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Bison science and governance manuscript

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Revision attached for your review and comments before submission to the journal *Policy Sciences*. Thanks.

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RESOLVING INTRACTABLE GOVERNANCE ISSUES TO RECOVER WILD BISON WHILE MAINTAINING PUBLIC AND TRIBAL TRUST

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Abstract

Current management that limits numbers of Yellowstone bison and restricts them to the national park and adjacent areas of Montana, unlike any other migratory wildlife species, is not serving the broader common good, but rather specific livestock interests based on perpetuated myths and misperceptions. The lack of tolerance for these wild bison on other suitable public lands in the Greater Yellowstone Area is not justified based on the comparative risks of brucellosis transmission to cattle, human injury, and property damage; all of which are much higher for wild elk that are tolerated without suppressive management. If the American public, and particularly people in the Greater Yellowstone Area, want wild bison living relatively unfettered outside parks and refuges, current conditions present an opportunity to manage them similar to other wildlife in suitable areas. Decades of management have shown there are relatively few conflicts between bison, cattle, residents, and the millions of visitors each year to the area. When conflicts occur, they can be promptly dealt with through appropriate fencing, hazing, hunting, and other actions. The challenge is to move from inflexible disputes regarding governance issues and untenable lines defining tolerance areas on a map to developing collaborative agreements that address conflicts and solve problems with adequate funding, staff, and support. Only then will the national mammal be accepted on more public lands outside parks and refuges, which will facilitate bison recovery, improve public and treaty hunting opportunities, enhance local and regional economies, and enrich the experiences of most residents and visitors.

Keywords

Bison management; Common and specific interests; Greater Yellowstone Area; Persistent policy problem; Resolving conflict; Science and governance

Introduction

In December 2000, the National Park Service (NPS), Animal and Plant Health Inspection Service (APHIS), and U.S. Forest Service entered into an Interagency Bison Management Plan (IBMP) with the State of Montana regarding bison chronically exposed to the disease brucellosis migrating from Yellowstone National Park (YNP) into the state during winter. These agencies were later joined by the InterTribal Buffalo Council due to their mission of restoring bison to tribal lands, as well as the Confederated Salish and Kootenai Tribes of the Flathead Nation and the Nez Perce Tribe due to their treaty hunting rights for bison on open and unclaimed lands, primarily national forests, adjacent to the park. Members of the Blackfoot Nation, Confederated Tribes of the Umatilla Reservation, Confederated Tribes and Bands of the Yakama Nation, Crow Tribe, and the Shoshone-Bannock Tribes also harvest Yellowstone bison and sometimes participate in management discussions, but are not formal members of the IBMP. Idaho and Wyoming were not included in the IBMP because few bison currently migrate from YNP into these states.

The goal of the IBMP is “to maintain a wild, free ranging population of [Yellowstone] bison and address the risk of brucellosis transmission to protect the economic interest and viability of the livestock industry in Montana” (USDI and USDA 2000:22). Brucellosis is a contagious bacterial disease that infects wild bison and elk in the Greater Yellowstone Area and induces abortions or the birth of non-viable calves in some animals (Cheville et al. 1998). Cattle can be infected through contact with fluids or tissues, causing producers to experience economic losses from killing infected animals, increased testing requirements, and decreased marketability (USDA, APHIS 2014). Under the IBMP, there has been no detected transmission of brucellosis from wild bison to cattle, while a viable, wild population of bison has been sustained in YNP. Also, numerous adaptive adjustments have been made to improve management, including increased tolerance for more bison in nearby areas of Montana (Bullock 2015, IBMP Members 2016). Nevertheless, the intensive management of bison migrating from YNP to limit their abundance and restrict their distribution to small, adjacent areas has led to persistent disputes among federal, state, and tribal agencies regarding issues related to authority, control, priorities, and sovereignty.

When the IBMP was negotiated during the 1990s, there was intense pressure at state and national levels to prevent cattle from being infected with brucellosis; thereby allowing their continued export without testing to facilitate interstate movements and trade agreements (Bidwell 2010). This anxiety escalated in 1995 when Montana

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sued the federal government, claiming bison migrating outside YNP would jeopardize the state's brucellosis-free status for cattle and, in turn, interstate and international trade (State of Montana 2000, Franke 2005, Bidwell 2010). As a result, maintaining a negligible risk of brucellosis transmission from bison to cattle was prioritized in the court-mediated IBMP over conservation interests. Maintaining a "low risk" of transmission was deemed unacceptable by Montana because brucellosis transmission might still occur under certain circumstances and, allegedly, threaten the viability of the livestock industry (State of Montana 2000). As a result, the state's objectives for the IBMP included assuring veterinarians in other states and countries that management would prevent the transmission of brucellosis from bison to livestock, reducing brucellosis prevalence, and reducing property damage and human injuries (State of Montana 2000).

In keeping with these objectives, a population target of 3,000 bison was chosen to reduce migrations outside YNP, rather than being based on assessments of ecological or genetic viability (Cheville et al. 1998, State of Montana 2000). Tolerance for bison migrating into Montana was constrained to a short time-period during winter and small areas adjacent to YNP, which did not achieve the goal of a free-ranging population or further the restoration of wild bison on more public lands in the ecosystem. Instead, the plan was intentionally designed to "prevent the reestablishment of a free-ranging bison herd in places where bison have been absent for more than a century," which essentially defined the park and small, nearby areas as "the acceptable limits for bison distribution" (State of Montana 2000:28-29, 33). In addition, the management of bison under the IBMP included many intrusive agrarian-type actions such as capture, test-and-slaughter, vaccination, and hazing animals back into YNP to constrain their abundance and distribution, while attempting to suppress brucellosis prevalence. Many of these actions are implemented by state agency personnel on public lands administered by the Forest Service. Furthermore, the Montana Legislature imposed severe restrictions on the movements and relocation of Yellowstone bison (Montana Code Annotated [MCA], Titles 81 and 87). This treatment differed from the management of other wildlife in the northern Yellowstone area, including elk that were also chronically infected with brucellosis yet allowed to move freely across the landscape without being subjected to similar intrusive actions.

This disparate management of sympatric bison and elk apparently resulted from several prevailing suppositions during the 1990s. Livestock regulators were adamant that compliance with the National Brucellosis Program required management to maintain separation between infected wildlife and cattle. Otherwise, Montana would reportedly lose its' brucellosis class-free status or trade sanctions would be imposed by other states or nations; thereby putting many producers out of business (State of Montana 2000). Elk were considered unlikely to mingle with cattle and transmit brucellosis because females typically isolate themselves while giving birth and clean up fluids and tissues at calving sites (State of Montana 2000). Indeed, the prevailing viewpoint was that brucellosis would disappear from elk in the Greater Yellowstone Area if winter feed grounds in Wyoming were discontinued; thereby, eliminating concentrations of elk that facilitated transmission (Cheville et al. 1998). In contrast, livestock regulators were worried about larger migrations of bison into Montana during winter as numbers within YNP increased because they believed bison numbers in the mid-1990s were at or near the maximum that could be sustained within the park (State of Montana 2000). For almost a century, as the bison population recovered from near extirpation by 1900 to more than 4,000 animals in 1995, few bison migrated outside YNP. However, more bison began migrating into Montana during the 1990s as numbers surpassed 3,000, and the higher prevalence of brucellosis exposure in bison (50-60%) compared to elk (<10%) increased the perception that bison would be the primary risk of transmission to cattle (Cheville et al. 1998, State of Montana 2000). Furthermore, all bison testing positive for antibodies indicating previous exposure to brucellosis were presumed to be carrying live bacteria and infectious (State of Montana 2000). Since the state had few funds or personnel allocated for bison management, and bison could not transmit brucellosis to cattle if they were confined within YNP, state officials rejected alternatives that would have allowed bison to recolonize most suitable public lands elsewhere (State of Montana 2000).

Reliable knowledge accumulated since 2000 indicates many of these premises were incorrect or quickly became faulty as circumstances and conditions changed (National Academies of Sciences, Engineering, and Medicine 2017). We now know brucellosis is sustained independently in elk populations and bacterial strains not associated with bison have increased in prevalence and spread within and outside the Greater Yellowstone Area (Kamath et al. 2016). In fact, elk exposed to brucellosis now inhabit an area encompassing about 17 million acres, whereas bison inhabit about 1.5 million acres near the core. Elk commonly mingle with livestock in the Greater Yellowstone Area and have transmitted brucellosis to them 27 times since 1998, whereas no direct transmissions from bison to cattle have been detected (Rhyen et al. 2013, National Academies of Sciences, Engineering, and Medicine 2017). In addition, we learned only 10 to 15 percent of adult female bison are infectious and could shed live bacteria, while bulls do not appear to transmit the disease (Roffe et al. 1999, Frey et al. 2013). Moreover, the risk of brucellosis transmission from bison to cattle was found to be insignificant (<1%) compared to elk, which have a much larger and increasing overlap with cattle and are often tolerated by livestock producers, some of which are associated with

outfitters during autumn elk hunting seasons (Kilpatrick et al. 2009, Schumaker 2013). Elk are also involved in hundreds of vehicle strikes in the Greater Yellowstone Area each year that cause substantial property damage and occasional human injuries.

Despite these findings, Montana recently rejected more intensive management of elk and, instead, decided to use fencing, hazing, and hunting in certain areas to keep elk separate from cattle during periods of high risk in late winter and spring (MFWP 2015). The intent was to reduce transmission risk while maintaining elk on the landscape; with no efforts to conduct test-and-slaughter or eradicate brucellosis (Legislative Audit Division 2017, MFWP 2017). This decision was reached, in part, because elk are highly valued by hunting and outfitting interests (Morris and McBeth 2003). In addition, APHIS promulgated a regulatory rule in 2010 that greatly reduced the risk of Montana losing its brucellosis-free status and experiencing associated economic costs by dealing with outbreaks in cattle on a case-by-case basis and eliminating the need to remove exposed herds and test across the entire state (USDA, APHIS 2014). To comply with this and other regulations, Montana developed a brucellosis management plan with a Designated Surveillance Area defined by the geographic distribution of brucellosis-infected elk which, in combination with APHIS' regulations, saves livestock producers about \$5.5 million each year in testing and other costs (MDOL 2013).

More recently, the Governor of Montana approved a greater distribution of wild bison on some lands near YNP and within the Designated Surveillance Area, which he concluded would not increase the risk of brucellosis transmission to cattle or result in trade sanctions by other states or nations (Bullock 2015). However, this concept has not been realized in practice due, in part, to resistance from livestock regulators to lessen existing constraints on bison distribution and alleviate the intrusive approach to managing them; even though fencing, hazing, and hunting have proven effective at preventing brucellosis transmission from bison to cattle. Instead, APHIS and Montana have increased pressure on the NPS to lower bison numbers and suppress brucellosis prevalence in bison through vaccination, fertility control, and hunting inside YNP (USDA, APHIS 2012, 2016; National Academies of Sciences, Engineering, and Medicine 2017; Montana Environmental Quality Council 2016); even though these same actions are considered inappropriate to control elk herds spreading brucellosis elsewhere (MFWP 2015).

This history indicates the risk of brucellosis transmission to cattle is not a credible reason for the incongruent treatment of wild bison compared to elk, which pose a much greater risk but are generally allowed to move freely without intrusive management. Elk are viewed as a beneficial asset, while bison are viewed as a new, unwanted burden by many state managers and ranchers; apparently because bison compete with cattle for grass and are seen as an uncontrollable threat to the ranching lifestyle (CWG 2011). Herein, we explore the reasons for these disparities, identify persistent problems with bison management, and propose ideas for resolution.

Science and Governance

The management of Yellowstone bison involves scientific issues related to having sufficient biological and technical information to make informed decisions and effectively implement actions, as well as governance issues related to how and by whom decisions and policy are made (Clark et al. 2014, Clark and Vernon 2016). Examples of scientific issues include having reliable knowledge on bison population dynamics and the risk of brucellosis transmission to cattle, as well as the technical knowledge and tools to regulate bison numbers, evaluate habitat availability and condition, increase hunting opportunities, or suppress brucellosis infection. Experience and research have provided information to support bison management, including on population demographics and dynamics, genetic lineages and diversity, migration patterns and grazing impacts, brucellosis prevalence and transmission risk, vaccine efficacy and delivery, and how to effectively use fencing, habitat, hazing, and hunting to influence bison distribution and movements. Better information and tools are still needed regarding the suppression of brucellosis through the development of effective vaccines, improvement of diagnostic tests to detect infectious animals, and how to reduce concentrations of elk that exacerbate brucellosis transmission (CWG 2011). However, these uncertainties have not precluded the IBMP agencies from recovering a viable population averaging about 4,195 bison since 2001, with no direct transmission of brucellosis to cattle.

This successful management suggests there is no compelling scientific or technical reason for the differential management of bison compared to elk, especially given the recurring transmissions of brucellosis from elk to cattle. Rather, it appears this disparity, as well as most other disputes about the management of Yellowstone bison, occurs because the agencies and tribes implementing the IBMP have varying mandates (or rights) and interests that have led to divergent priorities and management approaches (Clark et al. 2014, Clark and Vernon 2016). These political and social differences, which are summarized in the remainder of this section, complicate efforts to collaboratively and effectively manage bison moving across jurisdictions.

The Superintendent of YNP is charged with preserving the resources therein unharmed and in their natural condition for the benefit and enjoyment of people (16 USC [United States Code] 21, 54 USC 100101 *et seq.*). As a

result, bison and other wildlife are generally allowed to move freely and unpursued within the interior of the park, with their behaviors, movements, and reproductive success primarily affected by their decisions and natural selection (16 USC 26). The Superintendent has the discretion to transfer or dispose of “surplus” animals (16 USC 36; 54 USC 100101, 100752), though allowing populations to fluctuate naturally with minimal human intervention is preferred (NPS 2006). The Lacey Act passed by Congress in 1894 prohibits hunting and the harassment, possession, or removal of wildlife from YNP (16 USC 26).

In Montana, the Fish, Wildlife & Parks Commission typically sets policies for the protection, management, and public use of wildlife (MCA 87-1-201). However, in 1994 the Legislature assigned the management of Yellowstone bison to the Department of Livestock due to the population’s chronic exposure to brucellosis (State of Montana 2000). The Department can remove Yellowstone bison moving into Montana if they jeopardize programs to control livestock diseases (MCA 81-2-120, Montana Attorney General 2016). Pursuant to a plan approved by the Governor, the Department contains bison in small areas near YNP and keeps them separate from livestock (Bullock 2015, Legislative Audit Division 2017). Fish, Wildlife & Parks cooperates in this management paradigm, focusing on public hunting and preventing damage to people or property (MCA 87-1-216, MCA 87-2-730, Montana Attorney General 2016).

The Forest Service manages national forests pursuant to a multiple-use mandate, whereby renewable resources are used to best meet the needs of the American people (16 USC 528, 1604). Forest Supervisors have an obligation to conserve and manage wildlife on national forests, but cooperate with states in planning and implementing management actions, including harvests that conform with state laws (36 CFR 241; Nie et al. 2017). Comprehensive forest plans are prepared to sustain wildlife populations and their habitats, with the management of wildlife often primarily conducted by the respective states (16 USC 528, 1604). However, the Forest Service can preempt or supersede state laws and policy to meet their statutory and trust obligations regarding wildlife after consultation with the states (43 USC 1732; Nie et al. 2017).

The mission of APHIS is to protect the health, quality, and productivity of American agricultural resources. The Secretary of Agriculture establishes regulations to prevent the interstate or international spread of livestock diseases, including the quarantine of animals. Under the Animal Health Protection Act (7 USC 8301 *et seq.*), the Veterinary Services section of APHIS administers the National Brucellosis Eradication Program in cooperation with the states. The Uniform Methods and Rules for Brucellosis Eradication (USDA, APHIS 2003) describe standards for surveillance, testing, and interstate transport of livestock and domestic bison. They also contain a protocol for the quarantine of bison from Yellowstone and Grand Teton national parks to determine if the animals are brucellosis free.²

Native American tribes have aboriginal rights because they originally occupied the land, as well as rights reserved by treaties with the United States government. Since 2006, the Blackfeet, Crow, Salish and Kootenai, Nez Perce, Shoshone-Bannock, Umatilla, and Yakama tribes have used their respective treaty rights at various times to harvest bison migrating outside YNP onto open and unclaimed lands in Montana, mostly portions of the Custer Gallatin National Forest. Each tribe has their own permits, regulations, and wardens for enforcement. All federal agencies are responsible for respecting tribal sovereignty and self-determination, and ensuring decisions affecting tribes are consistent with the trust responsibility to act in their best interest (e.g., Secretary of the Interior 2014).

Common and Specific Interests

Given these various missions, statutes, and treaties, the challenge for collaboratively managing national public resources such as Yellowstone bison is to prioritize common interests beneficial to the broader community over special interests benefitting one or a few parties (Clark et al. 2014). Management policies or programs that contribute to common interests result when decision-making processes are transparent, include groups with different viewpoints, address valid concerns based on reliable knowledge, and select actions that resolve, or at least alleviate, conflicts or problems (Steelman and Elefante DuMond 2009, Clark and Vernon 2016).

When the IBMP was created in 2000, the federal government and Montana agreed to several objectives reflecting a mix of common and specific interests. Common interests included maintaining a viable population of bison; addressing the risk of brucellosis transmission to livestock; addressing the risk to public safety and private property damage; basing decisions on factual information and learning; and recognizing the need for coordination

² Yellowstone bison are designated as wildlife, not livestock, by Montana and the federal government; which casts doubt upon whether they are subject to, or bound by, these rules. House Conference Report 107-424 for the Farm Security and Rural Investment Act of 2002 (Public Law 107-171) indicates “[t]he purpose of the Animal Health Protection Act is to address pest and disease threats to animal health and production. ... However, nothing in this section or in this title should be construed as impliedly vesting in the Secretary [of Agriculture] authority to manage fish or wildlife populations” (page 389). Also, these rules do not, by themselves, have the force of law because they were not promulgated into regulations pursuant to rulemaking procedures under the Administrative Procedures Act.

among agencies and jurisdictions. Specific interests included protecting the economic interest and viability of the livestock industry; addressing bison population size and distribution; defining a boundary line beyond which bison would not be tolerated; committing to the eventual elimination of brucellosis; and protecting Montana from a risk of reduction in its brucellosis status. Objectives calling for complete elimination of brucellosis and overriding protection of the livestock industry (i.e., zero risk), coupled with stringent constraints on bison population size and distribution, were driven by specific interests of the livestock industry and reflect a viewpoint of intolerance compared to the broader common interest of allowing bison on suitable public lands while maintaining low risk to cattle, people, and property. As a result, the IBMP objectives constraining the abundance and distribution of wild bison contrast markedly with common interest objectives for maintaining wild, free-ranging elk on the broader landscape; even though many of these elk have been exposed to brucellosis and contribute to frequent property damage (e.g., broken fences, vehicle strikes) and occasional human injuries.

At meetings of the IBMP, the various agencies and tribes often emphasize their specific interests, which make it difficult to reach consensus on management decisions (see meeting notes at <<http://ibmp.info/meetings.php>>). For example, the NPS talks about recovering viable populations of wild bison and sustaining processes such as migration and dispersal on suitable public and tribal lands in the ecosystem and elsewhere. The Montana Department of Livestock emphasizes preventing brucellosis transmission to livestock, maintaining a relatively low number of bison, and hunting bison in YNP. APHIS focuses on the suppression and eventual eradication of brucellosis, including the use of fertility control and embryo transfer to eventually eliminate and replace brucellosis-exposed bison. The Forest Service highlights sustainable habitat for multiple wildlife species and uses, including enhancement projects and grazing assessments. Montana Fish, Wildlife & Parks concentrates on ethical and safe hunting, human safety, and property damage. The Nez Perce Tribe and the Salish and Kootenai Tribes raise issues regarding habitat restoration and treaty hunting rights, including maximizing harvests while eliminating the capture of bison for slaughter because it reduces the number of bison available to hunters. The InterTribal Buffalo Council focuses on the restoration of bison to tribal lands, including brucellosis-free Yellowstone bison completing a quarantine protocol.

In addition, there are many other parties affected by bison management actions, including other tribes with treaty hunting rights in the Yellowstone area, county commissioners, bison advocacy and environmental organizations, hunters and outfitters, livestock producers, seasonal and year-round residents and business owners, Congressional representatives, the Bureau of Indian Affairs, the U.S. Fish and Wildlife Service, interested American citizens, and interested international people. In 2011, a Citizens Working Group on Yellowstone Bison comprised of people with diverse viewpoints provided consensus recommendations on brucellosis risk reduction, bison population management, and bison habitat to managers of the IBMP. Their desired outcomes included a better understanding of disease, economic, and other risks posed by bison; reduced risk of brucellosis transmission; no expansion in the Designated Surveillance Area for brucellosis; bison viewed as an asset instead of a liability; an agreed-upon and justified bison population range; protection of genetic diversity in bison; expanded habitat for bison, while addressing private property rights and concerns; use of multiple tools (e.g., hunting, relocation, lethal removal) to manage bison; and minimal use of hazing, capture, slaughter, and other intrusive actions (CWG 2011).

Furthermore, a survey of 500 registered voters in Montana indicated 81% favored wild bison; 72% supported their management as wildlife instead of livestock; 76% supported their restoration on public and tribal lands; and 74% wanted Fish, Wildlife & Parks to make management decisions regarding wild bison instead of the Department of Livestock (Tulchin Research 2015). Moreover, 42 interviews by researchers from the University of Montana with residents living in areas where Yellowstone bison migrated found most people did not think bison posed a higher brucellosis transmission risk to cattle or should be managed differently than elk. However, residents wanted concerns about too many bison on their property, motorist safety, and property damage addressed (Metcalf et al. 2016). Many long-time residents wanted 3,000 or fewer bison, while other residents thought available habitat could sustain 6,000 or more bison. Hunting was strongly favored over shipments to slaughter to limit bison numbers, but residents opposed how hunts were being conducted with concentrated hunters shooting at herds of bison soon after they crossed the boundary of YNP; often near homes and roads (Metcalf et al. 2016).

Intractable Conflict

The surveys of voters and interviews with residents indicate broad support for managing bison as wildlife. However, occasional migrations of many hundreds of Yellowstone bison into small areas of Montana where bison largely were absent for more than a century, accompanied by shipments of bison to slaughter and unpopular harvest techniques near the park boundary and residential areas, lead to political and social conflict, negative media coverage, public outcry, and litigation (Bidwell 2010). Reaching consensus to make large-scale changes in the management approach to lessen these conflicts and address broader common interests is difficult given the divergent

authorities and specific interests of the IBMP members. As a result, the underlying framework of management established under the IBMP in 2000 tends to be maintained, which serves to perpetuate the myth that bison pose a much higher risk to cattle and people than elk, while undermining widespread national, regional, and local support for managing bison more like other wildlife. In turn, IBMP members with incompatible specific interests become frustrated and engage in persistent disputes about management and policy that tend to bolster or defend their viewpoints. Some of the persistent disputes among the IBMP members from our perspective include:

- The appropriate abundance, distribution, and treatment of wild bison;
- The contention that any change in management perceived to increase the risk of brucellosis transmission, property damage, or human injury is unacceptable (State of Montana 2000), as opposed to maintaining low risk similar to other wildlife;
- Montana's repeated calls for hunting in YNP, which was prohibited by Congress in 1894;
- Concentrations of hunters along the boundary of YNP that create safety issues and prevent bison from migrating into Montana to learn the landscape and enhance future conservation and hunting opportunities;
- Decisions by Montana and APHIS to stop participating in the capture, culling, and distribution of bison; thereby leaving the NPS to solely conduct these activities for the primary benefit of Montana's livestock industry;
- The capture and culling of wild bison in YNP for shipment to slaughter which is opposed by most everyone and reduces the number of migrating bison available for treaty hunting opportunities in Montana;
- Quarantine and relocations of bison to reduce the number shipped to slaughter;
- Whether bison have overgrazed habitats in YNP, and whether habitats outside the park can support bison due to historic and current grazing by elk and livestock; and
- What can and should be done about brucellosis in wildlife given inadequate vaccines and delivery mechanisms, the already low risk of transmission to cattle, and the disease's continuing spread in elk throughout the Greater Yellowstone Area?

These contentious disputes have led to increasingly strained relationships among some IBMP members, particularly the NPS versus federal and state livestock agencies. Also, the consensus decision-making process for the IBMP is difficult and inefficient to implement in a public setting where it is uncomfortable for managers to freely debate issues, acknowledge the validity of alternate viewpoints, and make concessions in front of critics and supporters (Clark et al. 2014, Clark and Vernon 2016). Furthermore, these seemingly irreconcilable disputes have led to agencies making independent decisions and implementing incompatible management practices that primarily support their special interests. As mentioned previously, Montana unilaterally decided to stop participating in the capture, culling, and distribution of bison circa 2006, following by APHIS in 2011. In addition, the NPS decided not to conduct remote vaccination of bison for brucellosis in 2014 following a review of its rationale and support from an independent panel of experts convened by Montana Fish, Wildlife & Parks and the NPS (2013). Subsequently, APHIS requisitioned a review of brucellosis in the Greater Yellowstone Area by the National Academies of Sciences, Engineering, and Medicine (2017) and developed a plan to separately implement vaccination for brucellosis, including with fertility control chemicals, with the Department of Livestock (USDA, APHIS 2016). Likewise, the Governor of Montana independently developed a year-round plan for bison abundance and distribution in areas of Montana near YNP that was adopted by the state agencies before being presented to the other IBMP members for inclusion as an adaptive management change (Bullock 2015). Also, it is difficult to responsibly implement treaty hunts for bison moving through areas near residences and businesses when hunts are simultaneously conducted by multiple and, at times, competing tribes with different perspectives and regulations.

These independent and sometimes inconsistent actions contribute to a lack of public confidence in IBMP members to resolve issues or problems. As a result, many people want more substantive input to influence management strategies before they are adopted and implemented (Metcalf et al. 2016). Currently, participation in decision-making at IBMP meetings is primarily limited to agency and tribal managers and their staff, with occasional reports from the Citizens Working Group on their deliberations and recommendations. The interests of individuals or groups with different perspectives, such as bison advocates wanting broader bison distribution with minimal human intervention, or livestock advocates wanting wild bison constrained to preserves with more stringent management, are generally dismissed as impractical and disregarded by most agency personnel. Currently, interested individuals and groups are only provided the opportunity for nominal input during IBMP meetings, which generally consists of a 3 to 5 minute comment period for each individual.

Resolving Conflicts

The resolution of persistent disputes related to bison management will depend on rectifying differences related to governance across jurisdictions and integrating valid perspectives and values to develop unified goals, objectives, and adaptive management approaches that satisfy the broader community (Clark 2002, Clark and Vernon 2016). To facilitate this process, we suggest a common goal for bison could be to conserve a sustainable population that moves across suitable public lands like other wildlife, while maintaining the public trust and supporting tribal treaty rights. Common interests contributing to this goal could include a viable population of wild bison, sustainable habitat for bison and other wildlife, low risk of brucellosis transmission to cattle, low risk of property damage and human injury, support of treaty rights in bison management, basing decisions on reliable information, improving public engagement and the decision-making process, and making progress towards resolving conflicts and conservation issues (Kavanaugh and Chrismer 2016). These proposed common interests provide a starting point for discussion and evaluation by a broad-spectrum of agencies, tribes, and groups with valid interests to refine them and/or develop other common interests.

The abundance of Yellowstone bison must be controlled at times because there is limited capacity for bison within YNP and limited political and social tolerance for bison migration and dispersal into surrounding states. The bison population is prolific, with little natural mortality and high reproductive and survival rates that lead to rapid population growth (Geremia et al. 2015). High densities of bison could cause resource degradation in YNP and mass migrations into local communities during winter that result in increased conflicts. The Montana state veterinarian and some legislators have repeatedly touted tribal hunting inside YNP as a panacea for reducing bison numbers and solving issues related to bison management. This idea arose after it became apparent public and treaty hunting, as currently implemented in Montana along the boundary of YNP, was not effective at regulating the abundance of bison by itself. Even if Congress authorized hunting within YNP, however, it would not be popular with much of the American and world-wide public due to wounding, behavioral changes (e.g., avoidance of humans) and other unintended effects to bison and other wildlife species (e.g., bears, elk, pronghorn, wolves), and diminished wildlife viewing opportunities and visitor enjoyment. Also, it is unlikely that hunting just inside the park boundary would be much more effective than hunting outside due to the late-winter and spring migration patterns of bison. Rather, hunting during autumn and early to mid-winter likely would need to occur in areas further within YNP and away from roads to be effective—actions that would have substantial adverse effects to the bison population, other natural resources, and visitor experience. Even if hunting was initiated near the park boundary, bison and other wildlife would eventually respond by avoiding the area when hunters are present and, as a result, hunting would need to encroach further into the park over time to be effective.

Moreover, hunting inside YNP is not in the best interest of the public majority, including Montana residents and business owners. About 80% of visitors surveyed during 2016 rated bison as one of the most important resources in the park, equivalent with Old Faithful Geyser (RSG 2017). Also, YNP plays a large economic role in the tourism industry of the Greater Yellowstone Area, with approximately 4.25 million visits to the park during 2016 contributing an estimated \$524.3 million to nearby communities, which supported about 8,156 jobs and had a collective benefit of about \$680.3 million to the area's economy (Cullinane Thomas and Koontz 2017). These economic benefits stem, in large part, directly from the preservation of abundant populations of wildlife that are often viewable from roads because animals are not harassed or pursued by humans. Viewing opportunities would diminish as animals respond to hunting by avoiding people, which would directly affect YNP's mission of preserving resources unharmed for the benefit and enjoyment of people (16 USC 22) and potentially result in reduced visitation and revenue. Proposals to hunt bison inside YNP represent specific interests of the livestock community because such hunts would maintain bison at lower numbers and within YNP; thereby preventing competition with cattle for grass on public lands elsewhere. However, hunting inside YNP would further impede one unattained objective of the IBMP, "to maintain a wild, free-ranging population," while not additively contributing to the objective of addressing the risk of brucellosis transmission to cattle because bison are already prevented from mingling with cattle, without any documented transmissions of brucellosis. Instead, this specific interest would perpetuate the differential treatment of bison compared to other wildlife such as elk, which have been allowed to increase in numbers, distribution, and brucellosis prevalence without being intrusively managed like bison.

An alternative management paradigm more in keeping with the broader, common interest would be to manage Yellowstone bison like other wildlife, such as elk, which may ultimately require legislative action to modify or repeal the Montana statutes (i.e., MCA Titles 81 and 87) that assigned legal authority to the Department of Livestock to manage diseased wild bison (instead of Fish, Wildlife & Parks) and imposed severe restrictions on the movements and relocation of Yellowstone bison. Such an action would require coalitions that want wild, wide-ranging bison on more public lands in Montana to develop the means and organization to elect representatives with the determination and legislative skills to change these laws. Until then, the intrusive management of bison to constrain them near the boundary of YNP is unlikely to change substantially. Certainly, a wider distribution of bison

near areas with cattle would increase the risk of brucellosis transmission, human injuries, and property damage, but the actual risk would still be manageable and comparatively small compared to the greater risk from more abundant and widespread elk. The contention that any additional transmission risk from bison is unacceptable (State of Montana 2000) is unreasonable given ongoing increases in the abundance, distribution, and prevalence of brucellosis in elk, which have contributed to numerous brucellosis outbreaks in cattle traced to wild elk since 1998 (Rhyan et al. 2013, National Academies of Sciences, Engineering, and Medicine 2017). Despite these occurrences, there have been no recent changes in class-free brucellosis status by APHIS, economic sanctions by other nations, or substantial efforts to restrict the abundance and distribution of elk in these areas. Thus, declarations that expanded tolerance for bison managed similarly to elk would threaten the economic interest and viability of the livestock industry appear to be exaggerations designed to bolster special livestock interests through fears of reprisal.

The resolution of persistent disputes to improve the joint management of Yellowstone bison across jurisdictions will be a long-term endeavor because it is unrealistic to expect reconciliation after a few inclusive, collaborative meetings. However, substantial progress in management could be made over the next few years by considering the following recommendations, which were provided to the IBMP managers for consideration in May 2017. First, managers should consider sustaining a population averaging about 4,200 bison, with less than 3,000 in either the central or northern regions of YNP. Under the IBMP, managers have demonstrated they can maintain separation with cattle when bison numbers are within a range of 3,500 to 5,500. The recommended population level would maintain a viable population, historic genetic lineages and existing diversity, and frequent migration to lower-elevation winter ranges in Montana to support public and tribal hunting (Freese et al. 2007, Hedrick 2009, Pérez-Figueroa et al. 2012, Geremia et al. 2014, Hobbs et al. 2015, Forgacs et al. 2016). However, the appropriate population range and distribution should be reevaluated periodically based on available habitat, genetic analyses, and the effectiveness of management strategies to reduce conflicts (CWG 2011).

Maintaining an average of 4,200 bison would require removing about 300 to 800 bison per winter using harvests and culls (Geremia et al. 2016). To date, hunting by itself has not been effective at reaching annual removal objectives for bison due, in part, to concentrations of primarily tribal hunters along the northern boundary of YNP that prevent further migration of bison and induce movements back into the refuge of the park. Also, the current location of the capture facility inside YNP results in the removal of bison that could otherwise be harvested if they were allowed to continue migrating further into Montana. Several tribes have suggested not capturing and culling bison until tribal hunts end in mid-March. However, the NPS cannot wait until then to conduct capture operations because there is a limited time (January through March) to ship females before late pregnancy, there are few facilities willing to process bison, and these facilities have a limited capacity to process bison (150-200 per week). Thus, we recommend managers evaluate the need, design, and potential location for permanent or temporary capture facilities north of YNP, which the 2000 IBMP anticipated would occur once managers began emphasizing hunting to help control bison numbers and distribution (USDI and USDA 2000:28-29). Allowing more bison to migrate into Montana and distribute across the landscape before capture operations take place would enhance hunting opportunities and alleviate concerns about the effects of culling on harvests. Over time, some of the bison allowed to migrate into Montana should learn refuges other than YNP, which should enhance conservation and hunting opportunities in the future. When culling is necessary, captured bison should continue to be provided to Native American tribes and tribal organizations for the distribution of meat and hides to their members.

Likewise, we recommend managers evaluate the collective use of existing quarantine facilities in YNP (Stephens Creek), north of the park in Montana (Corwin Springs), and on the Fort Peck Reservation in northeastern Montana, as well as the development of associated harvest pastures, to help regulate numbers and distribution of Yellowstone bison while decreasing the number of bison sent to slaughter. A study conducted by APHIS and Montana Fish, Wildlife & Parks during 2005-2010 demonstrated Yellowstone bison repeatedly testing negative for brucellosis exposure could be considered brucellosis-free and used to augment or establish new conservation and cultural herds. In 2016, the NPS proposed to transfer bison testing negative for brucellosis exposure from YNP to a double-fenced quarantine facility on the Fort Peck Reservation in northeastern Montana to undergo the testing protocol developed by APHIS and eventual release on the Reservation. This proposal was opposed by Montana because shipping Yellowstone bison outside the Designated Surveillance Area for brucellosis is not allowed per MCA 81-2-120 until the bison complete quarantine and are certified by the state veterinarian as brucellosis-free. Also, APHIS maintained quarantine facilities must be located in or near YNP and approved by state and federal animal health officials per their Uniform Methods and Rules (2003). Both the State and APHIS maintain other trading partners will implement sanctions or other restrictive measures on the livestock industry in Montana if Yellowstone bison are transferred outside the DSA before completing quarantine. However, that concern did not stop these agencies from transferring more than 30 Yellowstone bison (including 11 bison testing positive for brucellosis exposure) from Montana to a research and quarantine facility in Colorado, which is well outside the DSA

(USDA, APHIS 2017). Also, a state audit and an independent evaluation requested by APHIS reported cattle often were shipped from states in the Greater Yellowstone Area (including Montana) to livestock markets in neighboring states where routine brucellosis testing is not conducted; a scenario that "... represents an at-risk population of cattle outside the boundaries of the DSAs" (Legislative Audit Division 2017, National Academies of Sciences, Engineering, and Medicine 2017:93). In December 2017, the NPS, APHIS, and Montana reached an agreement in principle to quarantine bison and send brucellosis-free bison to the Fort Peck Reservation. However, implementation of this agreement has been stymied by a lack of mutual understanding regarding when such shipments can occur (i.e., before or after the completion of the entire quarantine testing protocol; USDI, NPS et al. 2017).

We recommend the IBMP managers develop cost-sharing agreements for leasing, maintaining, and operating quarantine facilities and harvest pastures. The facility at Stephens Creek in YNP could be used to conduct initial brucellosis screenings, with bison repeatedly testing negative for exposure sent to the other facilities to undergo APHIS' testing protocol to ensure they are brucellosis free. Some bison testing positive for brucellosis exposure could be sent to harvest pastures where they could be fed and, over time, killed onsite for field dressing or processing in a mobile meat harvesting unit rather than being shipped to slaughter facilities. Females late in pregnancy could remain in the harvest pasture through calving and nursing before being killed. Any calves born in the pasture and testing negative for brucellosis exposure when they are weaned could be transferred to a quarantine facility rather than being killed.

Concentrations of too many bison hunters in too small an area near the northern boundary of YNP have led to recurring ethical and safety issues. Firing lines of primarily tribal hunters engage most groups of bison that leave the park, with surviving bison running back inside where they cannot be pursued (16 USC 26). Also, incidents such as firing across roads and towards residences, as well as shooting elk when bison are not available, cause public relations issues with the local community. During summer 2017, several treaty tribes developed a unified harvest strategy with standardized regulations for all hunters to enhance communication, enforcement, safety, and hunting opportunities. Unfortunately, this agreement did not include all the tribes which came to hunt during the subsequent winter, nor did it address allowing some bison to distribute across the larger landscape before being engaged by hunters, which reduced its effectiveness somewhat. We recommend the treaty tribes continue to refine this strategy in the future to facilitate the dispersal of bison and hunters across the landscape and away from the park boundary, rural residences, and roads. Allowing bison to distribute across the landscape and learn other refuges than YNP should eventually contribute to better hunting experiences and enable more traditional autumn hunts once sufficient numbers of bison live in these areas. Also, IBMP members should anticipate how to incorporate additional tribes with treaty rights if and when they convey their intentions to hunt bison in the area.

We recommend managers develop guidelines for an incremental and success-driven shift from a zone-based management approach with delineated tolerance and non-tolerance areas to targeted, site-specific management similar to other migratory wildlife such as elk. Suggestions for consideration include increasing year-round tolerance for bison on more public lands by incrementally allowing for increased seasonal and year-round use by bison in suitable habitats. Agency staff could identify and monitor likely conflict areas, and initiate conflict resolution activities when necessary. Fencing, hazing, and hunting could be used to maintain separation between bison and cattle and protect people and property; similar to management activities for other migratory wildlife in the area. Bison that cannot be hazed or pose an imminent risk to humans, property, or livestock could be harvested or captured and removed. Managers should discuss interagency agreements to provide the necessary funding and staff to support management. Also, we recommend managers coordinate with the Department of Transportation to reduce nighttime speed limits and vehicle strikes of wildlife in the area.

It is not feasible to cost-effectively and substantially reduce brucellosis in wild bison and elk in the Greater Yellowstone Area given existing conditions and technologies (Cheville et al. 1998, CWG 2011, White et al. 2015a). Furthermore, intrusive management actions on bison in the core of the Designated Surveillance Area will not affect the spread of the disease outside the Greater Yellowstone Area or the transmission of the disease to cattle by elk (National Academies of Sciences, Engineering, and Medicine 2017). However, managers should continue to manage the already low risk of brucellosis transmission from bison directly to cattle, while monitoring brucellosis exposure and culture rates over time. Also, we recommend they evaluate research priorities for bison, genetics, assessing the effects of management actions, habitat, brucellosis dynamics, diagnostic procedures, quarantine, potential suppression methods, and other uncertainties. Collaborative research on brucellosis dynamics, diagnostic procedures, potential suppression methods, and improved vaccines for cattle and wildlife should continue.

Congress has stipulated the final decision-making authority must remain with the responsible federal agency, which complicates efforts to give stakeholders a more substantive role in the decision-making process (Schmidt 2000). However, managers could improve public involvement in decision-making by continuing to support the Citizens Working Group, which should strive to include representatives from all groups with valid concerns and

interests (Clark et al. 2014). Also, Montana could consider establishing a Bison Working Group (similar to elk) representing a broad set of interests to increase public participation and input into decision-making. Likewise, an Intertribal Council/Alliance could be established to discuss bison management topics and provide recommendations. Furthermore, managers could consider holding workshops on relevant management issues and establishing an independent scientific panel to periodically review data, analyses, plans, and outcomes, while continuing to hold periodic meetings with local officials (CWG 2011, Metcalf et al. 2016).

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