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ANALYSIS REPORT

H.R. 3446
YELLOWSTONE BUFFALO PRESERVATION ACT

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History

The American bison (*Bison bison*), more commonly known as buffalo, is an important wildlife icon for the United States. Historically, bison roamed across the Great Plains and western North America. With the advance of the railroad and settlement of the American west, buffalo populations greatly declined due to hunting and loss of habitat. The buffalo populations residing in Yellowstone National Park reached historic lows in the early 1900s. A concerted effort began to rejuvenate and manage this last free-roaming buffalo herd that has continuously occupied its native habitat. That herd is now referred to as the Yellowstone buffalo herd. Over the last century, the Yellowstone buffalo herd has grown from 23 individuals to over 4000.

Migration

The political boundaries of Yellowstone National Park do not wholly encompass the current migration patterns of the Yellowstone buffalo herd. A portion of the current herd annually migrates into lowland parts of Montana in search of more abundant food. Recently, an increased migration of the bison outside of the park has been observed during winter months. There is much disagreement about the actual cause of the increased migration. Three primary explanations have emerged that include population increases, winter severity, and the use of travel corridors.

Brucellosis

Brucellosis, a disease that infects both bison and cattle, is caused by the bacteria *Brucella abortus*. It is an infection of the reproductive tract and is transmitted primarily through contact with the reproductive tissue from an infected animal. The migration of the Yellowstone buffalo into surrounding states poses a problem because the buffalo are carriers of this disease. As a result of winter migration, infected bison may come into contact with cattle herds in neighboring states. This interaction increases the potential to cause significant economic impacts on the cattle industry, which is a specific concern for the state of Montana. In the winter, Yellowstone buffalo tend to migrate onto lowland areas in Montana. This annual migration increases the state's risk of losing their federal "brucellosis-free" designation, as described in this report.

Legislation

In recognition of the buffalo herd's unique plight in Yellowstone National Park, the Yellowstone Buffalo Preservation Act aims to provide safe winter grazing areas that extend outside of the Park's boundaries. The Act directs the Secretary of the Interior to secure access to lands outside the Park through land acquisitions, easements, and exchanges. It also recommends the temporal and spatial separation of cattle and buffalo herds as a means to reduce the possibility of brucellosis transmission. Finally, the Act designates the National Park Service as the sole management agency of the herd within the park, calls for disassembly of one capture facility, and suggests the use of vaccinations in cattle to reduce the risk of contracting brucellosis. The Act allots three years for implementing the goals as described above. It outlines certain prohibited actions, penalties for committing these actions, and rewards for individuals who provide information contributing to conviction of violators.

Solutions

The solutions outlined in the Act include: land acquisition, land exchange, and conservation easements; temporal and spatial separation of herds; and vaccination of cattle. The United States Forest Service and the Rocky Mountain Elk Foundation are in the process of finalizing a multi-phase land acquisition, exchange, and easement transaction with the Church Universal and Triumphant. This would enable the buffalo to graze in protected corridors north of Yellowstone National Park. The second component to minimize the risk of brucellosis transmission is the spatial and temporal separation of cattle and buffalo herds. The Act states several ways in which to achieve this separation and leaves opportunities for additional separation strategies once a management plan has been created and implemented. Finally, the Act proposes the vaccination of cattle as a means for controlling brucellosis. There are currently two vaccines available, Strain 19 and RB51, however, uncertainties exist regarding the efficacy of these vaccines. Through a combination of these solutions, the Act intends to protect the Yellowstone buffalo herd and surrounding cattle populations.

Measuring Success

Determining the success of the Act requires measuring the proposed interim solutions and stated goals of protecting the Yellowstone buffalo herd. There are several indicators that can be monitored. For the interim period, this includes the number of recorded violations and penalties and the progress of the Duties to be implemented within three years. When the Duties of the Act are implemented, some indicators to be monitored for success include: the change in buffalo population size, the number of slaughtered buffalo, and prevalence of brucellosis in cattle and bison herds

Conclusions and Direction for Future Research

Once viewed as a hunted commodity the American buffalo are now seen as a national treasure. The Yellowstone Buffalo Preservation Act provides a resolution to the conflicting interests of the cattle industry and conservationists. It outlines several Duties to be completed by the National Park Service to ensure the safety of the free-roaming buffalo herd. The Act includes provisions for extending the buffalo winter migration area into federal and private lands surrounding the Park. It also directs the Secretary of the Interior to take steps to separate cattle and buffalo herds, a critical component for preventing the transmission of brucellosis and maintaining the support of the cattle industry.

Future research should be directed at addressing the scientific uncertainties surrounding this Act. Questions exist about the reasons behind the buffalo migration, the prevalence of brucellosis in the bison herds, the efficacy of vaccines and tests, and the role that elk play as carriers of brucellosis. Each of these issues could potentially affect the success of the Yellowstone Buffalo Preservation Act and should be investigated further.

1. BACKGROUND

1.1. Buffalo

The American bison *(Bison bison)*, more commonly known as buffalo, have roamed North America as the largest land mammal since the end of the Ice Age (NBA 2004). They are gregarious as well as nomadic in nature, migrating in search of food resources throughout the year. These 800 to 2,000 pound grazing animals eat about 2 to 3 percent of their body weight per day, feeding primarily on low-lying grassy vegetation. Throughout history they ranged the grasslands, meadows, foothills, and plateaus of North America. Bison populations in North America were once very abundant, ranging from an estimated 30 million to 75 million. These large populations declined as the early European explorers pushed west. By the year 1819 most of the bison east of the Mississippi were annihilated. In the 1830s the American Fur Company and Hudson Bay Company started to view bison pelts as a valuable commodity. By 1840 the majority of bison west of the Rocky Mountains were gone. With the advance of the railroad and settlement of the American west during the 1850s, there was widespread slaughter of the plains buffalo (Arthun and Holechek 2004). By 1902 the herd residing in Yellowstone National Park had been reduced to 23 individuals.

Populations have rebounded over the last century, with a steady increase over the last 20 years (Dobson and Meagher 1996). The population rise began shortly after the turn of the century due to intensive protection programs (see Figure 1). In the early 1930s a program was instituted to control the population through culling, or removal of unwanted individuals. The program was ceased in the late 1960s and the Park adopted a strategy of natural regulation, allowing environmental pressures to control the population size of the Yellowstone buffalo herd. As is clearly displayed in Figure 1, the population grew steadily after the institution of the new policy. Currently there are an estimated 150,000 buffalo across the United States (US) with 4100 free ranging bison in Yellowstone National Park (BMPEIS 2003). The herd that currently resides in Yellowstone National Park is a descendent population from the historic population and is probably the only place that a herd has been grazing since prehistoric times (NPS 2003a). The buffalo population is divided into three smaller herds – the Mary Mountain herd in the Madison River valley, the Pelican herd in southeastern Yellowstone, and the Northern Range herd in the Yellowstone River and Lamar River valleys (Ferrari and Garrott 2002; Thorne et al. 1991). According to the US General Accounting Office (GAO) (1997) the Northern Range herd is comprised of approximately 900 bison, some of which migrate beyond the northern border of the Park during winter. Appendix 1 illustrates the main wintering valleys for the Yellowstone buffalo.

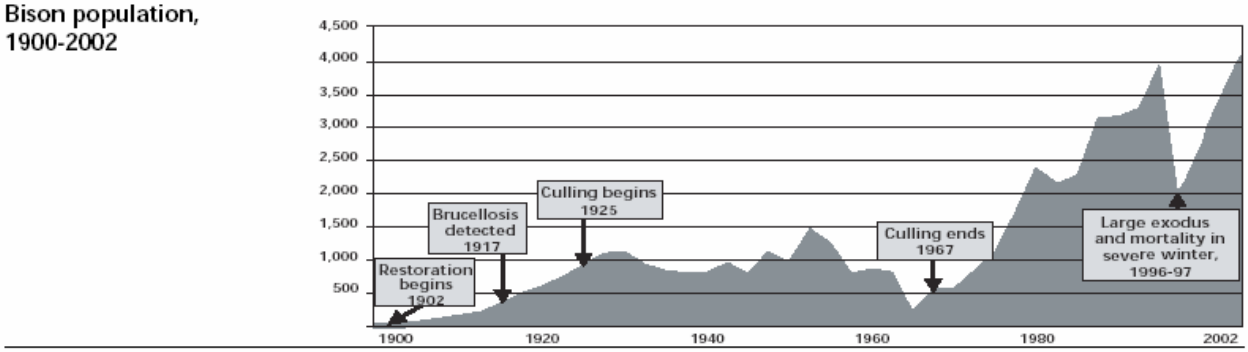

Figure 1: This graph illustrates the population trends of the Yellowstone buffalo during the 20th century (NPS 2003b).

1.2 Migration

For thousands of years, bison have migrated in and out of the area designated by the United States as Yellowstone National Park. Buffalo are characteristically nomadic (Rezendes 1997) because they require large quantities of forage. On average, adult bison require approximately 30 pounds of forage per day (Evans and Probasco 1977). Part of the current Yellowstone buffalo herd migrates outside of the Park boundary into Montana in search of lower elevation lands with more abundant food (Appendix 2). They find critical resources primarily in the Gallatin National Forest and on private lands to the north and west of the Park. The number of animals leaving the park and the extent to which they migrate varies yearly. Recently, an increased migration has been observed during winter months. There is much disagreement about the actual cause of this increased migration. Three primary explanations have emerged: population increases, winter severity, and use of travel corridors.

Population Increases

From 1935-1967 the National Park Service (NPS) controlled the bison population through culling, or the removal of unwanted or undesirable individuals (Rezendes 1997). In 1974 the Park adopted a natural regulation approach to management of the buffalo herd, allowing environmental factors to control the growth of the population. When the policy changed and they no longer removed animals, the population steadily increased. The herd has grown from a population that was once maintained at around 1000 animals (Dobson and Meagher 1996) to a population of over 4000 animals. According to the limits established by the NPS under the 2000 Bison Management Plan, 3000 bison is the "ecological carrying capacity," or the number of bison that Yellowstone National Park can support without damage to natural resources (YNP Planning 2000). Many believe the increase in numbers and resulting competition for available resources has caused the extended migration out of the park in search of adequate grazing lands.

Winter Severity

Furthermore, there is an apparent correlation between winter severity and the extent of the herd migration. The northern part of Yellowstone National Park has elevations ranging from 1500m to 2400m, which is generally lower and warmer than southern portions of the Park (elevations between 2300 and 2600m). Consequently, the northern range tends to receive less snowfall (Singer 1991), in turn, providing better winter grazing for the buffalo. However, as forage is affected by yearly fluctuations in seasons, the migration range fluctuates as well (Meagher 1989a). During more severe winters when there is greater snow accumulation, the buffalo migrate to lower elevations outside the park. Further studies indicate that competition for resources is not the only factor governing dispersal. Meagher (1989a) compared the severe and mild winter migrations of the northern herd of buffalo. Results showed that the herd migrated even during more mild winters, suggesting that the buffalo might be migrating in an attempt to recolonize historical habitat.

Use of Travel Corridors

Finally, there is research to suggest the extended migration is influenced by the use of snowmobile paths and plowed roads (Appendix 2). Ferrari and Garrot (2002) noted that buffalo seek out areas with less snow cover to minimize energy expenditure during travel. The NPS plows roads and pathways in the winter, providing easily traversable corridors for the buffalo to leave the Park. Meagher (1989(a)(b); 1996) found that travel along these corridors was a primary factor affecting the herd's migration outside the Park boundaries. The increased access to resources outside the park, in turn, affects the natural regulation of the buffalo population by effectively increasing the carrying capacity (Meagher 1990).

Whatever the reasons are behind the Yellowstone buffalo migration, the fact remains that it is happening. Management of the increasing migration pattern creates contention between interested parties. The areas where the buffalo migrate are shared with cattle. Buffalo are carriers of a disease, brucellosis, which can be transmitted to cattle. This report outlines the science behind brucellosis followed by an explanation of the controversy that has arisen.

1.3 Brucellosis

The bacteria *B. abortus* causes brucellosis, a disease that infects both bison and cattle. It is an infection of the reproductive tract and transmitted primarily through contact with the reproductive tissue from an infected animal. The hallmark of the disease is the abortion of the first calf. Other effects include lowered reproductive ability, sterility, poor growth in calves, and decreased milk production. Brucellosis can also be transmitted to calves at the time of birth and by grazing on contaminated forage, as the bacteria can remain viable in the environment for two weeks and up to one hundred days in freezing conditions (Galloway 1974 as cited in McLeod and VanTassell 1996). However, it is not usually a sexually transmitted disease, and as such males are not considered to be vectors. The disease, though not fatal, is chronic; it can remain dormant in an organism, enabling it to spread through a population unnoticed.

Brucellosis was first detected in Yellowstone bison in 1917. The most accepted theory behind its introduction to the herd is that it was transmitted by domestic cattle raised in the park in the early 1900s to provide meat and milk for visitors (NPS 2003b). Since brucellosis is a zoonotic disease, it can be transmitted from infected animals to humans. Human infection can occur through consumption of unpasteurized dairy products from infected cows or through direct contact of open wounds or broken skin with infected animal material or meat. Human effects of the disease include undulant fever, influenza like symptoms, weakness, aches and chills. Annually, there are 100-200 human cases in the United States.

As a result of winter migration, infected bison may come into contact with cattle herds in neighboring states. Although the US GAO and National Research Council concluded there was low risk of transmission between bison and cattle, it is not impossible (HR 3446 2003). Increasing population densities, as well as naturally or artificially induced collectives of host species facilitate the transmission of infectious organisms (Meagher and Meyer 1994). As a function of their gregarious nature, bison and cattle can share the same grazing grounds, thus increasing the possibility of transmission. However, there are no known cases of brucellosis transmission from bison to cattle in the wild.

Yellowstone elk and elk from the National Elk Refuge in Jackson Hole, Wyoming were most likely exposed to the *B. abortus* bacteria during the 1930s through interactions with introduced bison on feeding grounds and cattle in winter range ranches, respectively (Meagher and Meyer 1994). Because elk are solitary animals and isolate themselves while birthing, the risk of transmission of the disease by elk may be low. Conversely, the possibility of transmission by elk can be interpreted as high since 13,000 elk roam the Greater Yellowstone Area unimpeded. Concentrations of elk have also recently increased because of the establishment of feeding grounds to facilitate hunting in Wyoming. As a result of their greater numbers and higher concentrations, there is a possibility that infected elk can come into contact with cattle or bison herds and transmit the disease. Other wildlife, such as coyotes, bears, and wolves, may serve as decontaminators of infected sites by scavenging and dispersing infected material rather than transmitting the disease (Baskin 1998).

Testing

Tests for determining the presence of brucellosis are readily available. Serological/serum tests, tissue sampling tests, brucellosis ring test (BRT), blood agglutination test, and the brucellosis card test are all used to diagnose brucellosis in an animal. Of these, serological tests are the most common.

The serology tests detect the presence of antibodies in the blood serum. The presence of these antibodies indicates that brucellosis is present in that individual or that there was a recent infection (Cheville et al. 1998). This test can be administered on any living bison or cattle with relative ease. Samples can be taken in the field and tested later in a lab setting. The tissue tests attempt to isolate the *B. abortus* bacterial strain through the sampling of an organism's tissue or body fluids. Researches must take samples from organs, tissues, or lymph nodes from the genital system; or lymph nodes of the head and neck. One study found that the accuracy of the results was correlated with the size of the sample (Cheville et al. 1998). Although believed to be more accurate than serum tests, the animal must be dead to obtain an appropriate sample, thus limiting the extent to which this test can be used.

Cattle are tested for a number of reasons. Except for steers and spayed heifers, all cattle six months or older are required to be tested, at a cost of $5 to $7 per head. Surveillance testing occurs during milk production, at the point of slaughter or sale, or if evidence of an abortion exists. If an individual has brucellosis, the originating herd(s) undergoes testing to ensure the identification and eradication of brucellosis from the population. Additional testing occurs after the loss of a state's brucellosis-free status (addressed below). Some states, such as Montana and Idaho, have been known to require testing before and after cattle enter from a state that is not brucellosis-free.

Testing bison for the presence of brucellosis happens both inside and outside the Park. A few times a year, the bison are immobilized inside the Park and blood samples are extracted for testing (Baskin 1998). If bison leave park boundaries, then they may be subjected to further testing. Estimates of the prevalence of the disease in bison range from 10-60% depending on the type of test that is administered. According to serological tests, the prevalence of

brucellosis within the Yellowstone bison herd is between 40% and 60%, whereas tissue tests detected the disease at a rate of 10-20% (Dobson and Meagher 1996).

Brucellosis-free Status

The possibility of transmission threatens the brucellosis-free status of cattle herding states. Brucellosis-free status is a federally designated safety indicator affirming that no cases of brucellosis transmissions or infections in livestock have occurred; therefore human consumption of derived products will not pose the risk of brucellosis infection. The certified brucellosis-free herd status is valid for twelve months unless the herd becomes infected or participates in a whole-herd vaccination plan (APHIS 1998). This status has implications for trade on a domestic and international level.

If brucellosis is detected livestock, the entire herd is quarantined and tested. Animals that react positively when tested (reactors) are tagged, branded and moved to a recognized slaughter establishment within 15 days. If temporarily held in intermediate handling facilities, the reactors are segregated from all other classes of livestock in specially designated pens. Individual animals or the entire herd may be slaughtered if evidence of transmission within the herd exists. Efforts are made to test neighboring herds for the disease as well. State or federal officials responsible for notifying herd owners in the immediate community about the presence of cattle and/or bison herds that have been placed under quarantine for brucellosis. These officials must also establish quarantined feedlots and pastures (APHIS 1998). If the disease has spread beyond the local confines of a single herd, the state loses its brucellosis-free status.

To retain or reinstate a state's brucellosis-free status the following conditions must be met:

1) cattle and/or bison herds in the state must remain free from infections of *B. abortus* for at least 12 months
2) all quarantined cattle and/or bison herds in which the bacteria was known to exist must be legally released to an approved slaughter establishment before certification
3) all herds of other domestic livestock species in which the bacteria has been found or suspected must be tested negative, slaughtered, or quarantined, leaving no known uncontrolled site of infection
4) a minimum of 95 percent of the cases for the previous 12 months must be successfully closed (APHIS 1998).

As of April 2004, 48 states were designated as brucellosis free, Wyoming and Texas having recently lost their certified status (APHIS 2004).

2. THE CONTROVERSY: BUFFALO MIGRATION AND BRUCELLOSIS

When buffalo migrate outside the park into the surrounding federal and private lands in the state of Montana, they encounter cattle herds. According to the US GAO (1999), there are approximately 300 cattle on private lands and 80 on public lands north of the Park. To the west of the park there are approximately 350 cattle present during the period of time when the bison are likely to migrate. This is a total of about 730 cattle that could encounter the buffalo during the seasonal migration. As carriers of brucellosis, the Yellowstone buffalo pose a threat to the Montana cattle industry. The Yellowstone buffalo are known carriers of the disease and, consequently, there is risk of transmission to cattle in the area during winter migration outside the Park boundaries. Therefore, the environmental problem creates a clash between two distinct interests. Conservation groups and Native American Tribes value the Yellowstone buffalo as genetically unique remnants of an important American icon (Eilperin 2004). Cattle ranchers and the Montana Department of Livestock (DOL) believe the risk of losing their brucellosis-free status is too high, making them vulnerable to significant economic losses. Currently, buffalo that leave the safety of the Park boundaries are subject to harassment and risk being killed by landowners who are trying to prevent the transmission of brucellosis from the buffalo to cattle.

2.1 Key Players

The key players involved in the issues pertaining to management of the Yellowstone buffalo herd are the National Park Service (NPS); US Forest Service (USFS); US Fish and Wildlife Service (USFWS); the Bureau of Land Management (BLM); US Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS); State of Montana Department of Fish, Wildlife and Parks; and Montana DOL. There are many other groups that have a vested interest in this issue. These include environmental action groups, community groups, and cattle ranchers in all three states, especially Montana. Montana has a unique interest in the management of the Yellowstone buffalo because the seasonal migration corridors utilized by the buffalo extend into Montana. Thus, the buffalo may come into contact with cattle, raising concerns about disease transmission, addressed below.

The NPS has been involved in the management of the Yellowstone buffalo herd since the early 1900s (Yellowstone National Park Planning 2000). The NPS works with APHIS and other key federal agencies to ensure the maintenance of a healthy herd that does not pose a threat to local livestock or humans. The livestock industry and the Department of Livestock are concerned about the possible spread of brucellosis. Thus, they maintain that all bison herds should be separated from cattle herds. There is a strong belief that these bison should be tested and slaughtered, which is part of the current strategy.

Environmental action groups and some community groups have been pushing to end all slaughter of the bison from Yellowstone. Representatives from the National Parks Conservation Association have stated that they believe there should be an end to "the years of seasonal hazing, capture, and killing of buffalo in and around Yellowstone National Park by federal and state agencies until specific, common sense conditions are met" (NPCA 2004).

2.2 Economic Implications of Brucellosis

The beef industry is a significant generator of income for the Montana economy. More than 20,000 jobs and $800 million in personal income are generated annually by the beef and meat processing industries (Lawrence and Otto 2002). Montana is the eleventh largest cattle

inventory state and the sixth largest beef-cow state with an estimated 2.55 million head of cattle in 1992. For the same year, marketing and cash receipts totaled $921 million and $781 million, respectively (Lawrence and Otto 2002). The cattle industry also generates downstream economic benefits throughout the economy such as purchased inputs, supplies and services used by cattle producers, meat preparation and processing.

Retaining a brucellosis-free status has significant economic importance for cattle herding states such as Montana. The annual cost to retain brucellosis-free status to US dairy and beef producers is an estimated $30 million (Bittner 2004). Loss of this status negatively impacts the cattle industry as it curtails avenues for trade and increases costs of production to farmers. In 1951, the estimated losses in production for US dairy producers totaled nearly $500 million (reported in 1993 dollars) (Bittner 2004). Since the institutionalization of the Co-operative State-Federal Brucellosis Eradiation program in 1934, $3.5 billion was spent on eradication measures which included surveillance testing at farms, stock markets, slaughter facilities, quarantines, herd depopulation, herd management and vaccination efforts (Bittner 2004).

According to the Montana Department of Livestock Executive Officer, the loss of brucellosis-free status "could be devastating" to a state with a large livestock industry (Discovering Montana 2002). Wyoming lost its brucellosis-free status in February 2004 after animals in two herds in Sublette County and Washakie County were infected with brucellosis, due to a suspected transmission from elk. The economic losses associated with brucellosis infection are caused by the extensive mandatory testing and vaccination procedures involved, reduced milk production, lower beef yield, induced abortions, replacement animals, decreased fertility, and non-viable or slow growing calves. Although cattle farmers are compensated for the slaughter of infected animals by the federal government, the genetic progress, overall quality of the herd, and reputation of the owner suffer. For the 1994 fiscal year, the federal and state governments spent $694,000 in Wyoming as part of the national eradication program (Bittner 2004). Research shows that if brucellosis eradication efforts were to be eliminated, the cost of producing beef and milk would increase by approximately $80 million annually in less than ten years (Bittner 2004). Estimates also suggest that new emergency testing requirements on breeder cattle may cost producers $1-2 million annually, which may have a significant impact on a state's sparse populations and lack of economic diversification. Some state governments are helping with the additional testing by paying a percentage of the cost. For example, in Wyoming the state paid $3.50 per head for supplemental testing. However, this usually does not cover the entire cost of testing and ranchers are required to pay the remainder (State of Wyoming 2004).

2.3 Current Control Efforts

The most recent management plan proposed for the Yellowstone buffalo herd is the Modified Preferred Alternative of the Draft Environmental Impact Statement for the Interagency Bison Management Plan for the State of Montana and Yellowstone National Park. This plan was created through the cooperation of various federal and state agencies. The main agencies involved in this plan are the Department of the Interior, NPS, USDA, USFS, APHIS, and the state of Montana (Buffalo Field Campaign 1999; Discovering Montana 2004; NPS 2003a).

In accordance with this plan, participating agencies will first attempt to haze (see Section 9. Definitions) Yellowstone buffalo that travel outside the boundaries of Yellowstone back into the Park. When hazing is not effective, bison found outside of the park may be captured and tested for brucellosis. Agencies may capture and slaughter bison that test positive (seropositive) and pregnant females that do not respond to hazing (NPS 2003a).

Winter grazing corridors for bison have been designated outside the North and West Entrances of the park (Appendix 2). The Modified Preferred Alternative Plan designates dates by which bison must leave the management zones and return to the park. This creates a temporal separation for any livestock that might be grazing in the management zones during the spring, summer, and fall. The plan outlines a 45-day separation period. The separation period signifies that all bison must be out of the grazing corridors and back within the Park boundaries 45 days before cattle are allowed to graze in any area of the bison migration corridors. If bison are still present, they may be hazed off prohibited lands. If hazing is ineffective, "Agency (NPS) personnel…[may] shoot bison that could not be hazed, evaded capture, or were deemed unsafe to handle (usually large adult males)". Bison may also be hazed off private lands if requested by the landowner (NPS 2004).

3. THE LEGISLATION: THE YELLOWSTONE BUFFALO PRESERVATION ACT

3.1 Purpose

The main goal of the Yellowstone Buffalo Preservation Act (HR 3446) is to provide for the protection of the buffalo herd that resides in Yellowstone National Park and migrates to areas outside of the Park. This single herd of buffalo is the focus of this legislation because it is the only wild and genetically pure herd in the United States that has continuously occupied its original, or native, habitat. The Act identifies the American buffalo as an important "wildlife icon of the United States" that is "profoundly significant to Native American cultures" and has "influenced our history" as a nation (HR 3446 2003). In recognition of the Yellowstone buffalo herd's unique plight in Yellowstone National Park, the Act aims to provide safe winter grazing areas that extend outside of the Park's boundaries.

Management of the Yellowstone buffalo herd has been a concern for the state of Wyoming, where Yellowstone National Park is located. It has also been a concern for the states of Idaho and Montana, which share borders with Yellowstone National Park. In addition, private landowners and several government agencies, including the NPS, the USFWS, and the BLM have been concerned with the management issues of the herd. For over ten years, representatives from the above named agencies have attempted to devise a solution to the complex issue of managing the Yellowstone buffalo herd. This Act provides a legislative base upon which a management plan may be developed. There are four main issues addressed in the Act. These include: providing safe access for grazing on federal and private lands outside the boundary of Yellowstone National Park, the management of the herd while inside Park boundaries, the use of capture facilities, and the risk of buffalo infecting cattle herds with brucellosis.

3.2 Duties

The Yellowstone Buffalo Preservation Act sets a deadline for the completion of specific Duties. These Duties should be carried out within three years of this legislation's ratification and are to be ensured by the Secretary and other "appropriate Federal agencies".

Definitions

The following definitions are provided in the Act and are necessary to understand the Duties and interim regulations:

- Hazing – "any individual effort to drive away, obstruct, chase, scare, or deter natural movements of wildlife, including hazing efforts carried out on foot or horseback or efforts aided by machinery, aircraft, or any type of noise-making device"
- Individual – "any person representing a State or Federal Government"
- Park – "Yellowstone National Park"
- Secretary – "Secretary of the Interior"
- Yellowstone buffalo herd – "the wild, free roaming, unfenced buffalo living primarily within Yellowstone National Park"

Providing Safe Access for Grazing on Federal and Private Lands Outside the Boundary of Yellowstone National Park

The Act mandates that Zones 2 and 3 (Appendix 3) of the Gallatin National Forest be designated as lands where buffalo can freely roam without being hazed. These zones are recommended in the Modified Preferred Alternative section of the 2000 Bison Management Plan for the State of Montana and Yellowstone National Park Final Environmental Impact Statement. This plan was created in 1999 and modified in 2000 by the Department of the Interior, NPS, USDA, USFS, and APHIS as the preferred alternative for managing the Yellowstone buffalo herd.

Furthermore, the Act recommends the finalization of the land easement agreement allowing access to other key habitats (Appendix 4). During the winter months, part of the Yellowstone buffalo herd migrates outside of the Park boundary to surrounding areas of lower elevation in search of food. They find critical resources in the Gallatin National Forest to the north and west of the Park. There are also parcels of private lands that inhibit accessibility to lands along the Yellowstone River. Federal agencies have been working to secure a private land easement for this section. Currently, the buffalo that leave the Park boundaries are subject to harassment and risk of being killed by stakeholders who are trying to prevent the transmission of brucellosis from the buffalo to cattle. Allocation of the above named lands and finalizing the land easement agreement would guarantee safe access to critical habitat needed by the buffalo in the winter months.

Management of the Herd While Inside Park Boundaries

Under the Act, it is recommended that the management of the buffalo herd within Park boundaries continue to be the sole responsibility of the NPS. Currently, the management of the buffalo herd while inside the boundaries of Yellowstone National Park is the sole responsibility of the NPS. The NPS used various techniques in the past and continue to monitor the effects of their management approach. The NPS has been charged with conserving the land and wildlife within the Park boundaries. The Act explicitly preserves this responsibility.

Capture Facilities

The capture facilities are used to prevent buffalo from migrating into Montana and to confine the buffalo during testing for brucellosis. If brucellosis is detected from testing, the animal is slaughtered. The Act calls for the disassembling of the Stephens Creek Buffalo Capture Facility located within the boundaries of Yellowstone National Park.

The Risk of Buffalo Infecting Cattle Herds with Brucellosis

The Act recommends that the spread of brucellosis be controlled through cattle vaccination, cooperation with landowners, and separation of livestock from the buffalo on a temporal and spatial scale. The buffalo herd generally migrates outside of the Park boundaries during the winter season. At this time there are

only about 730 cattle in the area. Brucellosis is a disease that can cause abortions in cattle. The state of Montana is concerned that cattle herds will contract the disease from infected buffalo, putting them at risk of losing their "brucellosis-free" designation. This would result in the necessity of costly vaccinations and limit the trading across state lines. The Yellowstone buffalo herd is one of the few remaining animal populations that are still carriers of brucellosis. However, questions exist about the ability of brucellosis to spread from buffalo to cattle. Despite this, the Act calls for measures to prevent the spread of the disease such as separation of herds, landowner incentives, and cattle vaccination.

3.3 Interim Period

The Act specifies an interim period between the Act's enactment and the completion of Duties outlined within the Act. During this interim period there are certain prohibited acts, penalties, rewards, and a few exceptions to the regulations. The interim period should be completed upon successful implementation of the Duties, three years from the enactment.

Prohibited Acts

The Act prohibits hazing, capturing, or killing any buffalo on land held by the federal government or under a federal conservation easement. It also prohibits luring buffalo from federal to private land.

Penalties, Rewards, and Exceptions

There will be penalties for any individual who commits a prohibited act. An individual will be fined not more than $5,000 or imprisoned not more than 1 year or both for an initial violation of the prohibited acts. For subsequent violations, an individual will be fined not more than $10,000 or imprisoned not more than 2 years or both. There will also be rewards for individuals who provide information that leads to a conviction resulting from violation of the prohibited acts. Anyone who provides information that leads to a conviction will receive one half of the fine collected from the violator or $2,500, whichever is less. These penalties do not apply to anyone who hazes a buffalo as a result of physical endangerment or damage to private property.

4. SOLUTIONS

There are several solutions outlined specifically by the Act, including land transactions, temporal and spatial separation of herds, and the use of vaccines in cattle. These provide the base for developing a management plan, upon which adaptable strategies can be built.

4.1 Land Acquisition, Easement, and Exchange

The Yellowstone Buffalo Preservation Act defines the finalization of land agreements as one of the Duties to be carried out during the initial three years of implementation. In recent years, taxpayers in the area have supported a land purchase, exchange, and easement transaction on several parcels of the Royal Teton Ranch, located outside the North Entrance of Yellowstone National Park. Owned by the Church Universal and Triumphant, this ranch is comprised of key access points to foraging lands in the Yellowstone River valley. The Rocky Mountain Elk Foundation and the USFS helped finalize the two-phase deal with the Church.

The two parts of Phase I were completed in 1998 and 1999, resulting in over 3000 acres being acquired by the USFS. Phase II of the land deal was finalized in 1999. The second phase involved the acquisition of approximately 2000 acres and the designation of an additional 1500 acres as a conservation easement. Under the conservation easement, the Church maintains ownership and tax responsibility. However, restrictions are placed on the use of the land in exchange for money. Currently, the land exchange between the Church Universal and Triumphant and the USFS is still underway. Completion of this final portion will resolve the existing "checkerboard pattern" of private land parcels surrounding Yellowstone River, thereby easing access for the bison to the lowland vegetation. Appendix 5 outlines the parcels located north of the Park that are involved in the land transaction and displays the change in ownership (Montana Cadastral Mapping Program 2004).

4.2 Separation of Herds

The Act directs the Secretary to "make every effort practicable to allow the Yellowstone buffalo herd to freely roam federal lands through… landowner agreement pertaining to temporal and spatial separation of livestock from the Yellowstone buffalo herd" (HR 3446 2003). Currently, livestock grazing areas overlap the bison's traditional lowland winter habitat. The concern surrounding risk of brucellosis transmission to cattle highlights the necessity of temporal and spatial separation of livestock from the Yellowstone buffalo herd. The Act mentions several ways to achieve this separation and leaves opportunities for additional separation strategies once a management plan has been created and implemented. The designation of additional lands surrounding Yellowstone National Park, where the buffalo can freely roam, will help to create spatial separation between the cattle and buffalo herds.

This legislation establishes winter grazing corridors on federally managed lands to the north and west of the park. These lands consist of private land easements, land exchanges with private landowners and current livestock grazing leases as well as the designation of portions of Gallatin National Forest as safe grazing areas for bison (HR 3446 2003). This would inhibit the grazing of cattle on land designated for bison. Other measures, not specifically addressed in this Act, would need to be developed and enacted to assure separation. An example of this would be designated separation periods on land that might be used during different seasons by bison and cattle, such as that designated in the current Modified Preferred Alternative Plan (NPS 2004).

4.3 Vaccinations

Vaccines are used to control infections caused by bacteria and their toxins, parasites, and viruses. They are a crucial disease control component in intensive husbandry and animal management systems (Biggs 1985). Some believe vaccination is one of the potential mechanisms that could be used to control or eliminate the *B. abortus* bacteria in cattle in the Greater Yellowstone Area. The two vaccines that are used to treat the disease in cattle are the *B. abortus* Strain 19 (Strain 19) and the *B. abortus* Strain RB51 (RB51). Bison in captivity are usually vaccinated using protocols adapted from use in cattle herds and some elk are vaccinated at feeding grounds (Cheville et al. 1998). The main methods of delivery of these vaccines are by subcutaneous hand injection (preferred method), dart, bio-bullets and oral administration (Cheville et al. 1998).

Brucella abortus Strain 19

Strain 19 is an attenuated live strain of the bacteria which forces the animal to build immunity without contracting the disease. It has been shown to be 67% effective (APHIS 2004; Cheville et al. 1998). Strain 19 played a major role in the USDA brucellosis eradication effort in cattle from the 1930s to 1996. During the 1960s, bison calves in national and state parks were also vaccinated with Strain 19 as part of a program to control brucellosis. These chronically infected herds were declared free of brucellosis ten years after the start of the Strain 19 vaccination and management (including test and slaughter) program. However, when adult female bison were vaccinated, although the symptoms and infection rates decreased, the vaccine also caused abortions (Cheville et al. 1998). Some biosafety and efficacy studies reveal that Strain 19 appeared to be more virulent in bison than in cattle and induced a higher rate of abortions in pregnant bison (Cheville et al. 1998). The main disadvantage of using this vaccine to treat brucellosis is that it has been shown to induce abortions in pregnant cattle by inflammation of the placenta and necrosis (death) of living tissues. Additionally, it can produce false positives in surveillance tests and can cause disease in humans (Cheville et al. 1998).

Brucella abortus Strain RB51

RB51 has replaced the Strain 19 vaccine for cattle and is a recombinant form of the *B. abortus* bacteria. Licensed by the USDA APHIS in February 1996, its genetic arrangement creates a stable, maintainable molecular structure that is different from Strain 19 (Kowalaski et al. 2004). The bacterial surface of RB51 does not possess the characteristics which cause the false positive results in Strain 19 (APHIS 2004). It induces production of other types of antibodies that can be detected with a special assay to identify if an animal has been vaccinated (APHIS 2004). Although it is still under testing, the vaccine is estimated to be highly effective in cattle, but the data is limited on its use in bison and elk (APHIS 2004).

Although RB51 has been shown to cause abortions in pregnant cattle and bison, it is effective when given to calves. Furthermore, the brucellosis-free results that took ten years to appear with Strain 19, occurred one week after vaccination. Another important benefit is that females can later pass on immunity

to a fetus when vaccinated with the RB51 strain (Kowalaski et al. 2004). Animals that are over 12 months of age are vaccinated only if they are in high-risk herds (APHIS 2004).

Despite its success, RB51 is not entirely safe for use in bison because it can cause inflammation of the endometrium (endometrititis) and the placenta (placentitis), or abortions. The effectiveness of this vaccine is being tested in bison and elk; however the data that is available suggest that, as seen in the cattle, the vaccines do not provide complete protection (Cheville et al. 1998). Further research is needed regarding the safety and efficacy of the vaccine in these populations with respect to the correct dose ranges, appropriate delivery methods and routes, duration of immunity and age/sex differences (Cheville et al. 1998). Given the effects that the live brucellosis vaccines can have on pregnant cattle, research is also focused on developing a vaccine from dead *Brucella* bacteria, which would protect the animal from brucellosis without causing abortions (Kowalaski et al. 2004).

5. MEASURING SUCCESS

The legislation's success in meeting its protection and management goals for the Yellowstone buffalo herd will require measuring key indicators of the proposed solutions. There are two time periods of monitoring that will need to occur: the three-year interim period and the period after the Duties are implemented. After the Yellowstone Buffalo Preservation Act is passed, there is a three-year interim period. By the conclusion of this implementation period, the Duties outlined in the Act should be completed.

5.1 Interim Period

There are prohibited acts and subsequent penalties, during the three-year implementation period. The Act explicitly forbids killing, hazing, or capturing of buffalo on federal or conservation easement lands. The success of the interim regulations can be measured in two ways. First, law enforcement records, such as the number of violations and penalties, can serve as an indicator of the success. Secondly, changes in the population size of the Yellowstone buffalo herd can also indicate the effectiveness of the prohibitions. Sampling data taken during the interim period can easily be compared to the population data prior to the Act to detect changes.

During the three-year implementation period, there are several Duties that must be performed to ensure the safety of the Yellowstone buffalo herd. The progress of these Duties can serve as an indicator of success. The following questions should be asked at the end of the interim period:

1. Is Yellowstone buffalo herd freely roaming on the designated federal lands?
2. Has the National Park Service maintained management authority of the herd inside Park boundaries?
3. Is the land acquisition, exchange, and easement transaction finalized?
4. Is the Stephens Creek Buffalo Capture Facility dismantled?
5. Has every practicable effort been made to ensure the herd can roam freely on federal lands?

If, at the end of the three years, the answer to these questions is affirmative, then the Act has succeeded in implementing the first step toward obtaining access to low-elevation habitat adjacent to the Park and protecting the free-roaming herd. If they have not been implemented, further investigation will be warranted to determine the reason for delay and a revised time schedule will need to be created.

5.2 Scientific Indicators

Success of the Act requires cooperation among stakeholders. The success of the Act needs to be addressed in the context of salient issues such as migration, the potential transmission of brucellosis, the carrying capacity of bison within Yellowstone National Park, and the separation of cattle and buffalo herds. Accurate monitoring of the effects of implementation will be critical in maintaining support.

The success of the Act after the initial three-year period can be measured using several scientific indicators. Continued routine testing is recommended to measure the control of brucellosis transmission. The detected prevalence of the disease in the cattle and bison herds can be compared to pre-Act statistics and indicate the success of cattle and bison herd separation. Monitoring of buffalo herd movements should determine the use of the migration corridors, the

preferred exit pathways from the Park into surrounding lands, and the presence of aberrations in migration. If migration trends change in the future, then the safety of the buffalo as well as the spatial and temporal separation of cattle and bison could be compromised.

The possibility exists for the bison population to increase and herds to extend their winter migration farther beyond Park borders. This may warrant the need for additional monitoring and research. Possible fields of study include: the ecological effects of grazing on vegetation communities in the established lowland areas; detection of migration outside current corridors; the carrying capacity of Yellowstone National Park; and the carrying capacity for the herd as a function of their extended habitat.

6. CONCLUSIONS

6.1 Overview of Problem and Legislation

The Yellowstone Buffalo Preservation Act considers two environmental problems: (1) the winter migration of buffalo from Yellowstone National Park into surrounding lowland regions and (2) the possible transmission of brucellosis from bison to cattle. The buffalo migrate to areas in Montana where they may come into contact with cattle. Cattle ranchers have been known to haze or kill the buffalo in attempts to protect their herds. The management of the Yellowstone buffalo herd is a contentious issue among stakeholders. While some agree with the natural management ethic of the Park, others believe measures should be taken to control the brucellosis risk through stricter haze-capture and targeted slaughtering of infected animals. This creates a conflict between the livestock industry and advocacy groups concerned about the safety of the buffalo.

There are several issues addressed in the Act: (1) the safe access for buffalo grazing on federal and private lands outside the boundary of Yellowstone National Park, (2) the management of the herd while inside Park boundaries, (3) the use of capture facilities, and (4) the risk of buffalo infecting cattle herds with brucellosis. The resolution attempts to establish a compromise between the interests of the livestock industry and the conservationists' by decreasing the risk of brucellosis transmission while sustaining the buffalo population in a non-threatening manner. By enacting this bill, the management of the buffalo within the Park will be under the sole jurisdiction of the NPS.

6.2 Directions for Future Research

Further research should be conducted to understand the factors driving migration and the prevalence of brucellosis in bison herds. There are uncertainties about the use and effectiveness of brucellosis vaccines and tests. Elk also serve as carriers of brucellosis and the significance of their role in transmitting the disease is unknown. Each of these issues should be investigated to aid in the development of appropriate mitigation measures.

Bison

There is primarily one underlying question concerning migration: what is driving the migration of the herd? Despite years of investigation, there is still no definitive answer. Some believe the herd has surpassed the winter ecological carrying capacity of the park thus driving the bison outside of park boundaries, which is exacerbated by unusually harsh winters. Others assert that snowmobile paths create easy migration routes out of the park. In the future, an understanding of these factors will be necessary if the need arises to control the migration of the buffalo outside the Park. Further research should be conducted to elucidate the underlying factors of this complicated situation.

Brucellosis

There is no debate about the presence of brucellosis in the Yellowstone buffalo herd; however, there are differing opinions regarding the prevalence of the bacteria in the herd and the risk it poses to the cattle industry in lands surrounding the Park. Some studies have concluded that approximately 10-20% of the Yellowstone population is infected. Others report that the number of infected

bison is closer to 40-60% of the population. Although there have been no documented cases of brucellosis transmission in the wild from buffalo to cattle, it has occurred in privately managed herds thus warranting concern from cattle ranchers. Research should be directed to better understand the prevalence of brucellosis in the Yellowstone herd and the risk of transmission from this wild, free-roaming population. Establishing baseline data will be essential in monitoring and measuring success.

Vaccination and Testing

The accuracy of tests used to determine the prevalence of brucellosis in the bison population is a point of significant scientific uncertainty behind the problem. The prevalence of brucellosis in the bison population is questioned due to the shortcomings of the two major tests: serum tests and tissue samples. While the serum tests show 40-60% prevalence, the tissue tests results show 10-20% prevalence. Both the serum test and tissue samples have been shown to yield inaccurate results. The serum tests have resulted in false positives and the tissue tests have resulted in false negatives.

Besides presenting inaccurate results, there are other misperceptions surrounding the use of vaccines. While some view vaccines as a cure for brucellosis, others believe vaccine utility is limited to serving as a control device. There are also many unknowns surrounding the use of vaccines. The correct dosage of the vaccine for effective protection is unknown, as well as the safety for use in different sexes and ages. There is no known efficient way of administering the vaccine to the free-roaming bison and the duration of immunity given by the vaccine is also unknown.

Complications surrounding the different tests and their interactions with the Strain 19 vaccine must be understood if a true prevalence rate will ever be determined. Unfortunately, the unknown prevalence also prevents all stakeholders and researchers from understanding the true risk that bison may pose to cattle. Without further research, development of new tests, or increased accuracy and efficiency of existing tests, the risk that bison and cattle pose to one another can never be addressed effectively.

Elk

The role elk play in the spread of brucellosis is not yet understood. There is debate as to how much contact the elk have with the cattle herds outside Park boundaries. Many believe that the risk of brucellosis transmission from elk to cattle is high due to the great number of elk in the Greater Yellowstone Area and the elks' ability to travel unimpeded in and out of the Park. Furthermore, Wyoming attracts thousands of elk to feeding grounds in the Greater Yellowstone Area for hunting purposes. However, elk are generally solitary animals that avoid cattle grazing areas and are known to isolate themselves while birthing, further reducing the risk of transmission. Although elk are in no way mentioned in the bill, they have been seen as an increasingly large threat to cattle. Wyoming, having recently lost its brucellosis free status, believes that elk were the source of the transmission to cattle. As elk become increasingly involved in the spread of

brucellosis to cattle, their overall risk as well as possible management efforts must be assessed.

6.3 Next steps

Brucellosis and the proposed solutions to manage the disease in the Park are contentious issues. The varying perceptions surrounding the different issues as well as the many uncertainties that exist increase the complexity of the situation. Efforts to bridge a compromise between the conflicting elements and involved parties are keys to the success of the Yellowstone Buffalo Preservation Act. In the upcoming months, the analysis group will develop and implement a management plan for the bison in the Yellowstone National Park based on the recommendations provided by the bill. Within this management plan a timeline summarizing specific goals and objectives for the management of bison and the control of brucellosis will be provided.

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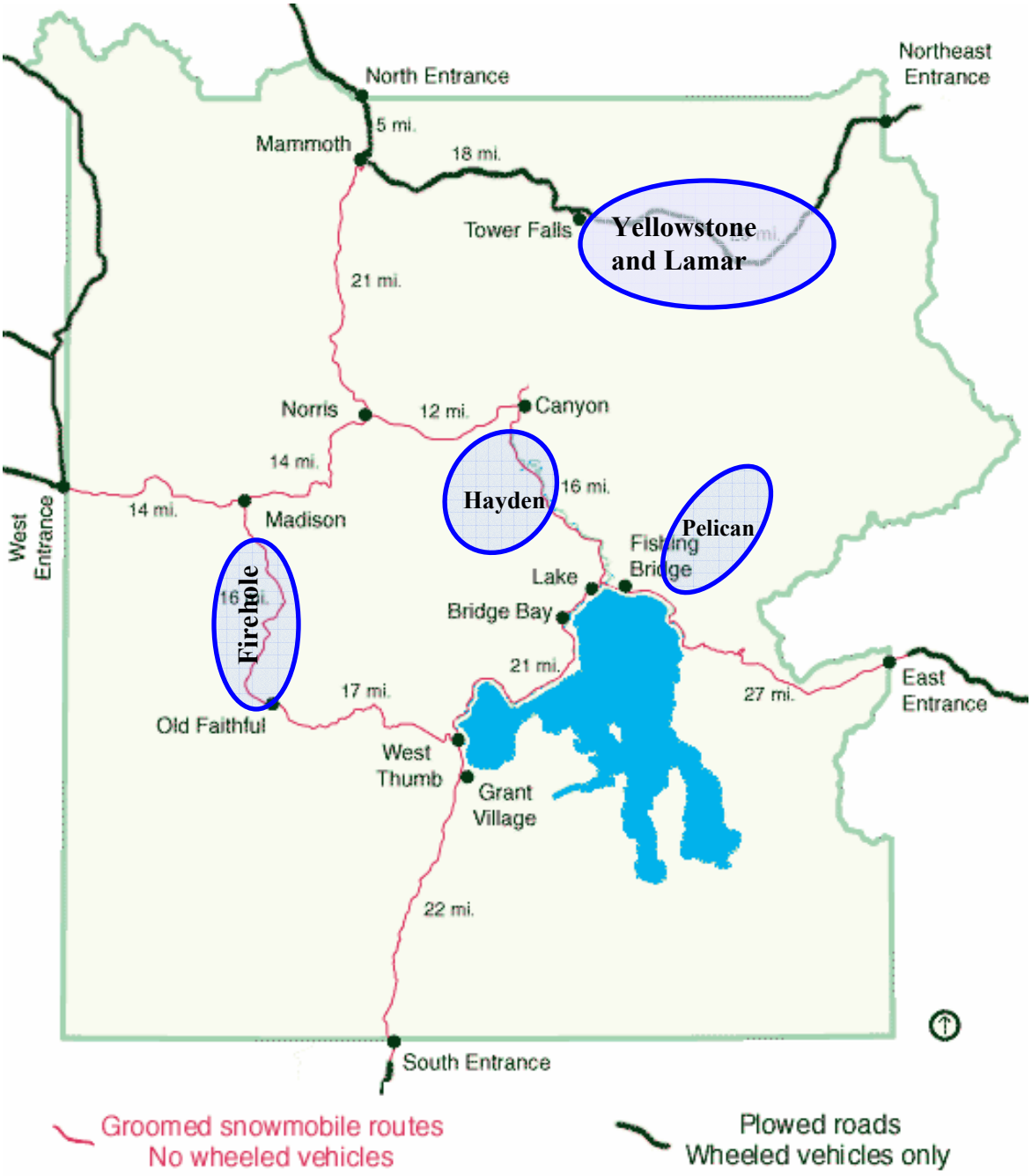
8. APPENDIXES

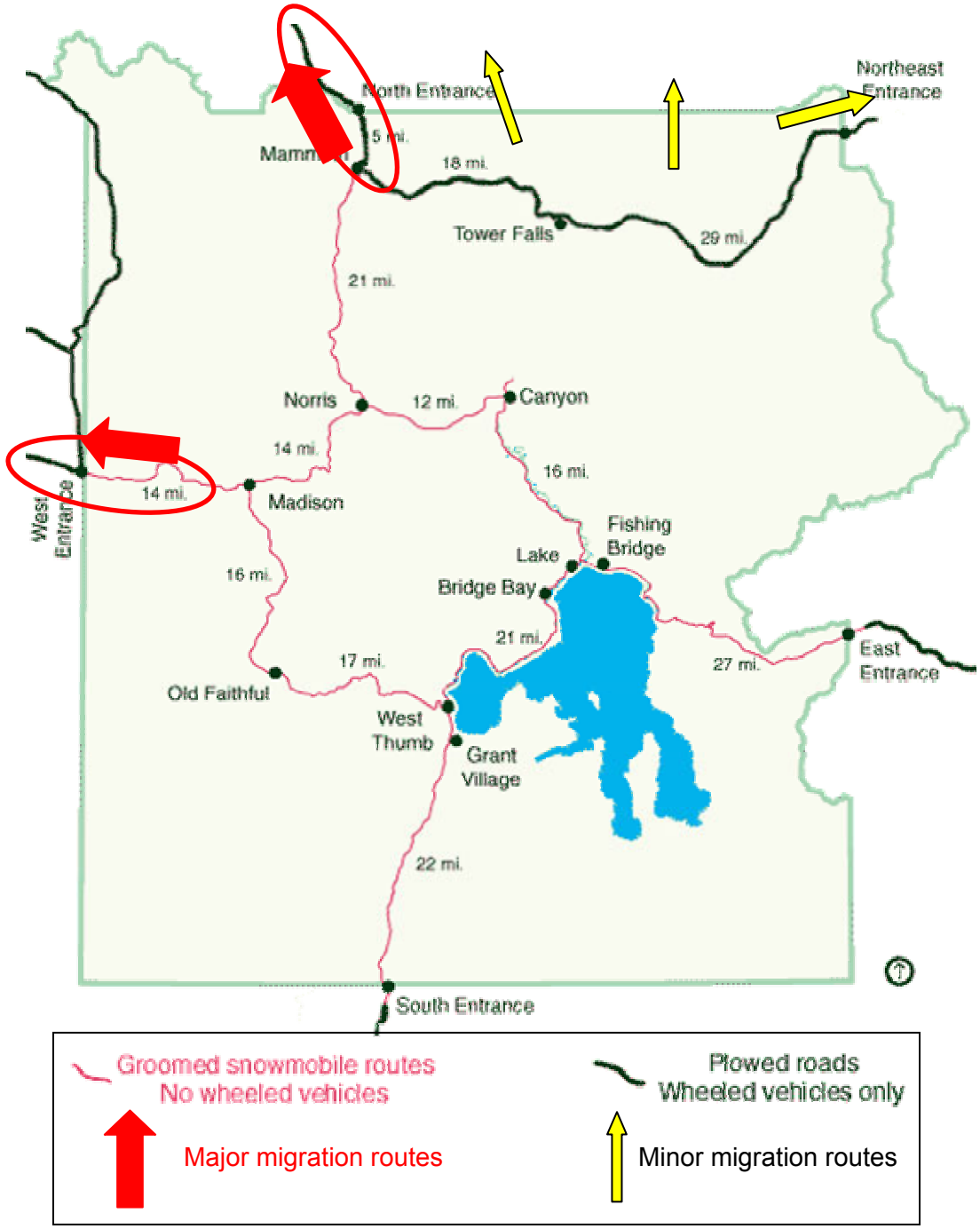
Appendix 1

Illustrates the core wintering areas within Yellowstone National Park – Lamar, Pelican, Hayden, and Firehole Valleys. (Base Map Source: Yellowstone National Park.Com 2003)



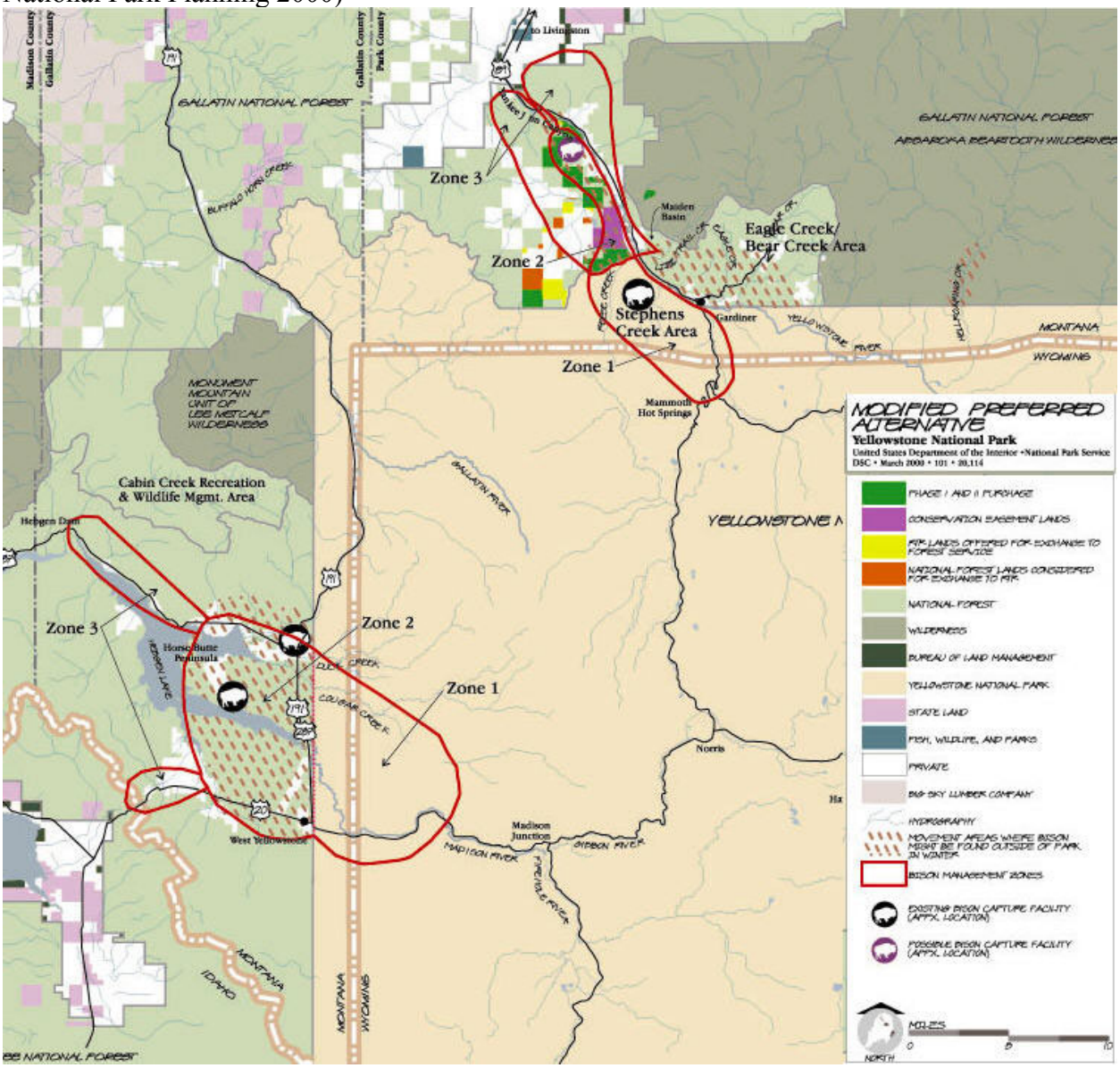
Appendix 2

Displays the winter travel corridors along groomed roads and snowmobile paths, as indicated by the red circles at the North and West Entrances. Red block arrows indicate major migration routes. Small yellow arrows are minor migration routes. (Base Map Source: Yellowstone National Park.Com 2003)



Appendix 3

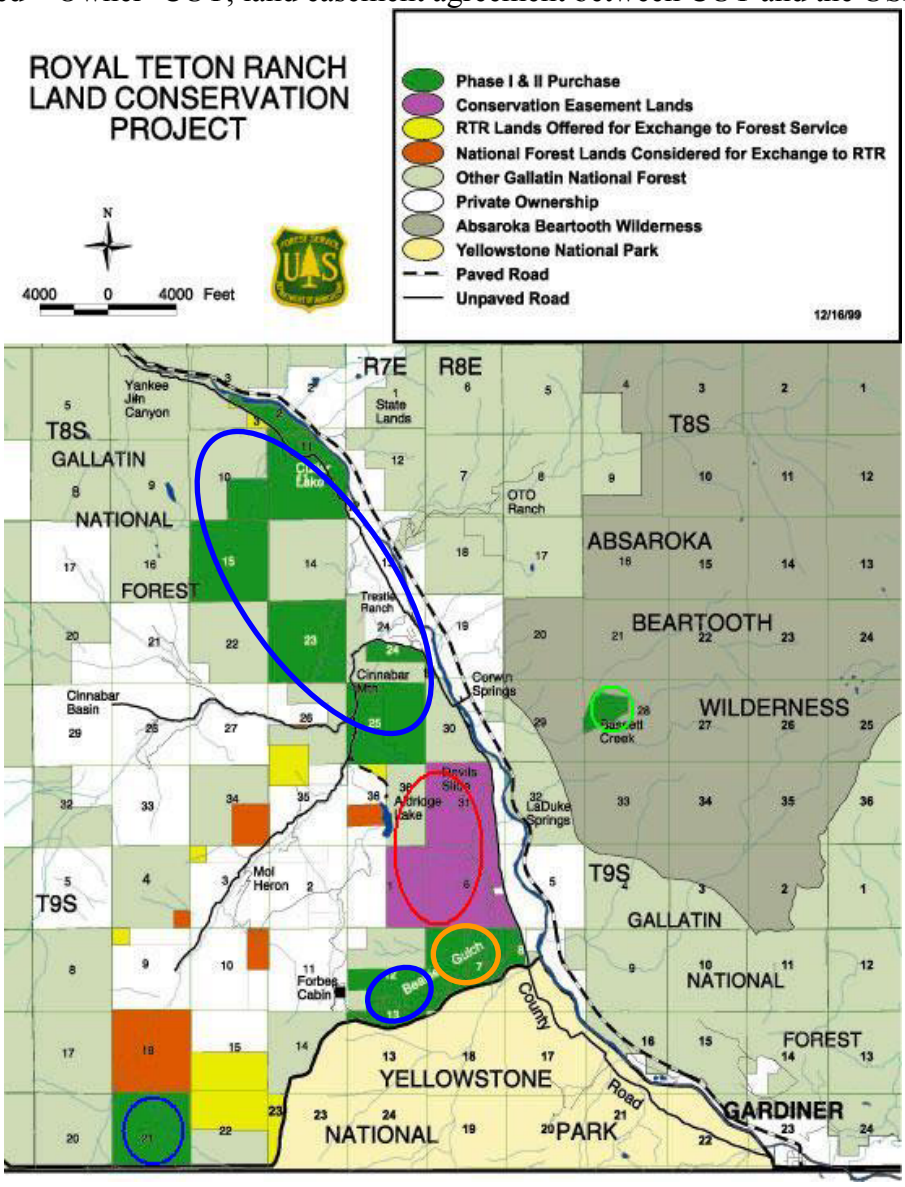
Map of Zones 2 and 3 from the Modified Preferred Alternative of the 2000 Bison Management Plan for the State of Montana and Yellowstone National Park Final Environmental Impact Statement. In these areas, bison shall be allowed to freely roam. (Map Source: Yellowstone National Park Planning 2000)



Appendix 4

According to the Montana State Cadastral Mapping Program, portions of the land deal are still in progress. As of June 2004 the majority of the land purchases were still undergoing deed transition (highlighted in blue and orange). The ownership and taxpayers for these parcels are listed below. It appears that the complete transfer of rights has not been completed. The area highlighted in red is the land easement project, also in progress. (Base Map Source: Montana Cadastral Mapping Program 2004)

- Green – complete transfer of property rights. Owner=USDA
- Blue – Owner and taxpayer is said to be USDA, but Owner Name 1=CUT; indicates that the parcel is being sold via contract for deed
- Orange – Owner=Church Universal and Triumphant (CUT); taxpayer=USDA
- Red – Owner=CUT; land easement agreement between CUT and the USDA



9. DEFINITIONS

APHIS – Animal and Plant Health Inspection Service

BLM – Bureau of Land Management
DOL – Montana Department of Livestock
NPS – National Park Service
US – United States
USDA – United States Department of Agriculture
USGAO – United States General Accounting Office
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service

Bison bison – the scientific genus and species name of the American buffalo

Brucella abortus – the bacteria that causes the disease brucellosis in cattle and bison
Brucellosis – a zoonotic disease caused by the bacteria *Brucella abortus*
Carrying capacity – the maximum number of animals an area can support

Culling – the removal of undesirable or unwanted individual in a population
Eradication – in the case of brucellosis, the elimination of the disease in host populations

Hazing – any individual effort to drive away, obstruct, chase, scare, or deter natural movements of wildlife, including hazing efforts carried out on foot or horseback or efforts aided by snowmobile, aircraft, or any type of motorized vehicle

Land easement – pertaining to the type of the Yellowstone Buffalo Preservation Act, an agreement made between the United States Department of Agriculture and a private landowner that grants access to the private land for use by the Yellowstone buffalo

Serum – a component of the blood or animal tissue used to test for disease immunity
Subcutaneous – under the skin
Transmission – the conveyance of disease from one organism to another
Vaccine – a derivative of a bacteria that induces an immune system response to a disease; in the case of brucellosis, Strain 19 and RB51 cause the formation of antibodies for brucellosis

Zoonotic – the ability of a disease to be transmitted from vertebrate animals to humans