

Robustness analysis of the Jackson Hole Valley: the Bison Management Case

1. Static Analysis – Collective Action

The Jackson Hole Valley (JHV) is a prime example of an iconic place. The natural environment surrounding the town of Jackson, Wyoming, is the resource system upon which wildlife and human settlements rely. This natural environment provides numerous streams of goods and services to all wildlife and many interested subgroups. For many of these subgroups, the natural beauty of the JHV brings substantial tourism to enjoy the natural ecosystem. Today the natural ecosystem within the JHV is subject to multiple anthropogenic and natural pressures. There has been a substantial increase in the human settlement throughout the JHV. Therefore, there is greater competition for habitat between humans and wildlife.

1.1 The Commons Dilemma

The natural environment surrounding the town of Jackson, WY is the resource system, which provides numerous streams of goods and services to all wildlife and many interested subgroups. These subgroups include: recreationalists, sportsmen, residents and governance agencies. Anthropogenic pressures have altered the dynamics of the natural system and management has maintained a narrow focus on populations of large ungulate species. This is exemplified by the process of supplemental winter feeding (SWF), which has decreased winter mortality of Elk and Bison.

A drastic increase in the Bison population has increased the cost and limited the effectiveness of SWF for Elk populations. The appropriation of limited natural resources (forage, net primary production, etc.) is the commons dilemma that will be examined. Management of Elk and Bison are bound by policy. The policies only take into consideration population sizes and not their ecological impacts on the natural environment. This management structure does not take into consideration the streams of goods and services that are provided to interested subgroups. This narrow set of policy objectives does not provide a holistic lens of the cross-scale interactions within the system. The coupled social-ecological system self-organizes, and narrow policy objectives introduce previously hidden fragilities.

1.2. Biophysical Context

Since the management of Bison and Elk are inherently connected, the biophysical context within this case consists of all the ecosystems in which Bison. There are a number of ecosystems within the natural environment and multiple agencies that govern the human-made infrastructure.

1.2.1 The Natural infrastructure

The social-ecological system (SES) of the Jackson Hole Valley is located within the greater Yellowstone ecosystem. The valley is situated west of the Gros Ventre wilderness, east of the Teton Range, and has an average elevation of about 6,500 feet. Throughout the Valley there are several jurisdictional boundaries. The Grand Teton National Park (GTNP) is adjacent to the Bridger Teton National Forest (BTNF), the National Elk Refuge (NER), and the John D. Rockefeller Memorial Parkway. The natural environment consists of alpine, forest, meadow, wetland, riparian and sagebrush ecosystems that support abundant wildlife throughout the year.

Of the mammalian species present in the valley, large ungulate species such as Moose, Mule Deer, Elk, and Bison are most prevalent. Ungulates, especially Elk and Bison, influence the natural environment's limited carrying capacity of the Jackson Valley by reducing the amount of resources available for other species. Conservation efforts from a number of agencies impinge on the process of self-organizing.

1.2.2 Human-Made Infrastructure

The creation of natural resources managing federal entities (NFS, NPS and USFWS NER) commit the natural infrastructure in the valley to exist as it is today. Since the late 19th century, there were contentions internally within federal entities and also the state on the questions of who manages, what to manage, where lies the boundaries, and how does the resources be managed in this case. The management of public infrastructure that manages the natural infrastructure is clearly heterogeneous and therefore less agile to decide and act swiftly. The system today has been developed through an intricate struggle between stakeholders locally and legislators on both state and federal levels (RW, 1982). The USFWS NER directly impact wildlife. The NER provides SWF and irrigation infrastructure to generate additional forage, with the aim of supporting the wintering Elk population. While the NER was established for the Elk population, Bison have also found the NER to be a rich source of forage during the winter months. This process has decreased winter mortality of these two large ungulate species, thus interfering with the process of 'self-organization'.

1.3 Attributes of the community

The Jackson Valley has a diverse, engaged and vocal community. Within the greater Teton County there are many subgroups that express their interests about Bison and Elk management. There are multiple commercial, governmental, and non-governmental organizational interests. Tribal nations also hold keen interest about bison with time-honored stories that ties them to the ecological community within the greater Jackson Hole valley and the Grand Teton basin. There are more than twenty tribal nations with direct and indirect aboriginal ties to the Jackson Hole valley in the form of spiritual, creation narrative stories, subsistence, and traditional knowledge. Although, tribal nations are traditionally linked to the Jackson Hole valley, yet their inputs have been marginally limited.

1.3.1 Human-infrastructure

The population of the town of Jackson Hole is approximately 9,600 people, nearly a quarter of which is transient in nature (2010 Census). Tourism is the backbone of the local economy. The valley is a destination for sportsmen, recreationists, and artists. These subgroups are recognized as 'Resource Users' (RU), and receive flows of goods and services from the natural infrastructure. These resource users include hunters, fishermen, tourists, artists, conservationists, hikers, cyclists, campers, tribal nations, residents, and ranchers. Each set of resource users is not exclusive, and many individuals receive multiple streams of goods and services that reflect their preferences. Additionally, the natural infrastructure and opportunities for RU vary seasonally. Public infrastructure providers (PIP) can be categorized as formal and informal agencies. Formal agencies govern the Resource (R), whereas, informal agencies educate the RU about the Public Infrastructure (PI). A table in the supporting information section illustrates the PIP that govern the R and the organizations that they are nested within. The management structure of the PI is

complex, and involves several agencies, with different missions and goals that govern the R. For example, the Wyoming Game and Fish Department (WGFD) is responsible for ‘wildlife,’ but do not manage the habitats on which they forage.

1.4 Rules in Use (IAD)

Position Rules

- Park Superintendent of Grand Teton National Park manages the national park operations.
- Program Director of National Elk Refuge manages the winter feeding in the elk refuge
- Game Warden of Wyoming Game and Fish Department enforces Wyoming State game rules

Boundary Rules

- The Wyoming Game and Fish Department sets hunters entry rules by requiring: rifle caliber size, hunter safety training course and clothing, report of kills, and providing biological samples for disease testing and genetic analyses.
- Hunting is allowed in certain hunting grounds.

Choice Rules

- Hunters with a hunting tag permit can hunt wildlife, designated bison or elk as defined by that hunting tag and within specified hunting area.

Aggregation Rules

- Population objectives are determined through public hearing process with the Wyoming Game and Fish Department.

Information Rules

- Hunters are provided instructional materials on identification of sex and age of bison in the field to enhance selection of animal their permit specifies.

Scope Rules

- Wyoming Game and Fish Department in collaboration with the National Elk Refuge set the 500 bison parameter.

Payoff Rules

- The CFR contains all the generally applicable rules with current and future effects as it pertains to bison and elk management at the National Elk Refuge and Grand Teton National Park.

1.5 Summary

The appropriation of natural resources to wildlife populations is inherently tied to prevailing cultural perspectives through governance by the PIP. The natural infrastructure is a self-organizing system that reflects many interactions within the social-ecological system. Considering, the diverse set of social actors who receive streams of goods and services from the R, there are differing opinions on how the PIP should manage the R through PI. In the recent years, these diverse cultural perspectives have impeded the governance structures ability to manage ‘wildlife’ resources. This roadblock in governance led to degradation of the natural infrastructure and increased the cost of SWF.

2. Dynamic Analysis - Shocks, Capacities, and Vulnerabilities

Resource - A number of shocks, linked to high densities of ungulates, affect the natural infrastructure and wildlife of the region. Among these shocks are the land overgrazing and reduction of woody riparian areas (Matson, 2000). On the other hand, the system is highly vulnerable to the spread of chronic wasting disease (CWD) and Brucellosis among the ungulates population that poses a high risk to domestic 'livestock,' particularly cattle whose exportation from this region is a major industry. Nonetheless, the natural infrastructure is known to show resilience and is self-organizing, which can maintain structure and function after multiple shocks.

Public Infrastructure - An example of a shock to the PIP was the 1998 litigation process between an animal rights group and the U.S. government. This litigation discontinued the Elk and Bison Management Plan implementation and thus, led to an increase of the ungulate population. On the other hand, the NER operation and maintenance rely on governmental funding and regulation. Therefore, governmental processes that influence negatively the National Parks and NER funding can increase the vulnerability of the public infrastructure. For example, the recent government shutdown (September 30, 2013) took a toll on several federal agencies across the nation that were forced to cease operations, among these agencies were the GTNP and the NER. However, if the government shutdown had occurred during the winter feeding process, funding to the refuge would have been open to support this process.

Public Infrastructure Providers - The performance and capacity of the PIP is contingent to governmental support and investment. Events such as the government shutdown increase the vulnerability of the management system. Nonetheless, the active participation of multiple groups in the management processes and goals allows for a robust conservation. Changes in soft infrastructure, such as laws to maintain the natural environment by NPS, USFS, and FWS and investment to hard infrastructure by man-made infrastructure for recreation and hunting activities, which ultimately affects potential shocks of the natural environment and guarantee of existence for future generations. A forum is created to facilitate communication between governmental agencies, so to lessen any potential deterioration in formal and informal communication forum that reduces the group's capacity to reach a conclusion to help governmental agencies to manage what they are mandated.

Resource Users - Future demographic change potentially leads to different public direction of wildlife management, which likely will occur at a generational time scale. Changes in demographic could lead to how resources are used and management directions of public infrastructures providers also pose external vulnerabilities. As the world income level catches up with the United States, the increase in international tourist to the U.S. will lead to increase tourist activities in Jackson Hole valley. There are possible pressure from tourism businesses through increase in wildlife and natural environment viewing activities that threaten the Teton Park and National Elk Refuge carrying capacities. The geopolitical views and boundaries of the greater Teton basin are often charged with new economic approaches that is not align with local and regional core values.

Bibliography

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Appendix

Public Infrastructure Providers Table

Public Infrastructure Provider	Hierarchically Nested Within:	Hierarchically Nested Within:
Grand Teton National Park (GTNP)	National Parks Service (NPS)	U.S. Department of the Interior
National Elk Refuge (NER)	U.S. Fish & Wildlife Service (USFWS)	U.S. Department of the Interior
Bridger Teton National Forest (BTNF) Gros Ventre Wilderness (GVW)	U.S. Forest Service (USFS)	U.S. Department of Agriculture
Wyoming Game & Fish Department (WGFD)	State of Wyoming	The United States of America

Table 1. Public Infrastructure Providers nested under State and Federal Organizations

Rules in Use (IAD)

Position Rules

- The Refuge Manager allows for the removal of up to five bison annually on the National Elk Refuge by Native American tribes for ceremonial purposes in accordance to the National Wildlife Refuge System Administration Act (Refuge Administration Act), 16, U.S.C. § 668ddee, and the Native American Policy of the U.S. Fish and Wildlife Services, Section VII. Culture/Religion.

Boundary Rules

- Grand Teton National Park General Management Plan (GMP) stipulates entry and exit rules for the general public.
- The Final Plan/Environmental Impact Statement (EIS), published February 2007, provides Refuge Manager with clear goals and objectives for managing the Jackson bison and elk herds.
- The National Elk Refuge determines wildlife management in accordance with its Supplemental Feeding Program, Irrigation Program, Collaring Elk, and Fire Management.

- The Wyoming Game and Fish Department sets hunters entry rules by requiring: rifle caliber size, hunter safety training course and clothing, report of kills, and providing biological samples for disease testing and genetic analyses.
- Tribal participants follow a Special Condition outlined in Special Use Permit and the requirements outlined in the national Elk Refuge Bison Hunting information.

Choice Rules

- The Second Amendment to the United States Constitution protects the right of individual Americans to keep and bear arm.
- Wyoming Hunting Rights Amendment was approved as part of the November 6, 2012 ballot. The measure preserved citizens' rights to hunt and fish.
- Hunters with a hunting tag permit can hunt wildlife, designated bison or elk as defined by that hunting tag and within specified hunting area.
- The tribes' treaties with the federal government grant them the right to hunt on traditional hunting ground within aboriginal, unclaimed land.
- Recreationalists may use the National Elk Refuge for snow-sledding activities.

Aggregation Rules

- Multiple governmental agencies, nonprofit, and public come together in decision making and produced Bison and Elk Management plan and Environmental Impact Statement of April 2007.
- The Final Plan/Environmental Impact Statement (EIS) has the following goals: Habitat Conservation; Sustainable Populations; Population objective of Elk and Bison; and Disease Management.
- Population objectives is determined through public hearing process with the Wyoming Game and Fish Department.
- National Elk Refuge sets wildlife herd objective levels in compliance with Public Review Process in accordance with the Wyoming Game and Fish Commission.

Information Rules

- The National Elk Refuge, the Grand Teton National Park, the Bridger National Forest, Wyoming Game and Fish Department, and multiple participants are able to generate and acquire information through their websites.
- Hunters are provided instructional materials on identification of sex and age of bison in the field to enhance selection of animal their permit specifies.

Scope Rules

- Wyoming Game and Fish Department in collaboration with the National Elk Refuge set the 500 bison parameter.
- The National Elk Refuge determines the winter feeding outcome for elk.
- The Grand Teton National Park provides adequate infrastructure for carrying capacity.

Payoff Rules

- The National Elk Refuge manager and the Grand Teton National Park superintendent are authorized to participate in the federal rulemaking process and in its execution as it pertains to their mission and goal.
- The CFR contains all the generally applicable rules with current and future effects as it pertains to bison and elk management at the National Elk Refuge and Grand Teton National Park.
- The Bridger National Forest applies sanctions per rules in the published CFR.