b(5) Attorney-client
> > > >
> > > > Will Meeks
> > > > U.S. Fish and Wildlife Service
> > > > Mountain-Prairie Region
> > > > Assistant Regional Director
> > > > National Wildlife Refuge System
> > > > 303-236-4303(w)
> > > > 720-541-0310 (c)
> > > >
> > > > On Jun 27, 2016, at 6:09 AM, Reed, Megan <megan_reed@fws.gov>

wrote:

> Good Morning,
>
> b(5) Attorney-client
>
> Megan
>
> On Mon, Jun 27, 2016 at 6:59 AM, Reed, Megan <megan_reed@fws.gov> wrote:
>> Good Morning Anna,
>>
>> b(5) Attorney-client
>>
>> Megan
>>
>> On Fri, Jun 24, 2016 at 11:34 AM, Munoz, Anna <anna_munoz@fws.gov> wrote:
>>> b(5) Attorney-client
>>>
>>> Anna
>>>
>>> Anna Muñoz
>>> Assistant Regional Director - External Affairs
>>> U.S. Fish and Wildlife Service, Mountain-Prairie Region
>>> Office: 303-236-4510
>>> Cell: 720-648-2542
>>>
>>> On Fri, Jun 24, 2016 at 9:12 AM, Caramanian, Lori <lori.caramanian@sol.doi.gov> wrote:
>>>> b(5) Attorney-client
>>>>
>>>> On Wed, Jun 22, 2016 at 1:51 PM, Munoz, Anna <anna_munoz@fws.gov> wrote:
>>>>> Hi Lori,
>>>>>
>>>>> b(5) Attorney-client

Thanks,
Anna

Anna Muñoz
Assistant Regional Director - External Affairs
U.S. Fish and Wildlife Service, Mountain-Prairie Region
Office: 303-236-4510
Cell: 720-648-2542

On Wed, Jun 22, 2016 at 1:44 PM, Caramanian, Lori <lori.caramanian@sol.doi.gov> wrote:

> Good afternoon--
>
> b(5) Attorney-client [redacted]
>
> Thanks, Lori
>
> ---------- Forwarded message ----------
> From: **Nesbitt, Tanya (ENRD)** <Tanya.Nesbitt2@usdoj.gov>
> Date: Wed, Jun 22, 2016 at 10:42 AM
> Subject: FW: National Bison Range Team Call
> To: "Caramanian, Lori" <lori.caramanian@sol.doi.gov>
>
> ATTORNEY-CLIENT PRIVILEGED COMMUNICATION/ATTORNEY WORK PRODUCT
>
> Hi Lori,
>
> b(5) Attorney-client [redacted]

b(5) Attorney-client
[redacted]

[redacted]

Thanks.

From: Brian Upton [mailto:brianu@cskt.org]
Sent: Wednesday, June 22, 2016 12:28 PM
To: Nesbitt, Tanya (ENRD) <TNesbitt@ENRD.USDOJ.GOV>
Subject: FW: National Bison Range Team Call

Tanya,

Below is the invitation I'd mentioned to you. I'll just hold off on responding altogether until I hear back from you.

Thanks,
BU

From: Reed, Megan [mailto:megan_reed@fws.gov]
Sent: Tuesday, June 21, 2016 11:41 AM
To: Cynthia Martinez; Shaun Sanchez; Anna Munoz; Michael Black; Scott Aikin; Will Meeks; Ira New Breast; Helen Riggs; brianu@cskt.org; Stephen Torbit
Cc: Charisa Morris
Subject: National Bison Range Team Call

Good Afternoon,

I am writing on behalf of Cynthia Martinez, Chief, National Wildlife Refuge System, to schedule a National Bison Range Team Call. Here is a Doodle poll for you to please fill out with

your availability:

http://doodle.com/poll/ezmicv5qu4mz83pu

When selecting times available, please be sure the correct time zone is listed for you in the top right corner.

Have a great day!

Megan

--

Megan Davis Reed || *Special Assistant*

External Affairs & National Wildlife Refuge System

U.S. Fish and Wildlife Service

1849 C Street NW, Room 3351

Washington, DC 20240

Office: 202-219-3898

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Lori Caramanian
U.S. Department of the Interior
Office of the Solicitor, Rocky Mountain Region
755 Parfet St, Suite 151
Lakewood, CO 80215
303-445-0604

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U.S. Department of the Interior

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Megan Davis Reed || *Special Assistant*
External Affairs & National Wildlife Refuge System
U.S. Fish and Wildlife Service
1849 C Street NW, Room 3351
Washington, DC 20240
Office: 202-219-3898

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