

CULTURAL PLANT BIODIVERSITY IN RELICT WALLOW-LIKE
DEPRESSIONS ON THE WIND RIVER INDIAN
RESERVATION, WYOMING, & TRIBAL
BISON RESTORATION AND POLICY

by

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of

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in

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DEDICATION

I dedicate this work to my kids, Hannah, Dorian, Kolbi and Kynan. May your future be grounded in your culture and your connection to buffalo be forever.

ACKNOWLEDGMENTS

I want to thank my advisor Rick Lawrence for his patience, guidance and direction while completing this important and relevant project. It was an endeavor of perseverance and I am thankful to have had the opportunity. A great deal of appreciation goes to my committee members, Cliff Montagne, Lisa Rew and Kristin Ruppel, who have supported me throughout my graduate as well as undergraduate education. Thank you. I want to thank Garrit Voggesser with the Tribal Lands Partnerships Program of the National Wildlife Federation. Bison restoration efforts on tribal lands would not be where it is today, if not for your hard work, dedication and vision. I am also very appreciative of the MSPHD's Program. Thank you Dr. Peter Gogan, for supporting and believing in my dream, and Hopa Mountain Native Science Fellows Program, for pivotal support in many of our dreams. I commend the Eastern Shoshone and Northern Arapaho leadership for recognizing and believing in my efforts to restore bison to the Wind River Reservation for the future of our people. A big thank you goes to my wife and field assistant, Patti, whom has been by my side through the thick and thin and ups and downs of this project, as well as in life, I love you. This work would have been nearly impossible to complete without the financial help of the EPA STAR Fellowship, the Alfred P. Sloan Foundation and Eastern Shoshone Higher Education Program. I am very appreciative of all the bison friends, supporters and colleagues that have a similar vision to restore this animal to more areas of this great nation and respect to the Tribes that are making it happen. Thank you Dad, for taking me to East Africa to witness the wildebeest migration. That changed my life. And last but certainly not least, thank you Buffalo, for being there.

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ABSTRACT

Bison and Native people have co-existed on the North American landscape for millennia. As a keystone species, bison support many other organisms including plants, animals, insects and birds. Their unique dust-bathing behavior create wallow-like depressions (WLDs), altering the landscape at the local level, and are believed to increase water accumulation and support different plant species in the surrounding area. Native Americans traditionally accessed forb plants as foods tools and medicines, which are believed to increase in wallows, and in the wallow like depressions (WLDs) studied in this project. The area chosen for this study is on the Wind River Indian Reservation (WRIR) in Wyoming, home of the Eastern Shoshone and Northern Arapaho Tribes. The northern boundary of the WRIR has been identified as an ideal location for bison restoration. As bison reintroduction might impact plant biodiversity, this study gathered baseline data of cultural plant frequency inside vs. outside 65 WLD locations. Thirty-three plants were associated with WLDs, 11 plants contained sufficient data for comparison, and five plant species had a statistically significant difference in frequency using a paired t-test. Three cultural plants were shown to have greater frequency inside WLDs vs. non-WLDs. This baseline data will potentially be used to monitor changes to the landscape after bison are restored to the WRIR.

Multiple tribes are maneuvering the political arena to acquire bison and the process is complex. Federal, tribal, state, and local agencies all vie for a say in management of genetically pure bison of Yellowstone National Park. Tribes are restoring bison and forming coalitions and international treaties to share and restore herds on tribal lands. The Fort Peck Tribes of Montana are re-acquiring land to allocate to their cultural herd of Yellowstone bison and lead the way in becoming a new tribally operated quarantine facility for excess Yellowstone bison. Tribal bison policy and acquisition is an exercise in tribal self-determination and will be a way for tribes to implement programs for cultural and ecological restoration in the coming years.

CHAPTER 1

INTRODUCTION

Between 30 and 60 million American bison (*Bison bison*) inhabited the Great Plains before they were nearly extirpated by humans in the 1870s (Flores, 1991; McHugh, 1972; Callenbach, 1996). Two sub-species of bison exist in North America, the wood bison (*Bison bison athabasca*) and the plains bison (*Bison bison bison*), both commonly called buffalo (Reynolds et al., 2003). The plains bison inhabited the grasslands of the Great Plains, and their dust bathing behaviors altered the landscape at the local scale (Knapp et al., 1999). Unique dust-bathing behavior of these bison resulted in small depressions (wallows) allowing for water accumulation (Knapp et al., 1999; Truett et al., 2001; Fuhlendorf et al., 2006). Water can alter soil nutrient patterns (Patrick & Mikkelsen, 1971) so that edaphic factors may also contribute to changes in plant community composition between wallows and adjacent prairie (Polley & Collins, 1984). Wallows vary in depth from several centimeters to a meter or more, and in diameter from a few meters to over 45 m when individual wallows merge (Barkley & Smith, 1934). Over millennia, wallows altered the landscape, creating microhabitats, enabling variation in plant cover and increase in species. Grazing and wallowing create specific environments that result in greater plant diversity across the landscape by holding water in depressions, enabling colonization by pioneering plant species, and increasing the diversity and use of areas by other animals (Knapp et al., 1999; Truett et al., 2001; Fuhlendorf et al., 2006).

The survival and proliferation of the bison is not only important in terms of ecological diversity of the Great Plains, but also the health and cultural preservation of the people indigenous to that land. Bison created a dynamic framework of patch vegetation, containing plants utilized by Native Americans for foods, medicines and tools. Bison were undoubtedly among the most important traditional foods before cattle-introduced diseases, over-hunting, and habitat conversion decimated bison numbers in the late 19th Century (Isenberg, 2000). The removal of bison and resulting effects on associated plants used by Native American people has led to the diminishment of overall health and the development of life-threatening and debilitating complications, food disorders, and diseases. Type II diabetes is more prevalent than other diseases on reservations and epidemics are more than twice the national average (Leffell et al., 2004). Wyoming mortality rates (per 1 million) for diabetes alone is 87.4 for Native Americans, and 19.0 for Euro-Americans, respectively (Wyoming Department of Health, 2014). Lorelei DeCora, a registered nurse and diabetes researcher, states that the illness is associated not only with chronic poverty but with reliance on imposed, non-indigenous foods (LaDuke, 1998). Attempts to renew the previous balance and relationships between Native peoples and bison have begun through federal conservation efforts and non-profit organizations' activities like those of the National Wildlife Federation (NWF), the Great Plains Restoration Council's Buffalo Commons initiative, the Inter-Tribal Buffalo Council (ITBC), the Wildlife Conservation Society (WCS), and the American Prairie Foundation (APF). It is possible that returning bison to the landscape as wildlife will improve tribal members' access to bison meat for subsistence and could also assist Native

American communities' access to unique foods, improve nutrition, and reduce diabetes, heart disease, and other debilitating diseases (Nabhan & Kindscher, 2006).

A wide variety of people are working to restore culturally diverse food traditions by joining together to find and restore traditional foods and promoting their conservation and education. Renewing America's Food Traditions (RAFT) is an alliance of food, farming, environmental, and culinary advocates who promote regional networking (Anderson, 1996, 2006; Daggett, 2005) and a return to cultivation and use of wild and heritage plant and/or animal based resources. Large tracts of the Great Plains have declining populations of people, and it has been suggested by conservation scientists and activists that these areas could be restored with bison (Popper & Popper, 1999). Free ranging bison herds could regenerate the kinds of wallows historically known as breeding sites for prairie chickens (*Tympanuchus* spp.), prairie turnips (*Pediomelum esculentum*, American groundnuts (*Apios Americana*), Jerusalem artichokes (*Helianthus tuberosus*), and other native foods and wildlife (Nabhan et al. 2010).

Grazing preferences of bison for grass species result in the maintenance of forbs within grazed areas, which contributes to overall plant diversity in grasslands (Collins & Steinauer, 1998; Knapp et al., 1999). This grazing pressure and preference for grasses opens up niches where forbs can establish. Seed dispersal occurs through feces deposition and by sticking to bison fur when they wallow (Shay, 1986). Many of these forb plants are considered to be cultural plants, because they are important as foods, tools, and medicines among Native Americans. Promotion and consumption of traditional Native American food plants rich in health-promoting components, including vitamins and minerals, and with low fat and high fiber contents could improve nutrition in Native

American populations (Burns-Kraft et al., 2008). Biodiversity of plant and other agricultural products is becoming increasingly important for sustainable food supplies (Burlingame, et al. 2009; Charrondiere, et al. 2013; Heywood, 2011; Toledo & Burlingame, 2006).

With the elimination of most bison herds followed by the privatization and parceling of land, the number of active bison wallows has rapidly diminished and their role in the dynamics of grassland vegetation is difficult to assess (Collins & Uno, 1983). There is little information about wallows' and relict wallows' association with cultural plants in short-grass prairie or high elevation desert. However, Polley and Collins (1984) noted species composition changes between wallows and adjacent prairie. The focus of this study was to determine plant species' association with relict wallows or depressions relative to adjacent areas.

The study was performed in the Owl Creek Mountains, Wyoming. The Eastern Shoshone and Northern Arapaho tribes of the Wind River Indian Reservation (WRIR) are attempting to improve the overall health of their members by the implementation of community programs to meet nutritional, emotional, cultural and spiritual needs. Many Native Americans no longer eat a traditional diet, and there is now an increased consumption of sugar, fats, salt, and processed foods (Byers, 1996). Fewer and fewer traditional foods are harvested today by youth or adults. A 2002 survey indicated that fewer than 10% of Native American children consumed traditional foods (Lytle et al., 2002). Twelve percent of WRIR residents are diagnosed with diabetes and a community partnership has been formed recently by the Eastern Shoshone Diabetes Program, the Northern Arapaho Tribal Health Department, Wind River Indian Health Service, the

State of Wyoming Diabetes Program, and Sundance Research to improve access and enhance services to help people live healthier lives and create a healthier community. Existing diabetes programs encourage the return to healthier foods but have limited access to traditional food supplies. Local organic food programs are being implemented but not on the scale needed to reach the majority of tribal communities, and national programs are absent or lack implementation due to tribal jurisdictional limitations, or little to no cross-cultural communication or collaboration with surrounding non-Indian communities.

This study is part of a broader effort to support cultural and ecosystem restoration of Native American reservations on the Great Plains and elsewhere aided by the re-establishment of bison. Since time immemorial, the bison served as commissary for Native Americans on the Great Plains, providing food, shelter, tools and clothing. Bison currently in Yellowstone National Park (YNP) and its environs are special to many Native American tribes because they are the last living link to the indigenous herds of bison that once roamed across North America (USDI/NPS, 2010). The tribes associated with bison view YNP bison as inextricably linked to their existence and survival as indigenous peoples (Plumb & Sucec, 2006). Additionally, a deep spiritual connection exists between ‘the people,’ as most tribes refer to themselves, and the bison. This connection includes songs, rituals, rites of passage, and ceremonies. Approximately 26 Indian tribes or indigenous nations hunted bison (Danz, 1997). These Native peoples have co-evolved with bison and prairie environments for millennia. As a keystone species, the bison not only provided food for humans, but also supported many other life forms dependent upon the bison for their survival. The presence of bison in tall-grass

prairie ecosystems has been shown to increase the abundance of mammals, birds, coprophilic insects and arthropods, lepidopterans such as the karner blue butterfly, and anurans (Moran, 2014; Hess et al., 2014; Gerlanc, 2003). This relationship is one of direct-dependence and is referred to by some as “sacred symbiosis” (Garrett, 1995; Ecoffey & Garrett, 2000; Zontek, 2003).

Many tribes are becoming key players in bison reintroductions and restorations to tribal lands. Strong cultural ties link the bison with cultural revitalization strategies in Native communities, including language preservation, Native food restoration, self-determination and spiritual and ceremonial stewardship. John Fire Lane Deer remarked in *Seeker of Visions*, “The buffalo was part of us, his flesh and blood being absorbed by us until it became our own flesh and blood. Our clothing, our tipis, everything we needed for life, came from the buffalo’s body. It was hard to say where the animals ended and the human began” (Erdoes, 1994).

Controversy surrounds the management of bison in the Greater Yellowstone Ecosystem (GYE). Tribal representatives have expressed concerns over management of YNP bison, including: (1) respectful treatment of the bison, (2), allowing bison to roam freely without fencing or hazing, (3) transferring brucellosis-free bison to the tribes, (4) distributing meat, skulls, and hides of bison that are killed to the tribes, (5) preservation of wickiups (remnant pole structures used for shelter), stone alignments, and other cultural features associated with bison, and (6) employment of tribal interns in bison management programs (USDI/NPS, 2010).

In 1990, The Inter-Tribal Bison Cooperative (ITBC) was formed to meet the need of tribes wanting to restore bison. The ITBC changed its name and is currently the Inter-

Tribal Buffalo Council. The organization has membership of 56 tribes in 19 states and collectively owns 15,000 bison. The ITBC is committed to re-establishing bison herds on tribal lands that promote cultural enhancement, spiritual revitalization, ecological restoration, and economic development (ITBC, 2015). The National Park Service consults with 26 American Indian tribes that claim some level of association with YNP (Figure 1.7). Twenty of these tribes are members of ITBC.

Place

The federal government is charged with acting in the best interest (i.e., has trust responsibility) of American Indian tribes to protect aboriginal and treaty rights that stem from their original occupation of the land and negotiated and written treaties with the United States Government (Meyers, 1991; Garrott, 2014). Treaties or “contracts among nations” are considered to be “the supreme laws of the land” and are equal to Congressional Acts (Pevar, 1983). They are grants of rights from Indians, not grants to Indians (*United States v. Winans*, 1905). These contracts — treaties between the U.S. and Native nations — are part of the foundation upon which federal Indian law and federal Indian trust relations are based. Millions of hectares of lands were ceded to the United States by tribes. Treaty tribes retained unique sets of rights, benefits, and conditions, and in turn they accepted protection from the United States. Relations between the federal government and Indian tribes have led to circumstances that are complex. An overview of the historical context is important for understanding present conditions on reservations, although each set of conditions is unique; no two reservations are the same.

The Shoshone Reservation originally spanned over 17 million hectares and was established by the Fort Bridger Treaty for the Eastern Shoshone Tribe in 1863 (Kappler, 1973) (Figure 1.1).

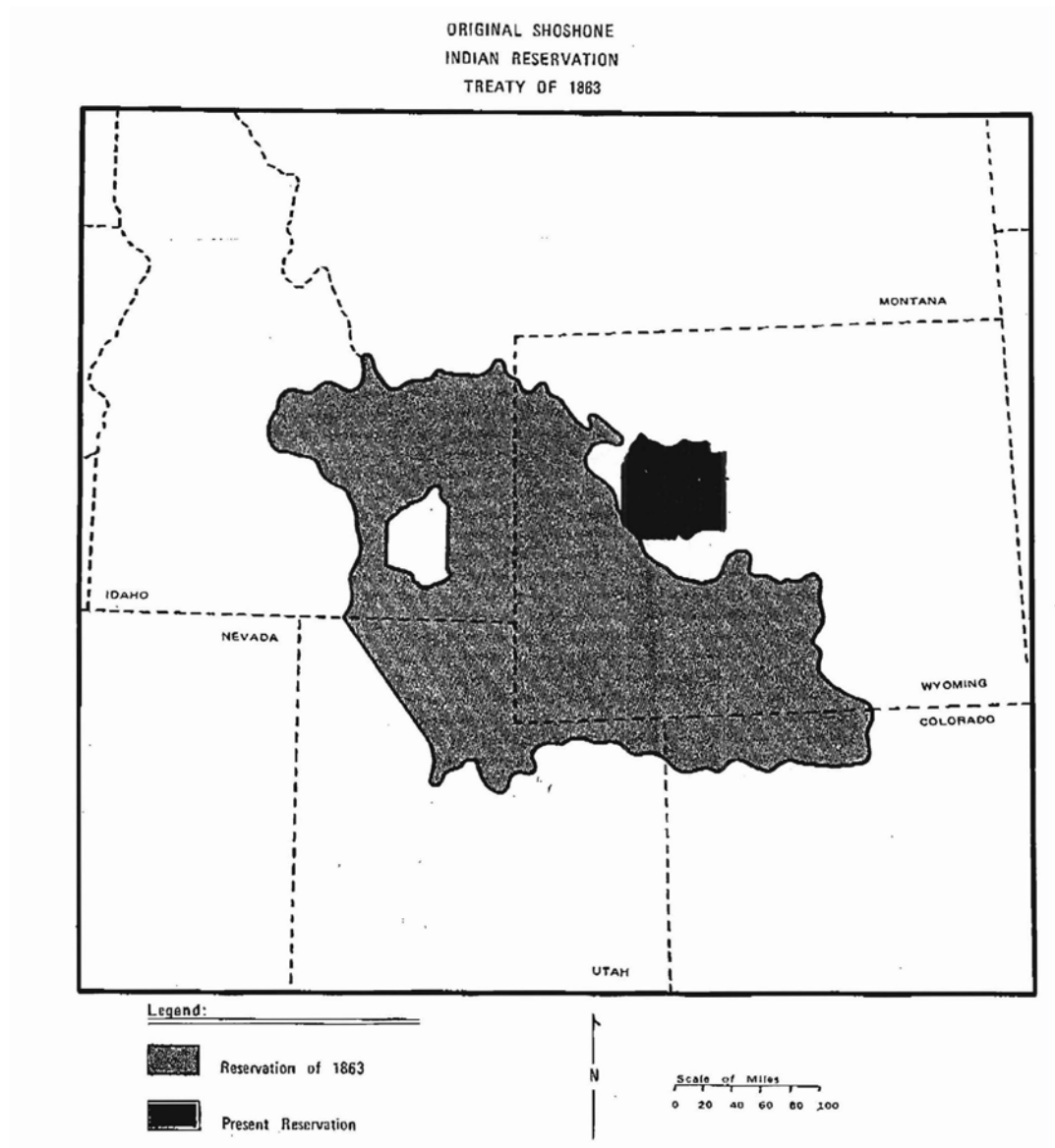


Figure 1.1. Original Shoshone Indian Reservation Treaty of Fort Bridger 1863 (Wilson, 1960).

Five years later, the treaty of Fort Laramie reduced the reservation to ~1.2 million hectares. Under duress to give up their land, the Eastern Shoshone made the best of the situation by choosing to keep an area known for its plentiful fish and game, and moderate climate. Ultimately, conflicts with settlers, discovery of gold, the Oregon Trail and other issues resulted in further land cessions.

Pressure from non-Indian interests continued after failed attempts in 1891 and 1893 to cede further portions of the Reservation. Indian Inspector James McLaughlin approached the tribes seeking the session of the hot springs and 55,040 acres surrounding present day Thermopolis Wyoming. McLaughlin secured the agreement, and Congress ratified negotiation and paid the Tribes \$60,000 at \$1.09/acre. Thermopolis Purchase Act, 30 Stat. 93 (1897) (Figure 1.2).

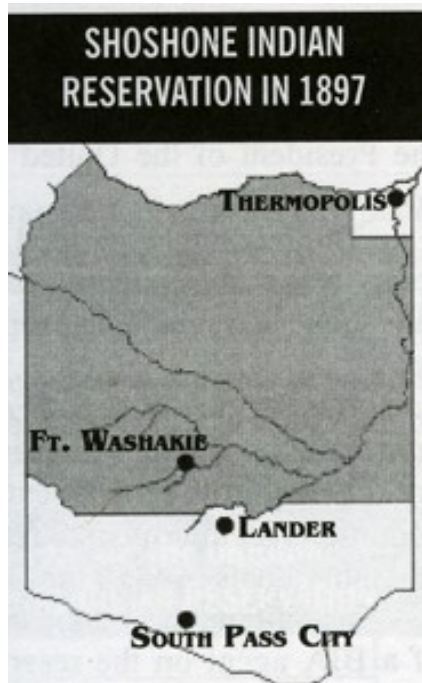


Figure 1.2. Shoshone Reservation 1897 (Flynn, 2008).

In 1904 McLaughlin pursued the largest land cession of all on the WRIR. In 1903, the U.S. Supreme Court had decided that Congress could exercise “plenary power” over Indian affairs and the United States did not need agreement from the tribes for settlement by non-Indians (*Lone Wolf v. Hitchcock*, 1903). Less than a year later nearly two-thirds (1.5 million acres) of the Reservation was opened for non-Indian settlement north of the Big Wind River. Lands were sold for pennies per acre to homesteaders wanting to farm. This cession of land was signed on April 4, 1904 and ratified by Congress in March of 1905 (Figure 1.3).

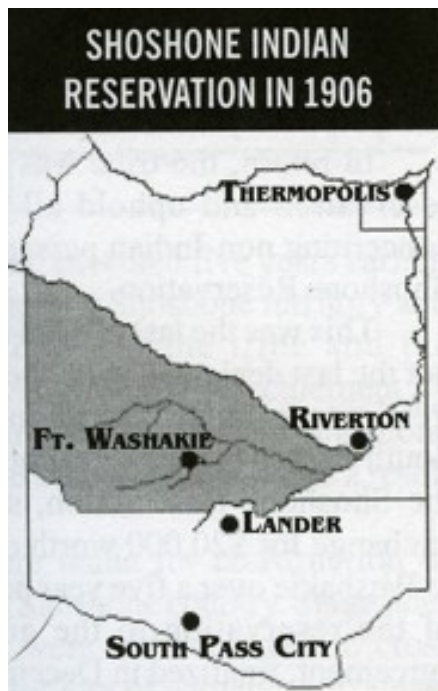


Figure 1.3. Shoshone Reservation 1906 (Flynn, 2008).

In 1939 the WRIR boundaries were restored to include areas that existed before the 1904 cession minus areas of the Riverton Reclamation Project established by the General Allotment Act of 1887 (also known as the Dawes Act). This finally established

the WRIR in its present form and size. Mineral rights in the Reclamation area were restored to the Reservation tribes in 1958 (Murray, 1989) (Figure 1.4).

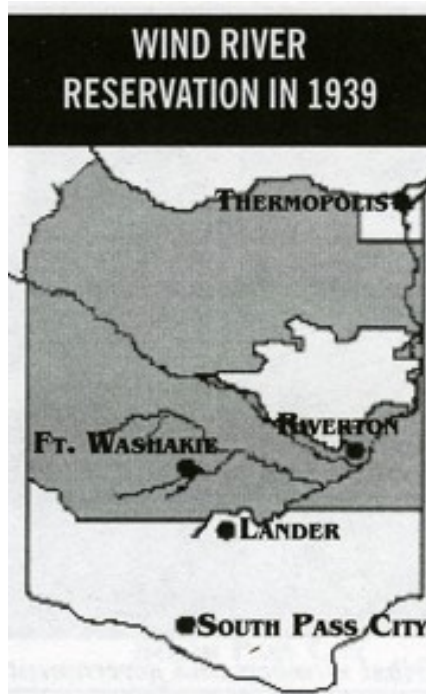


Figure 1.4. Wind River Reservation 1939 (Flynn, 2008).

The Northern Arapaho tribe arrived on the Shoshone Reservation in 1878 after many of their own conflicts with the U.S. Cavalry. The State of Wyoming joined the Union in 1898, with the WRIR encompassing the only reservation in the newly formed state. More land cessions reduced the Reservation to its present size. The two tribes were traditional enemies, making the association difficult at times, even to the present day. In 1924, the Northern Arapaho became part owners of, and have since jointly overseen, the WRIR, although each people has retained separate identities, languages, cultures, and tribal governments.

The Euro-American explorers and settlers that came to the North American continent and began advancing west characterized the land as “wilderness.” From the very beginning of their occupation of the land, this designation initiated an adversarial relationship with the land and all of its original inhabitants (Kimmerer, 2000; Cajete, 2000).

Tribes negotiated agreements to settle on reservations after decades of conflict with the U.S. military and encroaching settlers (Carlson, 1981). In the late 1800s, the tribes witnessed an increase in activity due to policies such as the Dawes Act that opened up reservation lands to non-Indians through homesteading. Senator Teller of Colorado remarked that “[t]he provisions for the apparent benefit of the Indian are but a pretext to get at his lands and occupy them and making available to non-Indian settlement lands within the Reservations” (Otis, 1934). This federal policy was designed to: break up the tribal social unit, encourage individual Indians to become farmers, and open up “surplus” land to non-Indians through homesteading (Kidwell, 2009). The Dawes Act was written with the intent of destroying Indigenous governance and imposing a quasi-privatized form of land-holding among Indigenous people. One of the effects of the Act was the involvement of the Bureau of Indian Affairs (BIA) in recording and monitoring tribal enrollment and in assessment of tribal land values (Flynn, 2008). Within 47 years, Native Americans relinquished 360,000 km² of treaty land, or about two-thirds of the 1887 land base. About 90,000 Native Americans were made landless (Case & Voluck, 2002) and 95% of fee-patented land was sold to Euro-Americans (Robertson, 2002). Senator Teller went on to say that, “If this were done in the name of greed, it would be bad enough; but to do it in the name of humanity, and under the cloak of an ardent desire to promote the

Indian's welfare by making him like ourselves whether he will or not, is infinitely worse" (Otis, 1973).

The Wind River Tribes felt that it was necessary to protect areas due to the pressure of roads and development on the Reservation. In 1938, with the encouragement of Bob Marshall, the Wind River Tribes set a unique example for wilderness conservation nearly three decades before the Wilderness Act of 1964 by preserving 76,000 hectares in the high country of the Wind River Mountains. The area contains over two hundred lakes and several hundred miles of rivers and streams. The wilderness/roadless area is not designated as a federal wilderness area; rather, it is classified as a class II airshed under the Federal Clean Air Act as amended in 1990 (Aragon, 2007). The 930,777 hectare Wind River Indian Reservation in Wyoming is the 3rd largest reservation in the contiguous United States and contains habitat that supports a wide array of fisheries and wildlife species. The terrain is rugged and mountainous, with elevations reaching 3505 meters, significant forests, and grazing lands in the lowest elevations (1372 m) (Figure 1.5).

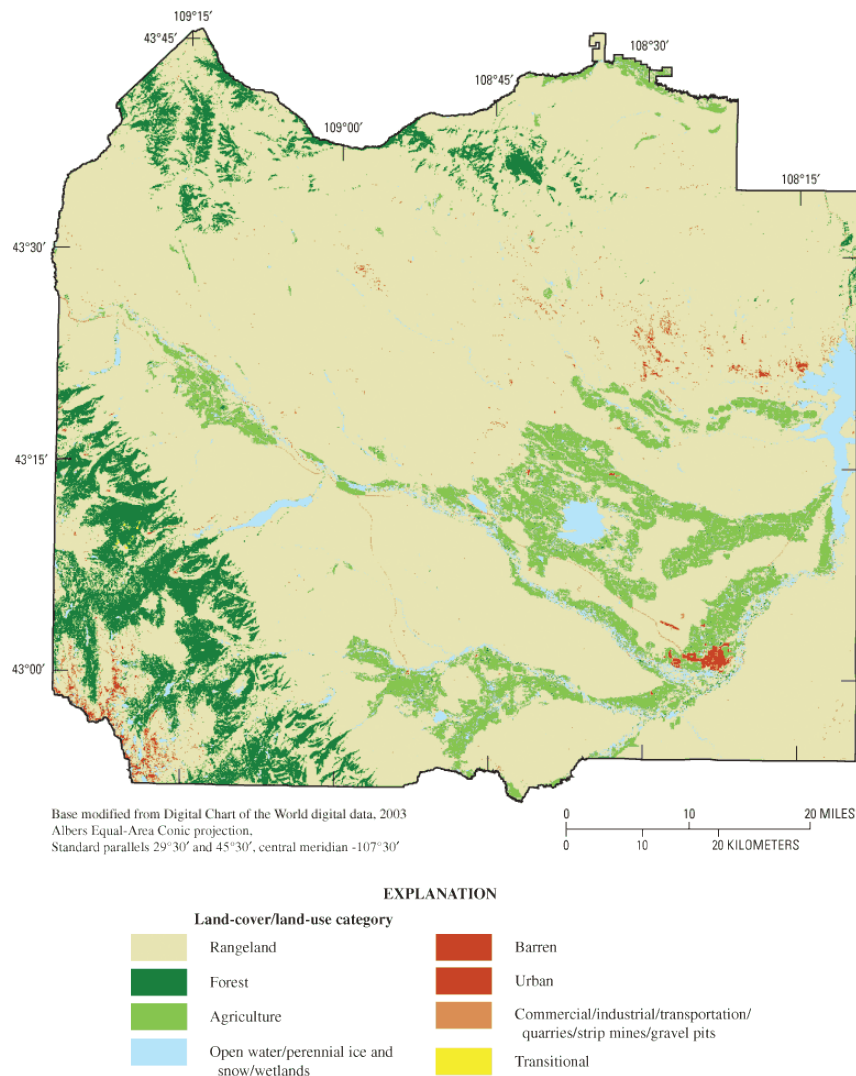


Figure 1.5. Land cover and land use on the Wind River Indian Reservation Wyoming (WRIR) (Modified from the U.S. Geological Survey, 1992). From USGS Scientific Investigations Report 2005-5027.

The Wind River tribes have been among the first to initiate protection of natural resources through environmental quality programs. The Lander Conservation Office (LCO) of the USFWS has had a long and productive relationship assisting the Tribes in managing their fish and wildlife resources on the WRIR since 1941 (Shoshone and Arapaho Tribal Fish and Game Department, 2009). In the 1970s the tribes collaborated

with the US Fish & Wildlife Service (USFWS), which as a federal agency has a trust responsibility to the tribes to gather baseline data on the numbers of animals and state of habitat on reservation lands, and to make management recommendations. The topography (Figure 1.6) varies and is supportive of a wide range of fisheries and wildlife resources. The tribes passed a comprehensive game code in 1984, limiting the bag limits and seasons for various wildlife game species (SATC, 2015). Through a concerted effort of the Eastern Shoshone and Northern Arapaho Tribes and the US Fish & Wildlife Service, the once extirpated pronghorn antelope (*Antilocapra americana*) and bighorn sheep (*Ovis canadensis*) have been reestablished and are now abundant on the Reservation. Since that time, the tribes' sustainable management of wildlife populations has increased dramatically, and the number of animals available for tribal members to hunt for subsistence has risen. In 1990 the Shoshone and Arapaho Tribes were awarded a special Conservation Achievement Award by the National Wildlife Federation, the largest member-based conservation organization in the United States (NWF, 1990).

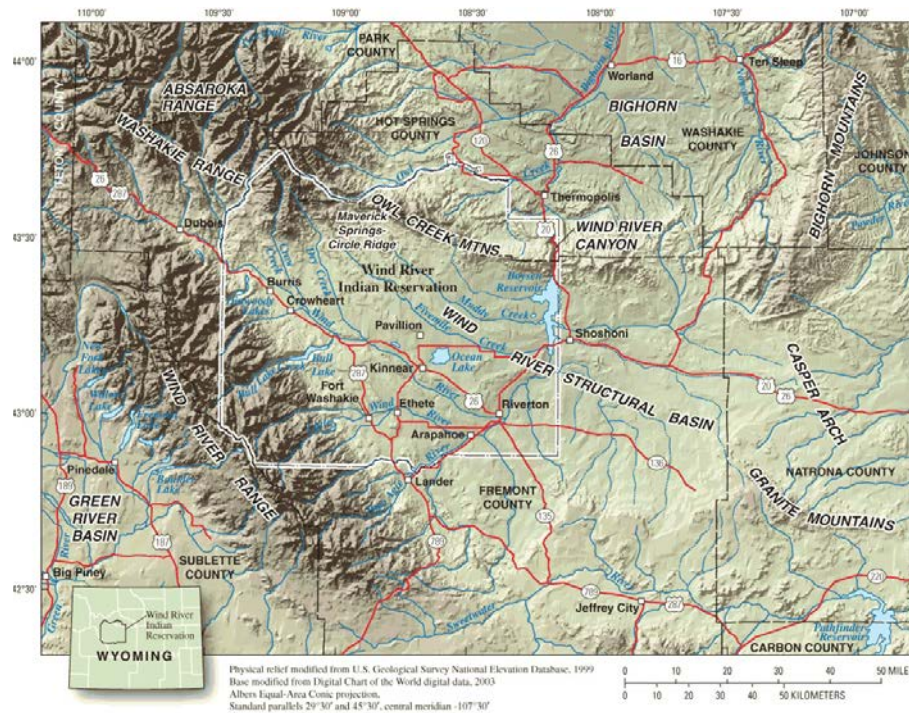


Figure 1.6. Topography of the Wind River Indian Reservation and surrounding landscape. From USGS Scientific Investigations Report 2005-5027.

The Wind River Tribes have taken steps to adapt and protect their natural resources. Historically and contemporarily hunters and gatherers, the Eastern Shoshone and Northern Arapaho people are still heavily dependent on the fish and wildlife resources on the reservation. These food sources are essential to the diet of Native Americans on the reservation and assist in minimizing the rate of diabetes and diseases associated with eating non-traditional forms of food. Today Native Americans are over nourished with unhealthy processed foods that are low in vitamins and minerals and heavy in fat content (Lytle et al., 2002; Stang et al., 2005; Story et al., 1998; Taylor et al., 2005; Zephier et al., 1997). It has been suggested that the addition of bison to this modern diet would improve the variety of healthy meat available to tribal members. In addition, its use has been encouraged for its high protein, low calorie composition, and because it

is a healthful alternative to beef and other domesticated animal meat and various processed options (Table 1.1).

Table 1.1. Nutritional Comparisons provided by Inter-Tribal Buffalo Council (ITBC).

NUTRITIONAL COMPARISONS						
Per 100 Gram (3.5 oz.) Serving – Cooked Meat – Updated January 2013						
SPECIES	FAT g	PROTEIN g	CALORIES kcal	CHOLESTEROL mg	IRON mg	VITAMIN B-12 mcg
BISON	2.42	28.44	143	82	3.42	2.86
Beef (Choice)	18.54	27.21	283	87	2.72	2.50
Beef (Select)	8.09	29.89	201	86	2.99	2.64
Pork	9.21	27.51	201	84	1.0	0.68
Chicken (Skinless)	7.41	28.93	190	89	1.21	0.33
Sockeye Salmon	6.69	25.40	169	84	0.50	5.67

Bison, separable lean only, cooked, roasted, USDA NDB No. 17157
 Beef, composite of trimmed retail cuts, separable lean only trimmed to 0" fat, choice, cooked USDA NDB No. 13362
 Beef, composite of trimmed retail cuts, separable lean only trimmed to 0" fat, select, cooked USDA NDB No. 13366
 Pork, fresh, composite of trimmed retail cuts (leg, loin and shoulder), separable lean only, cooked USDA NDB No. 10093
 Chicken, broilers or fryers, meat only, roasted USDA NDB No. 05013
 Salmon, sockeye, cooked, dry heat USDA NDB No. 15086

The Intertribal Buffalo Council was established as a mechanism to provide Native American tribes with bison and is responsible for distribution of either live animals, or in the process of culling in YNP, the distribution of meat and parts to ITBC member tribes. Some tribes have had to buy back previously ceded portions of tribal lands in order to have large enough 'pastures' to maintain herds of bison. Primarily, ITBC works to feed Native Americans bison meat, as a way to address health disparities and cultural revitalization. However, reintroducing bison to the landscape at a regional scale will help to maintain genetic heterogeneity and source animals for other tribes. Reservation or tribal lands are very important locales for the potential distribution of bison and bison genetics.

Today, tribal lands comprise ~38 million hectares in the lower forty-eight states and contain some of the largest remaining intact ecosystems. There exist opportunities on many reservations for conservation and restoration of various wildlife species that once were numerous and abundant. Native people are creating solutions for conservation and resource management programs in geographically distinct areas (Laituri & Harvey, 1995; Michaels & Laituri, 1999). Yellowstone bison are highly sought after by tribes with historic ties and treaty rights to YNP. The BIA has identified tribes involved in the Yellowstone Bison Initiative in Figure 1.7.

Aside from the ecological importance of the species, the bison is integral to the spirituality and culture of the Eastern Shoshone and Northern Arapaho peoples on the WRIR and is the only native ungulate species no longer present in the region. An area identified as potential bison habitat within the Owl Creek Mountains on the northern boundary of the WRIR comprises roughly 283,280 hectares, and is capable of supporting a substantial number of bison in addition to the various species already present. The Wind River Tribes are currently working to implement a strategy to restore and manage a population of bison under a full range of environmentally selective processes. They recognize the importance of ecological and community health while also preserving the 'reputable' bison genome. Establishing satellite populations is consistent with current national and international conservation efforts. The effort is an ambitious idea in reality, as the bison may be the most controversial species with regard to cattle and public lands in the agricultural west. The restoration of wild bison has advanced more slowly, and with much greater debate than nearly all other wildlife species over the past 150 years (Lott, 2002; Bailey, 2013).

The Eastern Shoshone Tribe passed a resolution to support an effort to return bison to the WRIR in March of 2009 and has made significant strides to reach that goal. These efforts will be further discussed in regard to policy in Chapter 4.

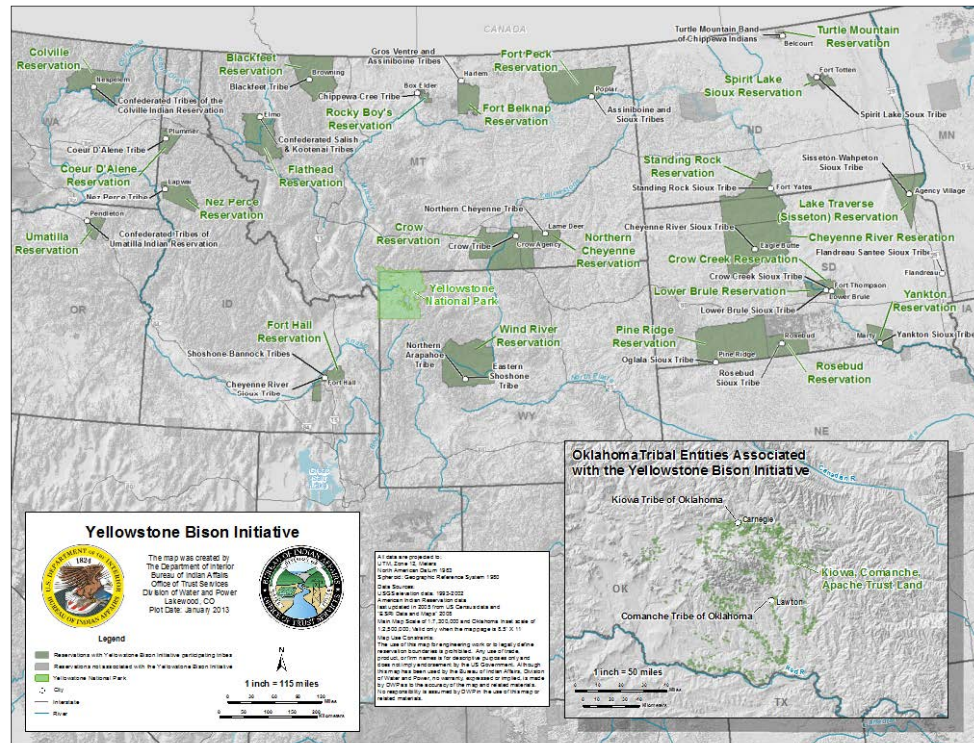


Figure 1.7. Participating Reservations involved in the Yellowstone Bison Initiative shown in dark green. Non-participating Reservations shown in grey. YNP shown in light green. Provided and used with permission by Dr. Peter Gogan, USGS. Created by the Department of Interior, Bureau of Indian Affairs, Lakewood CO. UTM Zone 12, NAD 83.

Bison & Native Americans

Native American people have been removed from the bison, which have essentially been removed from the land. The goal of this study was to examine that removal and subsequent restoration of bison to the landscape and back to Native

American people. It has been suggested that Native American people can heal historic wounds by reconnecting with bison.

Growing up on the reservation and spending a great deal of time in the mountains hunting and fishing, my father, siblings and extended family have noticed anomalies on the landscape. Relict wallows or wallow-like depressions are abundant and can be seen in many areas. The importance of bison as a keystone species on the landscape and the association with wallows and plants is the subject of Chapter 2. With progress of bison restoration underway to the WRIR, I had questions regarding the importance of wallows and more specifically relict wallows. I gathered the data to compare the cultural plant biodiversity within relict depressions to adjacent plant communities outside of the depression in order to determine if these areas are important to species diversity in a high elevation ecosystem. My objectives (Chapter 3) were to assess *1) whether plant diversity is higher within WLDs compared with adjacent areas, within my high elevation study area.* More specifically, *2) are the WLDs important in maintaining frequency of cultural plants, used as foods, tools and medicines by Native Americans.*

As bison have not been on the ground within the study area for ~ 130 years and because of other environmental factors within the region, perceived relict wallows will be termed “wallow-like depressions” (WLDs) for the purposes of this study. Wallowing activities of bison were once a constant source of disturbance across grasslands, but the virtual elimination of these activities has made their roles difficult to evaluate in detail (Collins & Uno, 1983). On several occasions over the years we have found bison skulls and bones in muddy hillsides and springs. In addition, arrowheads, scrapers, chips and further signs of my ancestors are prevalent on the landscape.

It is conceivable that the Wind River Tribes could restore bison to the area included in this study. Included in the plan for bison management on WRIR is the eventual release of tribal bison to lands on the northern and western mountain ranges of the Reservation. The baseline data gathered may be compared to changes in plant biodiversity if and when bison are returned to the area of study. Cultural plants are primarily forb species, which have been shown elsewhere to increase with the establishment of bison to the landscape (Coppock, 1983). Herds of bison have been observed in present day prairie complexes selectively foraging on graminoids (Joern, 2005; Knapp et al., 1999; Coppedge & Shaw, 1998). Will plant diversity increase when bison return to the landscape as has been shown in tall grass prairie ecosystems (Truett et al., 2001)? There is interest in monitoring bison wallow behavior and possible reoccupation or use of relict wallows or formation of new ones. Previous studies have shown that bison will reactivate relict wallows once returned to previously used lands (Coppedge et al., 1999). Thus, my data will provide a baseline for monitoring change when bison are returned to this landscape.

The next component to this document focuses on the policies surrounding tribal bison acquisition and the process of bison reintroduction to tribal lands (Chapter 4). How do tribes become involved with bison restoration? What are the constraints to returning bison to the landscape? Throughout my undergraduate and graduate studies, bison reintroduction has been the driving factor of my efforts. The newly established Boyzhahn Bid-en ('Buffalo Return' in the Shoshone language) program established by resolution by the Eastern Shoshone Business Council (October 2, 2015) solidifies the Tribe's efforts to return bison to WRIR. The effort has taken nearly 40 years.

ITBC member tribes and others are continuing to fight for bison restoration programs on tribal lands. A historic international treaty was signed on September 23, 2014 between several tribes in the Northern U.S. and Canada. The Northern Tribes International Buffalo Treaty, the first in 150 years, establishes “intertribal alliances for cooperation in the restoration of American buffalo (or bison) on Tribal/First Nations Reserves or co-managed lands within the U.S. and Canada” (WCS, 2014).

The Inter-agency Bison Management Plan (IBMP) was completed in 2000 and established guidelines for cooperatively managing the risk of brucellosis transmission from Yellowstone bison to cattle, while conserving a wild bison population and allowing some bison to occupy winter ranges on public lands in Montana (USDI, NPS & USDA, USFS, APHIS, 2000; see Chapter 3 for details).

Two cohorts of Yellowstone bison have been relocated to the Fort Peck and Fort Belknap Tribes. Disagreements continue in federal, tribal, state, and municipal interests with regard to bison. Cooperation, agreements, and negotiations are gaining momentum, and more bison are being established on tribal lands. What the future holds for bison on large landscapes however is yet to be determined.

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CHAPTER 2

REVIEW OF LITERATURE

Keystone Species

The historic Great Plains of North America consist of grasslands that extend south from Alberta and Saskatchewan, Canada to Northern Mexico and east from the Rocky Mountains to western Indiana and Wisconsin (Chadwick, 1995; Berger & Cunningham, 1995; Samson & Knopf, 1994). The Great Plains grasslands comprise the largest contiguous ecosystem in North America and historically consisted of an area approximately 162 million hectares in size (Chadwick, 1995; Sampson & Knopf, 1994). The plains bison (*Bison bison*, subspecies *bison*) once numbered 30 million (Lott, 2002) and roamed from Mexico to central Canada in scattered herds that could number in the tens of thousands. Through systematic extermination, the bison was reduced to just 25 animals by 1894 (Danz, 1997), and now exist on less than 1% of their former range, though that too has been extensively diminished by intensive agricultural practices. Their behavior and numbers shaped the physical environment and influenced a multitude of ecological interactions with other native species of plants and animals, including humans. The millions of plains bison historically ranging over North America's central grasslands were a keystone species (Knapp et al., 1999), essentially integral to a multitude of other interdependent species within the Great Plains ecosystem.

These grasslands were utilized by an association of plains bison, pronghorn antelope, elk, prairie dogs, birds and other species. Locally, bison may have depleted

forage resources (Hornaday, 1889; England & DeVos, 1969) and reduced the height of short and mixed grass prairie vegetation to the degree that they facilitated colonization by prairie dogs (Virchow & Hygnstrom, 2002). In turn, prairie dog activities encouraged further grazing by bison over more than 20% of the natural short and mixed grass prairie (Whicker & Detling, 1988). In much the same way a fire stimulates vigorous growth and removes chaff, similarly, prairie dogs create a zone of growth that is selected by bison (Coppock, 1980). The interconnectedness of the fire/prairie dog/bison relationship is important for ecosystem maintenance, yet has been removed from most of North America. The decline in prairie-dog numbers, the second most significant herbivore on the Great Plains, is estimated to be 98% since European settlement (Marsh, 1984).

Surface hydrology and runoff throughout the central grasslands was heavily affected by an estimated 100 million wallows (Butler, 2006). Bison use of wallows increases soil density relative to nearby areas (Butler, 2006). This reduces water infiltration and creates ephemeral pools of standing water for many days following spring snow melt or a rainstorm (Knapp et al., 1999). The ephemeral pools support wetland plant species and thereby increase the grassland species diversity (Collins & Uno, 1983; Polley & Wallace, 1986). Bison grazed heavily in some areas and lightly in others, creating a mosaic of vegetation (Hartnett et al., 1997; Knapp et al., 1999), which influenced not only the plant community, but a diverse suite of independent biota (Cody, 1985; Clark et al., 1989).

Today, there are nearly half a million bison throughout North America; however 95% of them are under commercial production (Boyd, 2003a). Of great concern is the threat to the further diminishment of the wild bison genome. The 95% of North

America's bison that are found in private herds are subject to artificial selection for domestication, with ease of handling and marketable meat production as major goals (Kunkel, 2006). Small herd size, unnatural culling practices, artificial genetic selection, and lack of coordinated management strategy for these herds make them questionable repositories for conservation of the plains bison genome (Kunkel, 2006). Today, the plains bison is ecologically extinct at any significant scale (Estes et al., 1989; Boyd, 2003a, 2003b). There are few plains bison populations within the original range that are considered viable (Boyd, 2003a). Free-ranging, disease-free, (i.e., from brucellosis, bovine tuberculosis, and anthrax) populations that are potentially influenced by naturally regulating factors in the original range of plains bison account for only 1,289 bison (Gross & Wang, 2005). Domestic cattle genes, or introgression in the bison genome is high, further complicating restoration efforts.

The current distribution of the uncontaminated bison genome, in fewer than five herds, calls for the need to establish additional conservation herds that will contribute to a comprehensive strategy to maintain the genome in an environment of natural selection pressure. Bison herds need to be established on a scale that: 1) reduces the risk of genetic erosion posed by small herd size; 2) allows the full expression of ecological, behavioral and evolutionary relationships; and 3) accounts for incorporation of ecosystem processes such as fire and drought (Kunkel et al., 2006). Reintroductions are the only way to expand the species' range, as there are few source populations and natural dispersal has been eliminated through management policy (Kunkel et al., 2006).

Although many American Indian tribes are restoring bison to tribal lands, (there are 57 member tribes of the Inter-Tribal Bison Cooperative (ITBC)), few contribute to

species conservation because 90% of the founding animals show significant cattle introgression (NPS & USDOJ Report, 2010).

Relict Bison Wallows

Bison developed intricate relationships over thousands of years with many other species that benefit from their presence, many of which were also utilized as important food sources by Native Americans. Several edible and medicinal plants traditionally utilized by Shoshone and Arapaho people are associated with bison wallows; therefore, establishment of bison is much more than a standard wildlife reintroduction, but restoration of Native food and medicine traditions.

Dust-bathing or wallowing is a common behavior of bison (McHugh, 1958; Reinhardt, 1985). Wallows were once a common physical feature of the Great Plains (England & DeVos, 1969) before bison were nearly extirpated due to overhunting ca. 140 years ago (Garretson, 1938). Many soil depressions existing today throughout the North American Great Plains are attributed to historic bison wallowing (Polley & Collins, 1984; Gibson, 1989; Hartnett et al., 1997).

Colloquially termed ‘relict’ bison wallows (Barkley & Smith, 1934), these depressions are thought to persist for centuries because of the intensity of the soil compaction that resulted from long-term bison use (Coppedge et al., 1999). According to the Merriam-Webster dictionary, a relict is “a surviving species of an otherwise extinct group of organisms; also: a remnant of a formerly widespread species that persists in an isolated area.” Other authors have dropped the ‘t’ in the word. Knapp et al. (1999) mention that relic wallows still exist in many areas where bison have not occurred in the

past 125 years. Merriam-Webster states a relic is “something that is from the past time, place, culture, also, an object (such as a piece of clothing or the bone of a saint) that is considered holy.” Whether relict or relic, the terms are nearly synonymous for the purposes of this study and comparison.

As bison have not been on the ground within the study area for an estimated 130 years, and because of other environmental factors within the region, perceived relict wallows will be termed “wallow-like depressions” (WLDs) for the purposes of this study.

Cultural Plants

Traditional foods of Native Americans (American Indians and Alaska Natives), largely influenced by climate, geography and tribal mobility, are specific to each Native American nation (Phillips et al., 2014). Consumption of wild plants, an important source of essential nutrients for which data are limited, has declined among American Indians (Phillips et al., 2014). Cultural plant use on the reservation today is generally limited to a few trees and forbs. Traditional foods and particularly plant foods are not being eaten on a regular basis. The incidence of chronic disease has increased in U.S. Native American Plains Tribes in the last several generations along with a shift away from consumption of traditional foods (Conti, 2008; Taylor et al., 2005; Welty et al., 2002).

The USDA’s Natural Resource Conservation Service (NRCS) identifies 265 plants as “culturally significant” (USDA, 2016). This useful resource can be cross referenced with other literature to gather significant information for plants utilized by Native people and others. There is likely incomplete information with regard to certain plants utilized for medicinal purposes by Native people as this information is closely

guarded by Native people. Culturally significant plants have a variety of different uses and, for the purposes of this study, were classified separately as a tool, food, or medicine.

In tall-grass prairie ecosystems, several species of plants are often associated with bison wallows and in some instances, even with relict bison wallows. These depressions, formed in the North American grasslands by the trampling and dust-bathing of bison (*Bison bison*), were a common feature of the North American prairie in pre-European times (England & DeVos, 1969). Wallows still exist in unplowed grasslands in central Oklahoma, where they support populations of wetland plants within a matrix of upland vegetation (Barkley & Smith, 1934; Collins & Uno, 1983; Polley & Collins, 1984).

Nabhan & Kindscher (2006) point out several plants of cultural importance in tall grass prairie ecosystems often associated with wallows. Prairie turnip (*Pediomelum esculentum*) and purple poppy mallow (*Callirhoe involucrata*) are taproot food sources that can be stored for extended periods. Prairie parsley (*Lomatium foeniculaceum*) is a perennial herb with large starchy roots, typically sweet with a slightly bitter aftertaste found on open hillsides and limestone ridges. Leaves were eaten like parsley and the roots were dug up and rubbed in hot ashes to remove bitterness, and then baked. Dessert root (*Glycyrrhiza lepidota*) is a perennial herb and gets its name from the sweet anise flavored rhizomes. The root like rhizomes can be roasted, pounded, and separated into sweet potato like pulp and stringy fibers and were utilized as a medicine of many tribes. Sunchoke (*Helianthus tuberosus*) is another very important food source with similar tubers to potatoes. The carbohydrate of sunchoke is insulin which the body converts to fructose rather than glucose, which is a better sugar for diabetics. Man-root (*Ipomoea leptophylla*) is a perennial that can grow an 18 kilogram tuber that often resembles the

human body. These are just a few of the plants associated with bison wallows utilized as traditional foods by Native Americans.

There is, however, little known about specific cultural plants associated with bison wallows, present or relict, in short-grass prairies or high elevation desert ecosystems.

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CHAPTER 3

CULTURAL PLANT BIODIVERSITY IN RELICT WALLOW-LIKE DEPRESSIONS

Introduction

Traditional Native American plant use has developed for millennia, and coevolved with complex metaphysical understanding. Native people have shared much of this knowledge, but much has been guarded and protected as well. This sacred knowledge often has been passed or given through ceremonial rites and is thus treated very respectfully. For the purposes of this study, only culturally valued plants that are well documented in the literature by ethnobotanists and plant specialists were measured.

Wallow-like depressions (WLDs) have been shown to support cultural plants (CPs) in the tall grass plains; however, the application of that analysis to that of short grass prairie or high elevation desert is unclear (Nabhan & Kindscher, 2006). The CPs observed in the present study have been investigated by tribes and later the scientific community for their useful properties as is suggested in the literature. Such ethnobotanical studies include a wide range of disciplines including botany, taxonomy, archaeology, mycology, ethnography, anthropology, pharmacology and more. *Native American Ethnobotany* (1998) by Daniel Moerman of Michigan State University proved to be a valuable resource for researching uses of specific plants. His extensive work includes 4,029 kinds of plants (species, subspecies, varieties, etc.) from 1,200 genera from 242 families, used in 44,691 ways in 291 different societies. Moerman's extensive work provides only written descriptions of plants; therefore, several other plant books

were used in identification and cultural plant determination. Other valuable resources were *Edible and Medicinal Plants of the Rockies* and *Plants of the Rocky Mountains* (2000) by Linda Kershaw, and *Ethnobotany of the Middle Rockies* (2012), compiled by Rebecca Stern of the Bureau of Land Management (BLM).

Materials and Methods

Study Site Description

The study site is in the Owl Creek Mountains on the Northern Boundary of the WRIR near the Crow Creek Drainage. The landscape is void of fences and is a vast expanse of rolling sagebrush merging into gentle foothill slopes, which give rise to slopes developed on limestone. These hills merge with steeper upper slopes of more resistant granite outcrop. Berner and Day performed a wildlife habitat and plant inventory assessment in 1981, and there have been no similar studies performed on plants in the area. Table 3.2 includes species that were identified in the sample plots. For the purposes of this study, CPs include those that were deemed useful as food, tool, or medicine per ethnobotanical literature of Moerman, Kershaw, Elias & Dykeman (1998, 2000, 2009). Table 3.3 includes the eleven plant species used for a paired t-test comparison of CP frequency in the WLDs surveyed.

The study area consisted of three primarily mountainous soil types as identified in a web soil survey of the USDA NRCS website. Most sampling occurred in the *Woosley-Decross-Starman* complex (2164-2807 m in elevation) (2-20 percent slopes), which consists of parent material of well-drained residuum weathered from limestone and/or slope alluvium derived from limestone. The dominant Woosley soil profile consists of a

loam (A: 0-12.7 cm) to clay loam (Bt: 12.7-38.1 cm, Bk1: 38.1-48.26 cm) to gravelly loam (Bk2: 48.26-78.74 cm) above unweathered bedrock (R: 78.74-104.14 cm). WLDs were also identified in the *Irigul-Caseypeak-Rock* outcrop complex, (2530-2621 m in elevation) (10-70 percent slopes). The Irigul soil formation is considered part of the upper third of mountain-flank, mountaintop. The parent material is residuum weathered from granite with a profile of very gravelly sandy loam (A: 0-17.78 cm) to very gravelly loam (B: 17.78-45.72 cm) and lithic bedrock (R: 45.72-52.4 cm). The third soil type is the *Cheadle-Nathale-Rock* outcrop complex (1978-2999 m in elevation) (5-50 percent slopes). The Cheadle soil formation is well-drained and found on mountain-flank mountainsides. The parent material is residuum weathered from limestone and sandstone with a typical profile of a very gravelly fine sandy loam (A: 0-10.16 cm) to very gravelly fine sandy loam (Bk: 10.16-22.86 cm) to bedrock (R: 22.86-152.4 cm). The Nathale soil formation is also located on mountain-flank mountainsides with a parent material of colluvium derived from limestone and sandstone or residuum weathered from limestone and sandstone. A typical profile is loam (A: 0-12.7 cm) to very flaggy loam (Bt: 12.7-58.42 cm) to bedrock (R: 58.42-152.4 cm).

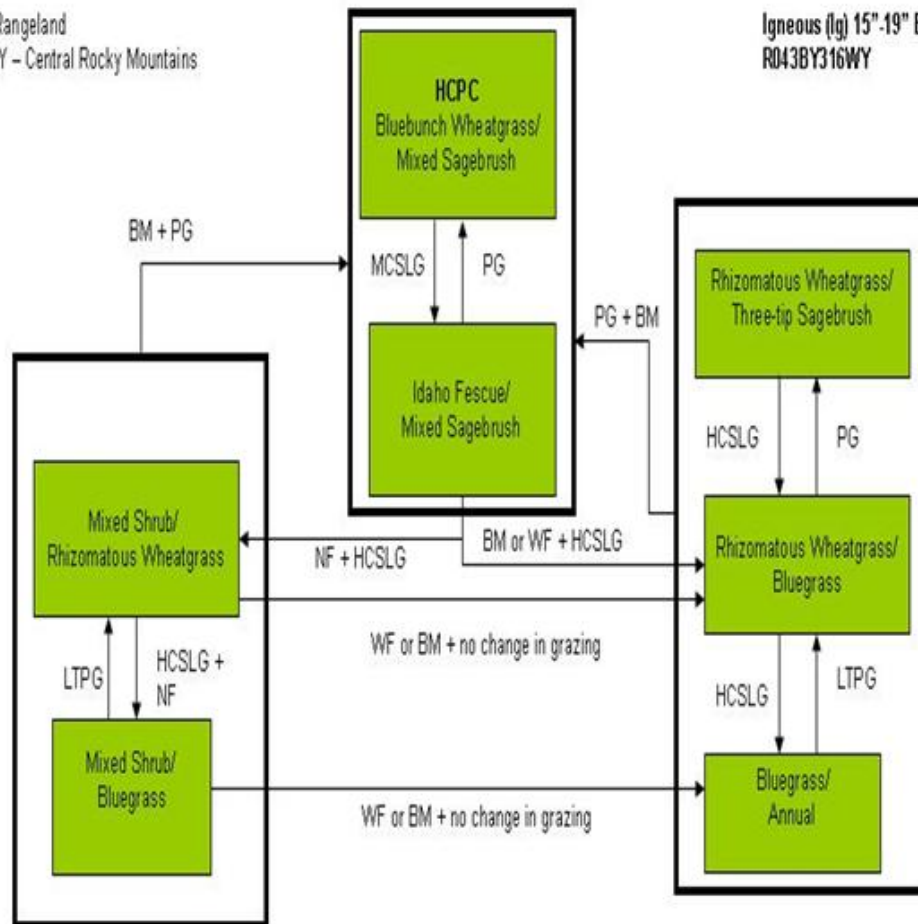
The USDA NRCS Ecological Site Description System under site name, Igneous (Ig) 15-19” Foothills and Mountains East Precipitation Zones, with site ID R043BY316WY Major land resource area (MLRA) 043B-Central Rocky Mountains. Figure 3.1 is the USDA NRCS State-and-Transition diagram and illustrates common plant communities or ‘states’ that can occur, and indicates transitions between plant communities. This diagram indicates the changes that result in plant communities based on grazing practices, fire and various management practices that influence plant growth.

According to the NRCS Ecological Site Description System estimates, the site should be Blue-bunch Wheatgrass/Mixed Sagebrush HCPC (Historic Climax Plant Community) plant community dominated by black sagebrush, three-tip sagebrush, and a variety of forbs. The expected potential composition for this site is about 75% grasses, 15% forbs, and 10% woody plants. Moderate, continuous season-long grazing accompanied by drought conditions is predicted to convert the HCPC to Idaho Fescue/Mixed Sagebrush Plant Community exacerbated by drought conditions. Heavy season long grazing and suppression from fire will further result in Mixed Shrub/Rhizomatous Wheatgrass Plant Communities.

The study site contains large areas of sagebrush (*Artemisia tridentata*, *A. ludoviciana*, *A. frigida*) and grassland interspersed with stands of limber pine (*Pinus flexilis*), Douglas-fir (*Pseudotsuga menziesii*) and Engelmann spruce (*Picea engelmannii*). Juniper (*Juniperus* L.) is common below 2500 m, and riparian zones of willow (*Salix* spp.) and quaking aspen (*Populus tremuloides*) are found up to 2990 m. Annual precipitation, most of which comes in the form of snow during fall and winter months, ranges from 25-48 cm throughout the study area, and 50 cm or more in the higher alpine areas (Berner & Day, 1981).

Site Type: Rangeland
MLRA: 43BY – Central Rocky Mountains

Igneous (lg) 15"-19" East P.Z.
R043BY316WY



BM – Brush Management (fire, chemical, mechanical)

Freq. & Severe Grazing – Frequent and Severe Utilization of the Cool-season Mid-grasses during the Growing Season

GLMT – Grazing Land Mechanical Treatment

LTPG – Long-term Prescribed Grazing

MCSLG – Moderate, Continuous Season-long Grazing

HCSLG – Moderate, Continuous Season-long Grazing

NU, NF – No Use and No Fire

PG – Prescribed Grazing (proper stocking rates with adequate recovery periods during the growing season)

VLTPG – Very Long-term Prescribed Grazing (could possibly take generations)

Na – Moderate Sodium in Soil

WF – Wildfire

Figure 3.1. State and Transition Diagram of the Natural Resource Conservation Service (NRCS).

Data Collection

Firsthand knowledge of the study area by the author was beneficial to access of WLDs, however remote sensing data provided additional useful information about the landscape. The study site comprises an approximately 40 km² (Figure 3.2) area of foothill and mountain landscape within the 2600 km² area proposed for bison use within the Owl Creek Mountains. Satellite imagery from various sources was considered. NAIP (National Agriculture Imagery Program) imagery provided the most high-resolution imagery available with one-meter ground sample distance (GSD). The GSD is the distance between two consecutive pixel centers measured on the ground. A larger GSD image value translates to lower spatial resolution, or less visible details. The true-color imagery showed areas on the landscape that resembled small circles of varying vegetation that were indicative of WLDs. These locations were noted on the image with coordinates and assigned a number. One hundred fifty seven of these locations were identified on the imagery and were later visited in the field to confirm whether they were depressions similar in size and depth to those made by bison. Classification as a WLD was based on depressions that were 3-5 meters in diameter and 10-30 cm in depth. The WLDs were located on bluffs, rolling hills, and valley floors from 1800 – 3300 m in elevation. Field observations confirmed 83/157 (53%) as WLDs. Sixty-five WLDs that met the criteria were randomly selected for botanical evaluation during July-August 2013.

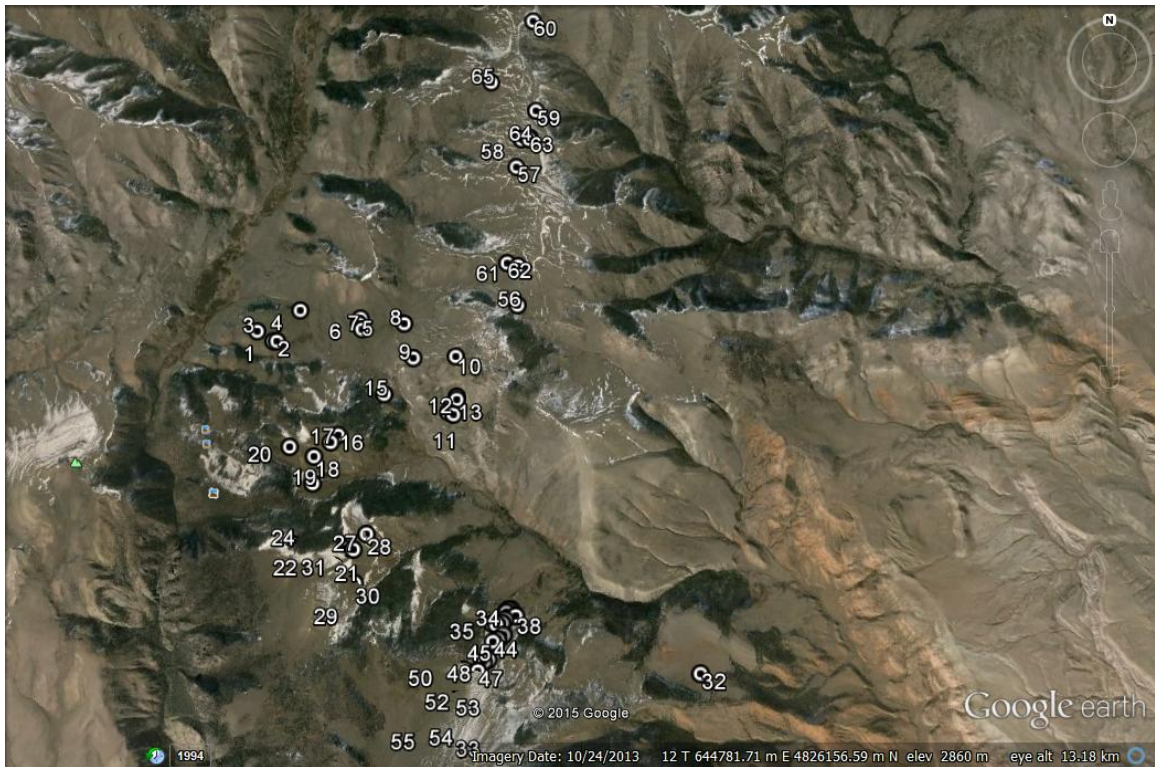


Figure 3.2. 65 paired WLD and adjacent non-WLD sites, numbered 1-65, on the Wind River Reservation, WY. Soil complexes consist of *Woosley-Decross-Starman*, *Irigul-Caseypeak-Rock outcrop*, and the *Cheadle-Nathale-Rock outcrop*.

Measurements at each WLD consisted of individual plant frequency within a $\frac{1}{4}$ m sampling ring, and an estimation of percent cover within the overall WLD along with measurements and descriptions of abiotic variables including slope, elevation, and aspect. The same measurements were recorded in a paired adjacent non-WLD site. At each WLD, a $\frac{1}{4}$ meter circular sampling ring was randomly tossed 10 times within the depression, and the frequency of each plant species was determined and recorded. To comparatively measure plant frequency adjacent to the WLD, a random direction was selected by my field assistant with the spin of a dial, noon being north and six south, respectively. This paired sampling plot was immediately adjacent to the WLD in a similar circular area (3-5 m). For each of the 65 WLDs, 20 samples were recorded, 10 within the

WLD and 10 adjacent. Figure 3.2 shows all 65 WLD locations encompassing the 40 km² study area. The area labeled South Trail Ridge in Figure 3.3 indicates locations of WLDs 1-16 and primarily consists of the soil complexes, *Woosley-Decross-Starman*.



Figure 3.3. South Trail Ridge WLDs 1-16. Primarily *Woosley-Decross-Starman* complex.

Figure 3.4 and 3.5 indicate locations of WLDs 17-31 and 33-55, respectively, and primarily consist of the two soil complexes, *Woosley-Decross-Starman* and *Irigul-Caseypeak-Rock outcrop*. The area called Trail Ridge (Figure 3.6) contains the highest elevation WLDs numbered 56-65 and are within the soil complex *Cheadle-Nathale-Rock outcrop*.

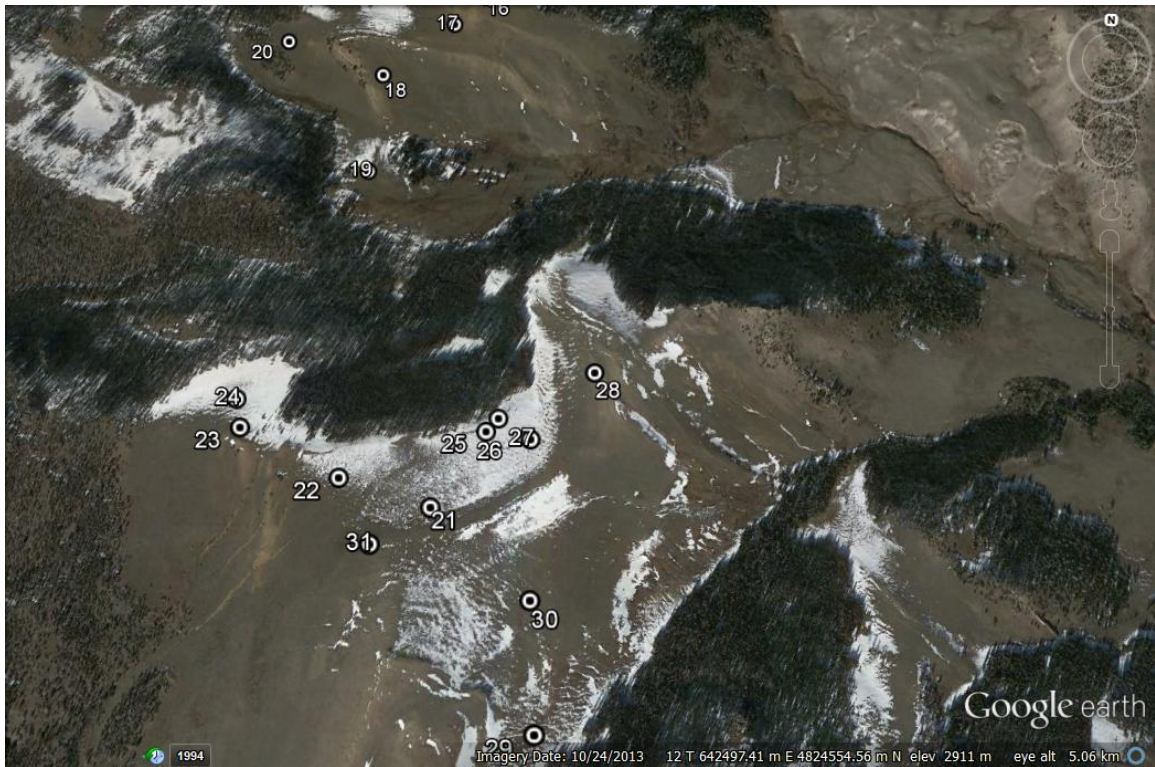


Figure 3.4. North Johnson Draw WLDs 17-31. Consists of *Woosley-Decross-Starman* and *Irigul-Caseypeak-Rock* outcrop.

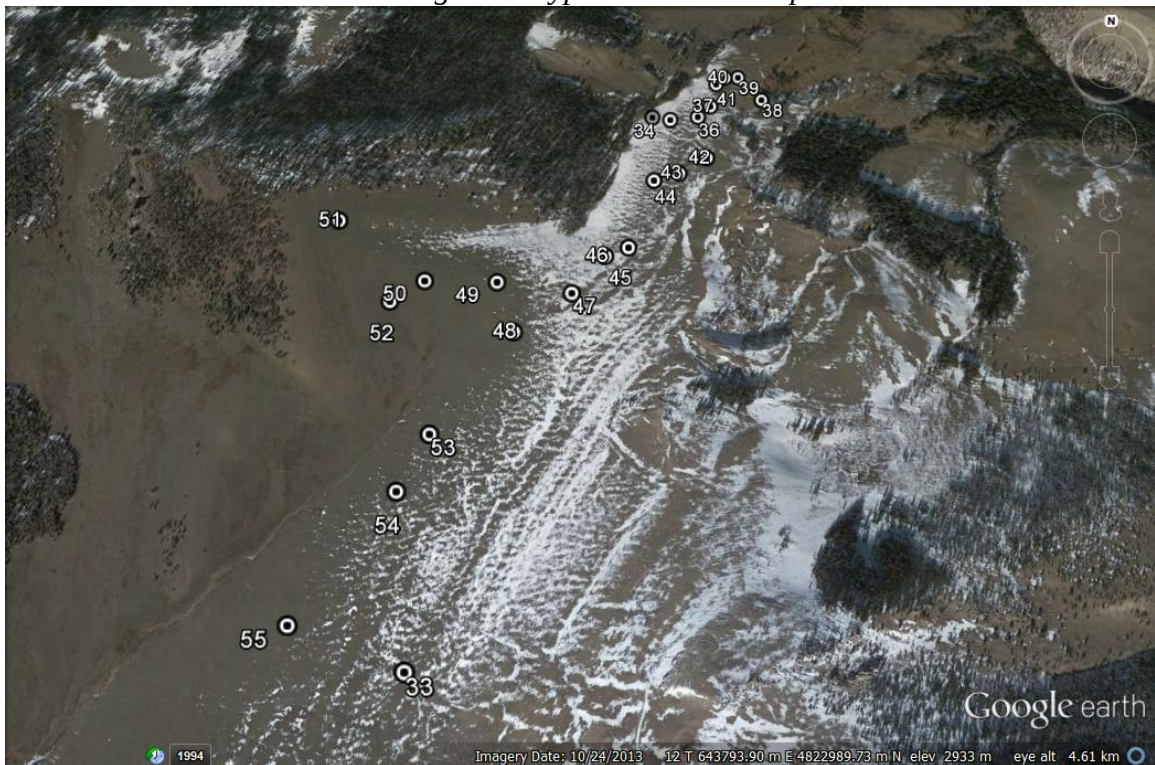


Figure 3.5. Johnson Draw WLDs 33-55. Consists of *Woosley-Decross-Starman* and *Irigul-Caseypeak-Rock* outcrop.

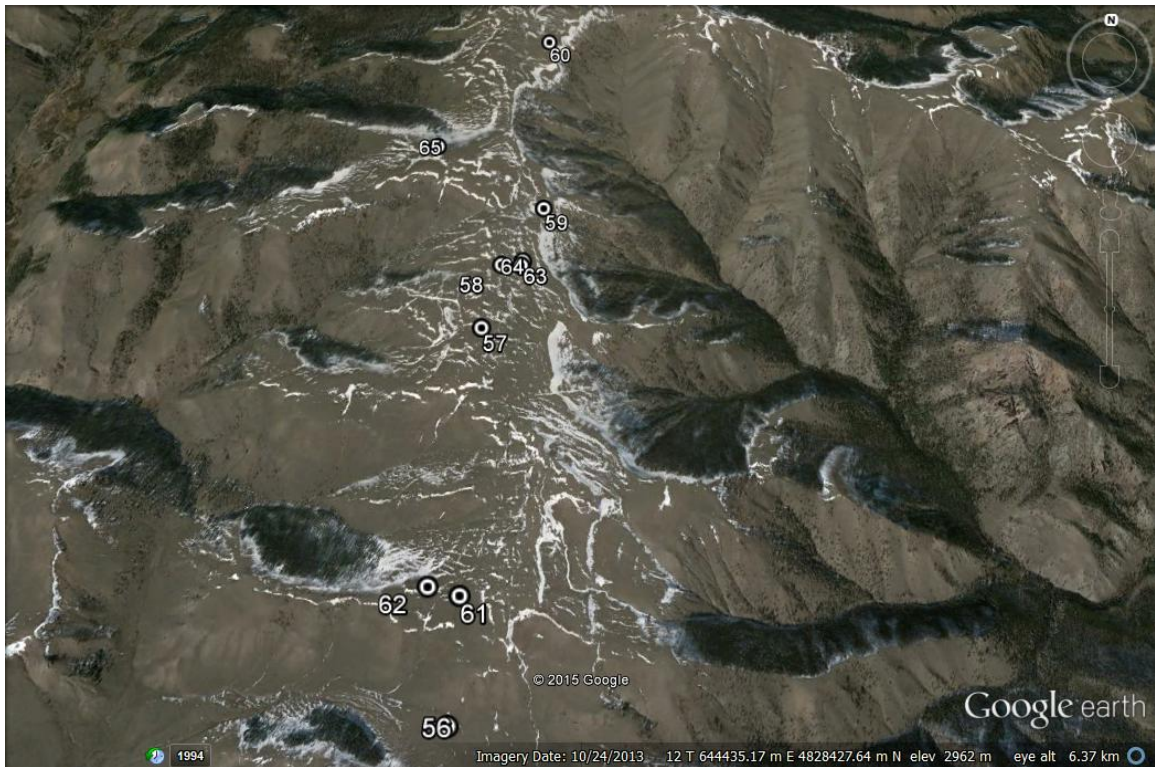


Figure 3.6. Trail Ridge WLDs 56-65. Highest elevation WLDs, consists of *Cheadle-Nathale-Rock outcrop*.

Table 3.1. Sixty-five sampled wallow-like depressions (WLDs) East/North/Elev/Aspect.

WLD	East	North	Elevation (m)	Aspect
1	641423	4826624	2744	W
2	641461	4826675	2745	N
3	641239	4826729	2720	N
4	642371	4826935	2820	S
5	642364	4826892	2817	S
6	642347	4826831	2804	S
7	642384	4826774	2808	S
8	642843	4826845	2788	W
9	642957	4826471	2801	W
10	643419	4826498	2876	SW
11	643415	4825868	2849	NW
12	643358	4825895	2849	NW
13	643446	4826030	2838	N
14	643445	4826061	2824	N
15	642656	4826072	2791	N
16	642177	4825621	2897	S

Table 3.1 Continued.

17	642100	4825542	2883	W
18	641926	4825386	2861	S
19	641926	4825099	2867	S
20	641658	4825484	2862	W
21	642196	4824237	2956	N
22	641989	4824290	2949	Summit
23	641756	4824388	2950	N
24	641734	4824455	2941	N
25	642296	4824420	2934	N
26	642320	4824454	2922	NE
27	642396	4824411	2925	N
28	642329	4823576	2956	Summit
29	642454	4823794	2925	E
30	642424	4824058	2939	E
31	642078	4824149	2960	W
32	646110	4823208	2612	N
33	643542	4822463	2915	NW
34	643946	4823665	2819	NW
35	643907	4823671	2821	N
36	644006	4823679	2824	N
37	644034	4823717	2808	N
38	644150	4823758	2788	N
39	644098	4823822	2779	N
40	644068	4823817	2783	N
41	644048	4823793	2794	N
42	644025	4823557	2847	NW
43	643967	4823510	2852	NW
44	643915	4823486	2852	N
45	643869	4823302	2890	N
56	643824	4823277	2893	N
47	643765	4823181	2915	N
48	643662	4823088	2924	NE
49	643621	4823191	2926	E
50	643484	4823181	2937	S
51	643309	4823286	2956	E
52	643424	4823133	2928	S
53	643528	4822880	2914	NE
54	643482	4822771	2905	NW
55	643325	4822531	2890	W
56	644076	4827073	2905	S
57	644020	4828614	3007	SW

Table 3.1 Continued.

58	644069	4828928	3028	SE
59	644220	4829256	3019	SE
60	644161	4830286	3009	SE
61	644068	4827506	2966	W
62	643949	4827535	2956	Summit
63	644157	4828953	3024	SE
64	644152	4828930	3029	Summit
65	643712	4829571	3044	S

Data Analysis

Data was entered into an Excel spreadsheet and then converted to a .csv file dataset that was imported into the R statistical program loaded with the nlme package. Analysis focused on comparison of frequency of plants. The total plant frequencies, in addition to CP frequencies, were calculated for WLDs and non-WLDs. In order to perform a comparison, for analysis of each CP, locations that had zero frequencies were removed to avoid biasing the analysis (i.e., these locations would indicate no difference in frequency for the paired locations when, in fact, no comparison could be made at that location). This left 11 plant species that had sufficient data for distribution of differences (Figure 3.7). Paired t-tests were performed on each of the 11 plants as indicated by Table 3.3. Normal distribution of differences was assessed to determine if the assumption for normality was met.

Results

Within the 65 WLDs, 33 total plant species were found, 20 (61%) of which were designated as CPs. Eleven plants had sufficient frequency of occurrence to compare between WLDs and non-WLDs.

The paired t-test is a reliable parametric statistical test but assumes that the differences between pairs are normally distributed. Based on the histogram of distribution of differences shown in Figure 3.7, I determined that only one plant, *Achillea millefollium*, may have violated the assumption of normality and therefore used a Wilcoxon non-parametric test instead, which revealed similar results to the paired t-test. Three of the 5 plant species that were statistically significant from the null hypothesis were shown to be in greater frequency within WLDs than outside, however 2 of the 5 species (*Artemisia frigida* and *Astragalus agrestis*) actually showed greater frequency in non-WLD sites. Four of the 5 plants (genus) tested are considered CPs based on Moerman (1998) and others.

For the paired t-test for 5 species, I rejected the null in favor of the alternative hypothesis that ($\mu_1 - \mu_2 = \text{diff}$). This indicated that 5 of the 11 plant species had statistically significant frequencies other than zero within WLDs vs. non-WLDs. The 5 plants were *Achillea millefollium*, *Arnica angustifolia*, *Artemisia frigida*, *Astragalus agrestis* and *Mertensia paniculata*. Of these 5 species, *Astragalus agrestis* was the only non-CP. Although there was significance in these five species, only three followed my assumption of higher frequency inside WLDs.

Achillea millefollium frequency in 18 paired WLDs and non-WLDs showed a mean and standard deviation of 9.61 ± 10.44 in WLD as opposed to 0.33 ± 0.84 in non-WLD indicating a statistically significant increase in frequency of 9.28 (95% CI, 4.05 to 14.50) in WLDs, $t(17) = 3.7454$. After considering the questionable histogram for *Achillea millefollium* (Figure 3.7), a Wilcoxon's matched pairs signed rank test was also used to determine whether a non-parametric transformation was necessary to account for

some abnormality in the distribution of differences. The robustness of the paired t-test proved to be sufficient as the Wilcoxon's comparison yielded similar results to the paired t-test.

Arnica angustifolia was measured in 60 sites with a mean and standard deviation of 7.42 ± 7.32 in WLDs as opposed to the non-WLD measurement of 4.87 ± 6.13 , indicating an increase of 2.55 (95% CI, 0.70 to 4.40) plants in WLDs, $t(59) = 2.7632$.

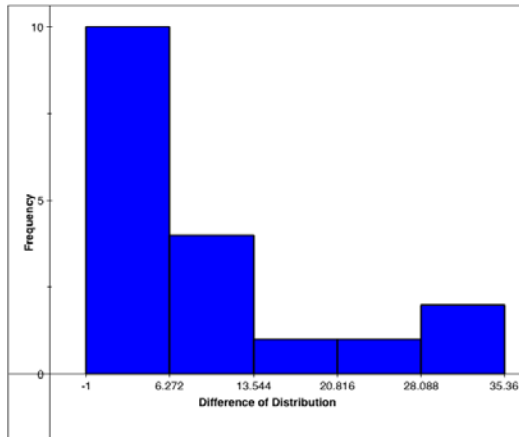
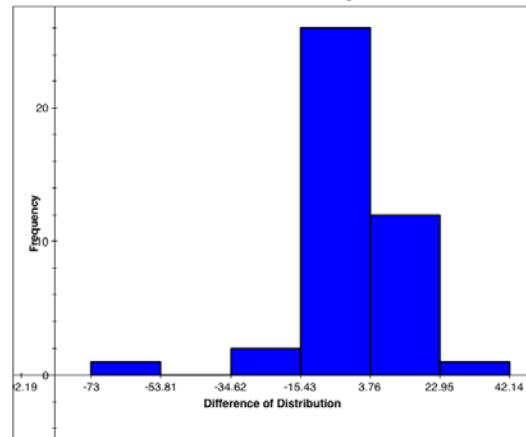
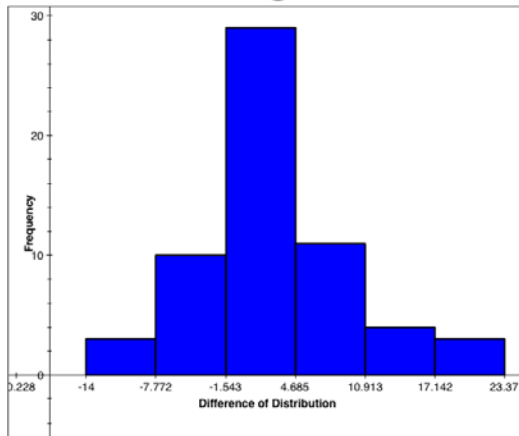
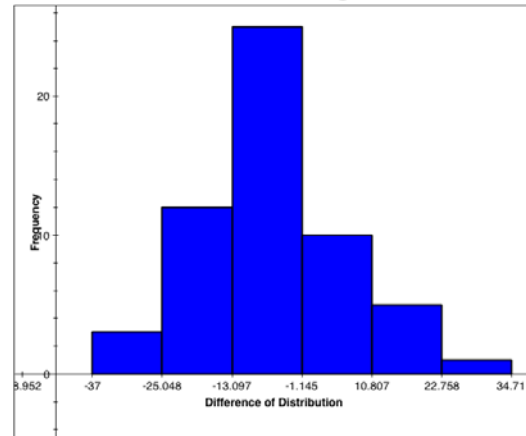
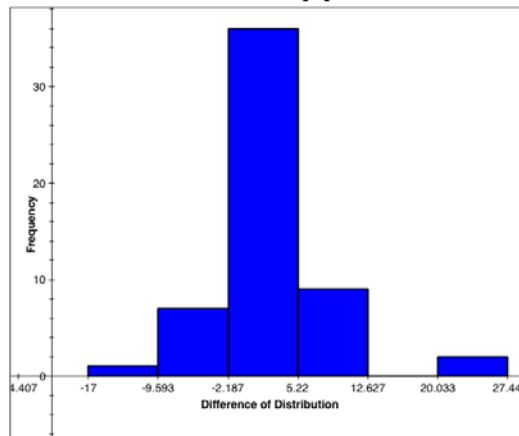
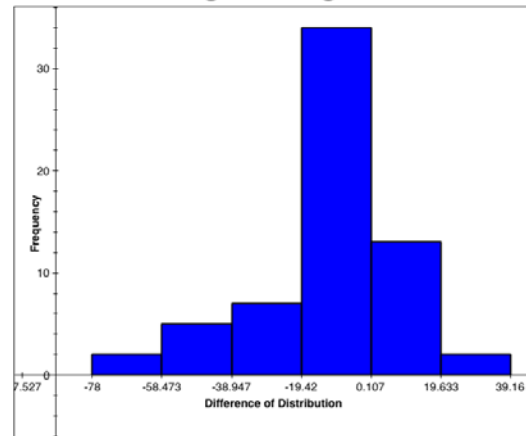
Artemisia frigida was measured in 56 sites with 11.86 ± 11.93 in WLDs compared to 18.73 ± 12.43 outside WLDs. The mean difference was -6.875 (95% CI, -10.39 to -3.36), $t(55) = 3.9166$, in this case indicating a higher frequency *outside* the WLDs.

Astragalus agrestis was measured in 63 sites with 22.25 ± 22.29 in WLDs compared to 33.41 ± 28.43 in associated non-WLD sites with a mean difference of -11.159 (95% CI, -16.08 to -6.24), $t(62) = 4.5333$, again demonstrating a higher frequency *outside* WLDs.

For *Mertensia paniculata*, the mean and standard deviation 11.81 ± 13.14 within the WLD and 6.55 ± 8.38 outside the WLD with a statistically significant increase of 5.258 (95% CI, 2.51 to 8.01) inside WLDs, $t(30) = 3.9076$.

Table 3.2. Species list of all plants found in WLDs and non-WLDs. Cultural plants (CPs) are indicated with an x. Overall plant mean frequency between WLDs and non-WLDs.

SCIENTIFIC NAME	COMMON NAME	CP	WLD	non-WLD
<i>Achillea millefolium</i>	Yarrow	x	173	6
<i>Allium cernuum</i>	Knodding Onion	x	2	0
<i>Antennaria alpina</i>	Alpine Pussytoes		262	257
<i>Arnica angustifolia</i>	Alpine Arnica	x	445	292
<i>Artemisia frigida</i>	Fringed Sage	x	664	1049
<i>Artemisia tridentata</i>	Big Sage	x	10	4
<i>Aster spp.</i>	Golden Aster		321	207
<i>Astragalus agrestis</i>	Field Milk-Vetch		1402	2105
<i>Campanula rotundifolia</i>	Common Harebell	x	23	9
<i>Castilleja linariifolia</i>	Indian Paintbrush		20	7
<i>Cryptantha virgata</i>	Miners Candle		22	1
<i>Erigeron glabellus</i>	Smooth Fleabane		43	40
<i>Eriogonum ovalifolium</i>	Cushion Buckwheat	x	52	93
<i>Eriogonum umbellatum</i>	Sulfur Buckwheat	x	9	0
<i>Erysimum cheiranthoides</i>	Wormseed Mustard		3	1
<i>Gentiana affinis</i>	Pleated Gentian		6	5
<i>Geum triflorum</i>	Prairie Smoke	x	743	667
<i>Heuchera cylindrica</i>	Round-leaved Alumroot	x	10	0
<i>Lichen spp.</i>	Lichen		28	3
<i>Lomatium dissectum</i>	Desert Parsley	x	9	50
<i>Lupinus sericeus</i>	Silky Lupine		30	11
<i>Mertensia paniculata</i>	Tall Bluebells	x	366	203
<i>Oxyria digyna</i>	Mountain Sorrel	x	6	5
<i>Oxytropis splendens</i>	Locoweed	x	46	43
<i>Phlox pulvinata</i>	Cushion Phlox	x	855	896
<i>Potentilla diversifolia</i>	White Cinquefoil	x	37	4
<i>Ranunculus acris</i>	Meadow Buttercup	x	10	1
<i>Rumex acetosella</i>	Sheep Sorrel	x	1	0
<i>Sedum lanceolatum</i>	Lance-Leaved Stonecrop	x	11	42
<i>Taraxacum officinale</i>	Dandelion	x	4	8
<i>Tomenthypnum nitens</i>	Golden Fuzzy Fen Moss		406	414
<i>Townsendia hookeri</i>	Hooker's Townsendia		337	386
<i>Toxicoscordion venenosum</i>	Death Camas		113	56

Achillea millefolium**Antennaria alpina****Arnica angustifolia****Artemisia frigida****Aster spp.****Astragalus agrestis**

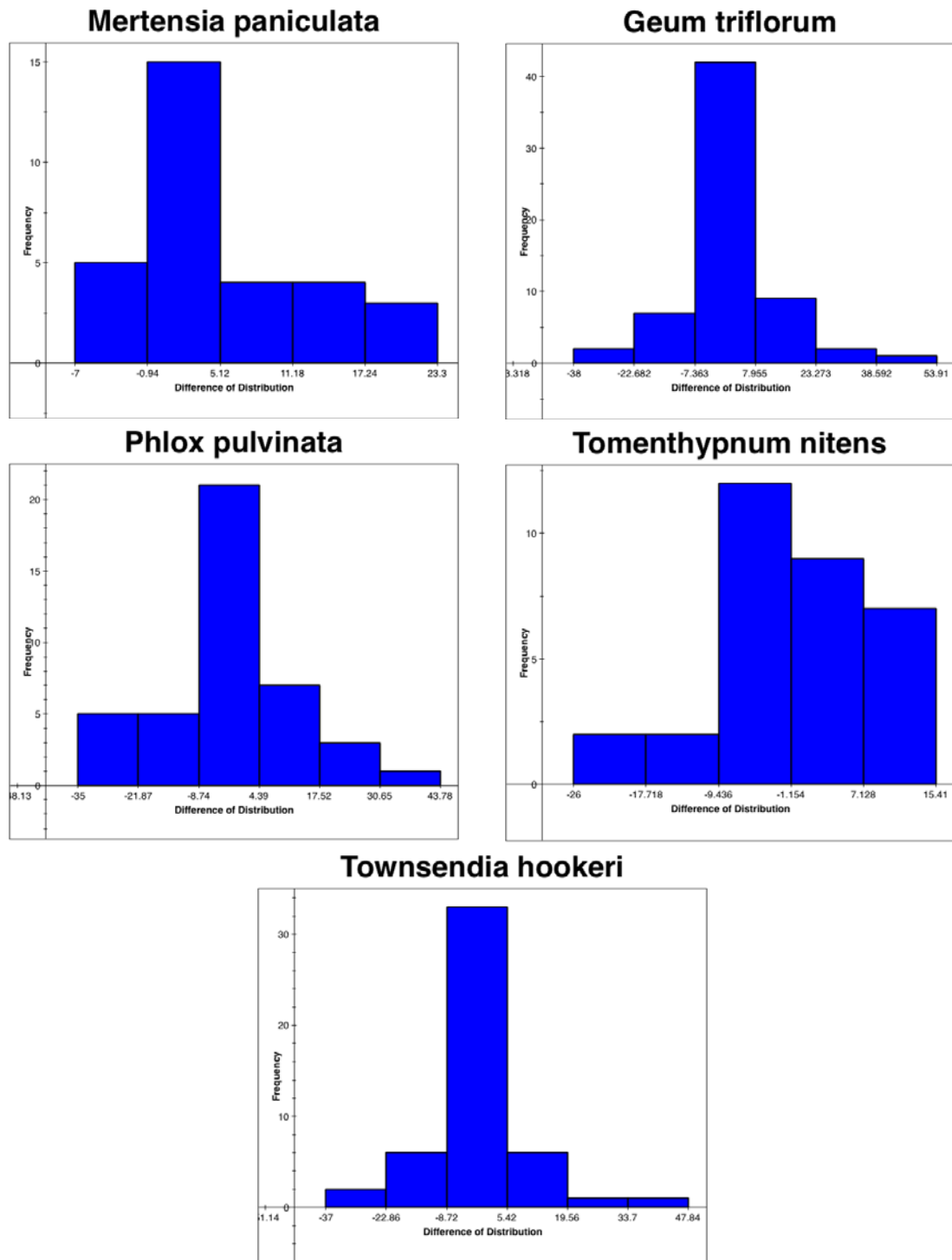


Figure 3.7. For eleven plant species with sufficient data for comparison, histograms of differences in frequencies within and outside WLDs. All distributions, except *Achillea millefolium*, demonstrate sufficiently normal distributions to support use of a paired t-test.

Table 3.3. Eleven plant species used for paired t-test comparison.

		Mean	SD	SEM	n	Mean Diff	P-Value	CI @ 95%	t	df	SED
<i>Achillea millefolium</i>						9.28	<0.01	(4.05, 14.50)	3.75	17	2.48
	yarrow										
	WLD	9.61	10.44	2.46	18						
	Non-WLD	0.33	0.84	0.2	18						
<i>Antennaria alpina</i>						0.12	0.96	(-4.58, 4.82)	0.05	41	2.33
	alpine pussytoes										
	WLD	6.24	8.69	1.34	42						
	Non-WLD	6.12	13.92	2.15	42						
<i>Arnica angustifolia</i>						2.55	<0.01	(.70, 4.40)	2.76	59	0.92
	alpine arnica										
	WLD	7.42	7.32	0.95	60						
	Non-WLD	4.87	6.13	0.79	60						
<i>Artemisia frigida</i>						-6.88	<0.01	(-10.39, -3.36)	3.92	55	1.76
	fringed sage										
	WLD	11.86	11.93	1.59	56						
	Non-WLD	18.73	12.43	1.66	56						
<i>Aster spp</i>						2.87	0.03	(.26, 3.88)	2.30	54	0.90
	golden aster										
	WLD	5.84	5.93	0.8	55						
	Non-WLD	3.76	4.96	0.67	55						
<i>Astragalus agrestis</i>						-11.16	<0.01	(-16.08, -6.24)	4.53	62	2.46
	field milkvetch										
	WLD	22.25	22.29	2.81	63						
	Non-WLD	33.41	28.43	3.58	63						
<i>Geum triflorum</i>						1.21	0.47	(-2.11, 4.52)	0.73	62	1.66
	prairie smoke										
	WLD	11.79	12.7	1.6	63						
	Non-WLD	10.59	12.08	1.52	63						
<i>Mertensia paniculata</i>						5.26	<0.01	(2.51, 8.01)	3.91	30	1.35
	tall bluebells										
	WLD	11.81	13.14	2.36	31						
	Non-WLD	6.55	8.38	1.51	31						
<i>Phlox pulvinata</i>						-0.98	0.69	(-5.91, 3.96)	0.40	41	2.44
	cushion phlox										
	WLD	20.36	16.31	2.52	42						
	Non-WLD	21.33	14.12	2.18	42						
<i>Tomenthypnum nitens</i>						-0.25	0.88	(-3.69, 3.19)	0.15	31	1.69
	golden fuzzy fen moss										
	WLD	12.69	9.32	1.65	32						
	Non-WLD	12.94	9.3	1.64	32						
<i>Townsendia hookeri</i>						-1	0.55	(-4.31, 2.31)	0.61	48	1.65
	hookers townsendia										
	WLD	6.88	8.95	1.28	49						
	Non-WLD	7.88	9.13	1.3	49						

Discussion

When comparing the species richness and density between WLDs and non-WLDs, there was little statistical evidence of differences; therefore, frequency of CPs between WLDs and non-WLD was assessed.

Achillea millefolium, *Arnica angustifolia*, and *Mertensia paniculata* are commonly referred to as yarrow, arnica, and blue bells, respectively, and like many other species, have been utilized by Native people for millennia. Yarrow was widely utilized by many tribes. It is a long stemmed member of the sunflower family and fights bacteria, can be used as a decongestant, an astringent, and an anti-inflammatory. It is also an expectorant, promotes digestion, and works as an insect repellent. Arnica was used for linaments, salves, washes, and poultices for treating bruising, sprains, and swollen feet. Extracts of the flowers and rhizomes are said to stimulate hair growth. Blue bells were used as a dermatological aid with infusion of powdered roots taken for itching from smallpox. This species was also used as a gynecological aid taken by women after childbirth to increase milk flow.

Interestingly, these three species were shown to be in greater frequency within WLDs. *Artemisia frigida*, or fringed sage, is arguably one of the most important cultural plants, however it was more abundant in areas outside the wallows. Questions are raised as to whether this is a function of soil water content or other soil parameters. As a drought tolerant species, is it more abundant due to overgrazing or shift in plant communities? *Astragalus agrestis*, or field milk-vetch, which is not a CP, was also in more abundance outside WLDs. It was the most frequent species sampled in this study.

Finally, the majority of CPs for which I was able to compare statistically (six species) demonstrated no statistically significant differences within or outside WLDs. Therefore, with three species showing higher frequencies inside WLDs, two species with higher frequencies outside WLDs, and six species with no significant differences, I found little compelling evidence that increases in bison wallows would generally result in an increase in CPs, although three CPs did show increased frequency within the WLDs surveyed.

The baseline data gathered in this study could provide a useful comparison in the future, when bison are restored to the study site. Efforts are underway to restore populations of bison to small enclosures belonging to the Eastern Shoshone and Northern Arapaho tribes with future intent of combining the populations and managing them as wildlife under the Shoshone and Arapaho Tribal Game Code. In tall grass prairie bison restoration, some of the relict wallows have been re-invigorated by new bison on the landscape (Fisher and Roll, 1998; Rasmussen, 2000). It will be instructive to see if active wallowing results in different species distribution than non-active WLDs.

Conclusion

The study site has undergone numerous changes over the years. For decades after 1906 (Figure 1.3), thousands of sheep were grazed in the Owl Creek Mountains. Establishment of grazing allotments opened up areas for cattle. Wild ungulate species were present, but it wasn't until the Tribes' Game Code was passed in 1984 that data were recorded regarding plant species. The Arapaho Tribe owns and manages one of the largest organic beef operations in the U.S. on a total of 241,000 hectares of the Owl

Creek Mountains. Some Tribal members are supporters of bison, and others livelihood is tied to cattle operations. There are conflicting interests on the Reservation similar to other landscapes and jurisdictions. The bison controversy in YNP is not limited to one issue or to that one location, but is the converging point for a large number of contentions over the basic human-land-animal relationship in the American West.

The landscape has changed considerably since the last bison was in the area ~135 years ago. WLDs are part of the landscape and might fulfill some level in maintenance of cultural plant frequency (three CPs had higher frequency within WLDs; failure to find significant differences with respect to other CPs could be a function of a sample size too small to detect differences). It is suspected that WLDs influence CP distribution, but further study is necessary in order to establish just what plants are affected, and by what ecological dynamics. Will CP distribution increase when bison are restored? Climatic factors, grazing, fire, nitrogen fertilization, and invasive species all have implications to rangeland biodiversity, but it can be argued that soil depressions are important for water accumulation and conditions conducive to plant growth, particularly for forb species.

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CHAPTER 4

TRIBAL BISON RESTORATION AND POLICY

The Challenge

How do Native American people today maintain cultural values in a society that has inadvertently or otherwise worked to remove the foundation of relevance in those communities on and off the reservations? Those uniquely tribal cultural foundations are also inextricably linked to the land. In the Americas, we had a ‘Serengeti’ of our own, with the bison at the center of this ecosystem, but that has dwindled to only contain remnants of its past glory. The history of bison is intricately intertwined with that of the American Indian. Bison and Native Americans share similar histories in that the indigenous animals have been relegated to National Parks and game reserves, much as indigenous people were relegated to reservations. American Indians and bison have suffered similar histories of subjugation and decline. My objective in this chapter was to document the development of Tribal involvement in bison policy.

In the present, the revitalization of some Native communities is intimately tied to the restoration of bison to Native homelands. Through self-determination policies, tribes today have the ability to make positive change in our communities. However, cultural revitalization efforts are difficult and often must contend with multiple ‘use’ models that have nothing to do with, and often are hostile to, the Native-bison relationship. For instance my colleague, Garrit Voggeser, with the Tribal Lands Partnerships Program of the National Wildlife Federation states,

“The bison controversy in Yellowstone is not limited to one issue, but is the converging point for a large number of contentions over the basic human-land-animal relationship in the American West. Behind the decision on whether to shoot or to save bison wandering outside Yellowstone National Park (YNP), debates exist over federal power versus states’ rights, agricultural progress versus wilderness and wildlife conservation, political bureaucracy versus cultural ethics, and people’s varied ideological viewpoints on the future of the American West (2000).”

Native Americans have a vested interest in the bison in YNP, however as a public resource, many other entities also have questions and concerns about bison management inside and outside the Park. Yellowstone bison are important, as they are a remnant population of millions that were abundant on the North American landscape 150 years ago and earlier. Despite annual culling to manage their numbers by the NPS, their genetic purity and existence under relatively natural regulating factors makes them unique in comparison with nearly all other conservation populations. With obstructions from wild-land-urban interface, agricultural development, cattle grazing operations, and governmental management strategies, ‘wild’ bison populations are nearly non-existent today. The role bison historically served in grassland ecosystems disappeared as society drove them to near extinction and usurped most of their habitat for agricultural, recreational, and residential development (Lott, 2002; Franke, 2005; Freese, et al. 2007; Bailey, 2013). In 1902, after bison numbers were diminished to 25 animals in YNP and a few other individual animals scattered around the region, settlers and cattle operations moved into areas once occupied by bison (Danz, 1997). These areas were also home territories of many plains tribes that had maintained established ownership and occupation for hundreds and even thousands of years.

Social recovery for Native Americans and bison, from eras of failed policies and relations with the federal government are continuing to this day. Wounds are still healing from the loss of bison as a commissary to life and culture. When Rosalie Littlethunder - Sicangu Lakota, co-founder of the Buffalo Field Campaign (BFC) witnessed the treatment of bison as they left YNP in 1997 seeking winter feed grounds, she reacted to their slaughter as 'déjà vu' with regard to the treatment of her own people by the US Army in 1855 (LaDuke, 1998). Littlethunder likening the experience to familial memories of the Wounded Knee massacre, expressed, "just as I am a survivor of massacre, so too are the Yellowstone buffalo survivors of massacre" (Bigelow & Peterson, 1998).

The killing off of the bison and their removal from the landscape reminds one of the similar history of Native American tribes, more specifically those tribes encountered after Lewis & Clark visited the region in 1804. As bison numbers diminished and receded to isolated pockets in the west, so, too, were tribes squeezed onto reservation lands undesirable to new settlers. The federal relationship with tribes was maintained through treaties but as settlers and pioneers encroached into territories occupied by Native Americans, hostility and conflict was exacerbated. As the frontier opened, states were formed, but the federal government separated the tribes from states to keep them far away from local hostility and ill feeling of prospectors, settlers, miners and others (Cohen, 1982).

The government-to-government relationship between Native American tribes and the United States federal government is unique; it exists with no other ethnic minority or group in the U.S. Federal Indian law is based upon a nation-to-nation relationship with

tribes, and treaties are critical to the protection of those tribes' rights and sovereign powers. Even today, state, federal, and municipal governments sometimes fail to acknowledge, or lack an understanding of the sovereign status of tribes and tribal governments. For example, the ownership of water, which is generally not thought of as a commodity among Native people, has been argued over since contact. In the United States Supreme Court case of *Winters v. United States* (1908), settlers argued that they appropriated water for agricultural use, or beneficial use, before the American Indians living on the reservation had, meaning they were justified in removal of all water from the Milk River (Thorson, 2006). This decisive court case acknowledged the vitality of American Indian water rights and set precedent that still affects water rights in the West today.

Tribal sovereignty has been challenged on many occasions, but Native Americans had operating governments long before the arrival of Europeans to this continent (Llewellyn & Hoebel, 1941). Indian treaties supersede state law, and are considered to be the supreme law for policies related to indigenous people's land rights (*United States v. 43 Gallons of Whiskey*, 1876; *State of Montana v. McClure*, 1954). During the treaty making process, decisions and manipulation of agreements were often not in the best interests of tribes at the negotiating table. Political control or influence of non-Indians over Indians in treaty negotiations has been recognized in the courts (*Washington v. Fishing Vessel Association*, 1979). Differences in world-views made negotiations difficult between Natives and Americans of European descent, and with over 300 different Native American languages spoken in the U.S. alone, difficulty with language and interpretation was inevitable (Crystal, 1987; Krauss, 1998; Grimes, 1997).

After 1871, the federal government resorted to legislation rather than the treaty making process when dealing with Indian tribes. The ‘father of Federal Indian Law’, Felix Cohen outlined several canons of interpretation that courts had established over the years which favored tribes, and held that treaties must be interpreted as the Indians would have understood them at the time of their signing (Cohen [1941] 1982; *Worcester v. Georgia*, 1832; *Winters v. United States*, 1908; *Choate v. Trapp*, 1912; *Carpenter v. Shaw*, 1930; *United States v. Walker River Irrigation District*, 1939; *McClanahan v. Arizona State Tax Commission*, 1973). What is often misunderstood or not common knowledge is that treaties do not *give* rights to the tribes. Rather, treaties *identify* rights granted to the United States *from* the tribes. In the immortal words of U.S. Supreme Court Justice Joseph McKenna, “the treaty was not a grant of rights to the Indians, but a grant of right from them – a reservation of those [rights] *not* granted” (*United States v. Winans*, 1905, emphasis supplied). Federal Indian law is built upon these foundational court cases that are critical to the protection of the sovereign powers of American Indian tribes. However, it is up to tribes to exercise that sovereignty.

Due to the sovereign status of tribes, there is often little if any constructive dialogue between Indian and non-Indian communities. That which occurs within tribal government on the reservation excludes non-tribal members. Similarly, on the WRIR, the Shoshone and Arapaho tribes operate as separate tribal governments and can exclude tribal members of the opposite tribe from governmental proceedings, even if the tribal member so excluded claims both Shoshone and Arapaho blood. Inherited federal policies, such as blood quantum, dictate who can be a member of a tribe and receive federal services, a policy designed to eventually breed Native Americans out of existence.

In a related attempt at eradication, the federal government placed the Northern Arapaho people together with the Eastern Shoshone, two tribes that were traditional enemies. Successive eras of failed federal Indian policies such as these has made it exceedingly difficult for tribes to exercise sovereignty in regard to overall and ultimate welfare of Native communities.

The exercise of treaty rights ensures maintenance of sovereign status among tribal governments. This has led to casino profits and court victories, in addition to opportunities to improve cultural values, education, and ecological restoration. Bison reintroduction to tribal lands has increasingly been used as a way to exercise cultural sovereignty and revitalization in tribal communities. Partnerships between tribes and other entities have improved the treatment of bison and allowed for opportunities to establish tribal bison programs.

Of interest in this effort is the procedural or social justice and public involvement in bison restoration and management with regard to tribes and tribal lands. When members of the dominant society participate in public decision-making, they understand fairly well how the process works. Native Americans are generally unfamiliar with public processes off of reservations and in non-tribal communities. Barsh (1992) compares the inclusive nature of Native people to that of non-Native people of European parliamentary procedures that “*exclude* all relevant parties *except* adult living citizens, and condition *effective* participation on having the leisure, literacy, and financial resources to make politics a profession.” The tribal public process for the majority excludes non-Indians, as Indians have tribal sovereign authority over such processes. Tribes, in the west especially, are tied to their own large land bases on reservations. Many of the issues dealt

with off reservation are exclusive of Indians, or have little perceived obligation from tribal members. Voting districts have often deliberately excluded the Native voice from the polls, and communities that historically had little voice, still feel that they don't, or don't know that they now have a voice. It hasn't been until recently that Wyoming voting district boundaries have been redrawn in order to include the Native American vote. In 2005, Mountain States Legal Foundation filed a lawsuit on behalf of the Eastern Shoshone and Northern Arapaho tribes in Wyoming federal district court demanding single-member commissioner voting districts, so that Native Americans would be represented on the Fremont County Board of Commissioners (*Large et al. v. Fremont County*, 2010). Does the exclusion of tribes from state and local voting influence treaty-based responsibilities/authorities? The exclusion from the democratic process may translate into momentum leading to self-determination of tribes to exercise rights that haven't been utilized heretofore. To be sovereign, or to utilize treaty rights and privileges, tribal leadership sometimes must challenge the status quo. This is almost nowhere more pronounced than with regard to bison restoration.

Current State of Participation

Yellowstone National Park is under the management of the federal government; therefore many of the decisions made with regard to management and control come from an office in Washington, D.C. Public comments and concerns vary as the constituents of the Park come from every corner of the planet. Some local concerns can be and often are opposed to the interests expressed by someone from a metropolitan area. When conflicts arise, participation is often conducted by NGOs, ranchers, and special interests in a series

of hearings, public comment periods, and litigation. Local tribal governments are often dealing with tribal community issues that are more immediately demanding than making suggestions to federal wildlife resource managers; tribal interests are, therefore, inadvertently excluded. Tribal NGOs have made the process easier in recent years. ITBC member tribes and entities specific to reservations are at the discussions and can speak on behalf of governments and tribal efforts to restore bison to tribal lands. For tribes looking to restore bison, participation means having someone show up at the talks on the tribes' behalf.

Much of the conflict over Yellowstone bison is due to the management dilemma of whether to recognize the animal as wildlife or livestock. Within YNP, bison are iconic, majestic creatures recognized as highly regarded wildlife, but outside of the Park they are scrutinized as disease carrying, life-threatening pests. Public outcry over the management of bison has been ongoing for years. Tribes, NGOs, special interest groups, and state and federal employees have all relentlessly debated their management.

In the winter of 1997, bison leaving YNP due to winter conditions were essentially slaughtered due to the perceived threat of brucellosis. As a result, and for the protection of bison, the National Wildlife Federation (NWF) signed a Memorandum of Understanding (MOU) with the Inter-Tribal Bison Cooperative (ITBC); the first-ever MOU between a tribal organization and a conservation NGO. In July 2001 NWF joined a lawsuit against the U.S. Forest Service to discontinue cattle grazing on the Horse Butte Allotment, an area west of YNP where bison roam to search for forage. The organizations announced a Seven Point Buffalo Management Solution to address brucellosis in the Greater Yellowstone Area, coined "The Citizens' Alternative". The National Wildlife

Federation reached an agreement in June of 2003 with the U.S. Forest Service, ending the conflict over the Horse Butte Allotment near the town of West Yellowstone, MT, settling the dispute over the cattle and bison interface near YNP (National Parks Conservation Association, 2015) such that bison can now be present on the allotment. Government officials have recognized the public outcry and have taken small steps to allow some movement of bison outside YNP. However, the public outcry and efforts of interested individuals, conservationists, and NGOs has made a difference for bison and management policies.

As an alternative strategy several NGOs, including NWF and ITBC, advocated for the development of a quarantine facility for Yellowstone bison with relocation of healthy bison to Native American tribes. As a result of that effort, a facility was built in 2005, a 5-year disease quarantine protocol was carried out, and bison were restored to tribal lands at Fort Belknap and Fort Peck Indian Reservations in Montana. Currently, quarantine sites have also been established at both reservations, but not in the capacity to meet the annual needs of excess bison within YNP.

In 2000, several state and federal agencies joined together to address management and disease issues concerning bison within and near to YNP by adopting the Interagency Bison Management Plan (IBMP). The cooperative agencies were the National Park Service (NPS), USDA-Forest Service, USDA-Animal & Plant Health Inspection Service (APHIS), the Montana Department of Livestock (MTDOL) and Montana Fish Wildlife & Parks) (USDI, NPS, USDA, USFS, APHIS, 2000). An agency wide group was assembled to determine solutions to the controversy, initially without input from Native American individuals or Tribes. It was not until November of 2009 that The

Confederated Salish & Kootenai Tribes of Montana, the ITBC, and the Nez Perce Tribe of Idaho were included in the discussions. Other tribes have since been at the table in discussions, including the Eastern Shoshone Tribe in February of 2016. According to the IBMP website, the strategy is to:

- Maintain a wild, free-ranging bison population;
- Reduce the risk of brucellosis transmission from bison to cattle;
- Manage bison that leave Yellowstone National Park and enter the State of Montana;
- Maintain Montana's brucellosis-free status for domestic livestock. (Interagency Bison Management Plan)

In 2010, 80-plus bison were moved from the quarantine facility north of the Park to the Turner Enterprise's Green Ranch, with the agreement that 25% of the offspring would be kept by Turner, and the original bison would be returned to Montana Fish, Wildlife, and Parks for relocation. These bison were originally intended to go to the Northern Arapaho Tribe, which ultimately failed to pass a resolution to accept the animals. After several years and many offspring later, these bison would be relocated to the Fort Peck and Fort Belknap reservations.

Meanwhile, other tribes were also working on bison restoration projects. For instance, members of the Blackfeet Confederacy (Kainai, Siksiika, Piikani and Amskapipikuni) held a series of trans-boundary dialogues that brought together elders and tribal members to create a grassroots restoration vision for Blackfeet Country. The Iinnii Initiative calls on the Blackfeet People to develop a new vision for the conservation of lands on the Rocky Mountain Front to help protect Blackfeet culture and to create a homeland for ii-nnii-wa (buffalo) (Aune, 2015). Recently, as part of the initiative and the

International Buffalo Treaty, a conservation herd of 87 bison were returned to the Blackfeet Reservation from Elk Island National Park in Alberta Canada (Brown, 2016).

The Assiniboine and Sioux Tribes of the Fort Peck Reservation in North East Montana have been involved in bison management and restoration for some time. The Tribes have been maintaining a commercial herd of bison for economic and cultural use for 16 years, but saw the need to assist in conservation of the species and pure genetics of Yellowstone bison (R. Magnan, personal communication, 5/13/2013). In February of 2012, the Fort Peck Tribes signed an MOU with the State of Montana to relocate wild, Yellowstone bison. One month later, 64 Yellowstone bison were transferred to the Fort Peck Reservation with the plan to later send half of the animals to the neighboring Fort Belknap Reservation.

In May of the same year, then Interior Secretary Ken Salazar issued a “Directive on the Placement of Yellowstone Bison,” identifying tribal lands as a priority. State political opposition was heavily against bison relocation outside of Yellowstone, despite great public support for bison restoration projects. Thirteen anti-bison bills were defeated in the Montana Legislature by tribes, sportsmen, NWF and other conservation organizations in the spring of 2013. In March of that year, the Montana & Wyoming Tribal Leaders Council passed a resolution,

“urging the Governor of Montana, The Montana Legislature, U.S. Department of Interior, YNP, U.S Department of Agriculture, and the U.S. Forest Service to recognize and honor its trust responsibility and treaty obligations to American Indian nations in providing for viable populations of migratory buffalo in the wildlife species’ native habitat” (MWTLC, 2013).

Ultimately, a decision handed down from the Montana Supreme Court was a win for tribes and other conservation partners, allowing for the transport and restoration of Yellowstone bison to the Fort Belknap Reservation. The political climate had prevented the transfer as originally planned, but by the fall of that year, 34 Yellowstone bison were successfully transferred from Fort Peck to Fort Belknap.

In March 2014, the *Journal of the American Veterinary Medical Association* published an article titled, “Feasibility of quarantine procedures for bison (*Bison bison*) calves from Yellowstone National Park for conservation of brucellosis-free bison” (Clarke et al., 2014). This study determined that the length of quarantine to qualify bison as brucellosis-free would be sufficient at 2.5 years (length of quarantine depending on age and gender), altering previous estimates of quarantining bison for five years (p. 590). This time will likely be further reduced with further scientific inquiry.

In April 2014, conservation partners secured a victory in Montana district court against opponents wanting to classify bison as livestock under state law (*Citizens for Balanced Use, et al. v. Maurier*, 2012). Shortly thereafter, the U.S. Department of the Interior released its “DOI Bison Report: Looking Forward,” as called for in Secretary Salazar’s May 2012 Directive (Salazar, 2012). The document discusses DOI lands, bison conservation, future efforts, collaboration and partnerships. The WRIR was listed as a top priority, yet discussions were few, and ultimately efforts were directed toward the Fort Peck Reservation quarantine facility. Even so, with increased efforts in Montana and elsewhere, bison re-establishment to Native lands is gaining significant momentum.

As mentioned above, a historic partnership developed in September 2014, with the signing of the International Buffalo Treaty between U.S. Native American Tribes and

Canadian First Nations, the first treaty in 150 years between tribal nations (Brown, 2014). Twelve Tribes and First Nations as well as several conservation partners developed an international agreement to restore bison to Native lands in the U.S. and Canada. The International Buffalo Treaty is “open” to other signatories and additional Tribes are expected to join. The following objectives are listed in the International Buffalo Treaty to support a lasting collaboration among tribes of the northern Great Plains:

1. **Engage northern Tribes and First Nations in a continuing buffalo conservation dialogue.** The treaty tribes will commit to ongoing intertribal meetings to support ecological restoration and the reintroduction of buffalo to parts of the Northern Great Plains.
 2. **Establish a Buffalo Treaty that unites the political power of Tribes and First Nations across the northern Great Plains.** This traditional treaty ceremony (among tribes) will establish intertribal alliances for cooperation in the restoration of American buffalo on Tribal/First Nations Reserves or co-managed lands within the U.S. and Canada.
 3. **Advance an international call for the restoration of buffalo.** The treaty tribes will present a compelling call for the return of buffalo through media events and public relations efforts among the treaty tribes.
 4. **Engage tribal youth in the treaty process to create lasting legacy for buffalo.** The Buffalo Treaty will include youth delegates at the treaty ceremony to inspire new conservation champions to carry forward the promise of healthy prairies and buffalo into the future.
 5. **Strengthen and renew ancient cultural and spiritual relationships with buffalo and grasslands in the Northern Great Plains.** The treaty tribes will articulate and further strengthen important relationships within their tribes, and among the tribes, to their lands and buffalo.
- (WCS, 2014)

As a result of the various partnerships and scholarship, bison reintroductions occur more and more frequently. In November 2014, 134 Yellowstone bison were transferred from Turner’s Green Ranch to the Fort Peck Indian Reservation, and in January 2015, 39 genetically-pure bison were restored to the Crane Trust in Nebraska from the Rim Rock Ranch near Crawford Nebraska (Lundquist, 2014; Valerie, 2015). A unique effort has been undertaken at the Soapstone Prairie Natural Area in Northern

Colorado, with the reintroduction of bison that were born to females impregnated through in vitro fertilization and embryo transfer to eliminate disease and potentially dangerous pathogens. Ten bison were released there in November of 2015 (Finley, 2015). In an unprecedented move, Interagency Bison Management Plan Partners announced on April 6, 2016 the opening of 134,000 hectares on primarily public lands adjacent to YNP's northern and western boundaries (Carr, 2016).

Introduction to Procedural/Social Justice

The notion of justice with regard to Native American communities ranges broadly and includes many facets of public policy. Experimental federal policies have led to injustices and breaches of the federal-Indian trust responsibility promised by treaty and imposed by federal statutes (e.g., the General Allotment Act of 1887). Environmental, social, procedural, economic and other ills that plague Native American communities are exacerbated by the constant undermining of tribal sovereign powers. The Big Horn case as an example, is the longest running court battle in the state of Wyoming. This case challenged the sovereign status of the Shoshone and Arapaho Tribes to implement “in-stream flow” or a dedicated amount of water to be left in the system to benefit a fishery. The Wyoming Supreme Court decided against the tribes, deciding that “instream flow” to maintain a fishery is not considered a beneficial use of water in the State. Interestingly, this case was decided when there was no evidence or actual injury, or deprivation of water to state users despite the Tribes’ instream flow permit.

Tribal governments are overwhelmed by having to address all of the issues that colonialism has brought, such as imposed systems of governments, foreign educational

systems, membership based on blood quantum, and cultural misappropriation. Tribes advocating for justice often focus on the human aspect first, like extreme poverty, health disparities, and social welfare, which depletes resources for other issues, such as the treatment of bison.

Public outcry over the treatment of the iconic animal has been prominent, yet management and treatment of the bison is still as controversial today as it was 15 years ago. Native American people, and especially the 26 treaty tribes with ties to YNP, have an enduring cultural relationship with bison, as do several factions from the agriculture and conservationist communities. As discussed above, steps to improve the handling and fate of bison within and outside of YNP have been taken by tribes, federal and state agencies, NGOs, and other special interest groups. The legal ramifications of these steps call into question the role of participation in the decision-making processes, and perceptions of satisfactory outcomes for the benefit of bison and people. Thirteen anti-bison bills were defeated in Montana courts in the two years preceding this writing. The scientific community has reached out to policy makers and legislators to incorporate facts into decision-making, and tribes have called for consideration of treaty right obligations and self-determination.

Procedural justice maintains that perceptions of justice are as important as actual justice and are brought about by the informed participation. However, conflict resolution that includes participation by stakeholders and managers that resulted in unsuccessful outcomes has in some instances been due to institutional arrangements (Wutich et al., 2013), such as placing two enemy tribes on the same reservation and expecting the Bureau of Indian Affairs (BIA) to represent the needs of all Tribal members on the

reservation. If conflict resolution is facilitated by those unfamiliar with the stakeholders then outcomes will not be satisfactory (Handmer et al., 1991; Beierle & Cayford, 2002; Baldwin, 2008). Agencies, departments or organizations – even the BIA – may not always be familiar with reservation communities or understand tribal government and sovereignty. This unfamiliarity with tribal realities severely limits communication with those stakeholders, resulting in unsatisfactory outcomes. Perceptions of justice and reality of justice differ depending on the needs of participating parties. BIA officials' accountability for projects can be considered complete on paper, but may not adequately, or in a timely manner, meet the expectations or wanted outcomes of community members.

Traditional tribal governments were inclusive to all members of the community with general consensus on decision-making. The current form government at WRIR is based on consensus of the general council, that is, of all voting Tribal citizens. Tribal participation, engagement and involvement across governance is crucial to maintenance of sovereignty. Informed public participation and engagement is critical in the natural resources decision-making process and can potentially improve environmental decision-making and outcomes (Tsosie, 1995). The WRIR tribes operate as two separate sovereign entities, with limited voter turnout in elections. Few tribal members take advantage of the opportunity or acknowledge that participation in the decision making process is a democratic right and responsibility (Reed, 2008). A new paradigm is needed to encourage Native people to participate in the democratic processes that determine desirable outcomes. If non-participation continues then the sovereign ability of Native nations to govern themselves will be further undermined. Native Americans have a wealth of

knowledge that has only recently begun to be tapped by state and federal agencies and academia, but it often is underrepresented in the current legislative process. The Shoshone and Arapaho tribes and others in the region are local stakeholders, and can provide useful local knowledge (Tan et al., 2012). Tribes working together for the benefit of other tribal entities build support for efforts across Indian Country. This is evident by the historic International Buffalo Treaty that demonstrates the potential of Tribal nations working together.

Framework for Decision-Making in an Indigenous Context

Tribal nations insist that treaties with the federal government be honored. Tribes often also rely on the federal government to make decisions that are in the best interest of tribes. This however has not been the case in a large number of issues effecting reservations and grassroots Native American people. Most tribal governments were restructured under the Indian Reorganization Act (IRA) of 1934, and were provided with boilerplate constitutions based on that of the national government. Unlike these “IRA tribes,” the Wind River tribes opted out of the IRA, and, as mentioned above, instead have a more traditionally indigenous style of government based on resolution and general council, wherein the body of tribal members makes the final decisions by consensus. The Shoshone Tribe and the Arapaho Tribe operate as two separate governments on the only reservation in Wyoming.

One way that tribes can participate in the decision making process is through the United States National Environmental Policy Act (NEPA), which established a national

policy for promoting the protection and enhancement of the human environment. The NEPA established a formal process for federal agencies to prepare Environmental Impact Statements (EISs) for projects, developments, construction or major changes that affect the environment. Unfortunately, however, NEPA processes are rarely ever heard of on tribal lands and when they are, “NEPAs sole reliance on a western scientific materialist evaluation of environmental impacts fails to consider and incorporate Native American perspectives of, values about, and relationships with the environment (Dongoske et al., 2015).” Anschuetz (2013) goes further, stating that the Judeo-Christian philosophy of human relationship to the environment elevates man’s “dominion” over it and other living things for his benefit (p. 13-33). This is a vastly different worldview than that of the indigenous peoples of the Americas. The shared basis of Native American worldviews is its spiritual orientation, wherein it is assumed that all beings (even those considered ‘inanimate’ by Western science) are alive and worthy of respect. This fact is usually absent, ignored, and devalued in the NEPA process.

Tribal environmental concerns in fact extend far beyond reservation boundaries and trust lands to a much wider range of variables than the immediate health and physical welfare of Tribal populations. Tribal connections with and responsibility toward the environment are grounded in their historical associations with the entire continent and are informed by the widespread Tribal belief in the interconnectedness of all living things, often broadly construed to include what Euro-American science sees as non-living environmental features like mountains and lakes (Dongoske, 2015).

In order to make the NEPA process work in the tribal/indigenous context, participants would have to come to a shared understanding of what Santa Clara Pueblo

tribal member and Professor Gregory Cajete describes as the scientific basis of Native American epistemological systems and the “Tenets of Native Philosophy,” (2000, p. 64-65), as follows:

- All human knowledge is related to the creation of the world and the emergence of humans; therefore, human knowledge is based on human cosmology.
- Dynamic multidimensional harmony is a perpetual state of the universe.
- Humanity has an important role in the perpetuation of the natural processes of the world.
- There is significance to each natural place because each place reflects the whole order of nature.
- There are stages of initiation to knowledge.
- Elders are relied upon as the keepers of essential knowledge.
- Every “thing” is animate and has a spirit.
- Dreams are gateways to creative possibilities if used wisely and practically.

Indigenous knowledge is increasingly becoming significant in decision-making, even at the federal and international levels, such as that between the U.S. and Canada. President Obama and Prime Minister Trudeau have stated they will continue to respect and promote the rights of Indigenous peoples in all climate change decision-making (White House, 2016). With the acknowledgement of traditional ecological knowledge and ways of knowing, the framework for decision-making is changing to be inclusive, once again.

Implications for Procedural Justice

Tribal environmental issues tend to focus on what happens in “Indian Country” – legally construed to mean land and resources associated with Indian reservations, administered by tribal governments, or held in trust by the US government (Grijalva, 2008; Harris & Harper, 2011; Ranco & Saugee, 2007; Suagee, 1991, 2002) – and on

human health issues related to tribal populations (O'Neill, 2000; Ranco et al., 2011). Leadership in federal agencies often ignores the voices of Native communities. The Bureau of Indian Affairs (BIA) has a notoriously negative track record in looking out for the best interests of Native communities. To tackle this problem, tribes have increasingly used what is referred to as the "638" statute to remove themselves from its authority by "contracting" with the federal government to provide their own services, such as health care and land management. Created by the 1975 Indian Self-Determination and Education Assistance Act, the statute has led to the turnover of 70+ programs to the Confederated Salish and Kootenai Tribes (CSKT) on the Flathead Reservation in Montana. The CSKT have taken lead roles in multiple programs and according to the tribes' webpage, have repurchased more than 99,000 hectares of Reservation land, and are among ten tribes to participate in a Self-Governance Demonstration Project (SKC, 2016).

The Wind River tribes cannot depend on the BIA to make sufficient inquiry and/or participation in affairs concerning bison and many other issues. The BIA has yet to implement a NEPA process with regard to the Wind River tribes or communities on any issue. According to the Indian Affairs National Environmental Policy Act (NEPA) Guidebook, 59 IAM 3-H, Division of Environmental and Cultural Resource Management:

Because the majority of activities on Indian trust lands include Federal funding or approval through the Bureau of Indian Affairs (BIA), the responsibility for complying with NEPA generally falls to the BIA. However, NEPA applies to every office and program within BIA, and compliance lies with the office with the direct responsibility to fund, develop or approve a proposal or action. Through allotments the BIA has trust responsibility to individual Indians as well as tribes. The BIA will seek

to involve all stake holders (tribes and allottees) in the NEPA process. Any requests by other tribes to participate as a cooperating agency with respect to the preparation of a particular EA or EIS must also be considered and either accepted or denied. However, the BIA retains sole responsibility and discretion in all NEPA compliance matters. (2012, p. 1).

There have been numerous times that the Wind River BIA could have looked out for the best interests of the Shoshone and Arapaho people but have failed to do so. The Wind River Agency BIA provides direct services in Executive Direction & Administration, Facilities Management, Agriculture, Forestry, Trust Services, Probate, Irrigation and Real Estate Services. Contract services through BIA include Job Placement & Training, Johnson O'Malley, Scholarships, Tribal Adult Education, Indian Child Welfare, Housing improvement, Tribal Courts, Water Resources, Tribal Management and Development, Endangered Species, and Wildlife & Parks. These services provided by BIA do not meet the needs for the Shoshone and Arapaho people. It will be necessary to separate or "638" from inadequate programs or develop grass roots non-profit organizations that can be managed better by the Tribes or individuals in the community.

Conclusion

Some scholars show increasing appreciation for the relevance of Native American worldviews under laws like NEPA, particularly in the context of environmental justice (Grijalva, 2011; Harper & Harris, 2011). However, what are the ramifications of this appreciation? It is generally not reflected in decisions over energy, or economic development that are culturally sensitive or relevant to tribes and reservations. One exception to this is the Obama administration's rejection of the proposed Keystone XL

pipeline, which was poised to cross several reservations and states. It was mainly grassroots Indigenous people who stood in defense of land and water that helped to prevent the pipe's construction on tribal and non-tribal lands alike.

Similarly, several federal environmental laws authorize the Environmental Protection Agency (EPA) to treat eligible federally recognized Indian tribes in a similar manner as a state for implementing and managing certain environmental programs. The EPA's "Treatment as a State" or TAS standards were invoked by the Shoshone and Arapaho Tribes in order to make recommendations about air quality standards on the WRIR. As a result, and highly motivated by lack of understanding, the state of Wyoming filed suit against the Environmental Protection Agency (EPA) to challenge the TAS status afforded the tribes in implementing environmental programs affecting Indian Country (*State of Wyoming v. EPA* (Challenge TAS status to Wind River Reservation) 2014). Even though the EPA decision is under appeal to the U.S. Court of Appeals for the 10th Judicial District, Native worldviews have generally not been considered in decisions regarding tribal lands. This is however changing with the rising participation of Native peoples/tribes and their allies in every aspect of Indigenous experience.

Members of Native American communities are often as well informed in science as their non-Native counterparts, however, they may be more powerfully *motivated* by culture beliefs, traditions, and way of life. Native American traditional perspectives on, and relationships to, the environment have been devalued and delegitimized because they do not conform to, and often conflict with, the quantifiable, scientific materialism employed by federal agencies (Dongoske et al., 2015). We are now in an era with tremendous opportunities to unite and educate one another. Social media provides access

to information, issues, and voice to people like never before. Tribal perspectives should be utilized in all aspects of decision making, not just on issues affecting ‘Indian Country.’ Awareness of Native imagery in media such as mascots, for instance, has prompted an international voice calling for the end to cultural misappropriation. If governments will not adequately represent people, federal, state or tribal, then communities are left to create a voice for themselves. This can be accomplished by the establishment of non-profit organizations that empower people in self-determination in health, education, economic development, and equality in decision-making. This is apparent in the rapidly expanding non-profit community organizing taking place on reservations throughout the U.S. and Canada, and other Indigenous homelands. Bison partnerships such as the International Buffalo Treaty and efforts to restore bison on tribal lands, as a way to ecologically and culturally restore communities, are working.

Bison restoration is an example of environmental justice in the fulfillment of treaty rights and part of the federal trust responsibility through participation in democratic processes. It re-establishes historical and cultural connections between Native Americans and an iconic, keystone species. But beyond what is required by the trust relationship between federal and tribal governments, isn’t it just the right thing to do in wildlife conservation?

The near future will tell. The Wind River Tribes and others are implementing programs with goals of cultural revitalization and ecological restoration, the two going hand in hand for tribal communities. Likewise, Indigenous knowledge and belief systems merge with the statement frequently heard in Native communities around the country: “Buffalo used to take care of us, now it is our turn to take care of them.”

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CHAPTER 5

CONCLUSION

Very few large expanses of intact grassland ecosystems exist today that have not been plowed up or paved over. Many American Indian Reservations are island vestiges where time is slowed down compared to the fast-paced lifestyle of the modern American dream. That pace was made even more evident with two months in a teepee camped in the Owl Creek Mountains gathering data for this study. The Wind River Indian Reservation is an incredible place, and I am very fortunate to call the area home. While collecting data from 65 sample locations, I was constantly reminded of the days when my ancestors hunted, fished, and lived in the Owl Creek Mountains.

There are stories passed down from elders and extended family that Shoshone people grow up with. One band of the Shoshone, the sheep-eaters or “Tukudeka” lived high in the mountains and subsisted primarily on bighorn sheep. Even though the Tukudeka haven’t lived in the mountains since the late 1880s, there are places in the Owl Creeks where sheep traps and drivelines can still be seen, in addition to camp locations, cairns, and cultural sites. Piles of rock material such as chert, flint, agate, and soapstone litter the ground indicative of human presence and occupation for a very long time. Growing up, I often thought of what it must have been like to live several hundred years ago and to witness a time when there were very few diseases, no invasive species, no wild-land urban interface, no fire suppression, and no clocks.

It is incredible to know that even though bison have not been on the landscape in the Owl Creek Mountains for over 130 years, there is still evidence of their presence.

Noticeably, wallow-like depressions (WLDs) tended to be on hills or bluffs, places that offered a good view of the surrounding areas. On many occasions I ate lunch in the wallow, simply because the area offered a great panorama of mountains and sagebrush.

People would have gathered food, tools, and medicines from the land, often from areas associated with bison and wallows. At that time, bison roamed over large areas, and cultural plants were abundant on the landscape. It is conceivable that forb plants would have been in greater diversity and with higher frequency than in this study, simply due to the unfelt affects of modern agriculture. Tribes had staple foods and resources in their respective territories. This understanding and ethnobotanical knowledge of people was passed down through language, ceremony, cultural understanding, and experience.

When bison were removed from the landscape, the Great Plains and the lives of Native people dependent upon them changed forever. Removal of this commissary undermined the very existence of Plains Indian people. As years went on, eras of federal Indian policy (westward expansion, Indian removal (~1820-1850), allotment and assimilation (~1887-1943), termination and relocation (~1945-1960), and tribal self-determination (~1960-present day)) have made it difficult for Native people to maintain identity, language, and culture.

Despite these difficulties, Native American people have remained resilient and have the ability, and sovereignty, to dictate a future of our own. Self determination of tribal governments is only limited by the ability of leadership elected to those positions. It is critical that young Native Americans realize the opportunity tribes have as sovereign entities in this day and age. The world is literally at our fingertips, and communication, collaboration, and ideas can be shared instantaneously. With cutting edge technological

capabilities, it will be vital to maintain cultural values and morals with regard to natural resource management decision-making with emphasis rooted in the respect and wisdom of our predecessors.

Elders have encouraged education as a way to deal with the challenges we will face. Tribal leadership has invested in education of young people to develop leaders of the future. Having a foot in the past to understand the future is honoring ancestral heritage while embracing change. Cultural revitalization does not have to be mutually exclusive of economic development. With young people (<30 years) as the majority of the population on many reservations, including Wind River, the future will bring challenges, but there is a new generation of leadership with fresh ideas, grounded in culture, and intent on revitalization of Native communities.

Future work will consist of re-establishing a population of bison to the WRIR for the Shoshone and Arapaho people. Plans are underway to monitor the transition of the landscape in areas where bison will be restored. Students from the Wind River Tribal College and elsewhere who are interested in bison ecology will record bison behavior as well as plant and animal changes on the landscape. The cultural plants found to be more abundant in WLDs (yarrow, arnica, and bluebells) in this study, ~130 years after bison have been removed, can be utilized for future work to compare biodiversity after bison have been re-established. Perhaps as interesting will be a future analysis of whether those cultural plants for which a significant difference was not found experience a change in distribution relative to wallows once wallowing again becomes active.

There are ecological questions for future work regarding the role that CPs have on the landscape. What are the functional roles of rhizomatous plants vs. those utilizing

taproots? Of interest is also the successional stages of the graminoids or “grass-like” species, from that of a HCPC to one that is degraded, and the affect on forb abundance. How has drought and grazing changed the HCPC of Blue-bunch Wheatgrass/Mixed Sagebrush to that of an Idaho Fescue/Mixed Sagebrush or even Mixed Shrub/Rhizomatous Wheatgrass plant community? Other abundance indices such as plant density and species richness measurements could provide additional information about plant comparisons. What are the relationships with CPs and soil parameters such as soil moisture content, pH, and bulk density? Understanding CP physiology would be important for future work to better understand the elemental needs of specific species to predict suitable conditions for growth.

Measuring the impact of bison on the landscape has improved with technological advancement. Remote sensing techniques will continue to be a powerful tool in identification and classification of new and old wallows, in addition to improved capability for comparing spectral changes in grassland species restoration. How will strategies in remote sensing develop new tools to identify anomalies such as wallows on the landscape?

Other tribes that are interested in bison restoration continue to look for ways to restore them on the landscape and also how to manage them after acquisition. There is no roadmap to bison re-introductions to tribal lands, but with continued involvement, exercise of sovereign authority and cross jurisdictional communication and partnerships, tribes are finding ways to reconnect with bison. Tribes face many issues today, but it can be argued that bison may be the way to heal our communities from the atrocities of the past and also be our foundation once again in the future. Bison can restore the spiritual

health of the people and landscape and bring communities together. In order to maintain suitable management of resources and programs, we will likely require tribally run governmental programs and grassroots non-governmental organizations to be the decision makers in the best interest of tribal communities.

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