INTERAGENCY BISON MANAGEMENT PLAN

USDA
ANIMAL AND PLANT
HEALTH INSPECTION
SERVICE

APHIS

NATIONAL PARK SERVICE

MONTANA FISH,
WILDLIFE & PARKS

Montana Fish, Wildlife & Parks

USDA
FOREST SERVICE

MONTANA DEPARTMENT
OF LIVESTOCK

CONFEDERATED SALISH
& KOOTENAI TRIBES

INTERTRIBAL BUFFALO
COOPERATIVE

NEZ PERCE TRIBE

Memorandum

October 29, 2010

To: Administrative Record

From: Interagency Bison Management Plan Partner Agencies

Subject: Annual Report, July 1, 2009 through July 31, 2010

The Interagency Bison Management Plan (IBMP) was signed in 2000 to coordinate bison management between the State of Montana and Yellowstone National Park. Eight entities are responsible for implementing the plan – the U.S. Department of Agriculture's Animal and Plant Health Inspection Service and Forest Service; the Department of the Interior's National Park Service; the State of Montana's Deparment of Fish, Wildlife, and Parks and the Department of Livestock; the Intertribal Buffalo Council; the Confederated Salish and Kootenai Tribes; and the Nez Perce Tribe.

Under the IBMP, these entities harness their respective skills and operational resources to work cooperatively within an adaptive management framework to conserve a wild, free-ranging bison population, while concurrently reducing the risk of brucellosis transmission from bison to cattle. In keeping with this adaptive management framework, the IBMP partner agencies and tribes met several times in public venues during 2009 and 2010 to deliberate on recent recommendations by the U.S. Government Accountability Office, assess the effectiveness and outcomes of IBMP management activities, and incorporate short and long-term adaptive management adjustments to the IBMP based on prevailing conditions. The partner entities created measurable objectives for the IBMP and developed a specific monitoring program to assess scientific and management questions.

The attached report includes narrative summaries that address the effects and effectiveness of each management action in the IBMP Adaptive Management Plan that was agreed-upon and signed by the partner agencies in December 2008. It also summarizes progress on the Yellowstone National Park Bison Monitoring and Surveillance Plan.

This report will be used to inform future management discussions and actions related to adaptive management for 2010-2011 and beyond. The report will be made available to the public and other interested parties through the IBMP website (ibmp.info).

Brian McCluskey, Animal and Plant Health Inspection Service	12-8-10 Date
Pat Flowers, Montana Fish, Wildlife and Parks	12/8/10 Date
Mary Erickson, Gallatin National Forest	12/9/10 Date
Christian Mackay, Montana Department of Livestock	12/8/10 Date
Colin Campbell, Yellowstone National Park	12/8/10 Date
Tom McDonald, Confederated Salish & Kootenai Tribes	12-8-10 Date
Ervin Carlson, Intertribal Bison Cooperative	12/8/10 Date
Brooklyn Baptiste, Nez Perce Tribe	12-8-10 Date

ANNUAL REPORT, INTERAGENCY BISON MANAGEMENT PLAN
JULY 1, 2009 TO JULY 31, 2010

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Since the mid-1980s, increasing numbers of bison have moved to low-elevation winter ranges outside the northern and western parts of Yellowstone National Park (YELL) in response to accumulating snow pack (Gates et al. 2005). These movements led to an enduring series of societal conflicts among various publics and management entities regarding bison abundance and the potential transmission of brucellosis to domestic cattle with widespread economic repercussions (Cheville et al. 1998). As a result, the federal government and State of Montana agreed to an Interagency Bison Management Plan (IBMP) that established guidelines for managing the risk of brucellosis transmission from bison to cattle by implementing hazing, test-and-slaughter, hunting, and other actions near the park boundary (USDI and USDA 2000*a*). This plan also identified the need to conserve bison and established conservation zones encompassing approximately 250,000 acres of the northern two-thirds of YELL and a small portion of the adjacent Gallatin National Forest.

Since the Record of Decision was signed for the IBMP in 2000 (USDI and USDA 2000*b*), the signatories have collected substantial new information regarding bison, brucellosis, and the management of disease risk and suppression. However, progress has been slow in completing the plan's three successive management steps to incrementally increase the tolerance for bison moving outside the park. As a result, the federal government and State of Montana were criticized for: 1) not clearly defining measurable objectives to express desired outcomes; and 2) not systematically applying adaptive management principles, including defining specific scientific and management questions to be answered, conducting specific activities to answer them, and incorporating findings into the IBMP (U.S. Government Accountability Office 2008). Thus, there was a need to develop specific management objectives, conduct surveillance to evaluate the effects and effectiveness of management actions, and develop methods for informing stakeholders and adjusting the IBMP based on these assessments.

In addition, the NPS is considering the implementation of a remote delivery vaccination program for brucellosis in free-ranging bison at YELL, an action previously directed by the IBMP (USDI and USDA 2000*a*, *b*). The overall goal of this action is to meet the NPS's mission to preserve native species as a component of a naturally operating ecosystem and protect them from exotic diseases. Simulation modeling suggests an effective strategy for reducing brucellosis seroprevalence in bison would be to combine boundary management (i.e., removal of seropositive, non-vaccinated bison and vaccination and release of seronegative bison) with the remote delivery vaccination of all female bison distributed throughout YELL (Treanor et al. 2007). This approach is expected to lead to the greatest decrease in brucellosis infection over time, though there is a need to reduce uncertainty in parameter estimates regarding bison demography and brucellosis transmission. Information obtained from monitoring and research activities will improve parameter estimation and model predictions, and enable an evaluation of the effects and effectiveness of a bison management and vaccination program.

To address these needs, the IBMP partner agencies met several times in public venues during August-December 2008 and 2009 to deliberate on recommendations by the U.S. Government Accountability Office, assess the effectiveness and outcomes of IBMP management activities and, considering prevailing conditions, develop and incorporate short- and long-term adaptive management adjustments to the IBMP for winter 2008-2009 and beyond (USDI et al. 2008). Also, NPS staff developed a surveillance plan to implement a long-term monitoring and research program for bison that obtains relevant information to guide decision making regarding the conservation of bison, adaptive management of the IBMP, and evaluation of the effectiveness of remote delivery vaccination.

This report includes narrative summaries that address the effects and effectiveness of each management action in the IBMP that was agreed-upon by the partner agencies during December 2008. These adjustments were based on the adaptive management framework and principles outlined in the USDI Technical Guide on Adaptive Management (Williams et al. 2007). The report also summarizes progress on YELL's surveillance plan for bison (White et al. 2008) and improvements on vaccines, vaccine delivery systems, and disease testing for brucellosis in bison since the working symposium organized by the U.S. Animal Health Association at the University of Wyoming in Laramie during 2005 (U.S. Animal Health Association 2006).

CONTENTS

MANAGEMENT ACTIONS FOR THE INTERAGENCY BISON MANAGEMENT PLAN

ACTION 1.1A: ALLOW UNTESTED FEMALE/MIXED GROUPS OF BISON TO MIGRATE ONTO AND OCCUPY THE HORSE BUTTE PENINSULA AND THE FLATS EACH WINTER AND SPRING IN ZONE 2.

Monitoring Metric 1: Weekly surveys of the number and distribution of bison on Horse Butte, the Flats, crossing the Narrows, and going beyond the Madison Resort (Lead = Montana Department of Livestock [MDOL]).

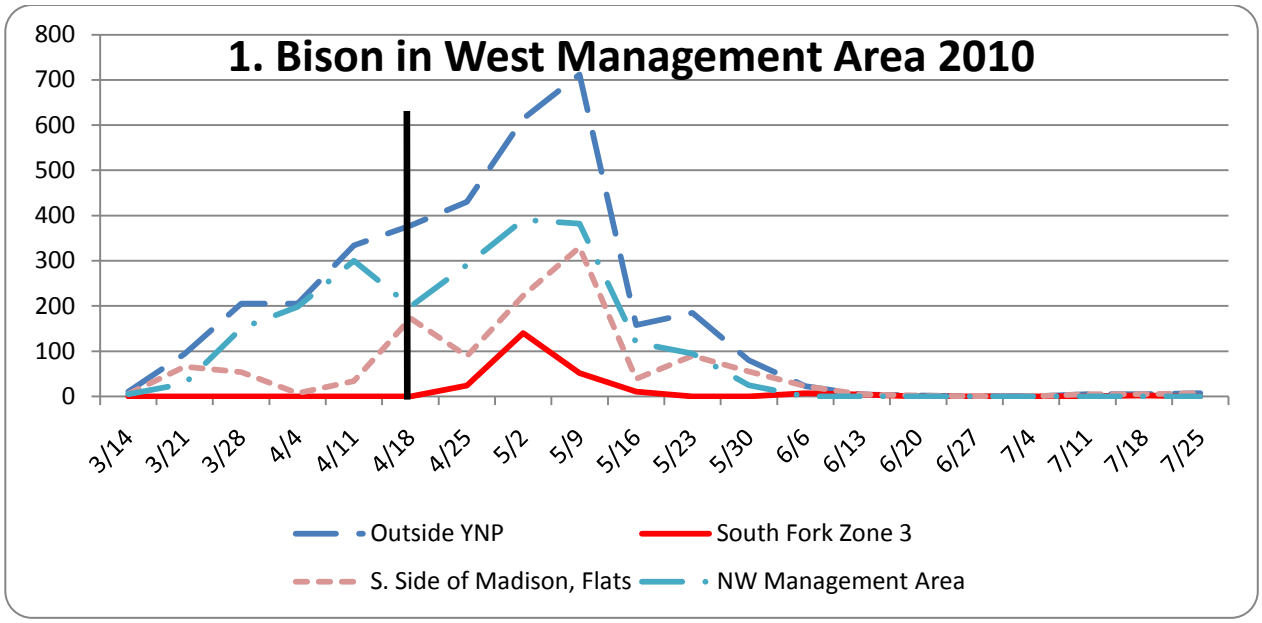


Chart 1: Bison abundance in various portions of the Western Management Area during the 2010 management season. The vertical line marks the week during which hazing operations began.

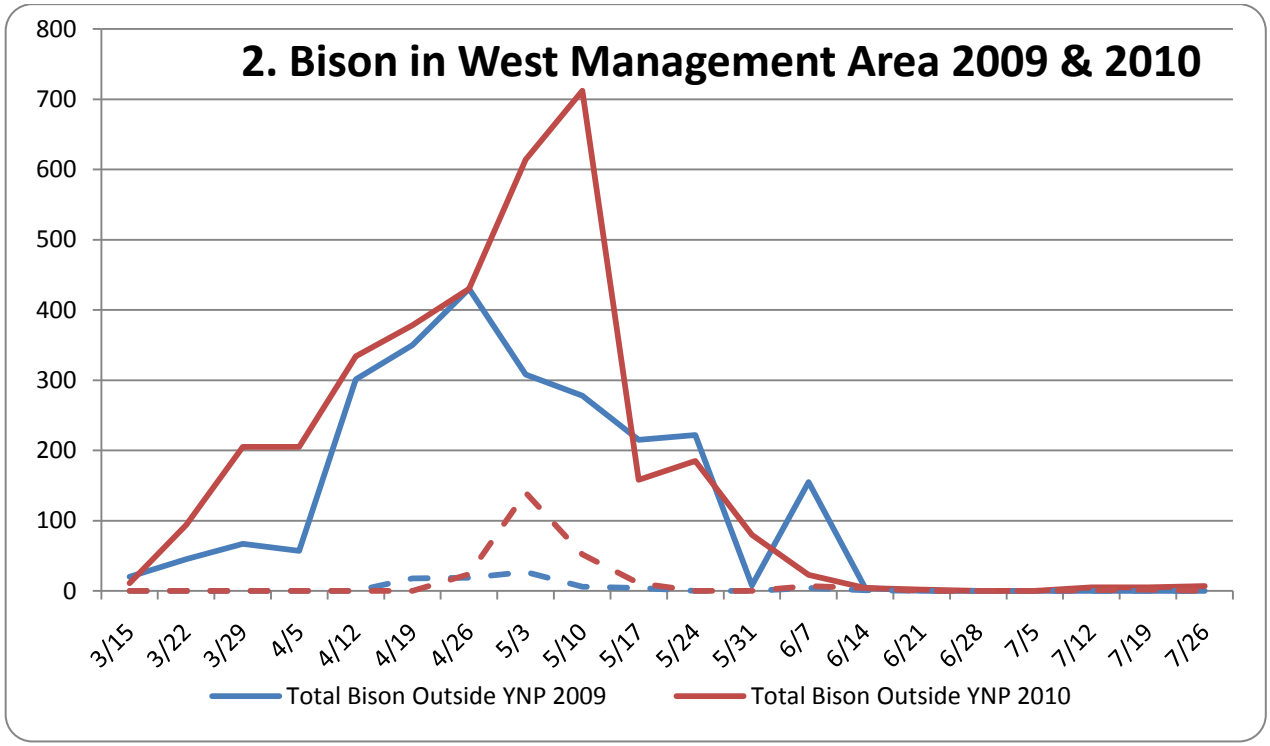


Chart 2: Comparison of bison abundance in the Western Management Area during the 2009 and 2010 management seasons.

Monitoring Metric 2: Annually document the number of bison using Zone 2 and the number and type of management activities needed to manage bison distribution (Lead = MDOL).

The numbers of bison using Zone 2 of the west management area ranged from 11 during the week of March 14 to 660 during the week of May 9, 2010. A maximum of about 712 bison simultaneously occupied Zones 2 and 3 during 2010. Twenty-eight hazing operations were conducted to manage bison distribution. Field operations were conducted on two to four days per week from late April to mid June and on numerous other occasions until the end of July. Twenty-five hazing operations were directly related to bison occupying Zone 3 (n = 11) or breaching other trigger points (n = 14) established in the adaptive management plan (e.g., bison entering non-tolerance areas or exceeding numerical tolerance levels; Appendix A). A helicopter was used for hazing bison during 15 operations.

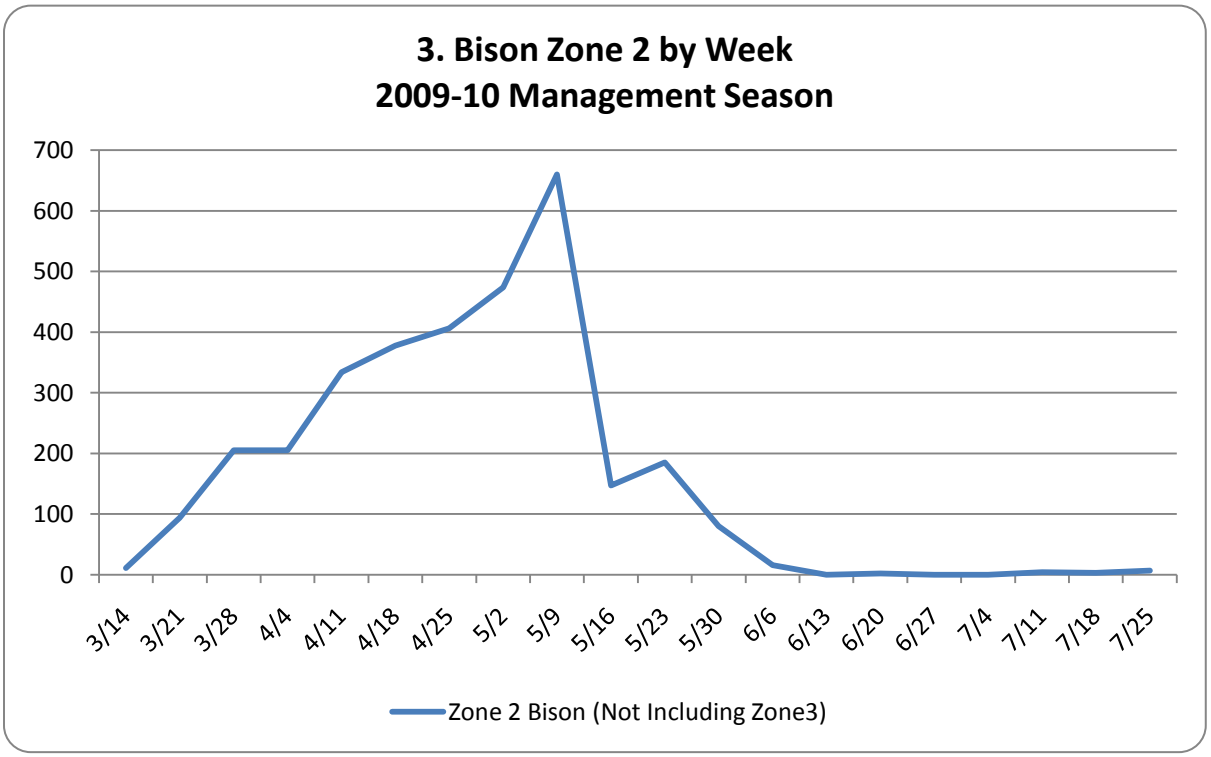


Chart 3: Weekly abundance of bison in Western Management Area. Numbers reflect average counts per week and actual numbers may have been higher or lower at a given point in time.

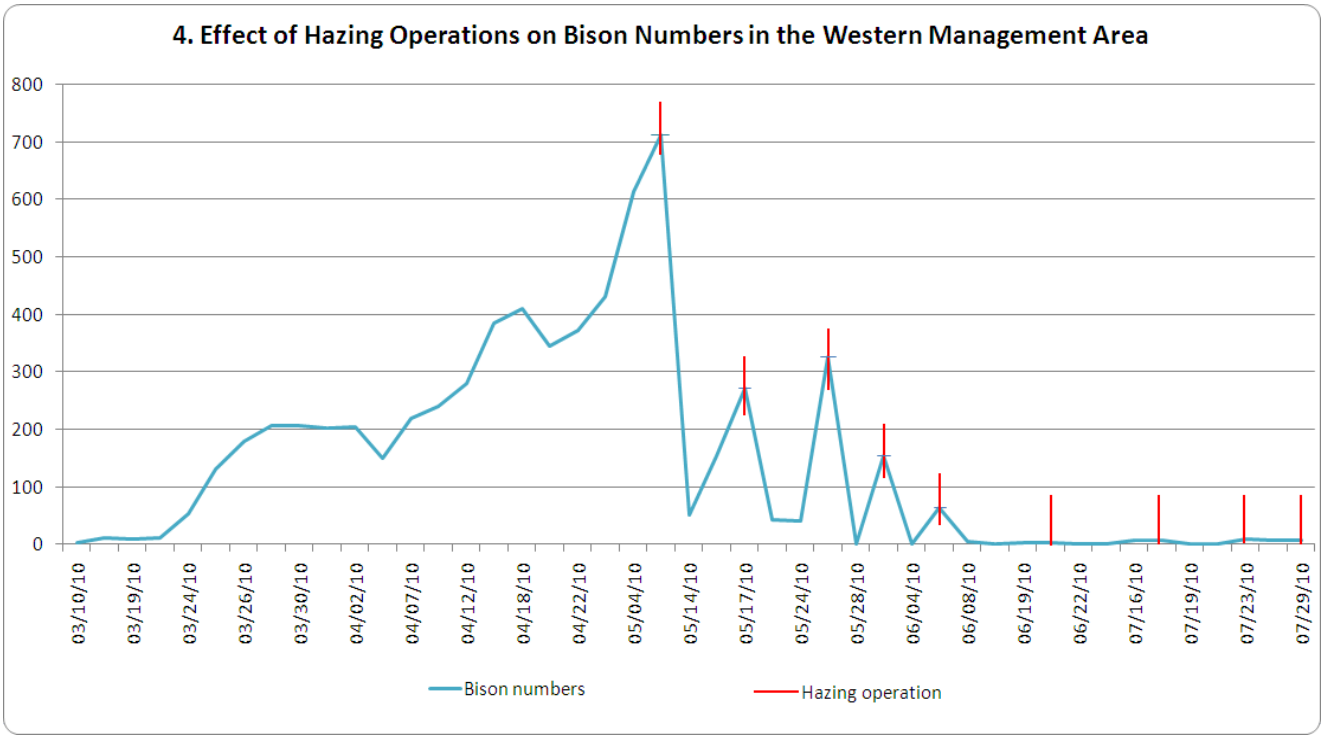


Chart 4: Bison abundance in the Western Management area showing decreases in numbers due to hazing operations. Some hazing operations actually occurred over a multiple day period. Only hazing operations associated with returning bison to YELL are included on the chart.

Monitoring Metric 3: Create a density curve of the threshold number of bison on Horse Butte that results in movements of bison to the South Fork Madison area (Lead = MDOL).

Bison numbers on the south side of the Madison Arm (Flats) exceeded tolerance levels on 6 occasions prior to April 23 when hazing operations were initiated, and bison began occupying habitat in Zone 3 during the last week in April. The total number of bison outside YELL increased rapidly during the last three weeks in April and into early May from approximately 245 to 712. There was a temporary decrease in bison numbers on Horse Butte after abundance there neared 300, with a total abundance in the west management area exceeding 350, during the week of April 11 and a concurrent increase in bison numbers on the Flats (Appendix D). Likely there were bison moving to both the Horse Butte and Flats area directly from the upper Madison River Valley. Many bison moved into the Zone 2 management area by first occupying the Madison River riparian corridor and the Flats and then moving onto Horse Butte (Appendices A and D). Bison numbers in the Horse Butte area peaked at 391during the week of May 2 with an additional 223 on the south side of the Madison, while bison numbers on the south side of the Madison and Flats peaked at 330 during the following week with 382 more in the Horse Butte area.

Monitoring Metric 4: Determine natural routes and timeframes (without hazing) for bison migration back into the park (Lead = NPS).

Bison began migrating from the Pelican and Hayden valleys, west across the Central Plateau, and onto lower-elevation winter range in the Lower Geyser Basin during mid- to late October 2009. In November, 221 bison were in the Firehole Geyser Basin, 32 bison were west of Madison Junction, and 35 bison were north of Madison Junction as far as Swan Lake. By late February, the number of bison in these areas had increased to about 600. In late March and April, the remaining portion of the central herd left the Hayden and Pelican valleys and migrated to west side ranges in the Madison headwaters, Cougar Meadows, and Horse Butte peninsula. A total of 757 bison were observed west of Madison Junction on May 7, 2010 during an aerial survey (Appendix D). Natural migration of bison from the Horse Butte area back into YELL and towards their higher-elevation summer ranges occurred in mid-May and June, following the wave of growing vegetation from lower to higher elevations, similar to other ungulates in this system (Frank and McNaughton 1993, White et al. 2007, 2010, Thein et al. 2009). Hazing activities precluded assessing these return movements more precisely.

Adaptive Management Recommendations:

IBMP agencies should continue coordinating in early April to compile and update knowledge on bison movements and distribution, snow conditions, vegetation green-up, stream flow in the Madison River, logistical issues (e.g., staff, horse, and helicopter availability, traffic control, visitation and road closures), and cattle turn-on dates and locations.

IBMP partners should complete an assessment of the expected late-winter scenario by May 1 and concur on tactics for hazing bison back into YELL. While maintaining a focus on brucellosis risk management, haze-back operations could occur earlier than the May 15 benchmark if forage and other conditions at higher elevations in YELL are suitable or later if conditions preclude safe and effective movements of bison to habitats that will hold/sustain them (e.g., adequate snow melt or vegetation green-up).

IBMP partners should evaluate individual animal movement patterns from telemetry data to assess the movement patterns of bison migrating to the west boundary range during spring.

ACTION 1.1B: USE ADAPTIVE MANAGEMENT TO GAIN MANAGEMENT EXPERIENCE REGARDING HOW BISON USE ZONE 2 IN THE GARDINER BASIN, AND PROVIDE SPACE/HABITAT FOR BISON IN CATTLE-FREE AREAS.

Monitoring Metric 1: Weekly survey of the number and distribution of bison in the Eagle Creek/Bear Creek area and the Gardiner basin (Lead inside YELL = NPS; Lead outside YELL = MDOL with the Montana Department of Fish, Wildlife, and Parks [MFWP]).

NPS staff conducted periodic aerial surveys through winter 2009-10 to estimate the number of bison occupying northern IBMP management monitoring areas, including the Eagle Creek/Bear Creek and Gardiner basin areas.

Northern IBMP Management Monitoring Area	November 4-5, 2009	December 3-18, 2009	February 21, 2010	March 12-14, 2010	April 9, 2010	May 15, 2010
Zone 1	0	0	1	1	27	2
Zone 2	0	0	0	0	0	0
Eagle Creek	0	0	1	0	19	0
Hellroaring Creek	78	18	55	462	31	NA
Blacktail Deer Plateau	137	65	148	533	268	380
Swan Lake	20	40	81	60	4	NA
Total	**235**	**123**	**286**	**1056**	**349**	

Monitoring Metric 2: Annually document the numbers and dates that bison attempt to exit Zone 2 by passing through Yankee Jim Canyon, west up Mol Heron Creek Canyon, or to the east side of the Yellowstone River and north of Little Trail Creek (Lead = MDOL/MFWP).

Two bulls moved up the highway near Slip and Slide Ranch in April and hazing was attempted. Ultimately, they were lethally removed by DOL agents on May 4.

Monitoring Metric 3: Annually document the number of bison using Zone 2 and the number of management activities needed to manage bison distribution (Lead = MDOL/MFWP).

There were two bulls in Gardiner that were hazed after damaging property. These bulls were previously immobilized as part of an APHIS brucellosis transmission field study. An additional single bull had to be hazed after damaging property at a hotel in Gardiner. On two occasions a small group of bison were hazed off of the school grounds by FWP wardens.

MDOL assisted with three additional hazing operations: a single bull was hazed from the Royal Teton Ranch (RTR) on April 20 and another on May 18, and one bull was lethally removed near the Corwin Springs area on July 14.

Monitoring Metric 4: Annually collect data to update the relationships between bison management at the Stephens Creek facility and the interaction between bison density and snow pack in the central and northern herds (Lead = NPS).

NPS staff previously completed a report (Geremia et al. 2008) summarizing analyses of the relationships between bison population size, winter severity, and the number of bison removed near the boundary of YELL. NPS staff worked with statistician Dr. John Borkowski at Montana State University and others to refine these analyses and summarize them in a subsequent report that is undergoing peer review (Geremia et al. 2010). Accumulating snow pack interacts with bison herd sizes to exacerbate the numbers of bison migrating to lower elevation ranges near the boundary of YELL. Under severe snow pack conditions, there is a significant chance that the majority of bison could migrate to these lower elevation ranges where snow pack is lower and new vegetation growth begins earlier in spring than on the higher elevation summer ranges in the park (Thein et al. 2009).

Monitoring Metric 5: Annually collect data to determine natural migration routes and timeframes (in the absence of hazing) for bison migration out of and back into the park (Lead inside YELL = NPS; Lead outside YELL = MDOL/MFWP).

Bison from the northern breeding herd left their summer ranges on the high plateaus above the Lamar Valley and congregated near the valley floor by late November 2009. These bison were distributed from the lower Lamar Valley westward to the Blacktail Deer Plateau, with the mid-elevation areas of Slough Creek, Little America, and Hellroaring Creek holding the majority of the bison during winter. The proportion of bison on the Blacktail Deer Plateau gradually increased until mid-March. Low snow accumulation through the winter allowed some bison to return to higher elevations during February and March. Three of 14 (21%) radio-marked bison that migrated west to the Blacktail Deer Plateau from the Lamar Valley moved into the Gardiner basin during April. These individuals spent only a short time (3 days to one week) in the basin. There were movements of bison from the central herd (Hayden and Pelican valleys) to the northern portion of YELL during winter 2009-10. Four radio-marked bison migrated north to Swan Lake and then to the Blacktail Deer Plateau during mid-March to early April. Two of these bison subsequently moved into the Gardiner basin. All four bison returned to central YELL ranges by mid- to late June. Aerial surveys conducted through the winter detected bison north of YELL only in April. Eastward movements back to the Lamar Valley occurred in April.

Adaptive Management Recommendations:

Continue to monitor the timing, numbers, and locations of bison movements to gain experience on how bison use available habitat north of YELL.

ACTION 1.1C: USE RESEARCH FINDINGS ON BISON BIRTH SYNCHRONY AND FETAL AND SHED *BRUCELLA ABORTUS* FIELD VIABILITY AND PERSISTENCE TO INFORM ADAPTIVE MANAGEMENT.

Monitoring Metric 1: Complete research reports and attempt to publish findings in a peer-reviewed, scientific journal (Lead = MFWP and NPS).

NPS staff monitored adult, female bison from April through mid-June during 2004-2007 to estimate the timing and location of parturition events (e.g., abortions and live births) that may shed tissues infected by *Brucella abortus*. They observed 115 bison parturition events including 54 live births (49 direct observations and 5 placenta retentions with a calf present), 29 reproductive failures (13 stillborn calves, 11 placenta retentions with no calves present, and 5 deaths of females during parturition), and 32 radio-collared females with newborn calves. Parturition events were primarily concentrated inside YELL, but 12 events occurred outside the western boundary on the Horse Butte peninsula in Montana. Reproductive failures, which may include *Brucella*-induced abortions, occurred primarily from January through April, with 76% of observations occurring by the end of April and the latest reproductive failure observed on May 19. Yellowstone bison exhibited a high degree of birth synchrony in which peak calving (80% of births) occurred between April 25 and May 26 and was finished by June 5. Bison mothers typically cleaned birth sites (i.e., consumed shed tissues) and typically left the site within two hours.

Results of this study suggest that allowing bison to occupy public lands outside YELL where cattle are never present (e.g., Horse Butte peninsula) until most bison calving is completed (late May or early June) is not expected to significantly increase the risk of brucellosis transmission from bison to cattle because (1) bison parturition is essentially completed weeks before cattle occupy nearby ranges, (2) female bison typically consume birthing tissues, (3) ultraviolet light and heat degrade *Brucella* on tissues, vegetation, and soil, (4) scavengers remove fetuses and remaining birth tissues, and (5) management maintains separation between bison and cattle on nearby ranges. Allowing bison to occupy public lands outside YELL

through their calving season will help conserve bison migratory behavior and reduce stress on pregnant females and their newborn calves, while still minimizing the risk of brucellosis transmission to cattle (Jones et al. 2010).

Adaptive Management Recommendations:

Managers should consider this information to balance Yellowstone bison conservation with acceptable risks of brucellosis transmission.

Because previous persistence studies were done based on the expected haze-back date of May15, consider additional research on persistence of tissues infected with *B. abortus* deposited beyond May 15.

ACTION 1.2A: ALLOW BACHELOR GROUPS OF BULL BISON TO OCCUPY SUITABLE HABITAT AREAS OUTSIDE THE WEST BOUNDARY OF YELL IN THE PORTION OF ZONE 2 SOUTH OF DUCK CREEK EACH YEAR WITHIN THE PARAMETERS OF CONFLICT MANAGEMENT.

Monitoring Metric 1: Weekly counts and locations of bull bison in Zone 2 (Lead = MDOL):

During the fall of 2009, a few bull bison consistently occupied the Duck Creek area. In late November, one bull used the Horse Butte area just north of the Madison River for a short period. From March through early June, one to four bull bison intermittently used the Duck Creek area, with a continuous stay of about a week in mid April. At three instances in July, a single bull was located in Zones 2 & 3 south and west of the Madison Arm and subsequently hazed because they were in non-tolerance areas pursuant to the 2008 Adaptive Management Plan. No bull bison were captured or lethally removed from the western management area.

Study of Shedding and Venereal Transmission of *Brucella abortus* by Bison Bulls in the Greater Yellowstone Area

This two year, two phase study began in the spring of 2010 to investigate several unknowns about the ability of bull bison to transmit *Brucella abortus.* The purpose of Phase 1 of the study is to collect samples to evaluate the semen from mature Yellowstone bison bulls for presence of *B. abortus* and to determine if semen quality is affected by *B. abortus* infection. This information is needed to determine and implement appropriate strategies and adaptive management practices such as habitat expansion while assuring mitigation of the risk of disease transmission to cattle grazing in the area. Under the current Interagency Bison Management Plan (IBMP) adaptive management strategy, allowing bull bison access to public lands in Montana year round is desired and will be evaluated as part of the expansion of bison habitat. The scientific data from this study should help inform future decisions about bull tolerance.

The purpose of capturing bulls in this study is to perform breeding soundness examinations and collect semen and blood samples from individual animals. The semen samples will be evaluated microscopically for semen quality using breeding soundness criteria and cultured for *B. abortus*. Serum will be tested for *B. abortus* antibodies using standard approved laboratory tests.

Summary of study activity for spring 2010 (Phase 1): Between April 5, 2010 and May 4, 2010, a total of 39 individual bison bulls were chemically immobilized and sampled in IBMP Zone 2 areas in Montana surrounding Yellowstone National Park. The average immobilization time was 26 minutes. Semen and blood were obtained from all these animals for *B. abortus* culture as well as serology. The age distribution of the animals sampled fit the goal of 75% of bulls sampled being over 2.5 years of age. All bulls were evaluated for body condition, scrotal circumference, and reproductive tract abnormalities. The semen was evaluated for sperm motility and defects. Serologic tests were performed by the MT Department of Livestock Diagnostic Lab and 64% were found to be positive for *B. abortus* antibodies and 5% were considered suspects. As of June 1, 2010, culture work on the semen samples is incomplete.

Monitoring Metric 2: Document threats to human safety and property damage (Lead = MFWP):

FWP consulted with landowners who complained of property damage from bison.

MDOL received the following human safety and property damage complaints:

- On May 10, 2010, MDOL received a complaint from a resident of the South Fork/Zone 3 area (VC) about bison damaging six trees on his property.
- On May 11, 2010, MDOL received a complaint from a Duck Creek resident (JW) about bison eating hay and damaging fences.

- On May 12, 2010, MDOL received a complaint from two Duck Creek residents (CK & MW) about bison damaging fences on their property.
- On May 15, 2010, MDOL received a complaint from a resident of the South Fork/Zone 3 area (PP) about bison comingling with his horses and another complaint from a Duck Creek resident (CK) about bison near her horses.
- On June 6, 2010, MDOL received a complaint from a South Fork/Zone 3 resident (DJ) about bison on private property.
- On June 8, 2010, MDOL received a complaint from the West Yellowstone Police about a bull in the town of West Yellowstone.
- On June 9, 2010, MDOL received a complaint from the West Yellowstone Police about a bull in the town of West Yellowstone.
- On July 11, 2010, MDOL received a complaint from a resident of the South Fork/Zone 3 area (GM) about a bull on the rodeo grounds south of Hwy 20.
- On July 18, 2010, MDOL received a complaint from a South Fork/Zone 3 resident about bison on his property.

Adaptive Management Recommendations:

Continue education and awareness of the social, public safety and private property impacts of bison tolerance in areas with residences or used for livestock operations.

Consider additional tolerance/discretion for bull bison north of Duck Creek.

Develop an experimental protocol using bison in captive facilities and, if necessary, field environments to test whether bison bulls can sexually transmit *B. abortus*.

ACTION 1.2B: ALLOW BACHELOR GROUPS OF BULL BISON TO OCCUPY SUITABLE HABITAT AREAS IN ZONE 2 OUTSIDE THE NORTH BOUNDARY OF YELL WITHIN THE FOLLOWING PARAMETERS OF CONFLICT MANAGEMENT.

Monitoring Metric 1: Weekly counts and locations of bull bison in Zone 2 (Lead = MDOL/MFWP).

Two bulls moved up the highway near Slip and Slide Ranch in April and hazing was attempted. Ultimately, they were lethally removed by DOL agents. There were two bulls in Gardiner that were hazed after damaging property. These bulls were previously immobilized as part of an APHIS brucellosis transmission field study. An additional single bull had to be hazed after damaging property at a hotel in Gardiner. On two occasions a small group of bison were hazed off of the school grounds by FWP wardens.

Monitoring Metric 2: Document threats to human safety and property damage (Lead = MFWP/MDOL).

Two bulls moved north into Zone 3 along the road right of way as far as the Slip and Slide Ranch in April. Attempts to haze these individuals back to Eagle Creek or Zone 1 were unsuccessful. Ultimately, they were lethally removed by DOL agents. There were two bulls in Gardiner that were hazed after damaging property. An additional single bull had to be hazed after damaging property at a hotel in Gardiner. On two occasions a small group of bison were hazed off of the school grounds by FWP wardens.

Monitoring Metric 3: Annually document the numbers and dates that bull bison attempt to exit Zone 2 by passing through Yankee Jim Canyon, west up Mol Heron Creek Canyon, or to the east side of the Yellowstone River and north of Little Trail Creek (Lead = MDOL/MFWP).

Two bulls moved up the highway near Slip and Slide Ranch in April and hazing was attempted. Ultimately, they were lethally removed by DOL agents.

Adaptive Management Recommendations:

Discuss expansion of the conservation area for bull bison to include habitats west of the Cutler Lake and Cutler Meadow areas and, also, in the Maiden Basin area off Little Trail Creek on the east side of the Yellowstone River.

ACTION 1.3A: WORK WITH PRIVATE LAND OWNERS AND LIVESTOCK PRODUCERS AND OPERATORS TO PROVIDE CONFLICT-FREE HABITAT IN THE HEBGEN AND GARDINER BASINS.

Monitoring Metric 1: Create an annual record of the: a) number of acres made available to bison from conservation easements (Lead = MFWP); b) locations, numbers, types, and turn-out/off dates for cattle grazed on private land in the Hebgen and Gardiner basins (Lead = MDOL); and c) extent of fencing erected to separate bison from livestock (Lead = MDOL).

No change in conservation easement acreage.

Locations, number, types, and turn-out/off dates for cattle grazed on private land in the Hebgen and Gardiner basins during 2010 are as follows:

West Management Area

Property Owner	Livestock Owner	Zone	Date in	No. Cows	No. Calves	No. Bulls	No. Yearling Heifers	No. Yearling Steers	No. Horses
SR Red Creek Ranch	BM Reed Point, MT	2	June 16	175	175	5			
RS Duck Creek	BM Reed Point, MT	2	July 7	34	34	1			
PP Deep Well Ranch	GT Twin Bridges, MT	3	June 25	305	301	15			
LD Quarter Circle JK	CC/BF Cameron, MT	3	July 1	22	21	1	1	1	
USFS South Fork Allotment	CC/BF Cameron, MT	3	July 1	11	11	1	5		
USFS Watkins Creek Allotment	CC/BF Cameron, MT	3	July 1	55	55	4			
BO Buttermilk Creek	BO West Yellowstone, MT	3	May 15			1			
RP Diamond P Ranch	BM Billings, MT	3	June 1		10	20	10		40

North Management Area

Owner	Zone	No. Cattle	Maximum	Class	On-date	Off-date
BH	3/GB	20/1		pairs/bull	year-round	
JT	3/GB	23		pairs	June 1	October 15
VS	3	100	250	pairs	May 21	December 31
Grizzly Creek	3	100	250	pairs	May 21	December 31
Yellowstone Cattle Co	3	100	600	pairs	May 21	December 1
B-Bar	3	150	600	pairs	June 15	November 15
Anderson Ranch	3	100	160	pairs	June 15	November 15
West Creek Ranch	3	100	100	pairs	June 1	November 1

The bison quarantine feasibility study is also located in the north management area near Corwin Springs, Montana, with approximately 50 bison in double-fenced pastures throughout the year.

One fence associated with private property at the boundary between zone 3 and the Eagle Creek tolerance area was constructed in the hazing corridor of the northern management area to separate bison from livestock during the 2010 management season.

Adaptive Management Recommendations:

Explore additional private land management options, including conservation easements, livestock grazing plans, and strategic fencing to separate livestock and bison as they arise or are proposed by individual landowners.

ACTION 1.3B: WORK WITH LANDOWNERS WHO HAVE HUMAN SAFETY AND PROPERTY DAMAGE CONCERNS, AS WELL AS THOSE WHO FAVOR INCREASED TOLERANCE FOR BISON, TO PROVIDE CONFLICT-FREE HABITAT IN THE HEBGEN AND GARDINER BASINS.

Monitoring Metric 1: Annually document the numbers, timing, and types of reported incidents for human safety and property damage related to bison (Lead = MFWP with support from MDOL).

There were two bulls in Gardiner that were hazed after damaging property. An additional single bull had to be hazed after damaging property at a hotel in Gardiner. On two occasions a small group of bison were hazed off of the school grounds by FWP wardens. FWP consulted with two landowners who complained of property damage from bison. FWP wardens responded on numerous occasions to haze and monitor a single bull bison in West Yellowstone.

Monitoring Metric 2: Annually document the numbers and types of actions taken to provide conflict-free habitat for bison (Lead = MFWP with support from MDOL).

FWP wardens worked in conjunction with the West Yellowstone Police Department and the Chamber of Commerce to educate the public on human behavior around wild bison.

Adaptive Management Recommendations:

Explore ways to reduce or eliminate human safety or property damage problems related to bison on a case-by-case basis.

Continue education and awareness of the social, public safety, and private property impacts of bison tolerance in areas with residences or used for livestock operation.

ACTION 1.3C: ANNUALLY, THE GALLATIN NATIONAL FOREST WILL ENSURE CONFLICT-FREE HABITAT IS AVAILABLE FOR BISON AND LIVESTOCK GRAZING ON PUBLIC LANDS, AS PER MANAGEMENT OBJECTIVES OF THE IBMP.

Monitoring Metric 1: Annually track the status (e.g. number of acres, location, etc.) of active and inactive cattle grazing allotments on public lands (Lead = U.S. Forest Service [USFS]).

Since the last report, change to grazing allotments have affected 10,200 acres of the Gallatin National Forest, Hebgen Ranger District. The 2,200 acre Horse Butte allotment (Hebgen Basin) changed from vacant status to closed; the 8,000 acre Wapiti allotment (Taylor Fork) changed from active to vacant (2 permittees waived permits for a combined 817 AUMs to the government without preference).

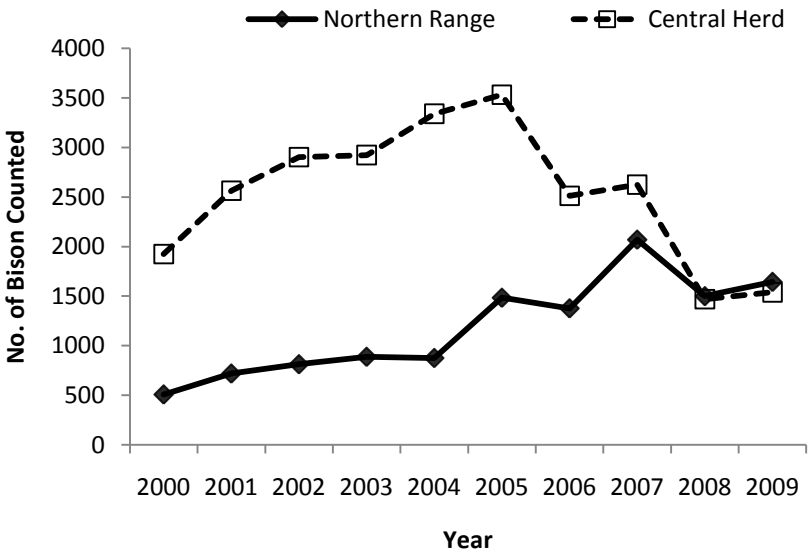
Adaptive Management Recommendations:

Continue monitoring of National Forest cattle allotments for opportunities to increase spatial or temporal habitat for bison on NF system lands (horse allotments need not be monitored).

ACTION 2.1A: INCREASE THE UNDERSTANDING OF BISON POPULATION DYNAMICS TO INFORM ADAPTIVE MANAGEMENT AND REDUCE SHARP INCREASES AND DECREASES IN BISON ABUNDANCE.

Monitoring Metric 1: Conduct aerial and ground surveys to estimate the annual abundance of bison each summer (Lead = NPS).

NPS staff completed three aerial surveys of the bison population during June and July 2009 and estimated a minimum population size of 3,248 bison, with a 95% confidence range of 2,045 to 4,451 bison. Based on the two July population counts, we estimated the central and northern herds were comparable in abundance.



Monitoring Metric 2: Document and evaluate relationships between bison migration to the boundary of YELL and bison abundance, population (or subpopulation) growth rates, and snow pack in the central and northern herds (Lead = NPS).

NPS staff collaborated with scientists from Montana State University, Watershed Institute, California State University Monterey Bay, National Aeronautical and Space Administration, and Yellowstone Ecological Research Center to further analyze the relationships between bison population size, winter severity, and the number of bison removed near the boundary of YELL (Geremia et al. 2010). Migration differed at the scale of herds (central, northern), but a single unifying exponential model was useful for predicting migrations by both herds. Annual maxima of bison migrating beyond the northern boundary occurred during the senescent vegetation period (February-March), while peak migration to the western boundary occurred during May when high quality forage was becoming readily available (Thein et al. 2009). Migration beyond the northern park boundary was affected by herd size, accumulated snow pack, and forage biomass. Migration beyond the western park boundary was less influenced by these predictors and model predictions since 2006 suggest that additional drivers of migration (e.g., learned behavior, onset of vegetation green-up) were not included in the model. Simulations of migrations over the next decade suggest that a strategy of sliding tolerance, where more bison are allowed beyond park boundaries during severe climate conditions, may increase hunting opportunities that could, in turn, decrease episodic, large-scale reductions to the Yellowstone bison population in the foreseeable future.

Monitoring Metric 3: Continue to obtain estimates of population abundance through the remainder of the year based on surveys, knowledge of management removals, and survival probabilities (Lead = NPS).

NPS staff completed an aerial survey of bison distribution on February 21, 2010, during which they observed 2,964 bison (1,299 on the central interior ranges and 1,665 on the northern range).

Monitoring Metric 4: Conduct an assessment of population range for bison in YELL that successfully addresses the goals of the IBMP by retaining genetic diversity and the ecological function and role of bison, while lessening the likelihood of large-scale migrations to the park boundary and remaining below the estimated carrying capacity of the park's forage base (Lead = NPS).

NPS staff synthesized available information and interpreted results of a spatially-explicit model of the Yellowstone system (Coughenour 2005) in a peer-reviewed article published in the journal *Biological Conservation* (Plumb et al. 2009). Findings suggest that bison abundance has not exceeded the theoretical food-limited carrying capacity of approximately 6,200 in YELL, but more bison migrate earlier to lower-elevation winter ranges as numbers increase and climatic factors interact with density to limit nutritional intake and foraging efficiency. NPS staff believe that a bison population that varies on a decadal scale between 2,500 and 4,500 animals should satisfy the collective long-term interests of stakeholders, as a balance between the park's forage base, conservation of the genetic integrity of the bison population, protection of their migratory tendencies, brucellosis risk management, and other societal constraints related to management of massive free-ranging wildlife.

Gross et al. (2006) showed that maintaining a herd size of 1000 bison would likely retain 90% of existing allelic diversity for 200 years. However, while the initial model of Gross et al. (2006) was informative, it did not consider the effects of variance in male reproductive success or annual variation in population size due to culling, both of which are relevant factors for maintaining genetic diversity. Pérez-Figueroa et al. (2010) considered both these factors when assessing the potential loss of genetic heterozygosity and allelic diversity from the Yellowstone bison population. Genetic heterozygosity was maintained at more than 95% over 200 years (~28 bison generations) for simulation scenarios with a population size greater than 500 bison. Conservation of 95% of the current level of allelic diversity was likely during the first 100 years under most scenarios considered in the model, including moderate-to-high variations in male reproductive success, population sizes greater than 2,000 bison, and approximately five alleles per locus, regardless of whether culling strategies resulted in high or low fluctuations in abundance. Maintenance of 95% of allelic diversity was likely with a fluctuating population size that increased to greater than 3,500 bison and averaged around 3,000 bison (Pérez-Figueroa et al. 2010). In addition, the findings of Pérez-Figueroa et al. (2010) suggest that culling will seldom accelerate loss of genetic variation when population size remains larger than 2,000 to 3,000 individuals.

Adaptive Management Recommendations:

Within a range of 2,500 to 4,500 bison, management agencies should prioritize the conservation of bison migration to essential winter range areas within and adjacent to YELL, while actively preventing dispersal and range expansion into areas occupied by cattle via hunting and risk-management actions.

While contingency measures are described in the respective state and federal ROD's regarding how the agencies would deal with management actions when the population declines to 2,300 bison, MDOL and USDA suggest that contingency measures should be described in the administrative record to describe how the agencies would respond to preventing population from exceeding an upper threshold of abundance.

ACTION 2.1B: INCREASE THE UNDERSTANDING OF GENETICS OF BISON IN YELL TO INFORM ADAPTIVE MANAGEMENT.

Monitoring Metric 1: Complete an assessment of the existing genetic diversity in bison and how the genetic integrity of bison may be affected by management removals (all sources combined) by October 2010 to estimate existing genetic diversity and substructure in the population (Lead = NPS).

Through collaboration with colleagues at University of Montana, DNA extractions were successfully conducted with fecal samples collected from Yellowstone bison in the northern and central breeding herds during 2006 and 2008. Genetic differentiation between the two breeding herds based on mitochondrial DNA extraction of the 2006 samples was described by Gardipee (2007) and resulted in rather large differences (F_{ST} = 0.402). However, estimates of differentiation between the breeding ranges based on microsatellite analyses showed a much smaller difference (F_{ST} = 0.02 in 2006; F_{ST} = 0.01 in 2008). F_{ST} is the portion of total genetic variance contained in a subpopulation compared to the total genetic variance. Values can range from 0 to 1 and high F_{ST} implies considerable differentiation among subpopulations. In bison, mitochondria are normally inherited exclusively from the mother, while microsatellites, which are repeating sequences of 1-6 base pairs of DNA, result from a mixing of DNA from both parents. Thus, while the mitochondrial DNA results suggest female Yellowstone bison exhibit moderate to high fidelity to their breeding ranges, the microsatellite results suggest that males commonly disperse and contribute to gene flow between the two breeding herds.

Monitoring Metric 2: Conduct an assessment of the genetic diversity necessary to maintain a robust, wild, free-ranging population that is able to adapt to future conditions (Lead = NPS).

NPS staff collaborated with colleagues at the University of Montana to complete an assessment of how management actions may affect the conservation of genetic diversity in Yellowstone bison. The team developed a mathematical model to quantify the influences of population size, removals, and male reproductive success on the maintenance of heterozygosity and allelic diversity for 100 and 200 years (Pérez-Figueroa et al. 2010). Input values to the model were derived from age structure, genetic, and demographic data on Yellowstone bison. Heterozygosity was maintained at more than 95% over 200 years (28 bison generations) for simulation scenarios with a population size of more than 500 bison. The conservation of allelic diversity was dependent on average population size in fluctuating populations. Simulations suggested that 95% of allelic diversity would be maintained over 100 years if the total population size remained above 2,000-3,000 bison. Culling scenarios had little effect on allelic diversity or the effective population size.

Adaptive Management Recommendations:

NPS staff suggests that a population abundance that fluctuates between 2,500 and 4,500 bison should conserve genetic diversity, especially if large population fluctuations are infrequent and average population abundance is maintained above 3,000 bison. IBMP managers should endorse a range of abundance to limit the frequency and magnitude of risk management removals and consider strategies to more consistently moderate population growth and limit the magnitude of fluctuations in population abundance to conserve demographic and genetic conservation values.

ACTION 2.1C: INCREASE UNDERSTANDING OF THE ECOLOGICAL ROLE OF BISON TO INFORM ADAPTIVE MANAGEMENT BY COMMISSIONING A COMPREHENSIVE REVIEW AND ASSESSMENT.

Monitoring Metric: Develop and implement by October 2011 a joint research strategy agreed to by the interagency partners that focuses on understanding the role and function of bison for providing nutrient redistribution, prey and carrion, and microhabitats for other species (Lead = NPS).

During summer 2010, YELL initiated a cooperative agreement with Dr. Doug Frank at Syracuse University to evaluate the role bison play in shaping plant communities within YELL. During the 1980s and 1990s, migratory ungulates on the northern grassland of YELL had tight biogeochemical linkages with plants and soil microbes that doubled the rate of net nitrogen mineralization, stimulated aboveground production by as much as 43 percent, and stimulated belowground productivity by 35 percent (Frank and McNaughton 1993). These biogeochemical linkages were largely driven by high densities of elk that deposited large quantities of nitrogen, phosphorus, and other nutrients via dung and urine. However, rates of ungulate grazing intensity and grassland nitrogen mineralization were reduced by 25-53 percent by 1999-2001, partially as a result of 60% fewer elk. Since 2002, bison numbers on the northern range have more than doubled from 813 to 2,070 in 2008. Larger groups of grazing bison could potentially have quite different effects than elk on nutrient redistribution and cycling on northern Yellowstone grasslands. The proposed research is planned to elucidate the influence of recent changes in elk and bison numbers and distributions on ecosystem processes such as the spatial pattern and intensity of ungulate grazing and grassland energy and nutrient dynamics. The project will replicate previous work describing plant production on grazed and ungrazed sites sampled 10 and 20 years ago (Frank and McNaughton 1993, Frank 2008) to compare the effects of grazing across multiple decades and evaluate the effects of changes in grazer densities (e.g., bison, elk) on nutrient cycling and plant productivity.

Adaptive Management Recommendations:

None at this time.

ACTION 2.2A: USE SLAUGHTER ONLY WHEN NECESSARY; ATTEMPT TO USE OTHER RISK MANAGEMENT TOOLS FIRST.

Monitoring Metric 1: Annually document the number, age, sex, and sero-status of bison sent to slaughter (Lead = Animal and Plant Health Inspection Service [APHIS] with the MDOL).

No animals were sent to slaughter form any capture facility.

Adaptive Management Recommendations:

Continue evaluating strategies to reduce the prevalence of brucellosis or eliminate the disease and increase conservation opportunities.

Continue evaluating opportunities and constraints for (1) transferring "surplus" bison to quarantine facilities for further surveillance and eventual release onto suitable restoration sites or to terminal destinations on tribal or other lands for periodic harvest for food or ceremonial purposes, and (2) adjusting conservation zones to increase state and treaty hunting opportunities in habitat outside the Park.

ACTION 2.2B: IN ZONE 2 LANDS ADJACENT TO YELL, EMPHASIZE MANAGEMENT OF BISON AS WILDLIFE AND INCREASE THE USE OF STATE AND TREATY HUNTS TO MANAGE BISON NUMBERS AND DEMOGRAPHIC RATES, LIMIT THE RISK OF BRUCELLOSIS TRANSMISSION TO CATTLE, AND PROTECT HUMAN SAFETY AND PROPERTY.

Monitoring Metric 1: Weekly and annual summaries of bison harvested by state and treaty hunters (Lead = MFWP/Nez Perce/ Confederated Salish and Kootenai Tribes).

One bull was taken by a state licensed hunter in the West Yellowstone area. There was no documented harvest by treaty hunters.

Adaptive Management Recommendations:

Continue to explore appropriate new areas within Zone 2 that could accommodate additional bison hunting opportunities. Expand the Eagle Creek area to include Maiden Basin, located north of Little Trail Creek and adjacent to Bison Hunting District 385. The Montana Fish, Wildlife, and Parks Commission would need to approve these areas as either a new Bison Hunting District or an extension of Bison Hunting District 385.

ACTION 2.2C: COMPLETE THE QUARANTINE FEASIBILITY STUDY AND CONSIDER AN OPERATIONAL QUARANTINE FACILITY TO PROVIDE A SOURCE OF LIVE, DISEASE-FREE BISON FOR TRIBAL GOVERNMENTS AND OTHER REQUESTING ORGANIZATIONS.

Monitoring Metric 1: Annual summary of bison sent to quarantine and bison transported from quarantine to suitable restoration sites (Lead = MFWP/APHIS).

No Yellowstone bison calves were brought into quarantine facilities in Corwin Springs during 2009 and 2010. The enrollment for second and last cohort of the study was completed in April 2008. In February of 2010 the 87 bison from the first cohort eligible for translocation were transported to the Green Ranch (Turner Enterprises). February 2010 marked the beginning of a 4-5 'soft release' period for these bison.

Monitoring Metric 2: Annual summaries from bison populations restored using quarantined bison from YELL, including numbers, demographic rates, and implemented risk management actions (Lead = MFWP/APHIS).

To date, no bison populations have been restored using quarantined bison from YELL.

Monitoring Metric 3: Evaluate regulatory requirements and constraints for moving live bison, including adults, to suitable restoration sites (Lead = APHIS/MDOL).

In April 2009, the IBMP Technical Committee was tasked with evaluating opportunities and constraints for transferring "surplus" bison from YELL to distant quarantine facilities for further surveillance and eventual release onto suitable restoration sites (i.e., brucellosis test-negative bison) or to terminal destinations on tribal or other lands for periodic harvest for food or ceremonial purposes (i.e., untested or brucellosis test-positive bison). Brucellosis disease status remains the most significant obstacle to non-lethal removal of "surplus" bison. A progress report presented to the IBMP managers in August 2009 stated that the interstate movement of YELL bison is feasible, but has numerous constraints. The disease-free status of bison that have "graduated" from quarantine may not be recognized by animal health officials and operators in possible recipient states until the five-year surveillance project is completed. Additionally, MFWP has halted bison "graduation" from the quarantine facility pending the outcome of ongoing litigation regarding the placement of the prior cohort at the Turner Enterprises, Inc. Green Ranch.

Monitoring Metric 4: Conduct an assessment of the quarantine feasibility study and offer recommendations regarding whether the quarantine of bison should become operational (Lead = MFWP/APHIS).

MFWP and APHIS initiated a 5-year research program in 2005 and 2006 with bison calves from YELL to determine the latent expression of brucellosis and test the sensitivity of quarantine procedures for detecting the bacteria in multiple generations. This quarantine feasibility study has demonstrated that it is possible to consider these bison as free from brucellosis. The second cohort of animals must finish calving before the study can be considered complete.

Monitoring Metric 5: Identify suitable release sites for brucellosis-free bison in quarantine, and solicit proposals from groups interested in restoring bison, through the Interagency/Tribal Bison Restoration Panel (Lead = MFWP/APHIS).

The Northern Arapahoe Tribe was awarded the opportunity to receive bison in the final phase of the bison quarantine feasibility study as a result of the first request for proposal in 2008. Ultimately, the Northern Arapahoe chose to not receive the bison. A second request for proposals (RFP) was offered in late June 2009. Five proposals were received following the June RFP. An interagency review committee decided further clarity was needed in the RFP and it was re-issued in late October 2009. In early February 2010 the decision was made to award Turner Enterprises Incorporated (TEI) the opportunity to receive quarantine bison to fulfill the final phase of the quarantine study. This partnership with TEI will provide for all of the quarantine bison and 25% of their offspring to be released to a suitable location at the end of the feasibility study.

Adaptive Management Recommendations:

Begin evaluating operational quarantine processes with willing tribes and other organizations for future transferring of "surplus" bison from YELL, including necessary NEPA/MEPA review. Evaluate the quarantine protocol for other age and sex classes of bison.

ACTION 3.1A: CONTINUE BISON VACCINATION UNDER PREVAILING AUTHORITY.

Monitoring Metric 1: Document the number of eligible bison captured and vaccinated outside of the park (Lead = MDOL/APHIS).

No bison were captured and vaccinated outside of the park during winter 2009-2010.

Monitoring Metric 2: Implement the Bison and Brucellosis Monitoring and Surveillance Plan (Lead = NPS).

The NPS implemented the bison surveillance plan during 2009-10 as described later in this document (see page 21).

Adaptive Management Recommendations:

Develop a coordinated and consistent vaccination program to ensure that vaccination is occurring at both the north and west boundaries of YELL and for both the central and northern breeding herds.

Discuss the potential for increasing the number of vaccinated bison at both the north and west boundaries.

ACTION 3.1B: COMPLETE EIS PROCESSES (MEPA/NEPA) FOR REMOTE DELIVERY VACCINATION OF BISON AND USE THE OUTCOMES TO INFORM ADAPTIVE MANAGEMENT.

Monitoring Metric 1: Complete the NEPA process and reach a decision on whether remote delivery vaccination of bison can/will be employed inside YELL (Lead = NPS).

The NPS released a Draft Environmental Impact Statement on May 28, 2010 (75 Federal Register 30022) for public comment to decide whether or not to proceed with implementation of remote delivery vaccination of bison inside YELL (U.S. Department of the Interior, National Park Service 2010). The purpose for the action is to address NPS responsibilities directed by a 2000 Record of Decision (ROD) for the IBMP regarding the release of bison outside the park that are untested for exposure to brucellosis. The need for remote delivery vaccination is to protect Yellowstone bison by reducing brucellosis infection, preserving threatened cross-boundary migration processes, increasing tolerance for bison on essential winter ranges in Montana (per the 2000 ROD), and reducing the need for capture and large-scale shipments of bison to slaughter. The tentative date for completion of the Final Environmental Impact Statement and Record of Decision is in winter 2012.

Three vaccination alternatives are included in the Draft Environmental Impact Statement. The no action alternative describes the current vaccination program that is intermittently implemented at the Stephens Creek capture facility in concert with capture operations. The second alternative would include a combination of the capture program at Stephens Creek and a remote delivery vaccination strategy that would focus exclusively on young, non-pregnant bison of both sexes. A third alternative would include all components of the second alternative, as well as the remote vaccination of adult females during autumn. Vaccination is intended to lower the percentage of bison susceptible to brucellosis infection. The vaccine SRB51 does not offer protection from *B. abortus* infection, but it has demonstrated protection from shedding *B. abortus* via

abortions, birth tissues, and mammary tissues. Reducing the shedding of *B. abortus* is expected to reduce transmission and, ultimately, *B. abortus* exposure (measured by presence of *Brucella* antibodies). Thus, overall population seroprevalence is expected to decrease as herd immunity is increased through vaccine protection. Monitoring this decrease will require estimating age-specific changes in seroprevalence. Bison age can be estimated up to 5 years old based on tooth eruption patterns. It is these young animals that will be the most informative regarding decreases in exposure resulting from vaccination and will serve as the focus of brucellosis monitoring.

Adaptive Management Recommendations:

Complete the NEPA process and reach a Record of Decision to decide whether to proceed with the implementation of remote delivery vaccination of bison in YELL.

ACTION 3.1C: TEST AND VACCINATE CATTLE.

Monitoring Metric 1: By June 15th, determine and document the vaccination status of all "at-risk" cattle in or coming into the Hebgen and Gardiner basins. (Lead = MDOL/APHIS).

About 70% of the eligible cattle in Montana are vaccinated as calves for brucellosis. The percentage of cattle vaccinated is >70% in the southwest portion of the state where the risk of transmission of brucellosis from wildlife is greater. All vaccination eligible cattle in or coming into the Hebgen and Gardiner basins have had an Official Calfhood Vaccination for brucellosis. All those producers for which the Adult Vaccination for brucellosis is appropriate have been offered this type of vaccination at no cost. One producer in the Gardiner basin and one producer in the Hebgen Basin vaccinate their adult cattle on a regular basis. One additional producer in the Hebgen Basin and one additional producer in the Gardiner Basin have indicated they will begin adult vaccination of their cattle in the Fall of 2010.

Adaptive Management Recommendations:

Continue to encourage producers to adult vaccinate any cattle in or coming into the Hebgen or Gardiner basins.

ACTION 3.2A: USE SPATIAL AND TEMPORAL SEPARATION AND HAZING TO PREVENT CATTLE/BISON INTERACTIONS.

Monitoring Metric 1: Document the minimum temporal separation and space between bison and cattle during February through June (Lead = MDOL).

Bison were often present on private property in the South Fork area of Zone 3(western management area) up to 18 days prior to cattle turnout. Bison were present up to 41 days prior to cattle turnout in the Zone 2/Duck Creek area.

On July 11, 2010, a complaint was received by MDOL about one bull bison on the rodeo grounds south of Hwy 20 in Zone 3 of the western management area.

On July 18, 2010, three bulls, three cows, and two calves were on private property west of the South Fork and hazed back into YELL.

On July 22, 2010, one bull bison was attempting to cross a fence into a pasture occupied by cattle west of the South Fork and was hazed to the east side of the Madison Arm Road.

Monitoring Metric 2: Document the number of times bison are successfully or unsuccessfully moved to create separation in time and space from cattle (Lead = MDOL).

Prior to May 15, 2010, bison moved into non-tolerance areas in the west management area 23 times. Bison moved west of the Madison Arm Resort three times after April 15 and occupied Zone 3 on 16 separate days, including nine times after May 15. Bison numbers also exceeded the trigger point of tolerance (30 bison) on the Flats nine times. Bison frequently remained in Montana after the May 15 haze-back date (up to 76 days) and resulted in hazing operations as referenced in Appendix C.

During the third trimester of pregnancy, when abortion events due to brucellosis infection are most common (February to mid-April), there were up to 400 bison west of the park boundary. While there were no cattle in the Hebgen basin at this time, the *Brucella* organism has been shown to have an environmental persistence of up to 81, 63 and 44 days in materials deposited in February, March and April, respectively (Aune 2007). During the parturition season (April 15 to May 31), there

remains the potential for a live birth event during which *Brucella* bacteria may be shed. There were up to 750 bison in the Hebgen basin at this time, which coincides with the early part of the parturition period. While there were no cattle in the Hebgen basin, the *Brucella* organism has been shown to have an environmental persistence of up to 44 and 25 days in materials deposited in April and May, respectively. One observation of a group of 21 female bison occurred in the Zone 3 area west of the South Fork of the Madison River after June 1. On May 4, a group of 12 mixed bison was observed on the Red Canyon Ranch. This event occurred approximately 43 days prior to cattle occupying the ranch, which was beyond the duration of persistence of the *Brucella* organism for that calendar date. Based on the intensive management operations conducted by the interagency partners, the risk of brucellosis transmission from bison to livestock in the Hebgen basin was minimized.

Adaptive Management Recommendations:

See recommendations for Management Action 1.1a on page 6.

ACTION 3.2B: EVALUATE THE USE OF LIMITED, STRATEGICALLY PLACED FENCING WHEN AND WHERE IT COULD EFFECTIVELY CREATE SEPARATION BETWEEN DOMESTIC LIVESTOCK AND BISON, AND NOT CREATE A MAJOR MOVEMENT BARRIER TO OTHER WILDLIFE.

Monitoring Metric 1: Document the number of additional acres of habitat made available for bison as a result of strategic fencing (Lead = MFWP/USFS/MDOL).

West Side

No fencing has been constructed on the West Side. During a meeting in early March the partners discussed the possibility of using strategic fencing from the northern end of the West Yellowstone airport fence approximately 1.8 miles to the Madison Arm. The fence discussed from the airport to the Madison Arm was meant to guide bison onto Horse Butte to reduce the utilization of the south side of the Madison and therefore prevent Zone 3 breaches.

Representatives from MFWP, USFS and DOL met on the ground and discussed the options. Several issues regarding public safety and wildlife impacts were discussed, but any further decision is currently pending and will be resolved in the future. See Appendix B for a complete list of comments on wildlife impacts, logistical fencing, and recreational/sociological issues.

North Side

North Side fence was fully constructed as approved and coordinated with Park County last fall. It was set up (it is electric temporary fencing) last winter and then dropped this spring. There was very little movement of bison out of YELL this winter due to low bison numbers and mild winter conditions.

Working to realign a fence (materials given by MDOL) between the Gallatin National Forest and private land placed this spring which encroached 100-300 feet onto Forest Service lands in the Little Trail Creek drainage.

Monitoring Metric 2: Document fence damage or the number of times fencing fails to inhibit bison trespass on private property occupied by cattle (Lead = MDOL).

In the northern management area, one instance of fence damage occurred when two bulls moved north of Corwin Springs, Montana, resulting in lethal removal by MDOL.

In the western management area, two complaints of property damage were received by MDOL and referred to MFWP.

Adaptive Management Recommendations:

Revisit placement of wildlife fence on the West side to limit bison movement onto private lands.

ACTION 3.2C: HAZE BISON FROM THE HEBGEN BASIN INTO YELL WITH A TARGET DATE OF MAY 15.

Monitoring Metric 1: Consistent with management action 1.1a, assess the prevailing environmental conditions and reach consensus by May 13 on a step-wise, integrated plan for the end-of-winter return of bison into YELL from Zone 2 (Lead = MDOL/NPS).

Consensus was reached between the IBMP agencies by April 30 on a step-wise, integrated plan for the end-of-winter return of bison into YELL from Zone 2.

Monitoring Metric 2: Annually document the timing of the end-of-winter return of bison into YELL, the number of bison returned, prevailing environmental conditions, and success or lack thereof of hazing bison and getting them to remain in the park (Lead = MDOL/NPS).

Work Week	Number of Bison moved from MT into YELL	Number of Bison left in MT
11-13 May	712	~50
18-20 May	289	~50
25-27 May	283	45
2-3 Jun	148	<15
7-9 Jun	68	<15
21-Jun	4	<15
18-23 Jul	20	<15
29-Jul	7	<10

Interagency hazing operations were conducted from April 26 to July 29, 2010 (see Appendix C for detailed explanations). The majority of bison movement from the west boundary ranges to interior park ranges occurred over a four week period from May 11 to June 3. As many as 64 bison remained for an additional week and up to 15 remained until July 29, at times occupying habitats in Zones 2 and 3. This year, bison were not moving eastward on their own prior to the initiation of hazing operations. Eventually all of the 700 plus bison were returned to interior park ranges as a result of the persistent hazing operations conducted by the interagency partners. Hazing operations were successful at moving a majority of the bison from Montana back into the park each week, but some bison would return to Montana during the weekend when operations were suspended. Following the first week of operations, the number of bison in Montana declined to less than 50% of the maximum count and again after the week of June 6, the number declined to less that about 15 individuals outside the park at a time.

In general, cow/calf herds were harder to haze than in previous years and early hazing events were not able to reach the intended destination such as Cougar Meadows. Thus, the majority of hazing events would not have been possible without the use of the MDOL or contract helicopter to move bison from Horse Butte and the South Fork into YELL, or from Cougar Meadows to Seven-Mile Meadows inside YELL. The helicopter worked well when trying to move bison long distances through vast meadows and re-growth lodgepole forests. During weekend breaks from operational activity, bison traveled back from YELL/Zone 1 to Horse Butte, South Fork/Zone 2 areas, suggesting that environmental conditions such as new vegetation growth in the Madison Corridor of YELL were not sufficient to support bison. Bison that were hazed from Cougar Meadows to Seven-Mile Meadows independently walked east to Madison Junction, while bison that grazed in the Madison Junction area independently walked south to Fountain Flats.

The prevailing environmental conditions during the week of May 10 included freezing temperatures at night, Madison River flows of about 450 cubic feet per second (12% higher than winter base flows and 32% of the peak flow that occurred on June 8), and an average height for newly emerging grasses of approximately 7 centimeters on upper south-facing slopes of Horse Butte and 3.5 centimeters at Cougar Meadows. Water pooling and accumulated snow across the west side ranges had nearly disappeared. Bison began to more readily move into the Lower Firehole Geyser Basin during the last week in May, which reduced the total number of bison in the Madison Valley. Some bison remained west of Seven-Mile bridge and continued to move across the west park boundary, resulting in limited hazing operations after June 8.

The large, highly productive meadow in the southeast portion of zone 1 near Seven-Mile bridge in YELL began to hold bison more consistently by the first week in June as new grass production eventually grew above the residual forage left from last year. A grass monitoring transect along the Madison River corridor west of the Seven-Mile bridge river ford acted as a control plot with little grazing occurring on this site. Average grass heights did not reach 8 centimeters on this transect until the last week in May and never reached 6 centimeters on two transects in the Firehole Geyser Basin during the monitoring period. Flooding of the meadow at Madison Junction occurred periodically throughout the hazing operations due to heavy rainfall. Flooding of large meadow complexes throughout the migratory route of the bison occurred mostly during the peak

of snowmelt and runoff in the first week of June. At this time, bison movements began occurring from the Firehole Geyser Basin over the central plateau and into the Hayden Valley.

Monitoring Metric 3: Annually review and apply *B. abortus* persistence information, private land cattle turn-on dates, and applicable research results to determine the effects of haze-to-habitat actions on bison and their effectiveness at preventing the commingling of bison and cattle (Lead = MDOL).

Cattle turn-on dates were previously described for action 1.3a on page 10. Research findings regarding *Brucella* persistence are currently being analyzed by MFWP staff.

Adaptive Management Recommendations:

See recommendations for management action 1.1a.

ACTION 3.2D: HAZE BISON FROM THE GARDINER BASIN INTO YELL WITH A TARGET DATE OF MAY 1.

Monitoring Metric 1: Consistent with management action 1.1b, assess the prevailing environmental conditions and reach consensus by April 15 on a step-wise, integrated plan for the end-of-winter return of bison into YELL from Zone 2 (Lead = MDOL/NPS).

Consensus was reached between the IBMP partners by April 15th on a step-wise, integrated plan for the end-of-winter return of bison into YELL from Zone 2.

Monitoring Metric 2: Annually document the timing of the end-of-winter return of bison into YELL, the number of bison returned, prevailing environmental conditions, and success or lack thereof of hazing bison and getting them to remain in the park (Lead = MDOL/NPS).

Bison movements beyond the conservation area were limited to a few incidents previously described under Management Action 1.1b. The only zone 2 hazing required this year was conducted on April 12 when a lone bull was moved back in to the park. As lead agency, MDOL made the decision to kill two adult male bison that were resistant to hazing in zone 3 near Yankee Jim Canyon on May 4-5.

Monitoring Metric 3: Annually review and apply *B. abortus* persistence information, private land cattle turn-on dates, and applicable research results to determine the effects of haze-to-habitat actions on bison and their effectiveness at preventing the commingling of bison and cattle (Lead = MDOL).

Cattle turn-on dates were previously described for action 1.3a. Research findings regarding *Brucella* persistence are currently being analyzed by MFWP staff.

Adaptive Management Recommendations:

None at this time.

Objective 1 (Estimate the abundance, demographic rates, and limiting factors for the overall bison population and two primary subpopulations)

NPS staff continued to collect data on bison demography and collaborated with Dr. Tom Hobbs from Colorado State University to develop a model that integrates annual observations of the bison population in YELL (i.e., demography, disease) with parameter estimates from process studies in a discrete time, stage-structured model. A dynamic state space model has been developed with monitoring data collected by YELL. The model does a reasonable job of tracking past trends in abundance and demography. The first rigorous estimates of brucellosis transmission rates have been calculated using this model and results indicate that disease prevalence may be increasing under current management scenarios. The model is currently being refined and used to explore the likely outcomes of different management scenarios. For example, under management scenarios for removals of 200, 250, or 300 female bison per year from the population, the probability of maintaining a population abundance of between 2,500 and 3,500 is similar (0.37 for 200, 0.42 for 250, and 0.38 for 300 animals harvested per year).

Objective 2 (Describe migratory and nomadic movements by bison at a variety of temporal and spatial scales in and outside the park)

The NPS is collaborating with colleagues at Colorado State University to develop a framework for analyzing the extensive movement data collected during 2003-2010 from bison with GPS radio collars and identify factors and processes that affect seasonal bison distributions and movements. A graduate student has been hired and will be conducting analyses through December 2011. The objectives for model construction are to (1) identify a network of areas consistently used by bison in YELL and adjacent lands in the state of Montana, (2) identify the movement paths that connect the network of areas used by bison, (3) build an informative state-space model that predicts temporal changes in the distribution of bison among major foraging areas and beyond park boundaries, and (4) determine the relative importance of climate factors, bison density and group size, forage biomass, diet quality, and chronic under-nutrition during winter on the timing and rate at which bison move to low-elevation winter ranges.

Objective 3 (Estimate the existing heterozygosity, allelic diversity, and long-term probabilities of genetic conservation for the overall bison population and identified subpopulations)

NPS staff collaborated with Drs. Gordon Luikart and Fred Allendorf and graduate student Flo Gardipee from the University of Montana to test the hypothesis that bison from the central and northern breeding herds would be genetically differentiated based on mitochondrial and microsatellite DNA from fecal samples. Based on mitochondrial DNA analyses, there was significant genetic differentiation between bison sampled from the northern and central breeding herds, likely due to strong female fidelity to breeding areas (Gardipee 2007). However, analyses using nuclear microsatellite markers indicated genetic differences between herds were much less, suggesting that male movements between the two breeding herds are likely substantial and resulting in significant gene flow throughout the population (G. Luikart, unpublished data).

NPS staff collaborated with Drs. Gordon Luikart and Fred Allendorf from the University of Montana and Dr. Mike Schwartz from the Forest Service Rocky Mountain Research Station to conduct a mathematical modeling assessment that provided predictive estimates of the probability of preserving 90 and 95% of the current level of genetic diversity values (both heterozygosity and allele diversity). Findings suggested that variation in male reproductive success had the strongest influence on the loss of genetic variation, while the number of alleles per locus also had a strong influence on the loss of allelic diversity. Fluctuations in population size did not substantially increase the loss of genetic variation when there were more than 3,000 bison in the population. Conservation of 95% of the current level of allelic diversity was likely during the first 100 years under most scenarios considered in the model, including moderate-to-high variations in male reproductive success, population sizes greater than 2,000 bison, and approximately five alleles per locus, regardless of whether culling strategies resulted in high or low fluctuations in abundance. However, a stable population abundance of about 2,000 bison was not likely to maintain 95% of initial allele diversity over 200 years, even with only moderate variation in male reproductive success. Rather, maintenance of 95% of allelic diversity is likely to be achieved with a fluctuating population size that increases to greater than 3,500 bison and averages around 3,000 bison (Pérez-Figueroa et al. 2010).

NPS staff collaborated with Dr. Betsy Bricker from the Agricultural Research Service, National Animal Disease Center, and Dr. Gordon Luikart from the University of Montana and his students to genotype 10 variable number of tandem repeat DNA loci in 58 *B. abortus* isolates from bison, elk, and cattle to test which wildlife species was the likely origin of recent outbreaks of brucellosis in cattle in the greater Yellowstone area (Beja-Pereira et al. 2009). Findings suggested that isolates from cattle and elk were nearly identical, but highly divergent from bison isolates. Thus, elk, not bison, were the reservoir species of origin for these cattle infections.

Objective 4 (Estimate the probabilities of brucellosis transmission within and between species (and areas)

NPS and APHIS staff are currently collaborating with the University of California-Davis on an assessment of brucellosis transmission risk among bison, elk, and cattle in the northern portion of the greater Yellowstone area. This work is attempting to quantify (1) the risk of brucellosis transmission from bison and elk to cattle, (2) brucellosis transmission dynamics within and between bison and elk populations, and (3) the potential for brucellosis vaccination of bison to mitigate transmission risks and contribute to brucellosis elimination. This work represents the first spatially-explicit risk assessment of brucellosis transmission among elk, bison, and cattle. The modeling approach is based on the timing and location of bacterial shedding by bison and elk on the landscape. Preliminary results show that population size and winter severity were major determinants influencing bison movements to lower elevation winter grazing areas, overlapping with federally-regulated domestic cattle grazing allotments. Increasing population size resulted in higher herd densities and increased bacterial shedding. Natural herd migration and boundary management operations were important in minimizing the contribution of bison to cattle exposure risk, which supports continued boundary management operations for separation between bison and cattle. Under current management practices, bison risk to cattle grazing in the northern portion of the greater Yellowstone area is expected to be small, with elk contributing the majority of the risk. Efforts should be taken to reduce the comingling of cattle and elk, especially during the late gestation period for elk, when spontaneous elk abortions pose a risk for interspecies disease transmission.

Objective 5 (Estimate age-specific rates of bison testing seropositive and seronegative for brucellosis that are also culture positive)

NPS and APHIS staff sampled more than 400 bison that were consigned to slaughter during winter 2007-08. Blood and tissues collected from these bison were analyzed to estimate the proportion of seropositive and seronegative bison that were actively infected with *B. abortus* (i.e., culture positive). Lymphatic tissues collected from slaughtered bison were frozen and shipped to the National Veterinary Services Laboratory in Ames, Iowa for *Brucella* culture. Culture tests were compared with serologic results from the same animals to better understand seroprevalence and the state of infection across bison sex and age classes. Preliminary results indicate that most Yellowstone bison are exposed (i.e., show an antibody response) to *B. abortus* early in life (less than 3 years old). The most frequent age of active infection (i.e., culture positivity) was found in bison approximately 3 years old. The frequency of active *B. abortus* infection decreased with age for bison greater than 5 years old, while seroprevalence remained high in older bison. Findings are currently being prepared for peer review and publication.

Objective 6 (Estimate the timing and proportion of removals from each of the two primary subpopulations each winter, including the proportion of removals from each age and sex class and the proportion of calf-cow pairs)

Only 6 bison were removed from the population this year by human management actions (1 bison from the central interior and 5 bison from the northern range). All removals were adult male bison.

Objective 7 (Document bison use of risk management zones outside the north and west boundaries of Yellowstone and commingling with livestock during the likely brucellosis-induced abortion period for bison each spring)

No female groups of bison moved out of the park and into the north risk management zone this winter. Bison continuously occupied Zone 2 of the west risk management zone from mid February until June 7, 2010. Bison were located near the Deep Well Ranch in zone 3 on 7 occasions during the first two weeks of May and on 3 other occasions during the subsequent month. Bison were hazed from zone 3 back across the south Fork of the Madison River on each of these occasions. No mingling of bison with cattle occurred because cattle had not yet been moved onto summer ranges in the valley.

Objective 8 (Estimate the effects of hazing or temporarily holding bison in capture pens at the boundary of Yellowstone on subsequent bison movements or possible habituation to feeding)

Thirty four radio-marked bison were released from the Stephens Creek capture facility in May 2008 following risk management capture and holding operations. After release, 6 bison returned to the central range and 28 bison returned to the northern range where they participated in the summer breeding season activities. One-half of the radio-marked bison from the central herd returned to the Gardiner basin in 2009, but only 20% returned in 2010. One-third of the radio-marked bison from the northern herd bison returned to the Gardiner basin in 2009, but only 7% returned in 2010. None of the radio-marked bison returning to the Gardiner basin during the past two winters have shown behavioral tendencies to focus foraging efforts near the Stephens Creek capture facility.

Objective 9 (Determine the strength and duration of the immune response in bison following parenteral vaccination for brucellosis)

NPS staff are collaborating with Dr. Ryan Clarke from APHIS and Dr. David Pascual from Montana State University to measure the cell-mediated immune responses (CMI) induced by SRB51 vaccination in bison.

During winter 2008-09, 12 yearling bison in the quarantine feasibility study were parenterally vaccinated with SRB51. Immune responses were assessed prior to vaccination and at 3, 8, 12, 18, and 21 weeks after vaccination. Additionally, 20 wild, yearling, female bison were captured at the Stephens Creek facility during late winter 2008 for measuring their CMI responses following parenteral vaccination with SRB51. Fourteen of these bison were parenterally vaccinated with SRB51 and six served as non-vaccinated controls. The CMI response of the 12 vaccinated bison was analyzed at 2 and 6 weeks post vaccination. Thereafter, all 20 bison were released back into the wild during May 2008. During autumn and winter 2008-2009, 14 of the 20 bison in the study were recaptured to measure cell-mediated immune responses 24+ weeks following vaccination. Preliminary results suggest that both study groups showed strong initial CMI responses (IFN-γ (Ng/Ml) at 2-8 weeks post-vaccination). CMI responses were significantly different from pre-vaccination levels for both study groups at nearly all post-vaccination time points. However, post vaccination CMI responses were more variable between individuals in the free-ranging bison compared to quarantined animals. These findings are currently being prepared for peer review and publication.

Objective 10 (Determine the strength and duration of immune response in bison following remote delivery vaccination for brucellosis)

Olsen et al. (2006) reported the ballistic inoculation of bison with biobullets containing photopolymerized, polyethylene glycol-based hydrogels with SRB51 induced a significant cell-mediated immune response similar to syringe injection of the vaccine. However, the immunologic responses of bison to hydrogel vaccination with SRB51 during 2007 indicated poor proliferation and interferon response compared to parenteral injection (S. Olsen, unpublished data). These findings suggest the measured immune responses to vaccination are variable or there may be consistency issues with vaccine hydrogel formulation and/or encapsulation in biobullets. The NPS is initiating an agreement with Drs. David Grainger and Jim Christie from the University of Utah and Dr. Steve Olsen from the Agricultural Research Service to provide and/or disclose:

- Methods for encapsulating the vaccine.
- A list of equipment and supplies needed to produce photopolymerized, hydrogel-encapsulated, vaccine projectiles.
- Known patent issues regarding the use of photopolymerization methods for production of remote delivery vaccination products.
- A critical review of the differences in findings from preliminary immunologic response experiments (e.g., Olsen et al. 2006) and subsequent experiments.
- A critical assessment of other research and development needs (e.g., recommended dose, shelf-life) that should be addressed prior to full-scale production.

Objective 11 (Document long-term trends in the prevalence of brucellosis in bison, and the underpinning effects of remote and/or parenteral vaccination, other risk management actions and prevailing ecological conditions on these trends)

NPS staff evaluated the impacts and effectiveness of the IBMP by comparing assumptions and predictions for the alternative selected from the Final Environmental Impact Statement and described in the Record of Decision for the IBMP (White et al. 2009) with observed impacts and changes since implementation of the plan began in 2001. Intensive management near conservation area boundaries maintained separation between bison and cattle, with no transmission of brucellosis. However, brucellosis prevalence in the bison population was not reduced and the management plan underestimated bison abundance, distribution, and migration, which contributed to larger risk management culls (total of more than 3,000 bison) than anticipated. The proportion of adult females in the population that are seropositive for brucellosis exposure has increased or remained constant at approximately 60% during the IBMP implementation period. Also, culls differentially affected breeding herds, altered gender structure, created reduced female cohorts, and dampened productivity. These findings demonstrate the difficulties of balancing competing objectives that are based on limited understanding of bison ecology and disease dynamics, and assessed at different temporal scales—managers act to prevent disease transmission annually, but effects to wildlife may not be detectable for decades. Managers should continually review and integrate conservation into management policies to better protect migratory ungulates and facilitate their restoration. The ecological future of plains bison could be significantly enhanced by resolving issues of disease and social tolerance for Yellowstone bison so that their unique wild state and adaptive capabilities can be used to synergize the restoration of the species. Bison managers have proposed adaptive management adjustments to implement smaller selective culls through hunting and relocating disease-free bison after quarantine. Increased tolerance for bison in Montana should be attainable through vaccination of bison and cattle, strategic fencing of remaining cattle operations, hazing bison to prevent range expansion, keeping cattle off grazing allotments until the significant risk of brucellosis transmission is past, and regulating bison population size between 2,500 and 4,500.

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APPENDIX A: TABLE OF BISON BREACHES TO RECORD OF DECISION AND ADAPTIVE MANAGEMENT PLAN IN WESTERN MANAGEMENT AREA FOR 2009-2010 MANAGEMENT SEASON.

DATE	TRIGGER POINT(S) BREACHED	# OF BISON	LOCATION of BISON	OPER-ATIONS
3/26	Limit of 30 Bison in Flats	101	South of Madison River	
4/1	Limit of 30 Bison in Flats	38	South of Madison River	
4/2	Limit of 30 Bison in Flats	53	South of Madison River	
4/18	Limit of 30 Bison in Flats	91	South of Madison River	
4/20	Limit of 30 Bison in Flats	60	South of Madison River	
4/22	Limit of 30 Bison in Flats	158	South of Madison River	
4/23	Madison Resort by 4/15	21	West of Madison Resort	YES
4/26	Zone 3, Limit 40 Bison North of Duck Creek	68	West of South Fork (24), North of Duck Creek (44)	
4/26	Madison Resort by 4/15	24	West of Madison Resort	YES
5/3	Bison crossed Narrows	9	Red Canyon	
5/4	After 5/1 Narrows Crossing	12	Private Property (Red Creek Ranch)	YES
5/4	Zone 3, Limit of 30 Bison in Flats, Limit 40 Bison North of Duck Creek	238	West of South Fork (140), South of Madison River (42), North of Duck Creek (56)	
5/5	Zone 3, Madison Resort by 4/15, Limit of 30 in Flats	148	West of Denny Creek Rd (23), West of South Fork/Lonesomehurst Area (66), West of Madison Resort (59)	YES
5/6	Zone 3	7	West of South Fork	YES
5/7	Zone 3	13	West of South Fork	YES
5/10	Zone 3	64	North of Duck Creek (17), West of Denny Creek Rd (17), West of South Fork (30)	YES
5/11	Zone 3, Limit of 30 Bison in Flats	194	West of South Fork (52), South of Madison Arm (119), Transfer Station area (23)	YES
5/13	Limit 40 Bison North of Duck Creek	109	Red Canyon (5) Duck Creek/Lower Bear Trap subdivisions (104)	YES
5/15	Zone 3 Limit 0 Bison in Flats or North of Duck Creek	2	West of South Fork (2), North of Duck Creek (50)	YES
5/17	Zone 3, Limit 0 Bison in Flats or North of Duck Creek, Bulls only North of Madison River and South of Duck Creek	271	West of South Fork (21), South of Madison River (55), North of Duck Creek (40), Mixed bison on Horse Butte/YRP (155)	
5/18	Zone 3	115	West of South Fork (115)	YES
5/19	After May 15 Deadline Bulls only North of Madison River and South of Duck Creek	152	Mixed bison on Horse Butte (YRP & subdivisions)	YES
5/20	Zone 3	21	West of South Fork	YES
5/21	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	1	Bull in town of West Yellowstone	YES
5/21	Bulls only North of Madison River and South of Duck Creek Limit 0 Bison in Flats or North of Duck Creek	43	Mixed bison on Horse Butte (41), North of Duck Creek (2)	
5/24	Limit 0 Bison in Flats or North of Duck Creek	40	South of Madison River (30), North of Duck Creek (10)	

5/25	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	150	Madison Arm Summer Homes, west of Resort	YES
5/26	After May 15 Deadline Bulls only North of Madison River and South of Duck Creek	129	Mixed bison on Yellowstone Ranch Preserve & Horse Butte	YES
5/27	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	4	North of Duck Creek/Hwy 287 (3) In town of West Yellowstone (1)	YES
6/2	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek Bulls only North of Madison River and South of Duck Creek	110	Mixed bison South of Madison River, East of Resort, then swam to North side of Madison River (56) South of Madison River, East of Resort (54)	YES
6/3	After May 15 Deadline Bulls only North of Madison River and South of Duck Creek	45	Mixed bison on Horse Butte/Tower Eagle Closure	YES
6/7	Zone 3 After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	64	West of South Fork (21) South of Madison River (43)	YES
6/8	After May 15 Deadline Bulls only North of Madison River and South of Duck Creek Limit 0 Bison in Flats or North of Duck Creek	6	Three pairs South of Madison River, West of Hwy 191	YES
6/9	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	1	Bull bison in town of West Yellowstone	YES
6/19	Zone 3	4	West of South Fork	
6/21	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	4	South of Madison River	YES
7/11	Zone 3	1	West of South Fork	
7/16	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	8	South of Madison River	
7/18	Zone 3 After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	8	West of South Fork	YES
7/19	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	1	East of South Fork, South of Madison River	YES
7/22	Zone 3 After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	1	West of South Fork	YES
7/23	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	10	South of Madison River and east of Resort	YES
7/29	After May 15 Deadline Limit 0 Bison in Flats or North of Duck Creek	7	South of Madison River and east of Resort	YES

APPENDIX B: PUBLIC SAFETY AND WILDLIFE IMPACT COMMENTS CONCERNING PROPOSED WEST SIDE STRATEGIC FENCING PROJECT.

Wildlife Comments

- Moose and elk use the area, and may be affected by the temporary fence in terms of their ability to move across the landscape and/or the possibility of a cow being separated from her calf
- Bears (grizzly and black) will be moving through this area in spring. They could be negatively affected by the fence as well.
- Newborn bison calves may become separated from their mothers across the fence
- It is absolutely possible that a bison (or other wildlife?) could run through the fence when/if the voltage is compromised thereby becoming entangled in electric wire resulting in injury/death.
- It is understood that Horse Butte has an unspecified carrying capacity and that we need to address the issue when bison become too plentiful on Horse Butte. This could exacerbate that situation.
- If the fence is effective, there could be potential for higher numbers of bison on Horse Butte resulting in potential increase in numbers crossing at the Narrows.
- Need a detailed evaluation of perceived benefits vs. risks to other wildlife?
- Potential for bison being unable to cross the river due to high water
- Potential for bison to be funneled toward town such as was seen after the first year of airport fence construction.
- Number of bison encroaching into Zone 3 could be reduced, thereby limiting the number of hazing operations and personnel needed to meet the requirements of the IBMP.
- Potential for increased highway mortality (i.e. animals encounter the fence and move back across highway increasing frequency of crossings.)

Logistical Fencing Questions/Comments

- Could the fence actually contain high enough voltage to shock a bison through its winter coat and thick hide?
- It is really difficult to maintain a charged fence when running hot wires through forested, brushy country. There's too much debris that could fall across the wires thereby shorting them out. Without constant maintenance, animals could move through when the wires are shorted out thereby becoming stuck on the other side.
- How would we build/maintain the cattle guards on the roads to continue to allow recreation access? Cattle guards get packed with snow then bison can go right over it.
- How would we bring the wires up and down? As snow pack level varies, we'd have to keep moving the wires up somehow.
- If a temporary fence, would the posts stay all summer or get put in each year?
- Determination would need to be made on how the fence would be charged.
- This is a potentially very expensive endeavor. Who would fund the project?
- Would this be a federal or state liability issue?
- No clear responsibility for contractor selection and hiring.
- Who is responsible for fence maintenance?
- Potential for changing water levels and ice jams could impact the fence.

Recreational/Sociological

- Recreational impacts to cross country skiers, snowshoers, fishing, snowmobiling, and hunting.
- No clear authority on who will provide law enforcement for potential acts of vandalism.
- Public perception could be that this action is contrary to IBMP for allowing a free ranging bison population.
- High potential for litigation.

APPENDIX C: DETAILED REPORTS OF HAZING OPERATIONS IN THE WESTERN MANAGEMENT AREA FOR THE 2010 SEASON.*

Zone 3 Summary

Bison operations began on May 4th when Montana Dept. of Livestock (MT-DOL) located 18 bison in Zone 3/ Red Canyon/HWY 287. On May 5, 150 bison were relocated from Zone 3/South Fork to Zone 2/Madison Arm Road. Between May 5, and May 11, all relocation efforts were focused on moving bison from Zone 3/South Fork to Zone 2 locations along the Madison Arm Road. During this time period 289 bison were moved from Zone 3/South Fork. On May 18th 83 bison, May 20th 9 bison and June 7th 21 bison were moved from Zone 3/South Fork. On June 19, four bison (1 bull, 2 cows and a calf) were observed in Zone 3/South Fork on property that did not have cattle allotments. These bison were observed on June 21 in Zone 2/South Fork and hazed back into YNP. During spring bison operations 420 bison were moved from Zone 3 locations.

Entire Western Management Area Operations

Interagency hazing operations were conducted from April 26 to July 29, 2010. Prior to May 11, operations were conducted in response to breaches in trigger points or bison occupying non-tolerance areas. On April 26, 24 bison were hazed from west of the Madison Arm Resort east to mile marker 3.5 on the Madison Arm Rd. MDOL located 21 bison in Zone 3/Red Canyon/Hwy 287 on May 4 and moved them east to the Duck Creek wetlands area. On May 5, 150 bison were relocated from Zone 3/South Fork to Zone 2/Madison Arm Road. Between May 6 and 10, 17 bison were moved from Zone 3/Hwy 287 to the Duck Creek wetlands area and 67 bison were moved from Zone 3/South Fork to Zone 2 locations along the Madison Arm Road.

Between May 10 and 13, the objective was to move all bison from Zones 3 and 2 back into YELL. Bison were hazed by helicopter and interagency riders on horseback from Zones 3 and 2 into YELL. Hazed herds of cows and calves ranged in size from 35 to 352 bison. In anticipation of bison moving from outside the park boundary, 45 bison from Cougar Meadows and 160 from Seven-Mile Meadows were hazed to Madison Junction and Terrace Meadows. On May 12, 352 bison were hazed from Horse Butte to the Slough west of Cougar Meadows/Zone 1. An additional 184 bison were hazed from Cougar Meadows to Madison Junction. Bison continued to be hazed from Barns Hole inside YELL toward Madison Junction. An additional 75 bison were hazed by helicopter from Cougar Meadows to Seven-Mile Meadows where they walked toward Madison Junction. By the end of these operations, all bison were out of zone 3 and several dozen were left behind in zone 2 as a result of the hazing efforts.

No bison hazing operations were scheduled between May 14 and 17. On May 15, 145 bison walked from Cougar Meadows to Madison Junction. Operations began again on May 18 when 115 bison were hazed from the South Fork/Zone 3 to Barns Hole/Zone 1. On May 19, 152 bison were hazed from Horse Butte/Zone 2 to Barns Hole/Zone 1 and 110 bison were hazed from Barns Hole/Zone 1 to Seven-Mile Meadows. These bison independently walked from Seven-Mile Meadows to Madison Junction during the evening of May 19. On May 20, 160 bison were hazed from Barns Hole/Zone 1 to Seven-Mile Meadows. Twenty-one bison were picked up from the South Fork/Zone 3. Fourteen were hazed to Barns Hole/Zone 1, with 7 remaining in Zone 2 along the way. By the end of these operations, 41 bison remained on Horse Butte, 8 in the Duck Creek area, and 7 east of the South Fork in Zone 2.

No bison hazing operations were scheduled between May 21 and 24. On May 25, 150 bison were hazed from the South Fork/Zone 2 to Cougar Meadows/Zone 1. On May 26, 170 bison were hazed from Cougar Meadows/Zone 1 to Seven-Mile Meadow. This herd independently walked from Seven-Mile Meadows to Madison Junction during the evening of May 26. An additional 129 bison were hazed from Horse Butte/Zone 2 to Cougar Meadows/Zone 1. On May 27, 200 bison were hazed from Cougar Meadows/Zone 1 to Seven-Mile Meadows. Three bulls were hazed from Duck Creek/Zone 2 to Cougar Creek/Zone 1. One bull was hazed from the city limits of West Yellowstone to Barns Hole. On the morning of May 27, 75 to 100 bison were observed walking south from Madison Junction to Fountain Flats. By the end of these operations, all bison were in Cougar Meadows/Zone 1 or in the Madison Corridor.

No bison hazing operations were scheduled between May 28 and June 1. On June 2, 110 bison were hazed from the South Fork/Zone 2 to Cougar Meadows. An additional 90 bison were added to the herd between the boundary of YELL and Cougar Meadows. Also, 20 bison that were along the boundary in the vicinity of the Transfer Station were hazed to Cougar Meadows. On June 3, 38 of 45 bison were hazed from Horse Butte/Zone 2 to Cougar Meadows. An additional 96 bison were added during hazing to Cougar Meadows. By the end of these operations, 7 bison were left on Horse Butte.

No bison hazing operations were scheduled between June 4 and 6. On June 7, 21 bison were hazed from the Denny Creek Road/Zone 3 to Cougar Meadows. An additional 43 bison were picked up along the Madison Arm Road/Zone 2 and hazed to Cougar Meadows. On June 8, 42 bison were hazed from Cougar Meadows/Zone 1 to Madison Junction. Four bison were

hazed from the Madison Arm Road/Zone 2 to Barns Hole/Zone 1. No bison hazing operations occurred between June 9 and 20. On June 21, one bull, two cows, and a calf were hazed from the South Fork/Zone 2 along the Madison Arm Road to YELL.

No bison hazing operations were scheduled between June 22 and July 17. On July 18, 3 bulls, 3 cows, and 2 calves were hazed from the South Fork/Zone 3 to east of the Bakers Hole campground. On July 19, one bull was located just east of the South Fork River and was hazed across the Madison Arm into YELL. On July 22, one bull was hazed from the South Fork/Zone 3 area to just east of the Madison Arm Road. On July 23, a total of 5 bulls, 3 cows, and 2 calves were hazed from various locations on the Madison Arm into YELL. No hazing operations occurred between July 24and 28. On July 29, 2 bulls, 3 cows, and 2 calves were located on the Madison Arm and hazed into YELL.

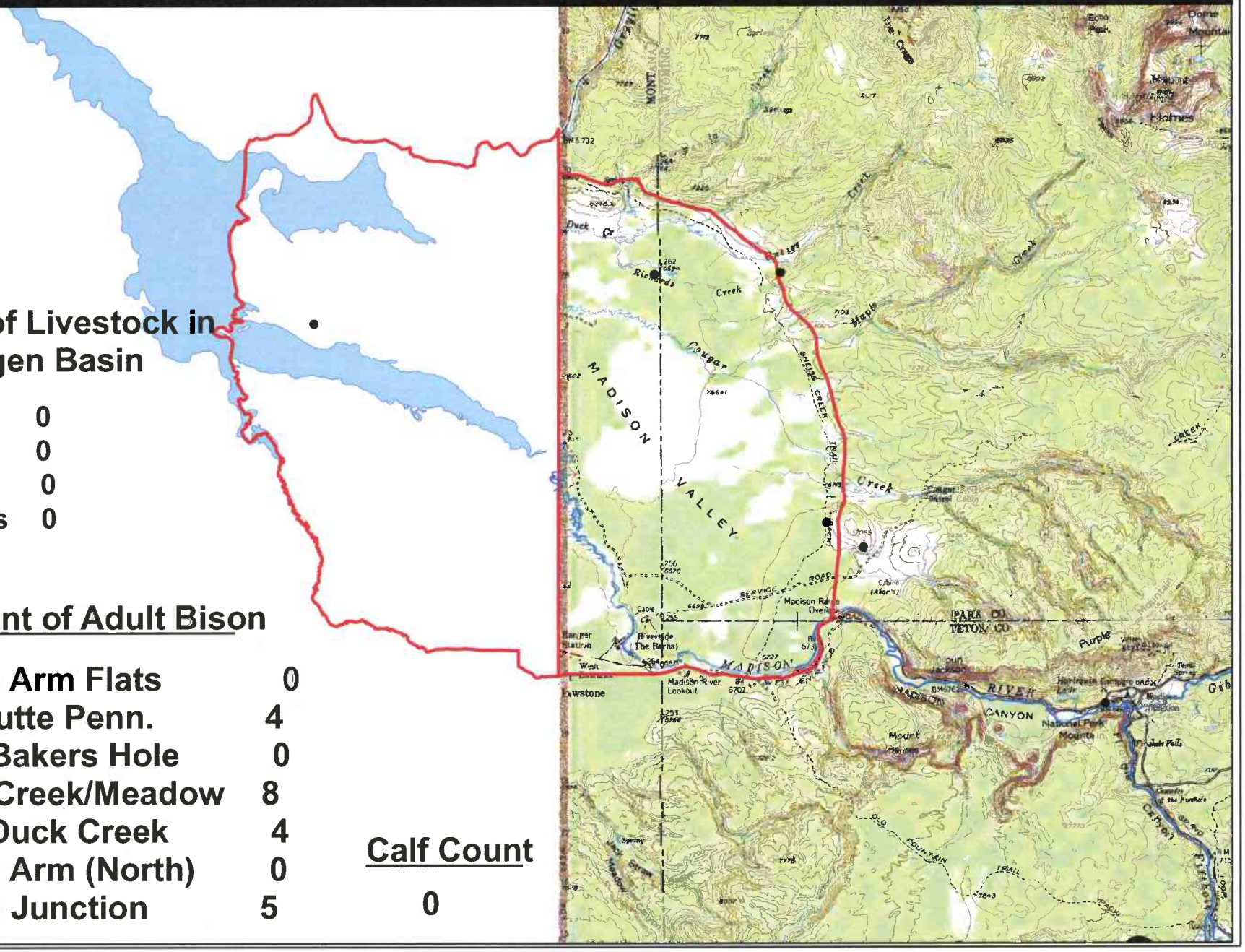
* There were numerous discrepancies between the NPS and MDOL regarding numbers of bison outside YELL following hazing operations.

APPENDIX D: AERIAL BISON SURVEYS OF THE WESTERN MANAGEMENT AREA (NPS DATA)

Distribution of Yellowstone Bison

March 12, 2010 West Boundary Survey

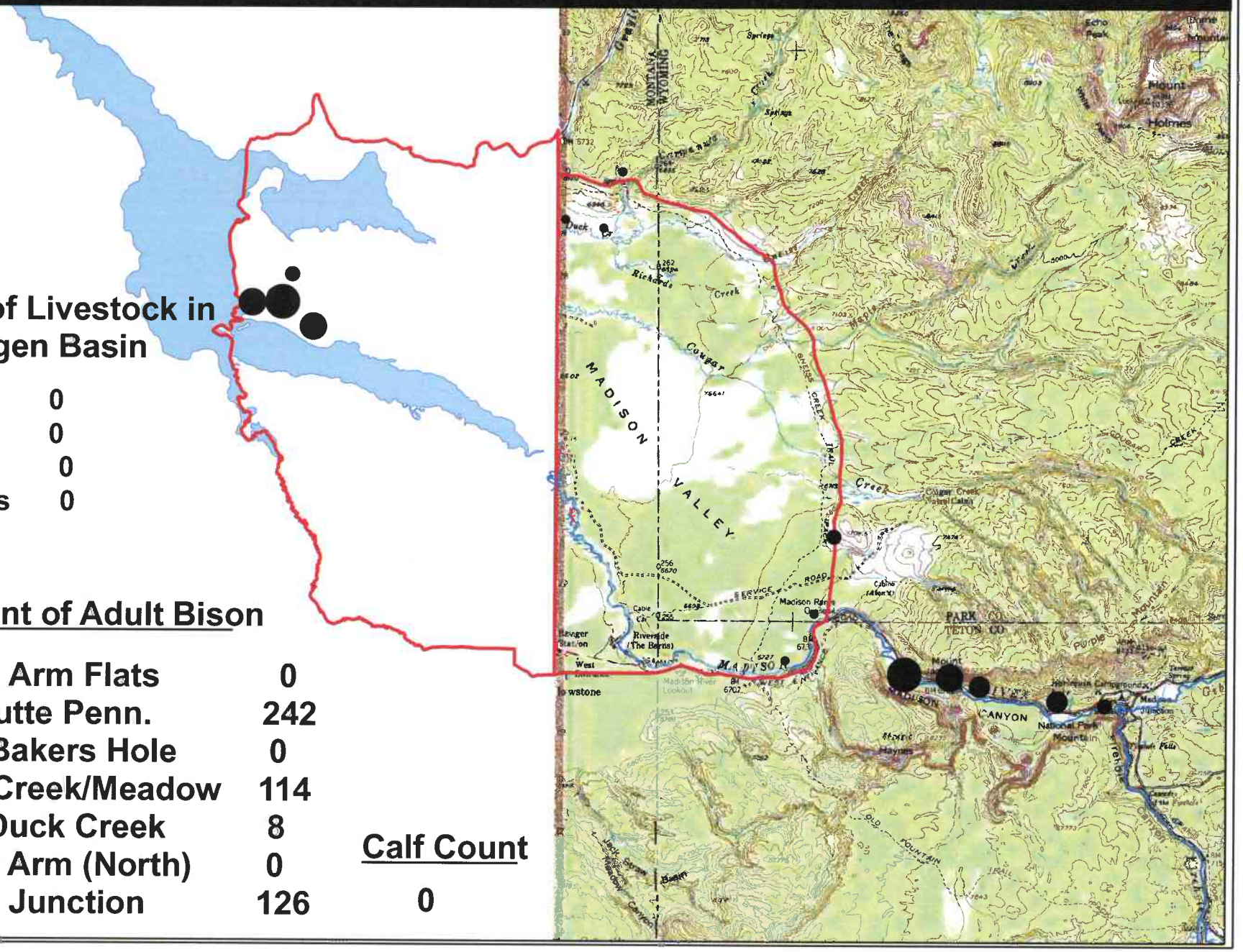
National Park Service
U.S. Department of the Interior



Distribution of Yellowstone Bison

April 9, 2010 West Boundary Survey

National Park Service
U.S. Department of the Interior



Number of Livestock in Hebgen Basin

Cows	0
Calves	0
Bulls	0
Yearlings	0

Total Count of Adult Bison

Madison Arm Flats	0
Horse Butte Penn.	242
Barnes/Bakers Hole	0
Cougar Creek/Meadow	114
Gneiss/Duck Creek	8
Grayling Arm (North)	0
Madison Junction	126

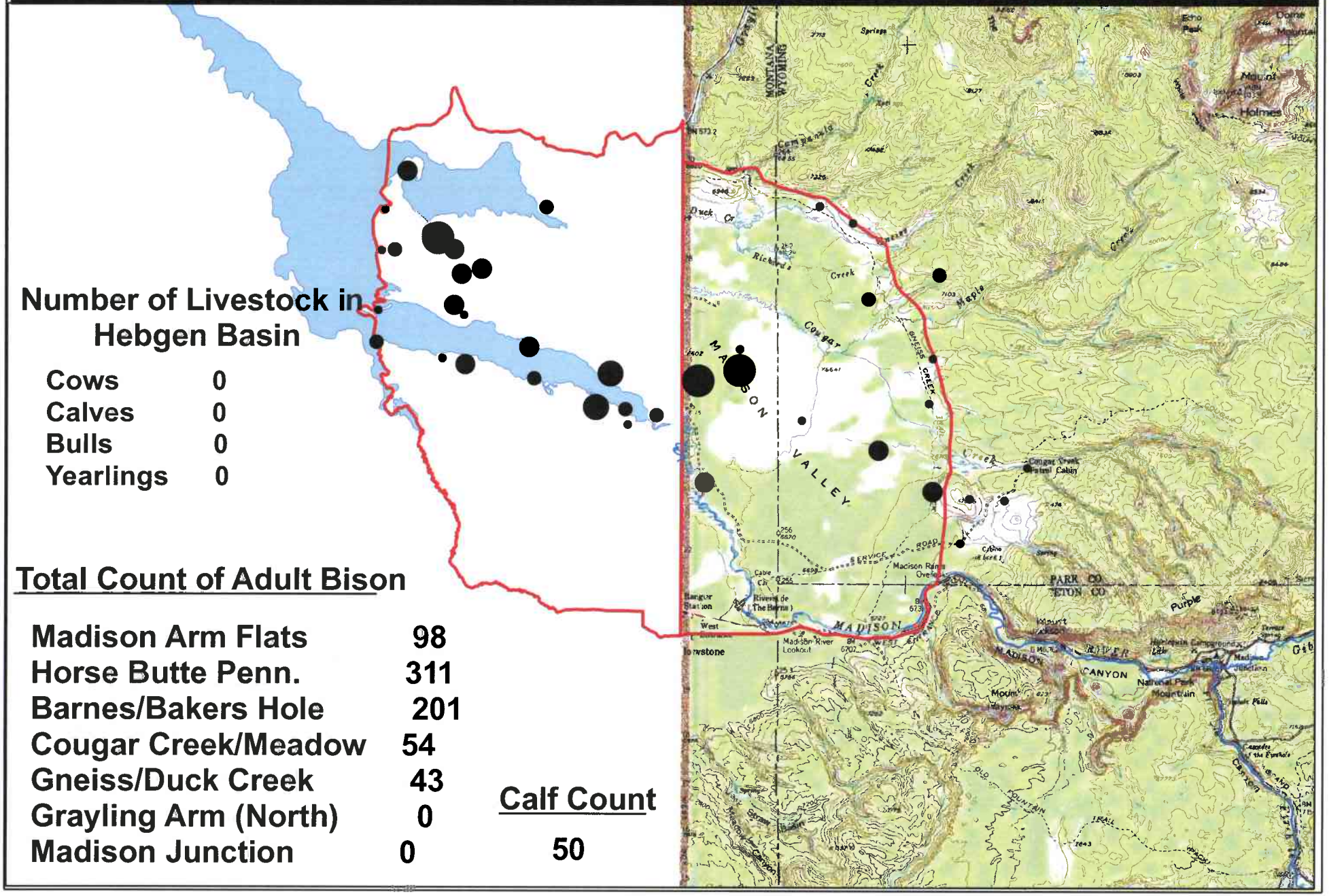
Calf Count

0

Distribution of Yellowstone Bison

May 7, 2010 West Boundary Survey

National Park Service
U.S. Department of the Interior



Number of Livestock in Hebgen Basin

Cows	0
Calves	0
Bulls	0
Yearlings	0

Total Count of Adult Bison

Madison Arm Flats	98
Horse Butte Penn.	311
Barnes/Bakers Hole	201
Cougar Creek/Meadow	54
Gneiss/Duck Creek	43
Grayling Arm (North)	0
Madison Junction	0

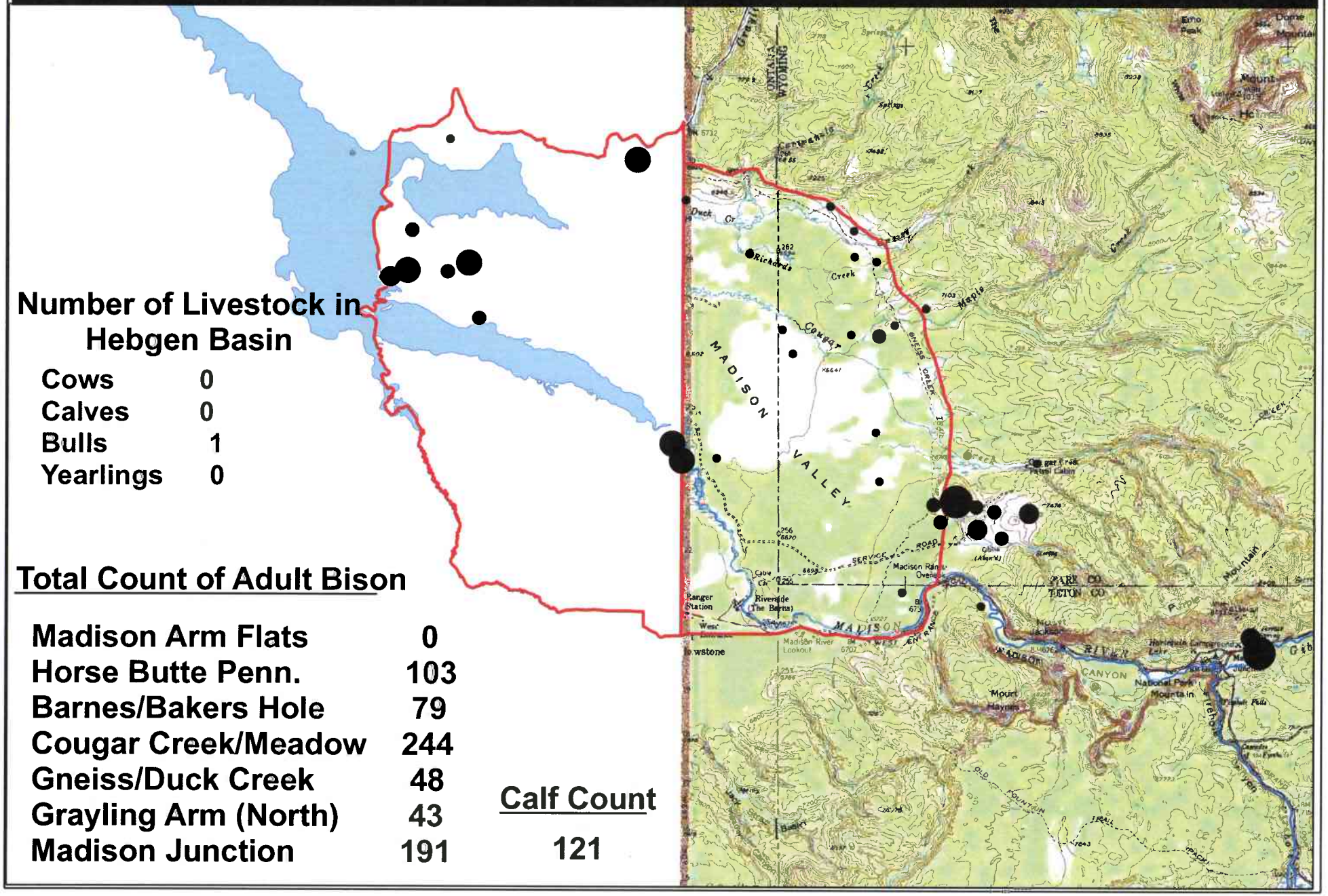
Calf Count

50

Distribution of Yellowstone Bison

May 15, 2010 West Boundary Survey

National Park Service
U.S. Department of the Interior



Number of Livestock in Hebgen Basin

Cows	0
Calves	0
Bulls	1
Yearlings	0

Total Count of Adult Bison

Madison Arm Flats	0
Horse Butte Penn.	103
Barnes/Bakers Hole	79
Cougar Creek/Meadow	244
Gneiss/Duck Creek	48
Grayling Arm (North)	43
Madison Junction	191

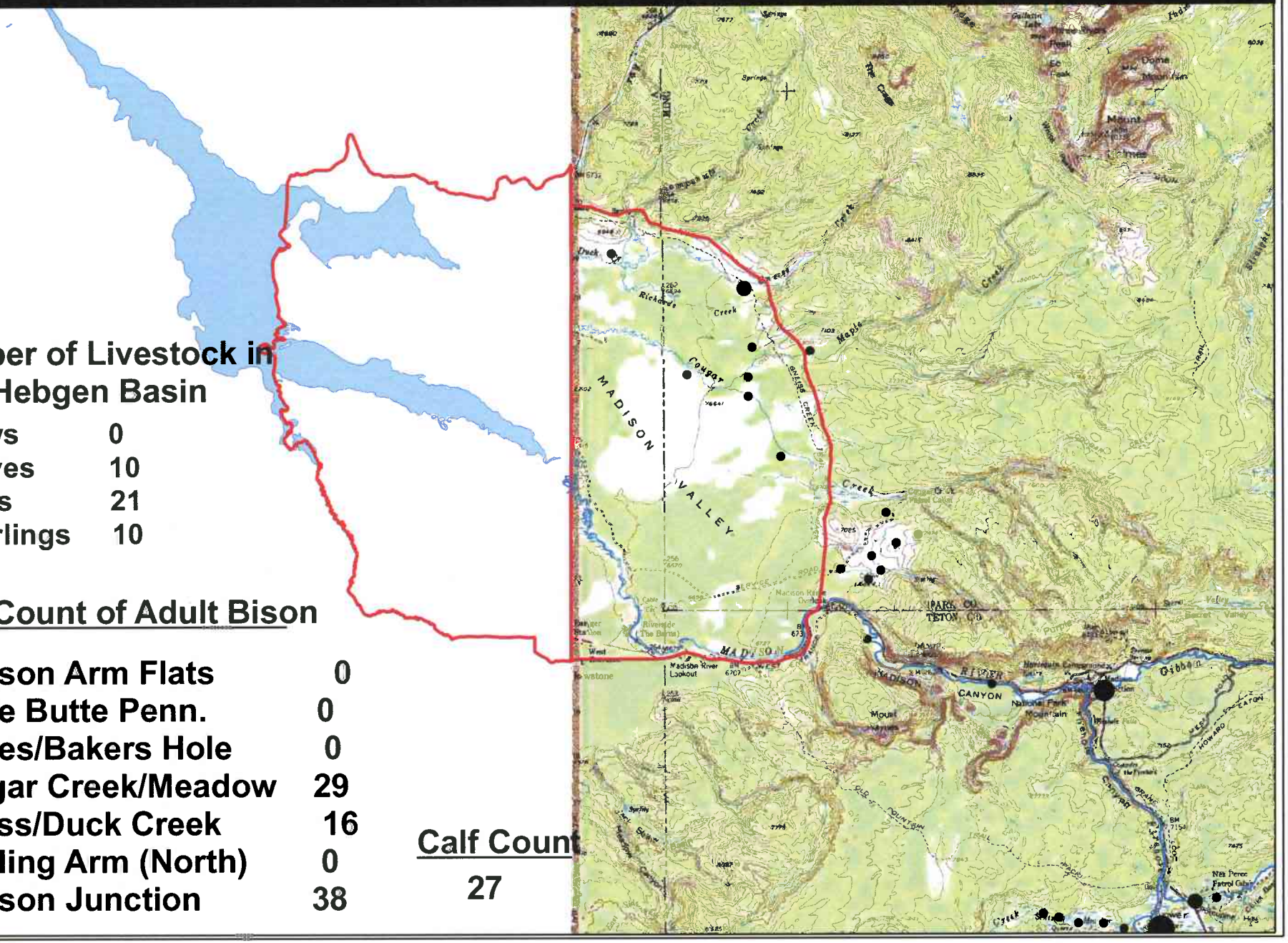
Calf Count

121

Distribution of Yellowstone Bison

June 14, 2010 West Boundary Survey

National Park Service
U.S. Department of the Interior



Number of Livestock in Hebgen Basin

Cows	0
Calves	10
Bulls	21
Yearlings	10

Total Count of Adult Bison

Madison Arm Flats	0
Horse Butte Penn.	0
Barnes/Bakers Hole	0
Cougar Creek/Meadow	29
Gneiss/Duck Creek	16
Grayling Arm (North)	0
Madison Junction	38

Calf Count

27