National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Department of the Interior:

History and Status of Bison Health

Natural Resource Report NPS/NRSS/BRD/NRR—2020/2201



ON THE COVER
Bison at the Wichita Mountains National Wildlife Refuge
Photograph by: S. Johnson, U.S. Fish and Wildlife Service

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August 2020

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Jones, L. C., J. G. Powers, and S. J. Sweeney. 2020. Department of the Interior: History and status of bison health. Natural Resource Report NPS/NRSS/BRD/NRR—2020/2201. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/nrr-2280100.

NPS 999/173875, December 2020

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Executive Summary

The North American plains bison once numbered in the tens of millions, but only around 1,000 individuals remained by the late 1800s. Through the actions of private individuals and organizations, the establishment of a few protected, federally managed, herds saved the subspecies from extinction and today the Department of the Interior (DOI) supports approximately 11,000 plains bison in 19 herds across 12 states.

DOI chartered the Bison Conservation Initiative in 2008, which established a framework for bison conservation and restoration on appropriate lands within the species' historical range. With the recent announcement of the 2020 DOI Bison Conservation Initiative, DOI outlined a diverse range of accomplishments made under the 2008 Initiative and reaffirmed the commitment to work with partners in support of managing bison as native wildlife.

Both the 2008 and 2020 DOI Bison Conservation Initiatives endorse a holistic approach, addressing health and genetic considerations, and recommend managing DOI bison herds together as a metapopulation to conserve genetic diversity by restoring gene flow. Bison conservation and restoration efforts must consider the significance of disease in bison herds and apply a multi-jurisdictional, multi-stakeholder approach to the management of bison on large landscapes. Robust herd health surveillance programs, both in the donor and recipient herds, along with strong partnerships and communication, are needed to protect the century-long success of DOI bison conservation and stewardship. This report discusses overarching principles affecting bison health decisions in DOI herds and provides detailed baseline herd health history and management, providing a foundation upon which the 2020 Bison Conservation Initiative vision for DOI bison stewardship can be realized.

Acknowledgements

The authors would like to acknowledge the contributions of Tom Roffe, Margaret Wild, and Kim Trust in earlier efforts to describe the status of bison health management in the Department of the Interior. Additionally, this report would not be possible without the timely engagement and on-going dedication of bison managers across the Department of the Interior who work daily to ensure that wild bison are conserved for the enjoyment of future generations.

Introduction

Since the late 19th century, the Department of the Interior (DOI), in cooperation with key private organizations and state partners, has served as the primary national conservation steward of North American plains bison (Bison bison bison). Once estimated in the tens of millions (Shaw 1995), by the end of the 1800s bison were pushed to the edge of extinction primarily from overhunting. In addition, habitat loss and possibly introduction of novel diseases have posed threats to bison survival (Flores 1991). Through the efforts of private individuals and organizations, several small herds dedicated to species recovery were established (Dary 1989, Coder 1975, Dratch and Gogan 2010). Over the course of the 20th century, the DOI's bison conservation efforts focused on stabilizing the population and protecting its remaining genetic diversity. The DOI 2014 "Bison Report - Looking Forward" (Department of the Interior 2014) details the conservation status, opportunities and limitations for the approximately 11,000 plains bison managed by DOI in 19 populations across 12 states (Table 1).

While the species is no longer threatened by demographic extinction, most DOI bison continue to exist in relatively small, isolated herds that are vulnerable to the effects of inbreeding depression due to the loss of genetic diversity. Often restricted by fences, in many cases to protect surrounding land uses, DOI bison face limitations to achieving full ecological restoration as wildlife across large landscapes (Berger et al. 2014, Department of the Interior 2014). Recognizing these limitations, the DOI Bison Conservation Initiative was established in 2008 (Department of the Interior 2008), creating a framework in which bison may be returned to their ecological and cultural roles on appropriate landscapes within the species' historical range. The 2008 DOI Bison Conservation Initiative also recognized that small, isolated bison populations may suffer from the loss of genetic diversity due to genetic drift.

Based on research suggesting that DOI herds be managed as a metapopulation through strategic movement of individuals between populations to restore gene flow across appropriate landscapes (Dratch and Gogan 2010, Hedrick 2009, Hartway et al. 2020), the 2020 Bison Conservation Initiative emphasizes the need for strategic translocation of a small number of bison between DOI herds to conserve genetic diversity. However, it is also recognized that moving bison may increase the risk of disease transmission. Disease threats vary across geographic and administrative boundaries and moving bison increases the risk of moving disease between herds or between bison and neighboring cattle or other livestock. Robust herd health surveillance programs, both in the donor and recipient herds, as well as knowledge of local diseases are needed to protect the century-long success of DOI bison conservation and stewardship.

Purpose

One of the priorities identified in the 2008 DOI Bison Conservation Initiative was to develop guidance on bison health management. In support of this goal, the U.S. Fish and Wildlife Service (FWS), the National Park Service (NPS), and the Bureau of Land Management (BLM) in partnership with collaborating states have compiled information on the history and current status of bison health in DOI herds. We discuss overarching principles affecting bison health decisions in DOI herds and detail baseline bison health history and practices across DOI units (Appendix A) as a foundation upon which a collaborative, adaptive approach to DOI bison health management may be developed to support future bison conservation and restoration efforts.

Authorities Guiding Bison Health Management

Bison are unique among large native ungulates with the majority of bison in the U.S. managed as commercial livestock compared to the few managed as wildlife. However, policies and programs established for controlling disease in domestic livestock do not always apply well to wildlife and often conflict with species conservation goals (Gates et al. 2010). Bison, including herds managed by DOI, were historically managed using traditional population health tools such as vaccination, quarantine, and test-and-slaughter, among other strategies, early in their recovery period and through most of the 20th century. However, with renewed interest in managing bison as wildlife, including conserving their wild character (Freese et al. 2007, Sanderson et al. 2008, Gates et al. 2010, Aune et al. 2017), bison health management has become socially, politically and administratively more complex in recent decades.

Under their authority for wildlife management, the FWS and NPS maintain primary responsibility for management of bison herds on Refuges (National Wildlife Refuge Administration Act; 16 U.S.C. §§ 668dd and 668ee, as amended) and NPS Units (Organic Act; 54 U.S. Code § 100101). Bison managed as wildlife on other federal lands (e.g., BLM or U.S. Forest Service) are under the primary management authority of the respective state wildlife agencies.

Table 1. Department of Interior lands that currently support plains bison.

DOI Unit	State	Bureau	Fenced or Free-Ranging	Approx. Herd Size	Approximate Area Size (ac)	Hunted (yes or no)
Badlands National Park	SD	NPS	fenced	900	64,000	No
Book Cliffs	UT	BLM	ranging	540	1,400,000	Yes
Chickasaw National Recreation Area	OK	NPS	fenced	10	84	No
Fort Niobrara National Wildlife Refuge	NE	FWS	fenced	357	17,000	No
Grand Canyon National Park – Kaibab Plateau	AZ	NPS	ranging	500	23,000	Yes (outside of the park)
National Elk Refuge/Grand Teton National Park/ John D. Rockefeller, Jr. Memorial Parkway	WY	FWS/NPS	ranging	936	360,000	Yes (outside of the park)
Henry Mountains	UT	BLM	ranging	440	300,000	Yes
National Bison Range	MT	FWS	fenced	302	19,000	No
Neal Smith National Wildlife Refuge	IA	FWS	fenced	53	800	No
Rocky Mountain Arsenal National Wildlife Refuge	CO	FWS	fenced	71	12,000	No
White Horse Hill (formerly Sully's Hill) National Game Preserve	ND	FWS	fenced	22	600	No
Tallgrass Prairie National Preserve	KS	NPS	fenced	89	1100	No
Theodore Roosevelt National Park (2 herds)	ND	NPS	fenced	615	71,000	No
Wichita Mountains National Wildlife Refuge	OK	FWS	fenced	576	59,000	No
Wind Cave National Park	SD	NPS	fenced	350	28,000	No
Wrangell-St. Elias National Park and Preserve (2 herds)	AK	NPS	ranging	181	100,000	Yes
Yellowstone National Park	WY/MT/ID	NPS	ranging	4200	2,200,000	Yes (outside of the park)

The U.S. Department of Agriculture's, Animal and Plant Health Inspection Service (APHIS) manages federally-reportable diseases of livestock and administers federal eradication and control programs under the authority of the Animal Health Protection Act (7 U.S. Code § 8301). Federal legislation sets minimum standards for state disease control legislation, and interstate movement of bison may be regulated by APHIS to prevent movement and spread of reportable diseases. Likewise, state departments of agriculture, through their State Veterinarians, regulate import of animals into and transport within states. State disease reporting requirements may be more stringent than federal requirements. State wildlife management agencies may also have importation or intrastate movement requirements for bison. As a result of this complexity, DOI bureaus work closely with animal health regulatory and management agencies regarding bison transport, restoration, and ranging outside of federal land boundaries.

DOI Bison Conservation Herds

Currently, nine NPS units, seven FWS units, and two BLM/State of Utah management units support about 11,000 bison (Table 1). Approximately half of these bison are within the brucellosis-endemic zone of the Greater Yellowstone Area (GYA) (National Elk Refuge/Grand Teton National Park and Yellowstone National Park populations). Of the remaining bison ~3,500 are managed in Refuges and Parks behind fences while ~1,500 are free-ranging in 5 small herds, including: a herd residing on the north rim of Grand Canyon National Park in Arizona; in two separate herds in Wrangell-St. Elias National Park and Preserve in Alaska; and in two herds which range on tribal, state, private, and BLM lands in Utah. Bison on all DOI lands, with the exception of the two Alaska herds, are managed within the historic range of plains bison.

With the exception of the National Elk Refuge/Grand Teton National Park herd co-managed by FWS and NPS, in partnership with Wyoming Game and Fish Department, bison within the FWS are managed as a metapopulation through small, periodic translocations to conserve genetic diversity by restoring gene flow among herds. NPS bison herds, once established, have generally been managed as closed populations with little to no historic supplementation from external sources; however, there has been recent, limited experimental movement of 12 bison from Badlands National Park to the North Unit of Theodore Roosevelt National Park in 2017. The DOI Bison Report - Looking Forward summarizes the status, partnerships, opportunities and limitations for DOI bison conservation herds in detail (Department of the Interior 2014), with additional information about DOI bison genetic diversity, introgression and genetic management strategies provided in Hartway et al. (2020).

DOI Bison Health and Disease Concerns

Historically, concern about DOI bison health has focused almost exclusively on bovine brucellosis, caused by the bacterium, *Brucella abortus*. Introduced to wildlife by domestic livestock, bovine brucellosis has been the target of a national eradication program since 1934. Although this disease has been virtually eliminated from domestic cattle, it is endemic in bison and elk in the GYA. While all 17 DOI herds outside of the GYA are considered brucellosis-free, conservation of bison is hampered by concern over movement of brucellosis-exposed animals from the two DOI herds in the GYA. Management of bison in the GYA is complicated by the desire to retain free-ranging herds of wildlife while minimizing the potential for transmission of *B. abortus* to livestock.

While concerns surrounding bovine brucellosis have been the most pressing, other diseases could pose significant risks to bison conservation. Endemic diseases such as anthrax, hemorrhagic disease, and disease associated with *Mycoplasma bovis* – as well as foreign animal diseases such as foot-and-mouth disease (FMD), heartwater, and Schmallenberg virus – could impact DOI bison herds. Bison are also susceptible to other cattle diseases, such as bovine tuberculosis (TB), paratuberculosis (Johne's disease) and bovine viral diarrhea virus, among others, and could serve as a source of disease if infected.

DOI Bison Health Management Practices

Wildlife health cannot merely be measured based on the lack of disease-causing pathogens but instead must incorporate the concepts of vulnerability, resilience, and sustainability of populations (Stephen 2014). Stephen suggested that, "wildlife health is not a biologic state but rather a dynamic social construct based on human expectations and knowledge". Therefore, DOI bison are managed to ensure healthy (i.e., resilient and sustainable populations that have the capacity to cope with disease threats), though not necessarily disease-free, herds of bison that contribute to the conservation of bison across North America. To ensure that bison health management practices employed by DOI also protect public health and the health of neighboring livestock, tools for managing healthy DOI bison may vary with location and across time.

All DOI bison herds are monitored through remote observation, during capture, or, in a few populations, during hunts (Table 1). Most DOI bison are not routinely treated for

illness; however, if the health of the herd, humans, or surrounding livestock is threatened, disease management is often employed. Additionally, sick animals may be euthanized for necropsy, gross pathology, histopathology, and ancillary diagnostic tests to determine the cause of disease.

Remote observation: DOI personnel observe bison remotely for clinical signs of disease. Depending on the accessibility of the bison and management goals for the population, the amount of dedicated or opportunistic observation time varies among DOI bison units. Body condition may also be assessed as an indicator of appropriate nutrition and overall health.

Capture and disease testing: Because bison reproduction often exceeds ecological and/or social carrying capacity, capture and removal of animals may be used to keep the population in balance with the available habitat. Many herds are gathered using a variety of techniques, including use of bait such as forage or water; or using people in helicopters, in vehicles, on horseback, or on foot. Excess animals are then donated to other DOI herds, tribes, or conservation partners. When bison are captured, blood and tissue samples are often collected for disease testing, genetic analysis, and archive purposes. Serum is often stored and banked for future disease testing from a subset of individuals. While serologic surveillance for bovine brucellosis may be required to meet interstate transport regulations, disease surveillance for other pathogens is conducted based on geographic location, herd health history, and herd management goals.

Marking and identification: Most bison in fenced DOI populations are permanently identified with subcutaneous radio-frequency identification tags (i.e., RFID, Passive Integrated Transponder [PIT] tag, microchip), providing long-term, reliable identification that can be read at the time of capture. Identification of animals early in life reduces handling stress by minimizing the number of times an animal must be handled and allows long-term health data to be maintained for individual animals. Small, metal "brite" ear tags approved by APHIS as part of a national animal identification system are often used as another form of identification and to meet interstate transport regulations.

Bison Health Management in the Greater Yellowstone Area: Management of free-ranging bison herds in the GYA varies and may include hunting outside of National Parks, hazing into areas where bison are tolerated, or capture using similar techniques as described above. Bison in and around Yellowstone National Park are managed within the framework of an Interagency Bison Management Plan (IBMP 2020), implemented by federal, state, and tribal partners. In this population, hundreds of animals are harvested or sent to slaughter in years when animals leave the park at a level exceeding tolerance threshold of surrounding landowners and managers. Additionally, Yellowstone National Park has recently adopted a brucellosis quarantine program, which allows for movement of bison outside of the GYA (Department of the Interior 2014, Clarke et al. 2014).

Similarly, management of the brucellosis-affected National Elk Refuge/Grand Teton National Park herd requires collaboration of multiple state and federal partners. This herd is managed within the Final Bison and Elk Management Plan and Environmental Impact Statement for the National Elk Refuge/ Grand Teton National Park/ John D. Rockefeller, Jr. Memorial Parkway (Fish and Wildlife Service and National Park Service 2007). This plan details open hunting areas, including the National Elk Refuge. Hunters and visitors are encouraged to report apparently sick bison, and a subset of harvested animals may be sampled for disease testing.

Addressing Future Health Risks

Bison conservation and restoration efforts must consider the significance of disease in bison herds and apply a multi-jurisdictional, multi-stakeholder approach to the management of bison on large landscapes. Appropriate management actions will vary depending on the geographic location of the herd, contemporary disease threats, and historical disease surveillance data. Careful selection of individuals to establish new herds or to augment existing populations, as well as herd health monitoring of source and recipient herds, using appropriate diagnostic tools, will be needed to minimize the risk of introducing new or exacerbating existing diseases. Heightened disease surveillance, spatial-temporal separation of bison and other species, pre or post-movement disease testing, quarantine, and preventive treatments may be warranted (Gates et al. 2010). Additionally, knowledge of wildlife and livestock health in areas targeted for bison translocation is essential in decision-making to protect the health of wildlife and livestock alike.

Within the context and framework of creating resilient and sustainable wild bison populations, health protocols used in planning bison translocations must be implemented on a case-by-case basis while considering a variety of factors, including: 1) disease history and status of both the donor herd and the recipient herd; 2) disease history and status of wildlife and domestic species associated with the donor and recipient herds; 3) appropriate treatment for bison prior to transport; 4) current regulatory requirements for transport;

and 5) post-release monitoring of translocated animals (Woodford 2000, Gates et al. 2010).

Enhancing wildlife health and maintaining thriving populations of wild bison require a dynamic and forward-thinking approach. Communication and cooperation with all affected wildlife and livestock health officials early in bison conservation and restoration efforts is critical for identifying disease regulations and specific testing requirements for transport (Gates et al. 2010). Such conversations must include thoughtful engagement of associated bison managers, DOI and state wildlife health professionals, State Veterinarians, APHIS, American Indian Tribes and intertribal organizations, and ultimately those who will be making final decisions on movement of bison. Through this approach, management priorities, potential disease concerns, and levels of acceptable risk can be clearly articulated, and decisions made in light of these factors.

Managing bison as a metapopulation includes some level of risk to wildlife health. DOI bureaus are therefore committed to using a team approach to develop appropriate bison health surveillance strategies, and to identifying potential source and recipient populations to meet genetic, demographic, and ecologic conservation goals. Additionally, we will apply the best available science to maintain or improve DOI bison health in support of species conservation and restoration.

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Appendix A: Department of the Interior Bison Herd Health

Unit: Badlands National Park

State: South Dakota

Year herd established: 1963

Bureau: National Park Service

Herd health surveillance: Although South Dakota is currently classified as a bovine brucellosis free state, brucellosis serology is conducted during fall capture events as requested for interstate transport. More than 5,000 animals have been tested for bovine brucellosis in the last 30 years. Bovine brucellosis has never been diagnosed in Badlands. Badlands NP submits a random sample of bison sera for archive with the Biological Resources Division of the National Park Service in Fort Collins, CO following fall capture events, for potential future testing. Body condition is assessed during fall capture events by recording total weight and height to shoulder measurements within the squeeze chute.

In 1998 and 1999, portions of the herd were tested using serology or bacterial culture as appropriate for *Campylobacter fetus*, *Tritrichomonas fetus*, bovine viral diarrhea virus (BVDV), epizootic hemorrhagic disease (EHD), bluetongue virus, and leptosira at the Wyoming State Veterinary Laboratory. Approximately 60% of animals showed antibodies to epizootic hemorrhagic disease and bluetongue virus, which are regionally endemic viral diseases that are transmitted by biting midges. All other results were negative.

A total of 62 bison shipped to New Mexico between 2003 and 2006 were tested for bovine tuberculosis by USDA/Animal and Plant Health Inspection Service veterinarians with no positive results. No evidence of Johne's disease was detected within the herd via ELISA serology from 398 bison in 2003, 80 bison in 2004, and 100 bison in 2005 (analyzed at the University of Wisconsin – Madison, Johne's Disease Testing Laboratory, of nearly 600 serum samples 3 were mildly suspect, a routine finding in Johne's disease negative herds). A young calf was found dead in June 2003 and tested positive for botulism (an environmental disease) and in 2005 a young female calf died of salmonellosis. No other known bison mortalities have been attributed to disease at Badlands NP to date.

Other herd health management considerations: Badlands NP supports approximately 900 bison on 64,000 acres. The bison herd shares this space with a variety of wildlife species (e.g., mule deer, bighorn sheep, pronghorn, prairie dogs) and therefore are gathered regularly (i.e., every 2-4 years) to maintain good range conditions to support these species. Due to the wide-ranging nature and desire to manage the herd as wildlife, veterinary care is not routinely provided. Surrounding land use is primarily grazing/ agricultural, with the potential for livestock to pose disease risk to Badlands NP bison and vice versa.

Unit: Book Cliffs

State: Utah

Year herd established: 2008

Bureau: Utah Division of Wildlife Resources/ Bureau of Land Management

Herd health surveillance: The Book Cliffs bison herd is managed through hunter harvest, and this herd co-mingles with a larger, adjacent herd managed by the Ute Tribe. Surveillance for bovine brucellosis is conducted annually by sending out blood collection kits to bison hunters, supplemented with samples collected from live captured bison. From 2016 – 2020, a total of 235 bison were sampled by the Utah Division of Wildlife and all tested negative.

In addition, a subset of serum collected from live captured bison have been tested for exposure to other diseases via serology. No exposure to bovine viral diarrhea virus (BVDV) or infectious bovine rhinotracheitis (IBR) was detected in 53 bison sampled between 2017 and 2020. A low level of exposure to bovine respiratory syncytial virus (BRSV) was detected in the same group.

Serology performed on a smaller subset of samples revealed common exposure to parainfluenza-3 (PI3). Low level exposure to epizootic hemorrhagic disease (EHD) and bluetongue viruses, transmitted by biting midges, was also confirmed.

Other herd health management considerations: Interaction with the adjacent Ute herd is not uncommon, and cattle and sheep allotments completely overlap with the Book Cliffs bison range. The potential for disease transmission with domestic livestock exists.

Unit: Chickasaw National Recreation Area

State: Oklahoma

Year herd established: 1920

Bureau: National Park Service

Herd health surveillance: This small demonstration herd (n = ~10) is a satellite population of the Wichita Mountains Wildlife Refuge population. The bison are maintained in an ~85-acre pasture with a small corral holding area. This pasture alone is insufficient to maintain the herd, thus supplemental feed consisting of native-prairie grass hay and in the winter high protein cubes are provided every 2-3 days. Mineral supplements are also provided and water is provided via a stock pond within the pasture and a water trough in the corral. Bison are observed nearly daily and if an animal becomes ill or dies staff can respond within hours. Veterinary care is provided by a local contract veterinarian.

In the last 20 years relatively little disease testing has been performed. In 2009 the herd was tested for internal parasite loads and feces were cultured for Johne's disease. Parasite loads were low and none cultured positive for Johne's disease. In 2016, two young bulls died of bluetongue virus, an endemic disease transmitted by biting midges. Starting in 2016, the bison have been dewormed annually and vaccinated twice a year for leptospirosis and *Clostridium chauvoi* (blackleg).

Other herd health management considerations: Surrounding land use is primarily grazing and agriculture. There is the potential for surrounding livestock to transmit disease to these bison and vise versa, but this is a low-likelihood event given there is no direct contact with domestic livestock.

Unit: Fort Niobrara National Wildlife Refuge

State: Nebraska

Year herd established: 1913

Bureau: U.S. Fish and Wildlife Service

Herd health surveillance: Pasteurellosis is a term used to describe a variety of disease syndromes caused by members of the family *Pasteurellaceae*. Septicemic pasteurellosis, historically referred to as hemorrhagic septicemia, is traditionally defined as a bacterial disease caused by a specific serotype of *P. multocida*. Although this disease has not been commonly reported to occur in U.S. bison, both the White Horse Hill National Game Preserve (formerly Sully's Hill NGP) bison herd and the Fort Niobrara NWR bison herd have experienced an outbreak. In 2006, the entire original White Horse Hill National Game Preserve bison herd was translocated to the Fort Niobrara NWR and was maintained in a separate but adjacent grazing unit to the Fort Niobrara bison herd. In 2008, a mortality event resulting in loss of approximately 10% of the White Horse Hill NGP herd was attributed to septicemic pasteurellosis. The following year, several mortalities in the Fort Niobrara NWR herd were also attributed to septicemic pasteurellosis, from which one isolate of *P. multocida* matched the isolate identified in the White Horse Hill herd the previous year. Attempts to identify a carrier animal in the Fort Niobrara NWR bison herd were made in the fall of 2009 during routine captures by collecting deep nasal swab samples from approximately 25% of the herd. *Pasteurella multocida*, *Mannheimia haemolytica* and *Bibersteinia trehalosi* were identified in different samples collected from four apparently healthy bison, but the serotype of the single *P. multocida* isolate did not match the pathogen identified during the outbreaks that occurred the previous years.

In 2010, the White Horse Hill NGP and Fort Niobrara NWR bison herds were combined, and in 2012 two cultures of *M. haemolytica*

were isolated from nasal swabs collected from 2 young bison that appeared to be ill during the routine fall capture operation. One of the animals was confirmed to have recovered during the following year's capture operations while the second animal was not found to have survived. In 2013, the deaths of two older bison were attributed to pasteurellosis during a viral epizootic hemorrhagic disease (EHD) and bluetongue virus outbreak. Two additional mortalities in this herd have been attributed to pasteurellosis, including one neonate bison in early 2014 and a single adult in 2015.

The Fort Niobrara NWR bison herd experienced an outbreak of epizootic hemorrhagic disease (EHD) and bluetongue viruses, endemic diseases transmitted by biting midges, resulting in mortality of approximately 5% of the herd in 2013. Refuge personnel reported the first clinical sign in early September with the finding of a dead adult bison, and observation of the herd found that many animals appeared lethargic and less alert than usual. Because the clinical signs of hemorrhagic disease are similar to those seen in foreign and reportable animal diseases such as foot-and-mouth-disease and vesicular stomatitis virus, a foreign animal disease (FAD) investigation involving several state and federal animal health authorities was initiated after the first oral lesion was discovered in the 5th mortality. The mortality event continued through early November with detection of EHD-2 and bluetongue virus serotypes 11, 13 and 17 via polymerase chain reaction (PCR) in most of the mortalities and ruling out of a wide variety of other pathogens during the investigation. Of 18 mortalities examined, only 6 presented with oral lesions typically seen in cattle, only 2 presented with hoof lesions, and most lesions observed with a few exceptions were very small and difficult to detect. Bloody diarrhea was reported in a few mortalities, and peeling hide lesions near the tailhead were also observed in 4 mortalities that either had oral or hoof lesions. Both EHD and bluetongue viruses were detected in whole blood via PCR in many of the animals that recovered, along with similar hide lesions.

Although bovine viral diarrhea virus (BVDV) has not been detected at Fort Niobrara, a subset of non-calf bison sera are tested annually using serum neutralization tests for BVDV, and all bison calf sera is screened annually for persistent infection using antigen-capture enzyme-linked immunosorbent assay (ELISA).

Annual serologic surveillance of a subset of the FTN herd for other bovine viral diseases, including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses do not often cause significant disease in wildlife, and no evidence of clinical disease has been detected in FTN bison from these bovine viral pathogens.

Periodic surveillance of a subset of the herd for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Periodic surveillance of a subset of the herd for Johne's disease has resulted in no detections. Periodic surveillance of a subset of the herd for leptospirosis has resulted in evidence of low levels of exposure with no evidence of clinical disease in the herd. Periodic sero-surveillance of a subset of the herd for anaplasmosis has resulted in evidence of exposure with no evidence of clinical disease.

Fort Niobrara NWR bison body condition is assessed opportunistically throughout the year in association with routine Refuge operations, with a whole-herd assessment conducted during fall captures using a 7-score protocol adapted from the Alberta Ministry of Agriculture. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health. Nebraska is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: Domestic livestock are common in the area, and mortalities due to EHD and bluetongue were reported in area cattle one year prior to the outbreak in Fort Niobrara bison. With the Niobrara River bisecting the Refuge, transmission of vector-borne diseases is not unexpected.

Unit: Kaibab Plateau Herd (formerly known as House Rock Herd) - Grand Canyon National Park

State: Arizona

Year herd established: 1905

Bureau: National Park Service and Arizona Game and Fish Department

Herd health surveillance: Hunter harvested animals from the Kaibab Plateau free-ranging herd have been consistently tested for bovine brucellosis by the state of Arizona since 2012 and none have tested positive (Anne Justice-Allen, AZGFD DVM personal communication).

As a closed herd with no new introductions since 2001, the risk of bovine brucellosis introduction is extremely low. All introductions have been made from herds that are brucellosis free. Primary disease risks at this time would arise from trespass livestock in the park or from other wildlife.

In 2003, six animals were tested for fecal parasites (including lung worm larvae) and feces were cultured for Johne's disease. All results were negative. Currently, the park archives samples for disease surveillance during live capture events. The park also conducts necropsies on freshly dead carcasses when found.

Other herd health management considerations: The Kaibab Plateau bison herd originated from the House Rock Valley but now resides on the Plateau which is remote from other bison herds. In 2017 a new herd was established at House Rock. The surrounding land use includes the Kaibab National Forest with a limited grazing allotment for cattle. Currently the bison range does not extend into the cattle allotment, but fences do not preclude co-mingling. The park and state are currently working on a bison management agreement.

Unit: National Elk Refuge, Grand Teton National Park/John D. Rockefeller, Jr. Memorial Parkway

State: Wyoming

Year herd established: 1948

Bureau: U.S. Fish and Wildlife Service, National Park Service, Wyoming Game and Fish Department

Herd health surveillance: The Jackson Bison Herd is one of the 2 Greater Yellowstone Area (GYA) herds affected by bovine brucellosis, and herd health surveillance in this free-roaming, hunted bison population is conducted through occasional research projects, reports by wintertime visitors and hunters on the National Elk Refuge (NER), and through daily herd observations made during wintertime feeding operations on the NER. A subset of hunter harvested animals are sampled for disease each year. Brucellosis has a significant impact on the management of the Jackson bison herd, and the history and management of brucellosis in the GYA is detailed by the National Academy of Sciences (2017) and also in the Final Bison and Elk Management Plan and Environmental Impact Statement (Fish and Wildlife Service and National Park Service 2007).

Jackson bison have been exposed to bovine viral diarrhea virus (BVDV), parainfluenza virus-3 and bovine respiratory syncytial virus (BRSV), but no mortalities have been attributed to these diseases and the contribution of these viruses, if any, to bison herd health is unknown. There is no serological evidence of infectious bovine rhinotracheitis (IBR). Past sero-surveillance for anaplasmosis has shown-evidence of exposure but no clinical disease has been detected. Although sample sizes are small, there is no evidence of Johne's disease in the Jackson bison herd. Culture and PCR has not detected *Mycoplasma bovis* in a very small number of bison sampled in 2019, and there is no evidence of disease from either epizootic hemorrhagic disease (EHD) or bluetongue viruses.

Pasteurellosis is a term used to describe a variety of disease syndromes caused by members of the family Pasteurellaceae. Septicemic pasteurellosis, historically referred to as hemorrhagic septicemia, is traditionally defined as a bacterial disease caused by a specific serotype of *P. multocida*. Although septicemic pasteurellosis has been reported as a cause of mortality in NER elk (Fish and Wildlife Service and National Park Service 2007), this disease has not been documented as a concern in the Jackson Bison Herd.

Other herd health management considerations: While there have been many benefits associated with wintering large numbers of elk and bison on the National Elk Refuge, high animal concentrations have created an unnatural situation that has contributed to increased risk for major outbreaks of exotic diseases, currently demonstrated by the high level of bovine brucellosis in the elk and bison herds. The Fish and Wildlife Service recently released a Step-Down Plan: Bison and Elk Management (2019) that implicitly assumes that the transmission rate and prevalence of diseases are density dependent and positively correlated with the number of elk and bison utilizing feeding grounds and the number of days they are fed. The Step-down Plan provides a structured framework for reducing reliance on supplemental winter feeding over five years, with initial emphasis on ending feeding earlier than in the past (U.S. Fish and Wildlife Service 2019).

Unit: Henry Mountains

State: Utah

Year herd established: The bison were introduced in 1942, with subsequent migration of the herd into their current range in the Henry Mountains a decade later.

Bureau: Utah Division of Wildlife Resources/ Bureau of Land Management

Herd health surveillance:

The Henry Mountains bison herd is managed through hunter harvest. Surveillance for bovine brucellosis is conducted on an annual basis by sending out blood collection kits to bison hunters, supplemented with samples collected opportunistically from live captured bison. From 2016-2020, a total of 208 bison were sampled by the Utah Division of Wildlife and all were negative.

In addition, a subset of serum collected from live captured bison have been tested for exposure to other diseases. No exposure to bovine viral diarrhea virus (BVDV) or bovine respiratory syncytial virus (BRSV) was detected in 32 bison sampled from 2018-2020. Exposure to epizootic hemorrhagic disease (EHD) and bluetongue viruses, endemic diseases transmitted by biting midges, was also confirmed in samples collected from this group. Exposure to parainfluenza-3 (PI3) was detected in a subset of 3 samples from the same group.

Other herd health management considerations: Interaction with livestock is possible through cattle grazing allotments in the area.

Unit: National Bison Range

State: Montana

Year herd established: 1909

Bureau: U.S. Fish and Wildlife Service

Herd health surveillance: FWS conducts routine surveillance for Johne's disease through annual serology testing and mortality investigations. The National Bison Range identified a small number of animals with clinical signs consistent with Johne's disease in the late 1990's and subsequent testing revealed a few animals with positive histopathology results. Animals with clinical signs consistent with Johne's disease were removed from the herd, and there has been no evidence of this disease in the National Bison Range herd since 2006.

An exposure event to bovine viral diarrhea virus (BVDV) is suspected in the National Bison Range herd in 2002 based on an increase in prevalence found during routine serological surveillance, but no mortality was detected in the herd. A bison mortality attributed to BVDV was detected at the Rocky Mountain Arsenal in 2010, and one persistently infected non-clinically affected (carrier) animal that had been previously translocated from the National Bison Range was identified and removed with her offspring. Whole herd BVDV antigen tests conducted at all Refuges resulted in no additional detections. A subset of National Bison Range non-calf bison sera are tested annually using serum neutralization tests for BVDV to determine exposure, and all calf sera is screened annually for persistent infection using antigen-capture ELISA.

Annual serologic surveillance of a subset of the National Bison Range herd for other bovine viral diseases, including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses rarely cause significant disease in wildlife and no evidence of clinical disease has been detected in National Bison Range bison from these bovine viral pathogens.

Although the National Bison Range historically attributed a small decline in recruitment to a leptospirosis outbreak, prompting vaccination for an unknown period of time, clinical disease in this herd has never been confirmed. Low levels of exposure to leptospirosis has been documented through sero-surveillance. Periodic sero-surveillance of a subset of the herd for anaplasmosis resulted in evidence of exposure but no clinical disease has been observed.

Pasteurellosis is a term used to describe a variety of disease syndromes caused by members of the family Pasteurellaceae. *Septicemic pasteurellosis*, historically referred to as hemorrhagic septicemia, is traditionally defined as a bacterial disease caused by a specific serotype of *P.*

multocida. This disease was reported to occur at the National Bison Range in 1965 and was described as producing stiff and swollen joints in bison calves. A bacterin vaccination program was initiated and was continued for an unspecified period of time with no further cases reported (Heddleston and Wessman 1973). A single case of pneumonic pasteurellosis was identified as the cause of mortality in a bison at the National Bison Range in 2013.

One bison mortality was attributed to malignant catarrhal fever (MCF Ovine Herpesvirus-2) at the National Bison Range in 2010. Ovine herpesvirus-2 is carried by apparently healthy domestic sheep and can spread to bison via airborne contamination, but is not thought to spread between bison. Domestic sheep periodically graze private land adjacent to and north of the Refuge.

Endemic diseases transmitted by biting midges, bluetongue and epizootic hemorrhagic disease (EHD) virus exposure has been documented via sero-survey in bison at the National Bison Range. Although no virus was detected in whole blood via PCR collected from a subset of the herd during fall captures, one mortality was attributed to EHD in 2013, with oral and hide lesions similar to those described during the outbreak at the Fort Niobrara NWR during the same year.

Periodic surveillance of a subset of the herd for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Periodic sero-surveillance of a subset of the herd for anaplasmosis has resulted in evidence of exposure with no evidence of clinical disease.

National Bison Range bison body condition is assessed opportunistically throughout the year in association with routine Refuge operations, with a whole-herd assessment conducted during fall captures using a 7-score protocol adapted from the Alberta Ministry of Agriculture. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health. With the exception of the Designated Surveillance Area surrounding the Greater Yellowstone Area, Montana is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: Domestic livestock are common in the area, and cattle occupy an area immediately upstream of and adjacent to the Refuge. Domestic sheep are also periodically grazed in a unit adjacent to and north of the Refuge boundary, posing a risk for transmission of MCF to the National Bison Range bison herd.

Unit: Neal Smith National Wildlife Refuge

State: Iowa

Year herd established: 2006

Bureau: U.S. Fish and Wildlife Service

Herd health surveillance: Although no mortalities have been detected from bovine viral diarrhea virus (BVDV) at Neal Smith NWR, sero-surveillance has identified a low level of exposure and a subset of FWS non-calf bison sera are tested annually using serum neutralization tests for BVDV to determine exposure. All bison calf sera are also screened annually for persistent infection using antigen-capture enzyme-linked immunosorbent assay (ELISA).

Annual serologic surveillance of a subset of the Neal Smith bison herd for other bovine viral diseases, including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses do not often cause significant disease in wildlife and no evidence of clinical disease has been detected in Neal Smith bison from these bovine viral pathogens.

Although Johne's disease was detected in the National Bison Range source herd, no evidence of this disease has been detected in Neal Smith bison during annual serology surveillance or in any bison mortalities to date.

Periodic surveillance of a subset of the herd for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Periodic surveillance of a subset of the herd for leptospirosis has resulted in evidence of low levels of exposure with no evidence of clinical disease in the herd. Periodic sero-surveillance of a subset of the herd for anaplasmosis has resulted in evidence of exposure but no evidence of disease.

An endemic disease transmitted by biting midges, epizootic hemorrhagic disease (EHD) viruses were identified as the cause of one bison mortality in 2012, and DNA from this virus was detected via polymerase chain reaction in whole blood of several apparently healthy ani-

mals sampled during fall captures in 2013. Exposure to bluetongue viruses has not been detected in a small sample from this herd.

Pasteurellosis is a term used to describe a variety of disease syndromes caused by members of the family Pasteurellaceae. *Septicemic pasteurellosis*, historically referred to as hemorrhagic septicemia, is traditionally defined as a bacterial disease caused by a specific serotype of *P. multocida*. This pathogen was identified in a small number of bison mortalities at Neal Smith in 2018.

Body condition of Neal Smith bison is assessed opportunistically throughout the year in association with routine Refuge operations, with a whole-herd assessment conducted during fall captures using a 7-score protocol adapted from the Alberta Ministry of Agriculture. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health. Iowa is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: Although surrounding land use is primarily agricultural, domestic livestock densities surrounding Neal Smith NWR are generally low.

Unit: Rocky Mountain Arsenal National Wildlife Refuge

State: Colorado

Year herd established: 2007

Bureau: Fish and Wildlife Service

Herd health surveillance: Two bison mortalities attributed to malignant catarrhal fever (MCF Ovine Herpesvirus-2) have been detected at the Rocky Mountain Arsenal, with single animals affected in 2009 and 2010, respectively. Ovine herpesvirus-2 is carried by apparently healthy domestic sheep and can spread to bison via airborne contamination, but is not thought to spread between bison. Although no domestic sheep occur on the Refuge, the surrounding urban environment may have one or more small, privately owned backyard flocks.

A bison mortality attributed to bovine viral diarrhea virus (BVDV) was detected at the Rocky Mountain Arsenal in 2010. One persistently infected animal with no clinical signs of disease (carrier) animal that had been previously translocated from the National Bison Range, and her offspring, were identified and removed. Whole herd BVDV antigen tests conducted at all Refuges resulted in no additional detections. A subset of FWS non-calf bison sera are tested annually using serum neutralization tests for BVDV to determine exposure, and all bison calf sera is screened annually for persistent infection using antigen-capture enzyme-linked immunosorbent assay (ELISA). FWS bison are not vaccinated against BVDV.

Annual serologic surveillance of a subset of the RMA herd for other bovine viral diseases, including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses do not often cause significant disease in wildlife and no evidence of clinical disease has been detected in RMA bison from these bovine viral pathogens.

Although Johne's disease was detected in the National Bison Range source herd, no evidence of this disease has been detected in RMA bison during annual serology surveillance or in any bison mortalities to date.

Periodic surveillance of a subset of the herd for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Periodic surveillance of a subset of the herd for leptospirosis has resulted in evidence of low levels of exposure with no evidence of clinical disease in the herd. Periodic sero-surveillance of a subset of the herd for anaplasmosis has resulted in evidence of exposure with no evidence of clinical disease. No evidence of disease caused by the epizootic hemorrhagic disease (EHD) or bluetongue viruses has been found in bison at the Rocky Mountain Arsenal.

RMA bison body condition is assessed opportunistically throughout the year in association with routine Refuge operations, with a whole-herd assessment conducted during fall captures using a 7-score protocol adapted from the Alberta Ministry of Agriculture. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health. Colorado is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: Surrounding land use patterns are primarily urban, with the potential for a small number

of backyard livestock and/or poultry flocks to pose disease risk to RMA bison.

Unit: White Horse Hill National Game Preserve (formerly Sully's Hill NGP, renamed December 2019)

State: North Dakota

Year herd established: 2006

Bureau: U.S. Fish and Wildlife Service

Herd health surveillance: White Horse Hill National Game Preserve does not have capture facilities, and bison herd health surveillance is conducted through periodic observations of the herd combined with carcass exam during regular population management activities utilizing lethal removal.

Although Johne's disease was detected in the National Bison Range source herd, no evidence of this disease has been detected in White Horse Hill bison mortalities to date. Periodic serologic surveillance for bovine viral diarrhea virus (BVDV) has identified low levels of exposure with no evidence of clinical disease.

Periodic surveillance for other bovine viral diseases including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses do not often cause significant disease in wildlife and no evidence of clinical disease has been detected from these bovine viral pathogens. Periodic surveillance for leptospirosis has resulted in evidence of low levels of exposure with no evidence of clinical disease in the herd. No evidence of endemic disease caused by epizootic hemorrhagic disease (EHD) or bluetongue viruses has been found. Periodic surveillance for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health. North Dakota is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: This small display herd is provided with supplemental forage during some years due to limited habitat availability, such that increased density may result in higher probability of disease and parasite transmission.

Unit: Tallgrass Prairie National Preserve

State: Kansas

Year herd established: 2009

Bureau: National Park Service

Herd health surveillance: This herd is small and relatively newly established as a satellite herd of Wind Cave National Park. Bison are tested annually for anaplasmosis and bovine brucellosis using serologic techniques. No brucellosis has ever been detected. Approximately 5% of the herd has been exposed to this tick-borne bacterium which can cause anemia. In the past, the herd has been periodically treated for anaplasmosis when prevalence was higher (~30%), but this practice is being phased out given no clinical signs of disease have been observed. During establishment of the herd, fecal culture for Johne's disease was performed. No animals were found positive and this testing is no longer performed. No clinical signs of disease have been observed in this herd.

Other herd health management considerations: Tallgrass Prairie National Preserve is a unique public/private partnership between the NPS and The Nature Conservancy (TNC). The preserve's General Management Plan (2000) states that only bison certified as disease free shall be introduced. Based on the best science available in 2009, the Wind Cave National Park bison herd met this requirement. Although TNC owns the bison, the bison herd is co-managed by NPS and TNC under an agreed upon Bison Management Plan (2009). Due to the small herd size on limited acres and within cattle dominated landscape, herd health management is more intensive than other typical DOI bison herds.

Unit: Theodore Roosevelt National Park

State: North Dakota

Year herd established: 1957-1962

Bureau: National Park Service

Herd health surveillance: Theodore Roosevelt NP supports approximately 600-900 bison in two separate herds ranging over more than 70,000 acres in the North Dakota badlands. Herds are gathered every 1-4 years using a helicopter into a permanent corral system. At the time of gather animals are weighed, blood is collected, and genetic samples are taken. More than 2,000 brucella tests have been performed in the last 20 years. In 2017 two animals were suspect positive. One animal was cleared on subsequent confirmatory tests and the other was euthanized and tissues were cultured, however, no *B. abortus* was isolated. Both are considered false positive cases. The park has moved toward only testing for brucellosis if the receiving state requires this for movement of animals given the very large number of negative tests and the potential for false positive tests to confound management options.

In the 1980s approximately 100 bovine tuberculosis tests were performed prior to shipping animals and none were positive. This test is no longer routinely required for movement of animals except in areas where the disease is established (e.g., Michigan).

No evidence of Johne's disease was detected within the herd via ELISA serology from 125 bison in 2002, 40 bison in 2004, and 83 bison in 2005 (analyzed at the University of Wisconsin – Madison, Johne's Disease Testing Laboratory). Additionally, 20 fecal cultures for Johne's disease were negative in 2004.

Approximately 200 serum samples have been archived from Theodore Roosevelt NP starting in 2001.

Other herd health management considerations: Surrounding land use is dominated by cattle grazing. Bison are not tolerated outside of the park and any animal that escapes the fence must be immediately returned or euthanized. Because separation is intensively maintained there is little risk of disease transmission through direct contact with domestic livestock, however, vector-borne diseases (e.g., anaplasmosis) are likely to be shared with surrounding livestock. The range is shared with a variety of wildlife herbivore species such as white-tailed and mule deer, elk, pronghorn and prairie dogs in addition to feral horses. Bison and elk are managed to maintain excellent range conditions and meet the nutritional needs of all of these species.

Unit: Wichita Mountains Wildlife Refuge

State: Oklahoma

Year herd established: 1907

Bureau: U.S. Fish and Wildlife Service

Herd health surveillance: Although no mortalities have been detected from Bovine Virus Diarrhea Virus (BVDV) at Wichita Mountains Wildlife Refuge, low levels of exposure have been confirmed via sero-survey. A subset of non-calf bison sera are tested annually using serum neutralization tests for BVDV to determine exposure, and all bison calf sera is screened annually for persistent infection using antigen-capture enzyme-linked immunosorbent assay (ELISA).

Annual serologic surveillance of a subset of the Wichita Mountains bison herd for other bovine viral diseases, including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3) and bovine respiratory syncytial virus (BRSV) have resulted in evidence of low levels of exposure to PI3 and BRSV, with no evidence of exposure to IBR. These viruses do not often cause significant disease in wildlife and no evidence of clinical disease has been detected from these bovine viral pathogens in Wichita Mountains bison.

Periodic surveillance of a subset of the herd for *Mycoplasma bovis* using culture and PCR has resulted in no detections. Periodic surveillance of a subset of the herd has not detected Johne's disease. Periodic surveillance of a subset of the herd for leptospirosis has resulted in evidence of low levels of exposure with no evidence of clinical disease in the herd. Periodic sero-surveillance of a subset of the herd for anaplasmosis has resulted in evidence of exposure with no evidence of disease. Although exposure to endemic EHD and/or bluetongue

viruses has been confirmed in other Refuge species, no documented evidence of disease has been found in the Wichita Mountains bison herd.

Wichita Mountains bison body condition is assessed opportunistically throughout the year in association with routine Refuge operations, with a whole-herd assessment conducted during fall captures using a 7-score protocol adapted from the Alberta Ministry of Agriculture. Fecal parasitology is assessed on a subset of animals annually as an index to animal distribution and range health, and anthelmintics have historically been used via distribution of medicated range blocks during years of high endoparasite intensity. Oklahoma is currently classified as a bovine brucellosis and bovine tuberculosis free state and testing for these diseases is conducted only as required for interstate transport.

Other herd health management considerations: Exotic animal facilities occur near the Refuge, with the potential for pathogen exchange. Domestic livestock also occur in the area.

Unit: Wind Cave National Park

State: South Dakota

Year herd established: 1913

Bureau: National Park Service

Herd health surveillance: Eradication of brucellosis, which was once endemic in Wind Cave National Park bison, was achieved in 1985 through a combination of bison population reduction through sharpshooting, capture-test-slaughter, and vaccination of female calves. Brucellosis vaccination was terminated in 1998 and bison are not vaccinated for other diseases. From 1996 to present, more than 4,500 bison handled during fall captures have tested negative for brucellosis. Bovine brucellosis sero-surveillance is now only conducted as needed for interstate transfer.

Wind Cave does not conduct any annual serologic surveillance of the herd. The park has done periodic TB testing since 1999 as needed for interstate transfer, with all results (242) being negative. Exposure to anaplasmosis, an endemic disease of both wildlife and cattle which is transmitted through tick bites, was confirmed in 23 of 65 bison in 2017.

No evidence of Johne's disease was detected within the herd via ELISA serology from 218 bison in 2003, and 60 bison in 2005 (analyzed at the University of Wisconsin – Madison, Johne's Disease Testing Laboratory, 4 samples were weakly positive on ELISA but subsequently negative on follow up Agar Gel Immune-Diffusion assay). In 2017 Wind Cave animals (n=55) were transferred to the Arizona Game and Fish Department and in 2019 one female was observed in poor body condition. A fecal sample was collected, and Johne's disease was confirmed through fecal PCR. Twenty-three animals in the herd were tested, and no additional positives were found. It is unclear where this animal was exposed to Johne's disease; however, it is possible it originated at Wind Cave or that the animal was exposed during or after transport.

In 2005 3/46 and in 2006 4/62 serum samples tested positive for malignant catarrhal fever (MCF ovine herpesvirus-2). Ovine herpesvirus-2 is carried by apparently healthy domestic sheep, and can spread to bison via airborne contamination, but is not thought to spread between bison. Upon confirmatory testing using PCR on whole blood none of the animals were positive.

In the last 20 years, sero-surveillance suggests that this bison herd has been exposed to bovine viral diarrhea virus (BVDV), bovine respiratory syncytial virus, bovine parainfluenza 3; however, no clinical disease has been observed. Additionally, there is extensive exposure to endemic epizootic hemorrhagic disease (EHD) and bluetongue viruses, which are transmitted by biting midges; however, no clinical disease has been observed.

The park submits a random sample of bison sera to the Biological Resources Division in Fort Collins, CO. Sera are archived for potential future disease or micronutrient testing.

Other herd health management considerations: The Wind Cave bison herd shares the Park with a variety of wildlife species that may carry diseases with the potential to affect bison. Surrounding land use patterns are primarily grazing/agricultural, with the potential for livestock

to pose disease risk.

Unit: Wrangell-St. Elias National Park and Preserve (2 herds)

State: Alaska

Year herd established: 1950 and 1962

Bureau: National Park Service and Alaska Department of Fish and Game

Herd health surveillance: There has been no disease testing in these herds in the last 20 years. The Alaska Department of Fish and Game manages population size through hunting permits.

Other herd health management considerations: These populations are managed extensively and interact with a full suite of other AK wildlife within their range. Based on population surveys population level impacts of disease are not suspected.

Unit: Yellowstone National Park

State: Montana/Wyoming/Idaho

Year herd established: Not applicable, this population was not entirely extirpated

Bureau: National Park Service and surrounding states

Herd health surveillance: Yellowstone National Park protects an unfenced and free-ranging population of 3,500 – 5,500 migratory bison. Bison are treated as an essential component of the ecosystem where natural selection acts to control migration patterns, mate selection, reproduction, and survival. Bison respond to a full complement of predators and large herbivores that were present in precolonial North America. Disease is not managed in the population through selective culling or vaccination but allowed to also act on natural selection.

The Yellowstone bison population is classified as chronically infected with brucellosis. The disease was first detected in 1917. Serologic screening occurs when bison migrate out of the park and some are corralled and slaughtered. About 6,000 serologic tests for *Brucella abortus* were completed during 2000-2020 with annual prevalence varying between 40-60%.

Minimal targeted surveillance for other diseases occurs in bison corralled for slaughter. During 2005-06, 102 sera were screened for Johne's disease with one ELISA positive. In 2012, 147 sera were screened for *Neospora caninum* with 1 serologic positive. More recently, 230 sera were screened for *Mycoplasma bovis* using ELISA and confirmation with Western Blot for the highest-ranking positives with two animals suspect positive.

Coordinated efforts among the National Park Service, State of Montana, and Animal Plant Health Inspection Service led to the successful quarantine of bison from the Yellowstone population and subsequent brucellosis-free designation of one cohort of animals in 2019. Bison completing the program can be transferred to other areas in accordance with disease surveillance in receiving tribes and states.

Other herd health management considerations: Bison commingle with wild elk, bighorn sheep, mule deer, white-tailed deer, moose and pronghorn. Bison have minimal spatial and temporal overlap with domestic cattle and sheep outside the park.

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.

NPS 999/173875, December 2020

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U.S. Department of the Interior

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