MANUFACTURING YELLOWSTONE
Political Management of an American Icon

Jordan Lofthouse, MS, Strata Policy
Randy T Simmons, PhD, Utah State University
Ryan M. Yonk, PhD, Utah State University
The Institute of Political Economy (IPE) at Utah State University seeks to promote a better understanding of the foundations of a free society by conducting research and disseminating findings through publications, classes, seminars, conferences, and lectures. By mentoring students and engaging them in research and writing projects, IPE creates diverse opportunities for students in graduate programs, internships, policy groups, and business.
AUGUST 2016

PRIMARY INVESTIGATORS:

Jordan Lofthouse MS
Strata Policy
Randy T Simmons, PhD
Utah State University
Ryan M. Yonk, PhD
Utah State University

STUDENT RESEARCH ASSOCIATES:

Devin Stein
Michael Cox
Jason Dahlin
Clint Robison
Colton Cowan
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary and Key Findings</td>
<td>1</td>
</tr>
<tr>
<td><strong>Part I: Institutions and Incentives in Yellowstone Management</strong></td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>History and Evolution of Yellowstone Management</td>
<td>3</td>
</tr>
<tr>
<td>Native Americans: Prehistory-1800s</td>
<td>4</td>
</tr>
<tr>
<td>Exploration and Protection: 1800-1872</td>
<td>5</td>
</tr>
<tr>
<td>Management under the United States Army: 1886-1918</td>
<td>7</td>
</tr>
<tr>
<td>Management under the National Park Service: 1918-Present</td>
<td>9</td>
</tr>
<tr>
<td>Contradictory Management Strategies Over Time</td>
<td>14</td>
</tr>
<tr>
<td>Fire Management</td>
<td>14</td>
</tr>
<tr>
<td>Elk Management</td>
<td>18</td>
</tr>
<tr>
<td>Bear Management</td>
<td>19</td>
</tr>
<tr>
<td>Fish Management</td>
<td>20</td>
</tr>
<tr>
<td>Wolf Management</td>
<td>22</td>
</tr>
<tr>
<td><strong>Part II: Natural Regulation Management</strong></td>
<td>22</td>
</tr>
<tr>
<td>Natural Regulation and its Unintended Consequences</td>
<td>22</td>
</tr>
<tr>
<td>What is Natural Regulation?</td>
<td>23</td>
</tr>
<tr>
<td>Origins of Natural Regulation</td>
<td>23</td>
</tr>
<tr>
<td>Overpopulation of Elk &amp; Bison</td>
<td>26</td>
</tr>
<tr>
<td>A Deteriorating Range</td>
<td>28</td>
</tr>
<tr>
<td>The Decline of Aspen and Willow</td>
<td>31</td>
</tr>
<tr>
<td>Loss of Riparian Habitat</td>
<td>41</td>
</tr>
<tr>
<td>Addressing the Elk Problem</td>
<td>46</td>
</tr>
<tr>
<td>Analysis of Natural Regulation</td>
<td>48</td>
</tr>
<tr>
<td>Contradictions to Natural Regulation</td>
<td>48</td>
</tr>
<tr>
<td>The Interagency Bison Management Plan</td>
<td>48</td>
</tr>
<tr>
<td>Non-Native Plant Species</td>
<td>50</td>
</tr>
<tr>
<td>Conclusion</td>
<td>55</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY AND KEY FINDINGS

In Yellowstone National Park, the National Park Service (NPS) is legally obligated to preserve ecological health and promote recreation. These two contradictory mandates have been interpreted differently over the course of NPS management, and these changing interpretations have altered the park’s ecosystems. We use a branch of political economy known as public choice analysis to explore how and why management regimes in Yellowstone have changed over time. We also examine what the ecological effects have been from these management changes. We identify how NPS decision-makers have responded to political rules and incentives over time. Management changes over time have both improved and impaired Yellowstone’s ecological health.

Political pressures, both from the public and Congress, have pushed the NPS to drastically change management policies that have ultimately altered the park’s ecology. Many policies in Yellowstone are rooted in the mischaracterization that Yellowstone is a primeval wilderness. NPS officials overlook how Native Americans actively shaped Yellowstone’s ecology for thousands of years. Because of this mischaracterization and political pressures, the NPS in Yellowstone has adopted management philosophies and practices that are causing environmental degradation in the park. The NPS’s current hands-off management approach, called “natural regulation” or “ecological process management,” assumes that nature will self-correct when ecological problems occur. This management philosophy ignores the fact that Yellowstone’s ecosystem evolved for millennia with Native American’s active management. The health of rangelands and riparian habitats (habitats near rivers and streams) has declined since the NPS adopted natural regulation.

Ecologically degrading management practices are a violation of congressional mandates. The Organic Act of 1916 charges the NPS to “conserve the scenery and the natural and historic objects and the wildlife” within the national parks to “leave them unimpaired for the enjoyment of future generations.” Natural regulation allows bison and elk populations to grow artificially large, which is politically popular because the public enjoys seeing wildlife, but actually harms the park’s ecology. The large populations of ungulates (hooved animals) are overgrazing rangeland and riparian habitats, which lowers the productivity of the land and harms other species. Beavers are essentially extinct within the park because of ungulate-caused overgrazing. Aspen stands within the park are also threatened by overgrazing. By allowing these negative changes, the NPS is not conserving the natural objects and the wildlife within the park, thus violating the Organic Act.

Measuring ecological health is problematic because ecological outcomes are subjective and based on the individual preferences of decision-makers. For example, natural regulation promotes large elk and bison herds, but natural regulation may limit biodiversity in the park. Tradeoffs between large animal herds and biodiversity are political decisions dictated by the preferences and incentives of NPS managers in Yellowstone.

NPS officials often contradict their own hands-off management philosophy when they engage in low-profile active management, such as bison culling and attempts at vegetation restoration. To eliminate hypocrisy and internal contradictions, the NPS will need to admit that natural regulation does not facilitate the desired ecological outcomes for Yellowstone’s ecological health in every case. Balancing politically popular policies with policies that promote ecological preferences is difficult because NPS officials are constrained by political and economic incentives.

The mistaken perception of Yellowstone as a static wilderness must change if the NPS is going to promote the ecological health of the park. A combination of active and passive management will be necessary to promote the ecological outcomes that the public desires and that the Organic Act mandates. The current management policies in the park are designed exactly for the outcomes they achieve. If the public demands different ecological outcomes in Yellowstone, then managers will need to choose policies that produce the preferred outcomes.

PART I: INSTITUTIONS AND INCENTIVES IN YELLOWSTONE MANAGEMENT

INTRODUCTION

Yellowstone National Park, a beloved icon to Americans and visitors from across the globe, is managed by the National Park Service (NPS). In 2016, the NPS will celebrate the one-hundredth anniversary of its formation under the Organic Act.

Yellowstone has served as the model of park management throughout the world since the NPS began managing in 1916, but current management practices may be producing undesirable outcomes in Yellowstone. Current management practices may be harming ecological and wildlife health, especially the northern range of the park. The National Park Service Organic Act of 1916 charged the NPS to "conserve the scenery and the natural and historic objects and the wildlife" within the national parks to "leave them unimpaired for the enjoyment of future generations."² Over the past century, the NPS has experimented with multiple management schemes in Yellowstone in response to political and public pressures resulting from the vague wording of the Organic Act. These management regimes have affected the physical landscape and wildlife within the park. Under the current hands-off management scheme, called "natural regulation" or "ecological process management,"³ the NPS may not be fulfilling its mandate to preserve the park unimpaired for future generations.

We explore Yellowstone using a public choice analysis of the institutions and incentives that have caused the NPS to change management strategies over time. In other words, we offer a public choice perspective of the NPS decision-making process and explain how these decisions have affected the ecological state of Yellowstone. Public choice theory is a field of political economy that explains why and how politicians and bureaucrats make decisions. We draw on the work of Dr. Charles Kay, a professor at Utah State University, who has spent many years documenting the landscape changes in Yellowstone National Park. Kay and other researchers have documented the ecological changes in great detail, but few researchers have studied the political and bureaucratic roots of these changes.

Ecology is the study of how organisms interact with one another and their physical environment; however, ecology cannot tell park managers what the "true" or "best" state of Yellowstone is. Ecology is incapable of determining the "true" or "best" outcome because these terms are subjective and preference-based, not scientific. Ecological outcomes can be widely considered better or worse than others, but each outcome depends on personal preferences. The means to achieve those preferences is a political decision, not an ecological one. Selecting ecological outcomes in Yellowstone is based on the preferences and incentives of NPS decision-makers.

Many park managers and members of the public interpret the mandate to "conserve the park unimpaired for future generations" as a mandate to freeze Yellowstone in its supposed "perfect" state. Because ecosystems are always

changing, regardless of human intervention, it is impossible to freeze any ecosystem in time. Ecological dynamics and human preferences cause every ecosystem to be in constant flux. Finding the “perfect” state of Yellowstone is also impossible because human preferences are subjective and change over time.

Public choice theory asserts NPS officials as rationally self-interested individuals who work to perpetuate their personal preferences, as well as maximizing agency budgets and power. Each preference leads to different policy decisions, and each policy decision results in different outcomes. In many cases, some outcomes may not be preferable to the majority of Americans, or they may violate the provisions of the Organic Act. For example, one group of people may want Yellowstone to resemble a zoo where elk and bison are abundant. Other people may prefer increased biodiversity in the park, which would come at the expense of large animal herds. For the past hundred years, the NPS has switched between active and passive management due to changing pressures from the public and Congress, altering the ecological dynamics of the park. Passive management does not reflect how Native Americans historically shaped the Yellowstone ecosystem for thousands of years.

As rationally self-interested actors, NPS managers are able to use the Organic Act’s conflicting mandates for recreation and conservation to implement contradictory management practices that align with public and political preferences. In the past and currently, NPS policies promote conservation for certain aspects of the park, while simultaneously promoting recreation at the expense of conservation. Because public and political preferences have changed over time, NPS decision-makers have switched conservation-based policies to recreation-based policies and vice versa.

Although popular culture characterizes Yellowstone as the epitome of wilderness, Yellowstone is a human construction and is one of the most heavily managed and regulated places in the world. One of the main drivers of Yellowstone tourism is its perceived wildness and naturalness, but these perceptions are romantic fantasies, not ecological realities. NPS officials manage the park to fulfill these expectations. Treating Yellowstone as wild and natural is not detrimental per se, but ignoring the historical role of humans in the park and the effects of government policies can lead to undesirable outcomes in the park.

Achieving a Yellowstone that aligns with the Organic Act requires knowledge about Yellowstone’s history, the political decision-making process, and ecological realities. This report is composed of two sections. Part I looks at the institutions and incentives that have guided management decisions in Yellowstone. This section begins with a historical examination of man’s role in Yellowstone to ascertain how the ecosystem has changed through time. Then we explore how and why the NPS has made specific management decisions. In Part II, we examine how the current management technique of natural regulation is affecting Yellowstone’s environment.

HISTORY AND EVOLUTION OF YELLOWSTONE MANAGEMENT

Since Congress established Yellowstone National Park in 1872, management practices in the park have undergone several shifts in response to political pressures. The actions of United States Army, National Park Service (NPS), and private citizens have produced today’s Yellowstone. Prior to the federal government’s formal management, Native Americans actively “managed” Yellowstone and the surrounding areas for millennia according to their needs. The current management philosophy of Yellowstone ignores the human history of the area and fails to integrate humans as a natural and historical part of Yellowstone’s ecology. The National Park Service ignores Native American history and supports the public’s mistaken perception of Yellowstone as a “Garden of Eden.” The Organic Act itself is problematic because of the contradiction between conservation and recreation within the national parks. The contradictory mandate gives the NPS wide discretion to change management practices easily with little challenge or oversight.
NATIVE AMERICANS: PREHISTORY-1800S

Humans have inhabited the area in and around Yellowstone National Park for at least 12,000 years. These native peoples actively managed Yellowstone’s resources to meet their needs, and their management shaped Yellowstone’s landscape and ecology. Humans co-evolved with the Yellowstone ecosystem, and they were an integral part of it.

Many native groups have resided in the area and have used Yellowstone’s natural resources. More modern Native American tribes began to migrate into the Yellowstone area relatively recently. The Crow tribe arrived in the 1500s, and the Sioux tribe arrived around 1700. Most recently, the Crow and Shoshone tribes have resided on the north and eastern borders of Yellowstone. Physical evidence connecting more modern tribes to older Yellowstone inhabitants is scarce, but oral histories of some tribes suggest that more recent tribes may be related to more ancient ones.

Humans have actively shaped Yellowstone’s ecosystem for millennia, especially the presence of wildlife. Archeological evidence points to native people hunting mammoths and other large mammals until they became extinct, showing that the first inhabitants had a profound impact on their surroundings. Anthropologist Paul Martin of the University of Arizona asserted that “the extinction of the mammoth, mastodon, ground sloth, and saber-toothed cat were directly or indirectly due to 'prehistoric overkill,'” meaning that the Native Americans killed these animals until they became extinct. This prehistoric overkill illustrates that Native Americans actively altered their environment, contrary to the belief that they were “noble savages” who lived in harmony with an unchanging environment.

Native Americans managed their land, but this management was not policy-oriented; rather, they actively managed Yellowstone’s resources for their own benefit. For example, Native Americans burned forests and hunted extensively. Setting fires benefitted Native Americans for several reasons. First, burning encouraged habitat diversity and replenished nutrients in the ecosystem. Second, Native Americans used fire to drive animals into specific areas, which allowed for easier hunting. Third, burning helped with insect reduction. Natives also used fires as a signal of imminent threats and to clear out possible hiding spots for enemies.

Because natives actively shaped their environment, the Yellowstone of today looks different from the Yellowstone prior to European contact. Evidence shows that the Native Americans never implemented an animal conservation policy and hunted freely to meet their needs. Yellowstone, for thousands of years, co-evolved with the human presence, and

---

9 Ibid.
Native Americans functioned ecologically as the apex predator.\textsuperscript{15} Apex predators serve as the top of the food chain and shape the populations of other organisms in an ecosystem.

Although Native American management of Yellowstone was not necessarily superior to current management, current park managers have dramatically changed the historical Yellowstone ecosystem by focusing on maintaining an environment mostly lacking human influence. Native Americans undoubtedly shaped the historical Yellowstone ecosystem by acting in their own interests for millennia. Yellowstone cannot be preserved in its historical state without considering the important role humans had in shaping the Yellowstone ecosystem.

EXPLORATION AND PROTECTION: 1800-1872

EARLY EXPLORATION

Europeans first explored the Yellowstone area during the late 1700s when fur traders followed the Yellowstone River in search of animals to trap and Natives to trade with.\textsuperscript{16} In the first decade of the 1800s, Meriwether Lewis and William Clark traveled near the present-day northern boundary of the park on their expedition to explore the Louisiana Purchase.\textsuperscript{17} After leaving the Lewis and Clark expedition in 1807, John Colter explored Yellowstone by himself.\textsuperscript{18} In the 1830s, the fur trapper Osborne Russell was the first white explorer to write about his experiences in Yellowstone.\textsuperscript{19} The trapping interests in Yellowstone disappeared abruptly in the mid-1840s after popular fashion shifted away from beaver pelt hats.\textsuperscript{20} The decline of the fur trade reduced the number of European-Americans in Yellowstone for about twenty years.

In 1863, rumors of gold deposits led prospectors to the Yellowstone area in search of quick wealth. From 1863 to 1871, miners combed the plateaus of northern Yellowstone in increasing numbers without any success. No major gold deposits were ever located within the boundaries of Yellowstone, though gold deposits were located close by.\textsuperscript{21}

The period from roughly 1800 to 1870 was a transitional period for Yellowstone as European-Americans displaced Native Americans. Because early European explorers brought Old World diseases to the Americas at first contact, much of the Native American population was wiped out. In addition to disease-caused decline, the European-American expansion across the United States displaced Native Americans from their traditional homelands and altered their traditional management strategies.

As Europeans displaced Native Americans during their westward expansion, Native Americans could no longer actively manage Yellowstone. Without Native Americans burning the land or hunting wildlife, forests grew denser and animal populations increased.\textsuperscript{22} Historical documents show that the first European-Americans who explored Yellowstone in the early 1800s saw open forests and few large animals.\textsuperscript{23} By the time Congress designated Yellowstone as a national

\begin{itemize}
\item \textsuperscript{15} Ibid.
\item \textsuperscript{19} Ibid.
\item \textsuperscript{23} Ibid.
\end{itemize}
park in 1872, Yellowstone’s ecology had shifted. When the first tourists arrived in the late 1800s, they saw a densely
forested wilderness teeming with animals. The first visitors and managers in Yellowstone mistakenly thought that the
forests and animal populations were the same as they had always been. This incorrect impression of Yellowstone
would become the basis of management policies for the park.

Unlike other places in the western United States, settlers and prospectors had minimal impact on Yellowstone, which
preserved the perception that the land was untouched. First, the area lacked the large buffalo herds that sustained the
Native inhabitants of the Great Plains. The lack of buffalo herds meant that the human population, both Native
Americans and Europeans, in the area was relatively light in comparison to other areas in the western United States.24
Journals from the 1800s indicated that elk and buffalo were rarely seen in Yellowstone, and one in particular stated
that over a two-year period, there was an elk sighting once every 18 days.25 Second, Yellowstone did not have
significant deposits of precious materials, like gold and silver, which brought thousands of prospectors to other areas.26
Third, the Yellowstone region was relatively isolated and had a harsher climate than surrounding areas, which
discouraged European-American settlement.27

FORMATION AND EARLY MANAGEMENT OF YELLOWSTONE NATIONAL PARK

Congress designated Yellowstone as a national park for two main reasons: first, railroad companies lobbied for a park
designation to capitalize on tourism potential; and second, scientific expeditions proved to Congress that the area was
geologically unique and deserved protection. Railroad companies were some of the strongest proponents of designating
Yellowstone as a park. In the early 1860s, Jay Cooke, owner of the Northern Pacific Railroad, began to lobby Congress
to designate Yellowstone as a park. Cooke saw the wonders of Yellowstone as a lucrative way to expand his railroad
business that he was building through Montana Territory.28 Cooke and the Northern Pacific Railroad also feared that
homesteaders would try to claim the geological features of the park and limit the company’s opportunity for profit.29
In California’s Yosemite, the federal government had previously extended leases to other railroad companies for tourism.
Cooke hoped to also win a profitable government lease into a potential tourist area.30

In the late 1860s, several expeditions into Yellowstone raised the public’s interest in the mysterious wonders of the
area. Several congressmen also became interested in Yellowstone, including Representative Henry L. Davis of
Massachusetts. Davis was the chairman of the House Committee on Appropriations and was a main driver of securing
the funding that allowed a formal, scientific expedition to explore Yellowstone. Ferdinand V. Hayden, the director of
the U.S. Geological and Geographical Survey of the Territories, received government funding to lead a team of
researchers through Yellowstone in 1871. Hayden’s team included geologists, botanists, and other scientists, as well
as the painter Thomas Moran and photographer William H. Jackson.31

In addition to railroad lobbying, the Hayden expedition’s reports, photographs, and paintings persuaded many congressmen to preserve Yellowstone. Members of Congress hoped to save the geysers and hot springs from vandals or from entrepreneurs who would try to claim the unique geologic features for personal gain. Congress formally established Yellowstone National Park in 1872 to protect and preserve the area for posterity. Yellowstone, which was located in federal territories, became a national park because no state governments existed to manage the land. The federal government had preserved other land prior to Yellowstone, but Yellowstone was the first area designated with the title “national park.”

Despite the designation, Congress did not provide specific laws and regulations for how the park was to be managed. Between 1872 and 1886, Yellowstone suffered its most ineffective federal management regime because Congress allocated insufficient funds and gave minimal guidance on how the park was to be managed. Nathaniel P. Langford was appointed as the first park superintendent. Serving from 1872 until 1877, Langford did not receive any federal funding for the park and did not receive a salary. During his tenure as superintendent, Langford spent a majority of his time working as the U.S. Bank Examiner for the Territories and Pacific Coast States. He only entered Yellowstone two times during his five years in office. With limited power and funding, the park was left vulnerable to poachers and ineffective management. Langford was handicapped from the beginning because the park received no federal funding, his position was unpaid, and there were no laws that protected wildlife within the park.

Due to political pressures, Langford was replaced in 1877 by Philetus W. Norris, and in 1878 Congress created appropriations to preserve and improve the park. These appropriations were used to build roads, headquarters, and recruit the park’s first gamekeeper to limit poaching. Three superintendents followed Norris before Secretary of Interior Lucius Lamar called for a new management system under the Army.

MANAGEMENT UNDER THE UNITED STATES ARMY: 1886-1918

In 1886, Congress denied funding to Yellowstone’s managers due to several years of poor performance. When the funds were denied, Secretary of the Interior Lucius Lamar called on Secretary of War William C. Endicott for assistance. The Secretary of War deployed troops and assumed control of Yellowstone on August 20, 1886. Over the next twenty years, the army implemented a number of policies that helped improve the park’s conditions. The army

---

32 Ibid.
33 Ibid.
40 Ibid.
41 Ibid.
42 Ibid.
established infrastructure, mainly roads and pathways around the park, limited poaching, and began active wildlife management.

The army stationed cavalry and troops to patrol the park and limit poaching. Problems with poachers, however, highlighted the weakness of the army and the laws of the time. The army struggled to limit poaching, even with cavalry and troops, because the maximum penalty for poaching was a ban from the park. Such a mild punishment did little to deter any poachers from hunting within the park. In 1894, Congress passed the National Park Protection Act, also known as the Lacey Act, which prohibited the trade of wildlife that was illegally taken from the park. The Lacey Act improved the army’s ability to provide protection to the park because it banned the unlawful import and export of wildlife.\(^{45}\)

One of the army’s largest management successes was saving Yellowstone’s bison from extinction. By 1894, Yellowstone’s bison herd was the last wild herd in the United States, and by 1901, the park’s herd only numbered 25 animals. When the herd dropped to 25 animals, the army implemented a policy that permitted the introduction of domesticated bison to bolster the herd, buying fourteen cows and three bulls.\(^{46}\) In 1907, a ranch was established in Lamar Valley to breed domestic bison that could be incorporated into the wild herd. In 1907, the bison populations began to show signs of rebounding, with captive animals numbering 61. Under army management, the bison population in 1916 had increased to 72 wild bison and 273 domesticated bison. The management policy was not completely successful, however, because the wild bison contracted brucellosis, a disease that causes miscarriages, infertility, and lowered milk production in bison.\(^{47}\)

Rescuing bison from the brink of extinction was only one of the wildlife management problems facing the army. The army’s management of Yellowstone also led to other major problems, primarily the overpopulation of elk within the park. A much more complex problem emerged when two large herds of elk began to seek shelter within the park during winter.\(^{48}\) Yellowstone’s elk herds migrated to lower elevations outside the park before the army and NPS began protecting the elk, which allowed the populations to grow rapidly.\(^{49}\) The army’s success in enforcing hunting bans and stamping out poachers had the unexpected consequence of allowing elk populations to grow exponentially. The army’s management exacerbated the population problem through systematic extermination of natural predators such as wolves, mountain lions, and coyotes. Without hunting pressure, the elk population boomed, and the amount of food available in winter was quickly exhausted. To prevent a mass starvation of elk, the U.S. Fish and Wildlife Service set up a feeding program nearby in Jackson Hole.\(^{50}\)

The army’s inability to solve the elk population problem meant that the NPS inherited the problem in 1918. The army’s failure to foresee how the elk population would respond to the elimination of hunting created a problem for the NPS for decades to come.

Overall, the army’s administration of Yellowstone was more effective than the superintendents’ that preceded it, but the successes of the army were accompanied by failures. The army was successful in saving bison from extinction, but the army also inadvertently introduced brucellosis to Yellowstone’s bison, which has caused serious problems for


population control that still exists today. Elk management, on the other hand, was largely a failure. The army’s introduction of a predator extermination policy, combined with the park’s hunting bans, created unmanageably large elk herds. The army’s limited resources necessitated a separate agency to manage Yellowstone and other newly established national parks. Congress created the National Park Service (NPS) in 1916 to protect, administer, and study parks. This new agency assumed responsibility for Yellowstone in 1918, with its first rangers including many army veterans.

MANAGEMENT UNDER THE NATIONAL PARK SERVICE: 1918-PRESENT

THE ORGANIC ACT OF 1916

Perhaps the most important institution shaping park management today is the Organic Act of 1916. The Organic Act created the National Park Service and outlines the agency’s responsibilities. The writers of the Organic Act imposed vague and contradictory mandates on park managers because legislators disagreed about whether national park should be used primarily for recreation or preservation. The Organic Act was supported by conservation enthusiasts, as well as private interests that would benefit from increased recreation, including the railroad industry.

After Congress designated Yellowstone a national park in 1872, the number of national parks and monuments began to grow. In the early 1900s, the Department of Interior, the War Department, and the Department of Agriculture were managing the national parks and monuments throughout the country. Each department managed the parks and monuments differently according to the preferences of the individual managers so some park advocates and members of Congress called for a unified management system.

In 1915, Secretary of the Interior Franklin K. Lane asked Chicago businessman and park enthusiast Stephen Mather to help campaign for a national park bureau. Mather hoped to amass public and political support for the parks by making them more accessible to larger numbers of people. Mather persuaded writers, magazine publishers, and entrepreneurs to make the parks more prominent in everyday life for Americans. Mather and his assistant, Horace Albright, also persuaded several key congressmen, including California congressmen John Raker and William Kent, to introduce legislation that would set up an official national park management system.

By early 1916, Congress responded to the call for more unified national park management. Many congressmen wanted to emulate the Canadian park service that had been established in 1911, which would not only protect the resources of the parks, but also increase revenue from tourist traffic in the parks. In August 1916, President Woodrow Wilson signed the National Park Service Organic Act into law.

Under the National Park Service Organic Act of 1916 and subsequent amendments, the NPS directs day-to-day functions of Yellowstone National Park, as well as the other parks, monuments, and historic sites throughout the country. The Organic Act outlines the NPS’s most basic duties and functions. Its purpose was to create an organization that would oversee all national parks, monuments, and reservations to ensure their preservation and public enjoyment. The Organic

53 Ibid.
Act stipulates that the NPS must "preserve" the natural and historic amenities of the parks so that they are unimpaired for future generations. The NPS in Yellowstone has experienced drastic shifts in its management styles over the past century as different officials have responded to evolving scientific knowledge and political pressures.

The Organic Act stipulates that, the National Park Service "shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified...which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."\(^57\) The act then states that the Secretary of Interior can work with the NPS to create rules and regulations for the "proper management" of the national parks.\(^58\)

Contradictory mandates in the Organic Act give the NPS considerable discretion in how they manage national parks. Congress did not specify in the Organic Act how the NPS was meant to conserve the parks while also providing for recreation and enjoyment. The paradoxical mandate to promote conservation and recreation enlarges the NPS's decision-making power because nearly any decision falls in one of these two categories. The inherent contradiction between recreation and conservation creates tension between different groups of people. Some faction of the public will almost always think that NPS management is illegal because any action will contradict one of the two NPS mandates. For example, people who value conservation may think that a new shopping facility within a national park violates the Organic Act. On the other hand, for someone who values recreation, limiting cars or hiking in certain areas of parks violates the Organic Act.\(^59\) Although the NPS's duties are paradoxical, management policies that neither promote conservation nor provide for the public's enjoyment violate the provisions of the Organic Act.

THE LANE LETTER

The vague wording of the Organic Act led to uncertainty regarding NPS jurisdiction and responsibilities. In 1918, Secretary of Interior Franklin Lane and the Director of the NPS issued guidance on how national parks should be managed.\(^60\) The "Lane Letter" provided three general principles for NPS park management: (1) all parks must be maintained in absolutely unimpaired form for the present and future generations; (2) parks must be set apart for use, observation, health, and pleasure of the people; (3) the national interest must dictate all decisions affecting public or private enterprises in the park.\(^61\)

Park managers became more confused after these requirements were published because the arbitrary and subjective wording led to broad interpretation. The phrase "unimpaired" occurred in both the Organic Act and the Lane Letter, but the practical application of keeping parks "unimpaired" was not clarified. Determining the "national interest" was also problematic because the term is a subjective, preference-based political decision. NPS leaders did not provide guidelines on how to define the national interest.

The broad power of the NPS in Yellowstone has allowed park managers to experiment with different management strategies over time, which are subject to political pressures from the general public and Congress. Some management strategies have emphasized conservation, while other have promoted recreation. The subjectivity of the Organic Act

\(^{57}\) Ibid.
\(^{58}\) Ibid.
has allowed the NPS to change management in Yellowstone in response to changing preferences. Some management changes have benefited the Yellowstone ecosystem, while others have caused environmental harm.

**PUBLIC CHOICE THEORY: THE NPS AS A GOVERNMENT BUREAUCRACY**

As a bureaucracy, the NPS is subject to political pressures, like any other government agency. The changes in Yellowstone’s management policies make sense when viewing the bureaucratic decision-making process through a public choice perspective. Public choice theory is a field of political economy that explains why and how politicians and bureaucrats make decisions. Bureaucracies are composed of rationally self-interested individuals who make decisions that benefit themselves, maximize their budgets, and promote their preferences. Each bureaucracy is bound by institutions that function as the “rules of the game.” These institutions may consist of formal laws and informal social norms. Economist Douglass North defined institutions as “the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights).”

Bureaucrats are different than elected officials because they do not have to respond to election pressures, meaning that bureaucrats have wide discretion in deciding what they can do within their bounds. Oversight is generally limited, which allows bureaucrats even more discretion. Using public choice theory, past and current NPS policies in Yellowstone are rational and explainable.

One of the core principles of public choice theory is that government officials are rationally self-interested. All people pursue activities that benefit them the net of costs, meaning that government officials act the same in the public sphere as they would in the private sphere. Policymakers do not always make decisions based on altruistic intentions or pure environmental benevolence. They make policies strategically for their own advantage and to advance their own preferences. Bureaucratic decisions in the NPS may benefit environmental quality and recreation, but bureaucrats may have other goals that impose economic or environmental harm. Because policymakers are not all-knowing or benevolent, their decisions can backfire despite good intentions. Public choice theory uses “methodological individualism,” which asserts that individuals, not groups, have preferences and make choices. When analyzing specific policy decisions, individual leaders in the NPS make specific decisions about park policies. The NPS itself does not make policies because the NPS is simply a collection of rationally self-interested individuals who make decisions based off their own preferences and incentives.

Laws serve as the rules for how much power bureaucratic agencies have and what decisions they can make. The Organic Act serves as the main set of rules for the NPS, but the law’s contradictions have given Yellowstone’s managers wide discretion to make policies with minimal criticism.

Another institution that guides the NPS policy-making process is congressional budget-making and congressional oversight. Bureaucrats in any agency want to maximize budgets and power, so they respond to incentives that will allow them to expand budgets and power. Leaders in each agency also want to advance their own preferences, which can be done only if Congress allocates money to bureaucratic leadership. Therefore, NPS leaders try to please congressional leaders who have the ability to enlarge the NPS budget and purview.

---

64 Ibid.
Although Congress controls how much money is allocated to each agency, Congress has done very little to scrutinize the spending and policies of NPS leadership since the passage of the Organic Act. The NPS, and all bureaucracies, are subject to only four checks on their actions.

First, congressional oversight committees can investigate and scrutinize how agencies are run and how well agencies are fulfilling their legislatively dictated duties. Congressional oversight committees are constrained in their effective oversight because of the imbalance of information that passes from the agency to the committee. Congressmen can also incur large time costs to effectively oversee bureaucracies, and congressmen often have limited time because they devote scarce resources to reelection and drafting legislation.

Second, bureaucratic power is constrained, in theory, by the amount allocated from Congress in the federal budget. Because legislators do not accurately know how much money bureaucrats actually need to fulfill their responsibilities, legislators often increase budgets each year with few questions. Bureaucrats formulate regulations to maximize their budgets and secure their jobs, so they rarely cut costs and often provide services beyond what society demands. As rationally self-interested actors, bureaucrats are incentivized to show that they need larger and larger budgets each year, and Congress often complies because individual congressmen do not have the resources or incentives to adequately review the spending of thousands of bureaucrats.

Third, the president can appoint agency heads with the advice and consent of the Senate, but this mechanism is not particularly effective because agency heads and the president do not have sufficient time to oversee every bureaucratic decision. In the case of the NPS, the president, the Secretary of the Interior, and the Director of the National Park Service cannot oversee every policy decision made in each national park, as well as each dollar spent on each project. With so many people and such little oversight, individual bureaucrats in local offices have wide discretion to implement their personal preferences, as long as there is no public outcry.

Fourth, average citizens can sue agencies who violate legislation, and if the courts agree that agencies are in violation, agency leaders must change their policies. Prosecution against agencies’ conduct has been the most effective check on bureaucratic behavior. This check, however, is costly for individuals to pursue and usually means a class-action lawsuit, which is difficult to organize. With all of these factors combined, each agency has large discretion and little practical oversight.

For the past century, the NPS in Yellowstone has changed management policies many times due to changing institutions and incentives. In the early days of the NPS in Yellowstone, NPS leaders responded to public opinion and promoted recreation. By bringing in as many tourists as possible and showing Congress that park visitation is increasing, bureaucrats can increase revenue through entrance fees and federal budget allocations. After the environmental movement began in the 1960s, Yellowstone managers have focused less on recreation and more on conservation, which is what the public has demanded.

Although the rationale for each decision may be explainable, the outcomes of policies often contradict what NPS officials may have intended. Policymakers often have a difficult time foreseeing what the effects of any law will be. Even aided by the most knowledgeable experts, policymakers cannot know the specific details about every situation in every time and every place. Because it is impossible for government officials to gather and process all relevant information or foresee all possible outcomes, unintended consequences easily arise from even the most well-intentioned policies.

---

MODERN DECISION-MAKING PROCESS

NPS officials in each park take guidance from the president, the Secretary of the Interior, and environmental laws to form specific directions for how each park is to be managed. The Director of the National Park Service has the authority to create NPS-wide policies that affect all parks and historical sites, and the superintendent of each park has the authority to create park-specific policies. The director works with his chief of staff and the Office of the Controller to manage the National Park Service as a whole. The director has two deputy directors to implement NPS-wide policies. The Deputy Director of Congressional and External Affairs works with Congress and handles communication with the public. The Deputy Director of Operations works with the six regional directors to oversee park management for all the parks within their region. The superintendents of each park work under the regional directors to manage day-to-day functions and park-wide management schemes. Congress and the Secretary of Interior may also create policies they deem necessary for the NPS.

The Superintendent of Yellowstone National Park makes day-to-day park policies with his discretionary authority. Under Title 36 in the Federal Code of Regulations, the superintendent has the authority to implement special designations, closures, use of limits, permit requirements, and other restrictions. These policies may address commercial operations, boating, recreation, traffic safety, and fines. These policies can be found in Yellowstone National Park Superintendent’s Compendium. Because the superintendent has discretionary authority, these decisions are made only within the superintendent’s office.

For larger decisions that exceed the superintendent’s discretionary authority, the NPS hierarchy follows specific guidelines in the NPS Directives System. The Directives System includes instructions for NPS managers and staff to understand current NPS policies and how to carry them out. When Yellowstone officials propose a new park-specific policy, they create a justification statement that explains the subject and purpose of the desired new policy. Yellowstone officials conduct research on other policies and guidelines on the same subject to help the office create an outline and draft for the new policy. The draft is reviewed and edited, and once a final draft is created, it is submitted to the Office of Policy for approval. The Office of Policy sends the draft to the National Leadership Council, a representative body of managers from the NPS, who will review it and add their comments. The originating office has the opportunity to address the comments that were made, and after doing so, the National Leadership Council will look at it another time to see if the concerns that they had were addressed. If there are no major details that need to be addressed, the final document is sent to the director for approval. If the director approves the document, a new policy is created.

---

74 Ibid.
CONTRADICTORY MANAGEMENT STRATEGIES OVER TIME

After assuming control from the Army in 1918, the NPS was forced to address many of the Army’s lingering problems. The NPS employed several types of management strategies during the mid-twentieth century that were meant to control the wolf, bear, elk, and bison populations. These management policies changed drastically several times because of the public's values and perceptions of Yellowstone shifted. Each policy change altered the wildlife and ecosystem of the park. Many of these policy changes illustrate how NPS managers respond to contemporary scientific understanding and political preferences.

Some recent policy changes have been positive in the sense that they more accurately reflect historical management under Native Americans. The policy change from fire suppression to let-it-burn improved forest health because Yellowstone’s forests have evolved to be dependent on natural and man-made fires. Other policy changes, however, have not been as positive. Removing non-native species is expensive and nearly impossible in many cases. Some tactics for removing non-native species have been cost effective, but others have not been cost effective or effective at removing non-native species.

The Organic Act’s conflicting mandates for recreation and conservation have allowed NPS managers to implement contradictory management practices. The NPS has simultaneously had management strategies that promote conservation or recreation, but these policies have not necessarily aligned with one another. Some policies have promoted conservation of certain aspects of the park, while at the same time promoting recreation at the expense of conservation in other ways. Over time, as public and political preferences have changed, many conservation-based policies switched to recreation-based policies and vice versa. This section describes some of these policy changes as the NPS has responded to changing public pressures.

FIRE MANAGEMENT

Since the late 1800s, the army and the National Park Service actively suppressed fires because they thought fire was harmful to park resources. Park managers failed to recognize the ecological importance of fire in Yellowstone’s ecosystem. Park managers faced public pressure to suppress fires because tourists did not want to go into a burnt or burning park. Fire suppression altered the historical fire regimes that supported Yellowstone’s ecological health. The suppression policy culminated in the massive 1988 fires that burned one third of the park.

Native Americans, early explorers, and even some foresters for the U.S. Forest Service recognized the ecological importance of human-induced fires. As early as the 1910s, the Forest Service experimented with fire management by allowing some fires to burn in the West. Political pressures made this management practice unviable in most locations, especially national parks.75

The practice of using small fires to burn limited areas (referred to here as light burning) was cynically referred to as “Paiute Forestry” after the Paiute Indians who practiced light burning regularly. Many foresters subsequently viewed light burning as a primitive management technique. Of the foresters who did actively practice light burning, some were unable to control their prescribed burns, which threatened the lives and property of those living nearby. Foresters argued extensively through the 1950s regarding the benefits and drawbacks of light burning. The Forest Service enacted an immediate fire-suppression policy in 1935, called the “10 AM policy,” that required Forest Service fire managers to suppress known fires by 10 AM the next day. Other land management agencies, including the NPS, adopted this

mindset. A 1957 Supreme Court ruling held government officials liable for damages caused by prescribed burning, which also kept light burning from widespread use. 76

Federal land managers also suppressed fires to please the general public. NPS managers in particular were focused on keeping fire out of the parks to encourage tourism because they feared many tourists would be less willing to visit a park that had recently burned. From 1872 to 1972, the U.S. Army and NPS tried to completely suppress all fires in Yellowstone. 77 According to the NPS, many ecologists and foresters recognized the importance of fire in certain ecosystems as early as the 1940s. Park managers, however, tried to suppress natural fires in Yellowstone until 1972 because the general public viewed fires as dangerous and damaging. 78

In 1972, fire managers began allowing natural fires to burn two areas of the park, Mirror Plateau and Two Ocean Plateau. The 1970s and 1980s were wetter than average, making them optimal years to control wildfires, but natural fires burned very little land area. 79 In early 1988, Yellowstone’s fire managers were in the final stages of approving a new fire plan that would allow more natural fires in the park, as well as prescribed burns. Later that year, one third of the park, totaling 793,880 acres, burned in some of the largest fires in U.S. history. Park officials suspended the proposed fire plan. After a policy review team made safety recommendations, a new fire plan was enacted in 1992 that included a “let-it-burn” policy, allowing more natural fires to burn, as well as permitting some prescribed burns. 80 81

Yellowstone is prone to large fires because of the region’s topography and climate. Although the 1988 fires were exacerbated by past fire suppression, large fires occasionally occur in Yellowstone. Small fires have occurred regularly in Yellowstone for thousands of years, and were vital in shaping the Yellowstone ecosystem. Small fires reduce accumulations of flammable materials, including fallen trees. Small fires also create natural fire-breaks of burned land that prevent fire from spreading, thus reducing the risk of catastrophic fires. Douglas B. Houston, a research biologist with the NPS, suggested that much of the area in Yellowstone would have burned at least one to four times since the park’s establishment if it were not for the actions of modern man. Houston’s study reconstructed the frequency and size of fires for the past 300-400 years in northern Yellowstone and found that fires historically burned most areas every 20-25 years. 82 This estimate suggests that Yellowstone’s management over the twentieth century did not reflect its historical fire regime.

---

Photo 2. 1988 Fires in Yellowstone approaching Old Faithful Photo Shop and Snow Lodge. The 1988 fires in Yellowstone burned 36 percent of park acreage or 793,880 acres.

Charles Kay is a Utah State University professor with specialization in wildlife ecology and range management. He noted that lightning-caused fires burned very little of Yellowstone’s northern range, even 25 years after enactment of Yellowstone’s “let-it-burn” policy. The northern range of Yellowstone is depicted in Figure 1 below. Park Ecologist Don Despain believes this is because lightning has not struck the northern range. The Bureau of Land Management’s Automatic Lightning Strike Detection System contradicts Despain’s claim. The detection system shows that lightning strikes the northern range four times per square-kilometer per year, on average. Most lightning strikes fail to ignite wildfires because the majority of lightning strikes occur when vegetation is too wet to carry a fire. The 20-25 year fire frequency is likely the result of aboriginal burning, rather than lightning ignitions. Natives likely ignited fires intentionally to burn an enemy tribe’s territory or to clear the landscape for better hunting and defense.

Yellowstone’s northern range consists of the lower valleys and grasslands near the Lamar River and the Yellowstone River. Altering the historical fire regime of Yellowstone has changed wildlife populations and the ecology of the park. At its simplest form, large fires like the 1988 fire displace wildlife from native habitats. The moose population on the northern range declined substantially after the 1988 fire burned much of its high-elevation winter habitat. Wildfires often disrupt the interactions between predators and prey in a stream ecosystem by changing light levels, nutrient concentrations, and hydrology. When forest canopies are burned in wildfires, more light reaches streams, creating a larger quantity of plants and algae. This increase in plant life can substantially alter entire aquatic ecosystems, causing some animal populations to spike and others to plummet. Water levels can also change rapidly if vegetation along stream banks is altered, creating even more changes in aquatic ecosystems. As with any change in ecology, these effects are never confined solely to one community of organisms. Large fires can have direct impacts on a select few populations, and these population changes can dramatically alter entire ecosystems.

The NPS now acknowledges the importance of fires in the Yellowstone ecosystem. The 2014 Yellowstone Fire Management Plan is the most recent fire management policy, providing park managers with directives to manage fires for resource benefits while minimizing risk to humans and property. According to the Yellowstone Fire Management Plan, the NPS will allow at least 70 percent of naturally started wildfires to burn, potentially reducing hazardous fuel accumulations. Current wildfire management allows lightning-ignited fires to burn, but all human-caused wildfires are suppressed. The current fire management plan does not completely reflect the historical burning of Yellowstone by Native Americans, but allowing natural fires to burn more closely reflects Yellowstone’s historical fire regime.

Yellowstone’s fire managers are divided into the Protection Fire Management Unit, the Ecological Fire Management Unit (FMU), and a Fuels Interdisciplinary Team (IDT). The Protection FMU suppresses all fires within a quarter mile of developed areas to protect visitors and human developments. The Ecological FMU focuses on monitoring and managing lightning-caused ignitions away from human developments for ecological benefits. The IDT uses prescribed fires to

---

treat hazardous fuel buildup when the weather allows. The IDT uses a Fire Management Plan and prescribed burn plan in conjunction with a “go/no-go” checklist when managing fuel buildup through prescribed burns. The IDT often uses mechanical treatment to remove fuel buildup, burning the piles of removed fuel with prescribed fires. If Yellowstone managers truly want to return Yellowstone to its pre-European state, then lightning-ignited fires will remain insufficient. Yellowstone’s native hunters-gatherers actively set fires in Yellowstone, which helped reduce fuel buildup. Yellowstone cannot be returned to its true pre-European state as long as human-induced fires are limited. Small fires will help mitigate the risk of another disaster like 1988 and more accurately reflect the historical state of Yellowstone. Human-caused fires are politically unviable due to the wilderness myths that surround the park, meaning that the public’s preferences will have to change before managers could attempt to more actively prescribe burns.

ELK MANAGEMENT

In the late 1910s, the NPS adopted a program of trapping live elk and transporting them out of the park to avoid overgrazing on Yellowstone’s northern range. The NPS had two main concerns regarding elk management. First, when elk populations grew too quickly, food supplies became depleted. Second, overgrazing by elk populations could reduce food supply for other species in the ecosystem. The NPS enlarged the elk relocation program during the 1930s, eventually removing almost 58,000 elk from the park between 1935 and 1961. NPS rangers soon realized that trapping alone was not enough to control elk populations in the park. As a result, in 1949, live trapping operations were augmented with the euthanasia of excess numbers of elk. The NPS established population quotas for elk, using livestock management formulas, and the excess animals were “culled” (killed to reduce a population). Between the inception of elk culling in 1949 and its end in 1968, rangers in Yellowstone killed more than 13,500 elk.

Mass media, including television and newspapers, reported on the park rangers killing elk in Yellowstone. The combination of mass media and the environmental movement sparked public outcry against the culling of elk, creating a public relations nightmare for Yellowstone’s managers. In addition to the general public, sports hunters aggressively attacked the policy of culling excess elk because the hunters wanted to kill the elk themselves. These public pressures prompted a Senate hearing in 1967. In the hearing, the director of the NPS and Secretary of Interior agreed to stop the direct reduction of elk in Yellowstone. Later that year, the NPS completely reversed policies from active elk population management to hands-off population management. Political pressures were the main driver of the policy reversal in the 1960s. After the policy shift, elk populations grew rapidly, altering the composition of Yellowstone’s ecology.

---

BEAR MANAGEMENT

Prior to 1970, the NPS did not have specific bear management policies in Yellowstone. Many visitors were drawn to Yellowstone because they wanted close encounters with bears. Many bears became dependent on humans for food because they received food directly from park visitors and from trash bins throughout the park. Bear behavior changed as the animals became more comfortable around humans. The NPS allowed animal behaviors to change from their natural state to become dependent on humans supplying food. The environmental movement of the 1960s drew concern for the unnatural diet of Yellowstone’s bear populations. Yellowstone’s bear populations also injured and killed many visitors, creating more incentive to change bear management policies.

In 1970, the NPS adopted a new management plan for the park’s bear population. The policy prohibited feeding the bears and mandated proper storage of food and eliminated the open dumps within the park. These provisions were originally intended to reduce human interaction with black bears. In 1983, Yellowstone created a new grizzly bear management program that focused on establishing and maintaining habitat in remote locations.

Photo Set 1. Bear Feeding in Yellowstone. Prior to 1960, the NPS allowed tourists to feed bears from their cars and at garbage dumps within the park.
In 1975, Congress listed the grizzly bear as threatened under the Endangered Species Act. Estimates of the grizzly bear population fell from more than 50 thousand in 1800 to fewer than 1,000 in 1975.\textsuperscript{106} An estimated 200-300 grizzlies resided in Yellowstone in 1975, encompassing a large fraction of the thousand grizzlies that were living in the United States.\textsuperscript{107, 108} The NPS created bear management areas within the park where grizzly bears were known to congregate and isolated many of those areas from tourists to reduce human-caused bear displacement.\textsuperscript{109} By doing so, the NPS limited the public’s interactions with bears. Many of the park’s most popular tourist areas are near grizzly bear habitat, which makes interactions between humans and bears difficult to avoid.

The history of bear management in Yellowstone shows how NPS management has changed over time due to changing preferences. Human interaction with bears was unrestricted in Yellowstone to promote the recreation requirement of the Organic Act. The NPS then changed their management policy to try to treat bears as wildlife, rather than objects for recreation. Another objective was to reduce visitor injuries by reducing human interactions that changed bear behavior. This change in management policy further illustrates the contradictory nature of the Organic Act, which allows park managers to complete reverse management styles.

**FISH MANAGEMENT**

The NPS focused on providing recreational fishing opportunities for the public at the expense of preserving native species in the early days of park management. Today, Yellowstone’s water ecosystems are largely dominated by invasive species (aggressive non-native species that displace native species), including lake, brook, brown, and rainbow

trout. Yellowstone managers intentionally stocked many of these species until the 1950s. The U.S. Fish Commission, predecessor of today’s U.S. Fish and Wildlife Service, added lake trout to Yellowstone’s Lewis Lake and Shoshone Lake in the 1890s. Lake trout were likely moved into Yellowstone Lake by park tourists. Because lake trout prey on native cutthroat trout, the native populations have been decimated. Westslope cutthroat trout of the Madison River in Yellowstone have been completely eliminated by invasive species, and Yellowstone cutthroat trout are heading towards a similar fate.

Early park managers believed the best way to manage Yellowstone was to make it more appealing to the general public. Managers tried to create a better park experience for visitors by stocking Yellowstone’s waterways with popular fish. Early park managers did not recognize the ecological consequences of introducing non-native species to Yellowstone. Introducing lake trout, among other species, has unintentionally altered the Yellowstone ecosystem.

The NPS acknowledges that invasive trout populations harm other animals in the food chain. Many predators of cutthroat trout, including grizzly bears, bald eagles, and river otters, are dependent on these fish for survival. Lake trout live and spawn deeper beneath the water’s surface than cutthroats, making it more difficult for fish-dependent species to eat. The combined effect of lake trout preying on cutthroat and living deeper beneath the surface allows lake trout populations to increase while cutthroat populations plummet.

Although many animals depend on cutthroat trout, river otters are one of the most affected by the decline in cutthroat populations. By examining river otter scats, researchers at the University of Wyoming found that cutthroat trout are the most common prey and that river otters are unlikely to use lake trout as an alternative to cutthroat trout. River otters are ecologically important because they transport nitrogen and other nutrients from aquatic ecosystems to fertilize terrestrial vegetation. This nutrient cycling shapes the prevalence and growth of riparian (riverside) plants. With diminished cutthroat trout populations, river otters may not be able to fill their ecological role.

Bears appear to be more capable of adapting to a decline in cutthroat populations. Although bears in Yellowstone historically preyed heavily on cutthroat trout, they are now turning to alternate food sources because of the decline in cutthroat. Grizzly and black bears killed about 12 percent of elk calves in northern Yellowstone annually in the late 1980s, but by the mid-2000s, bears killed about 41 percent of calves. This shift suggests that bears are replacing much of their fish-based diet with elk and other food sources.

Despite initially introducing these invasive species, the NPS is now trying to remove non-native species. Beginning with the environmental movement of the 1960s, NPS management across the country has focused on returning parks to a pre-European state. Earlier public preferences focused on fish that were more enjoyable to catch, but the NPS has changed policies to reflect the public’s demand for Yellowstone’s “original” state.

111Ibid. pp. 269.
The NPS has contracted with commercial fishing companies to trap invasive lake trout in Yellowstone Lake. The NPS also encourages anglers to kill as many lake trout as possible from Yellowstone Lake and its tributaries. Between private anglers and contracted fishing companies, over 1.7 million lake trout have been removed from Yellowstone Lake since 1994 when this invasive species was first sighted there. Of all lake trout that have been taken from Yellowstone Lake, commercial contractors have eliminated about 90 percent while private anglers have removed the rest.117

The non-native fish species may never be completely eradicated from the park for two main reasons. First, the park contains many large lakes and rivers, making it nearly impossible to locate all non-native fish. Second, the park contains millions of native and non-native fish in its waterways, which makes complete eradication prohibitively costly. Managing non-native species that have already been introduced, as well as preventing more introductions, are the most realistic options for NPS officials to consider. Allowing park visitors to catch and kill invasive fish species is an inexpensive way to limit invasive populations. Contracting with commercial fishing companies, however, is a costly and time-consuming process. Non-native fish management will likely continue indefinitely, unless NPS officials find a politically viable reason to stop managing non-native fish.

WOLF MANAGEMENT

Wolf management in Yellowstone made a complete policy reversal over the course of the twentieth century. NPS officials actively sought to exterminate wolves from the park up until the 1950s, but decades later, NPS officials changed their original management plan by reintroducing wolves to the park.

Early park managers thought that wolves contributed to the “wanton destruction” of animals, which they interpreted as a violation of the Organic Act. In the early twentieth century park visitors generally viewed wolves as dangerous and undesirable. Starting in 1914, the army began to kill wolves in Yellowstone to protect other animals.118 By the mid-1920s, the NPS had killed an estimated 136 gray wolves, and by the 1940s, all resident wolf packs were eliminated.119 After decades without wolves in the park, FWS officials, working with the NPS, reintroduced wolves to Yellowstone in 1995. They used the Endangered Species Act (ESA) and new public perceptions favoring wolves as their justification.120

Later in this report, the sections “Loss of Riparian Habitat” and “Addressing the Elk Problem” explore wolf reintroduction in more depth.

PART II: NATURAL REGULATION MANAGEMENT

NATURAL REGULATION AND ITS UNINTENDED CONSEQUENCES

Part II analyzes and explains how natural regulation management has directly and indirectly affected the Yellowstone ecosystem. Natural regulation has been one of the most detrimental NPS policy shifts because the NPS switched from active management of wildlife populations to a hands-off management philosophy. The NPS has recently renamed natural regulation “ecological process management,” but the philosophy is essentially the same. Natural regulation

---

has led to cascading effects through Yellowstone’s ecology that has reduced biodiversity and limited the productivity of rangeland and riparian habitats.

Making firm causal arguments about ecological changes is difficult because more than one force can affect ecosystems. Many factors contribute to Yellowstone’s ecological changes, including climate change and human development, but by using historical accounts, repeat photography, and logic, we can reasonably infer that one of the largest drivers of ecosystem change is park management.

Natural regulation does not reflect the effect that humans have had in Yellowstone for thousands of years. Hands-off management has caused environmental degradation in Yellowstone’s rangeland and riparian habitats, which contradicts both the conservation and recreation provisions of the Organic Act. Hands-off management is not necessarily inferior to active management, but complete hands-off management does not reflect the historical influence that humans had on the Yellowstone ecosystem. Natural regulation generally calls for hands-off management, but the NPS contradicts this philosophy when it actively manages more controversial aspects of the park. Creating preferred outcomes in Yellowstone will require a more strategic mix of active and passive management, depending on the political context of what Yellowstone should be.

WHAT IS NATURAL REGULATION?

Natural regulation, also known as ecological process management, is the NPS’s current hands-off management policy regarding wildlife. Natural regulation is radically different than the NPS’s active management of wildlife populations. In the late 1960s, the NPS changed to from active management to hands-off, asserting that passive management would return Yellowstone to pre-European conditions. The logic behind this management technique is faulty as it fails to consider the role Native Americans had on managing the Greater Yellowstone Ecosystem.

Charles Kay of Utah State University argues:

“Native Americans structured entire plant and animal communities. Because ecosystems with native peoples are entirely different than those lacking aboriginal populations, a ‘hands-off’ or ‘natural regulation’ approach by today’s land managers will not duplicate the ecological conditions under which those ecosystems developed.”

ORIGINS OF NATURAL REGULATION

Before 1968, the NPS recognized that Yellowstone was not a historical elk wintering area. Park managers believed that European settlement forced elk to winter in the park, which helped Yellowstone’s northern elk herd to grow to 35,000 animals in 1914. NPS officials realized that an unnaturally large elk population was damaging Yellowstone’s northern range, changing plant species composition, and allowing for soil erosion. From 1918 until the late 1960s, the NPS killed and relocated large numbers of elk as a form of active management. An aerial census of the northern range only recorded 3,172 elk in the winter of 1967 and 1968.

---

Public outcry against rangers killing elk in the park prompted political support for a policy change. In 1968, a subcommittee to the Senate Appropriations Committee conducted a hearing on elk management in Yellowstone. During the hearing, the Director of the NPS, George Hartzog, stood by his agency’s position that an unnaturally large elk population was destroying the northern range, arguing that “direct control is an integral part of wildlife management in national parks, and may always be essential.” Besides Hartzog, three other NPS officials also advocated for the continuation of active wildlife population management: Dr. A. Starker Leopold (chairman of the Wildlife Management Advisory Board), John McLaughlin (Superintendent of Yellowstone National Park), and Bill Barmore (the NPS’s wildlife biologist). Other participants in the committee hearing, including hunting groups, state agencies, senators, and local residents pushed for an end to active population management.

The NPS received massive amounts of national attention for this hearing, with some coverage suggesting that the NPS would lose funding if officials did not end culling. One local resident who attended the hearing was concerned that it had been “hinted in some of the press releases about this meeting, that it may be one of threat and innuendo, and possible reduction in appropriations by Congress…” Following the hearing, in March 1967, Senator McGee announced that the Secretary of Interior and the Director of the NPS agreed to stop killing elk in the park.

On December 5, 1967, the NPS made a complete policy-reversal by issuing a statement claiming that “elk have lived in the Yellowstone region thousands of years before modern man arrived on the scene. The elk could not have persisted over this span of time if natural control processes had not existed to keep the animals in balance with their plant food sources.” Although "natural control processes" did regulate elk populations, the NPS failed to consider that natural control processes include the role of predators like wolves and Native Americans.

Two days later, the NPS released a statement entitled “Administrative Policy for the Management of Ungulates,” which initiated a new management style called natural control. This management strategy had the primary goal of providing Yellowstone visitors with an experience of “primitive” America. The statement defines primitive America as “having natural conditions where scenery and ‘balance of nature’ in ecosystems are not altered by man.” The park service’s “primitive” theory fails to consider that Europeans were not the first ones to shape America.

Natural control was the NPS’s first attempt at hands-off management in Yellowstone. Natural control theory asserted that predators would sufficiently control other animal populations without human intervention. In 1968, Yellowstone’s official park biologist Glen Cole asserted that “the combined action of native predators and weather should be relied upon to control elk which winter in the more remote interior of Yellowstone National Park.” In 1969, Cole also wrote that “original predator and scavenger population probably played an important role in reducing the extreme highs and lows in elk population fluctuations.” From late 1967 through 1970, the NPS continued to employ the hands-off management of natural control.
Beginning in 1970, the NPS changed from natural control management to natural regulation management. Natural regulation is contradictory to natural control because natural regulation assumes that predators were never the primary factor that limited ungulate populations. Natural control, a top-down approach to ecology, assumes that predators at the top of the food chain are the primary force that shaped population dynamics. Natural regulation, a bottom-up approach to ecology, states that ungulate populations are self-regulating. Cole, who had rejected natural control in favor of natural regulations, wrote, "Predation on either winter or newborn ungulates seemed a nonessential adjunct to the natural regulation process because it did not prevent population from being self-regulated by competition for food."\textsuperscript{131} Natural regulation theory asserted that the availability of food for ungulates was the main force that controlled their populations, not the presence of predators.

Over the past several decades, the term "natural regulation" has adopted several definitions. The original definition strictly referred to the hands-off management practice that asserted that food availability, not predation, was the main control for ungulate populations. Now, natural regulation has more commonly come to mean any management practice that does not involve direct manipulation by humans, regardless of the top-down or bottom-up view of population dynamics. In this report, we refer to natural regulation with the wider definition of general hands-off management.

Political pressures and the growing science of population ecology drove the switch from active management to natural control, and then from natural control to natural regulation.\textsuperscript{132} The NPS never released any data supporting natural regulation, but population ecologists including David Lack, author of The Natural Regulation of Animal Numbers, wrote extensively about density dependent regulation in the 1950s and 1960s.\textsuperscript{133} Density dependent regulation claims that elk and other wildlife populations will naturally find an equilibrium because, as populations increase, food supply and predation will naturally control the population.

In 1963, the National Park System Advisory board and its Science Committee issued the Leopold Report as a response to early public pressure to stop killing elk in Yellowstone.\textsuperscript{134} The Leopold Report set the primary goal of park management to maintain the biotic associations within the park, encouraging natural predation as the primary method of controlling animal populations.\textsuperscript{135} Although the Leopold Report encouraged some degree of passive management of animal populations, the report clearly states that "Where other methods of control are inapplicable or impractical, excess park ungulates must be removed by killing."\textsuperscript{136}

The rise of population ecology gave the NPS a politically viable way to change management philosophies. Although there is little, if any, evidence that the NPS was considering natural regulation prior to the 1967 elk controversy, public outrage over direct reduction forced the NPS to consider different wildlife management techniques. Natural regulation gave the NPS a justification for ending proactive wildlife management to please the general public. The NPS was given an opportunity to begin a new period of experimental management. Yellowstone’s current range deterioration is evidence that experimental management was unsuccessful. Yellowstone’s elk and bison populations need more than just density dependent control mechanisms to adequately control their populations.

\textsuperscript{131} Ibid, pp. 10-15.
\textsuperscript{132} Huff, D., Varley, J. (February 1999). Natural Regulation in Yellowstone National Park’s Northern Range. Ecological Society of America (ESA).
OVERPOPULATION OF ELK & BISON

Natural regulation has led to an overpopulation of elk and bison in Yellowstone. These large populations overgraze rangeland in the park, and subsequently kill aspen and willow trees to meet their dietary needs. The NPS recognizes that elk and bison populations grow too large at times. Some NPS estimates assert that an elk population of around 5,000 on the northern range will not degrade the land. Historical evidence, however, suggests that even 5,000 elk might be more than have historically lived in the area.

Archaeological remains in Yellowstone show that elk were not historically abundant in Yellowstone. After his first visit to Yellowstone, Philetus Norris, the second superintendent of the park, reported in 1880 that “there were extensive networks of brush driveways, traps, and corrals throughout the park.” These are all methods Native Americans used to trap big horn sheep, antelope, deer, and elk. The remnants of aboriginal hunting techniques, along with the at least 1,800 archaeological sites that have been found in Yellowstone, indicate that Native Americans did live and hunt in Yellowstone before European arrival. The NPS has historical evidence of Yellowstone’s early inhabitants from about 9,000 years ago. This evidence suggests that Native Americans have lived in the Yellowstone area for at least several thousand years. Anthropological evidence suggests that Native American diets contained only small amounts of meat from elk and other ungulates, even though Native Americans had the capacity and willingness to hunt all ungulates. Archeological sites in and around Yellowstone contain relatively few elk remains, suggesting that elk were rare in the park for the past 10,000 years. If elk populations were as large as today, Native Americans would have likely consumed larger amounts of elk.

When Yellowstone was created in 1872, park managers protected desired animals like elk, bison, and deer by feeding them, while killing undesired animals like wolves and mountain lions that threatened livestock. Gray wolves played an important role in structuring the Yellowstone ecosystem. Wolves regulate the population of animals like elk, which, in turn, regulates the population of other animals, and the vegetation those animals feed on. Because wolves were considered undesirable during the park’s early history, they were exterminated in Yellowstone by the 1930s. Shortly after, the NPS believed elk and other ungulate populations were becoming overabundant. A larger elk population requires more food, which puts more demand on the rangeland they graze on. The NPS became concerned about range deterioration, which led them to begin trapping and relocating elk. When these techniques were not enough to prevent range deterioration, rangers began shooting elk directly in the park to thin the herd. This program was called “direct reduction,” and the park service shot over 13,500 elk on the northern range from 1949 to 1968. The park service then donated the elk meat from direct reduction to nearby Indian tribes.

Natural regulation philosophy asserts that even without an apex predator, wildlife will naturally regulate their populations by the availability of food. In practice, however, natural regulation has not worked because elk in Yellowstone have proved to be very capable of adapting to new food supplies. Although elk initially competed for food with other ungulates, elk turned to aspen trees when their traditional food supply became limited. Aspens are a

---


primary food source for beavers and other animals that were once plentiful in the park, but have since been outcompeted by overgrazing elk. Elk have adapted to new food supplies while beavers are ecologically extinct within much of the park.

High lined trees are those that show evidence of grazing at the base of the tree, within reach of elk or other ungulates. The presence of high lined trees in Yellowstone, as depicted in Photo 3, suggests that elk are turning to new food sources over their traditional grasses and small plants. Many NPS officials are still claiming that Yellowstone could hold more elk and bison, but larger elk and bison populations come at the expense of healthier, more productive grassland and riparian habitats.

*Photo 3. Example of high lining by elk, near Floating Island Lake.*

The vegetation near Floating Island Lake shows evidence of high lining. This spruce tree is generally not a preferred food source for elk, but the bottom branches of the tree have been grazed by elk. High lining is evidence that there are not sufficient preferred food sources for elk, so they resort to eating food sources that they normally would not.

In addition to adapting to new food sources, Yellowstone’s elk are able to feed at the nearby National Elk Refuge in Jackson, Wyoming. The National Elk Refuge is managed by the U.S. Fish & Wildlife Service (FWS). The FWS supplies hay bales to elk in large enclosed fields during the winter months, giving some of Yellowstone’s elk herds yet another way to grow larger. When the NPS was performing direct reductions, the agency directly contradicted the management

---

144 Lofthouse, J. (2015). *Example of high lining by elk, near Floating Island Lake.* *Strata Policy*


objectives of the FWS, which was trying to bolster the area’s elk population. After direct reductions stopped, the elk population was able to grow because few predators were left to control the population.

A DETERIORATING RANGE

As elk and bison populations grew over the later twentieth century, overgrazing became a more pressing problem. Overgrazing native plant species generally lowers productivity, reduces the number of palatable native plants, and makes it easier for non-native species to replace natives. In general, rangeland dominated by native plants is a more productive and diverse plant community. A key component of range productivity is composition of litter, with high levels of unprocessed litter (fallen grasses) being preferable to high levels of processed litter (animal scat). Healthy soils require nutrients to be returned through plant litter. Overgrazing decreases unprocessed plant litter and replaces it with processed animal litter. Further, plant litter helps to protect the soil surface from erosion and modifies the soil’s surface environment by changing rates of evapotranspiration and temperature. 147

The productivity of a range site is often evaluated in terms of pounds per acre of forage. Many of the range sites in Yellowstone’s Gardiner Basin are capable of high levels of productivity: 1,000 pounds per acre (lbs/acre) under the plant community that existed at the time of European exploration. Instead, many range sites today have productivity levels of less than 500 lbs/acre. 148 Overgrazing is subjective, and determining whether this low productivity is caused by overgrazing is difficult. A natural rangeland used by wildlife will not have as high productivity as a commercial rangeland. Although Yellowstone’s northern range is not devoid of grasses altogether, ungulates have also overgrazed willows and aspens on the northern range, which are less preferred to other grasses and shrubs. The decline of these less-preferred food sources indicates that the range is overgrazed to a degree. The severity of overgrazing varies heavily throughout the park, but there are too many grazers for the northern range which is forcing wildlife to rely on alternative forage sources like aspens and willows.

In 1963, Yellowstone National Park underwent a range inventory by the Soil Conservation Services, precursor to today’s Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture. In this range inventory, government scientists determined how many animals could live on the northern range using a measurement called animal unit months (AUMs). AUMs measure how many animals can graze on a given area of land for a month. One AUM is roughly the equivalent of the forage necessary to feed a single thousand-pound cow and its calf for a month. In 1963, there were 350 bison and 5,000 elk on Yellowstone’s northern range. With adjustments for the amount of land available at any one time to the animals given snowfall and other climate variables, the Soil Conservation Services estimated that the total carrying capacity of the northern range was approximately 25-30 thousand AUMs. Today’s elk and bison populations in Yellowstone are substantially larger than they were in 1963, with an estimated 4,000 elk and 5,000 bison using the northern range in the winter. The AUM necessary to support today’s populations, as well as other grazing animals in the park, is in excess of 80 thousand AUMs—more than double the 25-30 thousand AUMs estimated in the 1960s. 149

---

149 Ibid.
Photo 4. NPS signs near the North Entrance explaining the health of the northern range. This official NPS sign says,

“It is because of this dry and ‘beaten’ appearance that many people have questioned the health of the northern range. Some wonder if the sheer number of Yellowstone’s elk, deer, pronghorn, and other wild grazers are destroying the habitat. Many years of research on the interaction of wildlife and plants here show that these naturally dry grasslands remain productive and healthy. Wildlife continues to depend on the northern range for winter forage, maintaining a cycle of growth, grazing, and rebirth that have occurred here for thousands of years.”

The sign is misleading for several reasons. First, the grasslands of the northern range are generally semi-arid, so they do appear dry and beaten, but the large number of ungulates on the northern range has clearly decreased the productivity and health of the northern range from its historical conditions by any measure of range health. The health of the rangeland may still be sufficient to support the populations of ungulates currently, but the productivity and health of comparable rangelands just outside the park borders are often higher than the rangelands within the park borders. Second, wildlife depends on the northern range for winter forage and has depended on the northern range for thousands of years, but the northern range has not historically experienced such heavy grazing from so many ungulates. The ungulate population for the past several thousand years has been much smaller due to Native American hunting and other predation. The current productivity of the northern range within the park is much lower than it has historically been.

This official NPS sign says, “Northern Yellowstone sustains one of the largest and most diverse populations of free-roaming wildlife seen anywhere on earth. It is often called ‘America’s Serengeti.’ About half of the approximately 30,000 elk that summer in the park spend the winter here on the northern range.” This sign is technically correct because the northern range has such a large and diverse population of ungulates. The sign, however, does not express the fact that Yellowstone has not historically been so populated with large animals. Large ungulate populations in Yellowstone only occurred after European-Americans began settling around Yellowstone and displacing Native American’s who hunted there.

Photo 6 below shows the difference between a grazed range and an exclosure in Gardiner that contains rangeland untouched by most wildlife since 1957. Exclosures were built by the NPS as early as the 1950s to study the effects of grazing on rangeland. Exclosures are designed to keep wildlife out so researchers can compare range conditions throughout the park with rangeland not subject to grazing pressure. Exclosures are not necessarily representative of the natural ecosystem because they completely exclude wildlife. The exclosures demonstrate healthy and productive rangeland nonetheless. If ungulates continue to graze freely without adequate population control, many parts of the Yellowstone ecosystem may change from a forest ecosystem to a grassland. Elk and bison in Yellowstone have grazed the rangeland extensively, most notably damaging aspens and willows.

---

Photo 6. Exclosure near North Entrance that shows difference in rangeland quality. This photo, taken near the Gardiner Cemetery, shows the differences in vegetation due to the fenced exclosure. The NPS began constructing exclosures to study the difference between rangeland quality without the presence of grazers. The fence of the exclosure can be seen running diagonally near the center of the photo. To the right of the fence, the exclosure contains a more productive parcel of rangeland with taller grass and sagebrush. In the foreground and to the left of the fence, there is very little sagebrush and less dense grass. The rangeland exclosures in northern Yellowstone are evidence of ungulate overgrazing.

THE DECLINE OF ASPEN AND WILLOW

Overgrazing has lowered the productivity of Yellowstone's rangeland, and elk have been unable to meet their dietary needs with grasses alone. Elk have resorted to eating some plants that are generally considered unpalatable, such as conifers, aspens, and willows. Elk overgrazing has reduced aspen cover throughout the park.

Aspens reproduce both asexually and sexually. Aspens reproduce asexually far more often than they do sexually, regenerating new trees through offshoots called suckers to create genetically-identical trees. In rare circumstances, such as after severe fires and the certain climatic conditions, aspens reproduce sexually. In about the last hundred

---

years, stands of aspens in Yellowstone have not successfully regenerated asexually because new aspen stems are repeatedly browsed by elk.\textsuperscript{158} Because elk are grazing new aspens soon after they begin to grow, stands of aspens in Yellowstone have struggled to produce suckers larger than two meters tall. Aspen suckers are found throughout the park, indicating that the aspen population is trying to regenerate, but the large elk population grazes nearly all aspens before they reach maturity.\textsuperscript{159} Aspens are an important component of the Yellowstone ecosystem because they provide cover for other plants to grow, slowly turning grasslands and riparian areas into forests.

\textit{Photo Set 7. Aspens in Junction Butte Exclosure.} The photos below show an exclosure of aspens near Junction Butte, which is located near the Tower-Roosevelt Junction in northeastern Yellowstone. The exclosure was established in 1962.\textsuperscript{161} The first three photos were taken in August 2015, and the last photo was taken in November 2015. The first photo shows the fenceline of the Junction Butte Exclosure. To the right of the fence is a dense aspen grove that ungulates have not been able to graze. To the left of the fence is a grassland where aspens cannot regenerate because they are quickly grazed by ungulates.

\begin{figure}[h]
  \centering
  \includegraphics[width=\textwidth]{jasper_01.jpg}
  \caption{Aspens in Junction Butte Exclosure.}
  \end{figure}

The photo below shows the Junction Butte Exclosure in relation to its surroundings. All of the aspens visible are completely within the protection of the exclosure. The surrounding grassland has been heavily grazed by ungulates.

The photo below shows the density of the vegetation within the Junction Butte Exclosure. Contrast the density of the aspen grove with the sparse vegetation outside the exclosure, as seen in the photo above.
The photo below shows Dr. Charles Kay at the Junction Butte Exclosure in November 2015. The fence is clearly visible with a dense aspen grove within the exclosure. The outside of the exclosure has no aspen regrowth, despite the fact that aspens can regenerate by sending suckers under the fence line.
Photo Set 8. Repeat Photography of Aspen Stands at Junction Butte Exclosure in Yellowstone.\textsuperscript{162} In the two photos below, you can see the same view of the fence at the Junction Butte Exclosure taken 24 years apart. The NPS took the first photo in September 1962. Dr. Charles Kay took the second photo from the same viewpoint in July 1986. The same boulder sits at the left side of both photos. In the first photo, four mature aspens are visible to the left (outside) of the exclosure fence. By 1986, the four mature aspens outside the exclosure had died off, but a mature aspen stand has grown inside the exclosure.\textsuperscript{163}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{image1}
\caption{Photo of Junction Butte Exclosure in 1962.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{image2}
\caption{Photo of Junction Butte Exclosure in 1986.}
\end{figure}


35
Photo Set 9. Repeat Photos of Aspens inside Junction Butte Exclosure in Yellowstone.\textsuperscript{164} This photo set shows the interior of the Junction Butte Exclosure in 1962 (top) and 1986 (bottom) taken from the same vantage point. When the exclosure was first built in 1962, the aspens were small. Without grazing pressures, the aspens had grown large and dense by 1986.\textsuperscript{165}
Photo Set 10. Repeat Photos of Porcupine Creek Exclosure in Gallatin National Forest. Just outside the North Entrance of Yellowstone, the U.S. Forest Service built an exclosure similar to the NPS’s exclosures. Porcupine Creek Exclosure faces many of the same grazing pressure as the exclosures within the park. The Porcupine Creek Exclosure was built in 1945, and the top photo here was taken in 1946. The fence was built through a single aspen clone. The interior of the exclosure is on the left while the exterior is on the right. The middle photo was taken by James Peek in 1963 from a similar vantage point and shows that willows had grown inside the exclosure. The aspens do not appear much different in the 1963 photo. Dr. Charles Kay took the bottom photo in 1987. The bottom photo shows that aspens inside the exclosure had grown much larger. Aspens had replaced sagebrush and grass on the interior of the exclosure. These repeat photos show the damage that extensive grazing can lead to.

166 Ibid.
167 Ibid.
In addition to aspen decline, elk overgrazing has led to the decline of willow communities on Yellowstone’s northern range. Willows, like aspens, can reproduce both asexually and sexually. 168 Yellowstone’s willows have struggled to reproduce asexually because new willows are repeatedly browsed by elk. Willows’ flowers and seeds grow most commonly on the previous year’s growth. When elk eat the newest growth, willows are not able to produce flowers and seeds as effectively. When willows are grazed, they also allocate their energy to regrowth instead of reproduction. These factors combine to make sexual reproduction difficult in situations of overgrazing. 169 Limited sexual reproduction stunts genetic diversity, which is important because it makes a species more resilient to changes in the ecosystem. For example, if all the willows in Yellowstone were genetically identical and drought intolerant, a dry year might kill many of the willows. Because of genetic diversity, however, only the drought intolerant willows would die and those better suited to dry conditions would continue to survive and reproduce, passing on their drought-tolerance genetics. If all trees are genetically identical, an ecological change has the potential to destroy a large segment of the population.

The NPS established exclosures outside Mammoth, Junction Butte, Lamar-East and Lamar-West in the 1950s and 1960s to study willows that were not subject to grazing pressure. In the 1990s, Charles Kay and Steve Chadde of Earthworks Environmental Research found that willows in these exclosures produced 307,000 seeds per square meter of female canopy cover on average, while plants outside of exclosures produced no seeds at all. Elk also apply grazing pressure to the few seedlings that do manage to start, making it extremely difficult for any willow communities to grow substantially.170

The decline of willows in Yellowstone has adverse effects on birds, small mammals, and grizzly bears, among other species. Willows only grow along the sides of waterways and are vital components of riparian ecosystems. Willows prevent erosion, enhance sediment deposition during floods, maintain stream water quality, and provide habitat for a number of other animals.171, 172 They are critical sources of diversity in the West where riparian areas make up less than 0.5 percent of the total land area, but provide habitat for large numbers of birds and other wildlife.173

170 Ibid.
Photo Set 11. Willows in Junction Butte Exclosure. The two photos below show the portion of the Junction Butte Exclosure where willows are growing. Willows grow densely inside the fenced exclosure, but they cannot regenerate outside the exclosure due to grazing pressures from elk and bison. The muddy area in the foreground is evidence of heavy ungulate traffic.

Natural regulation philosophy has led to overgrazing and a subsequent loss of aspens and willows in Yellowstone. Without considering historical populations of grazers, the NPS is allowing elk and bison populations to grow much

---

larger than they have historically been. Large populations of grazers might be able to survive in Yellowstone for decades or possibly even centuries, but at the expense of the historical Yellowstone landscapes. Park managers are allowing grazing animal populations to grow because of political incentives. In general, the public is more interested in seeing abundant wildlife than a healthy rangeland, and park managers are managing Yellowstone accordingly.

LOSS OF RIPARIAN HABITAT

As willows have been overgrazed, beaver populations have declined. Beavers were once plentiful in the park but are now considered ecologically extinct on the northern range. Several historical accounts from the early twentieth century describe large beaver populations in Yellowstone. A 1927 account stated “beavers occur in practically every stream and pond” and estimated about 10,000 beavers in the park during the early 1900s. In 1930, a park visitor claimed that “beavers are found along almost every stream,” but also noted that elk were grazing on the beavers’ food supply of young aspens and willows. In 1935, two park visitors concluded that beavers were “endangered through the destruction of aspen and willow on the over-browsed elk winter ranges.”

A widely-cited 1955 study by Robert Jonas found no beavers or any recent beaver activity on Yellowstone’s northern range. Jonas concluded that a lack of preferred food plants, poor water conditions, and natural sediment polluting beaver ponds led to the decline in beavers. He also concluded that the lack of food was a result of elk overpopulation more than anything else, noting that poor water conditions and siltation of beaver ponds were caused by overgrazing. In 1968, D. T. Patten of Arizona State University added more evidence that overgrazing was the fundamental problem when he found that willows on the Gallatin River only declined in places where wintering elk were most heavily concentrated.

Beavers are ecologically important because they improve riparian areas and shape their surrounding ecosystem. Willows provide necessary food and building material for beavers. Thus, overgrazing is a problem for the entire Greater Yellowstone Ecosystem. Beaver dams have historically formed and maintained Yellowstone’s floodplains, water table dynamics, and vegetation composition. Beavers cannot reassume their ecological niche while overgrazing still occurs. Beavers are often unable to find sufficient food or dam-building material without willows. Beavers cannot survive without willows, and willows are unlikely to reproduce without the raised water tables and deposition of sediment that beavers create.

The loss of willows and beavers in Yellowstone has substantially impacted the ecosystem as a whole by making it drier and less habitable. During dry periods, anywhere from 30 to 60 percent of the water in a stream system can be held in beaver ponds. Beavers can also increase the amount of riparian habitat in the northern Rockies from 2-4 acres.

176 Ibid.
to 24 acres of habitat per mile.\textsuperscript{183} Because beavers have such a profound effect on riparian ecosystems, the loss of beavers is shifting many ecosystems in Yellowstone from a beaver-willow ecosystem to an elk-grassland ecosystem.

Evan Wolf, David Cooper, and N. Hobbs of Colorado State University have studied the transition from Yellowstone’s beaver-willow state to the new elk-grassland state. Willow communities that once dominated Yellowstone’s northern range are now limited to small, isolated sections without beaver dams. The riparian woodlands that have likely existed for many millennia are now being replaced by grasslands, dramatically altering the Yellowstone ecosystem. Moreover, Wolf, Cooper, and Hobbs suggest that the new elk-grassland state may resist change back to the beaver-willow state even if browsing is reduced. The authors claim that hydrologic changes in stream networks are not rapidly reversed, especially in the absence of beavers.\textsuperscript{184}

The loss of the beaver-willow landscape has destroyed habitat for moose. On the northern range, moose generally feed on willow until snow forces them to higher elevations where they browse subalpine fir.\textsuperscript{185} The 1988 fires are typically blamed for the loss of moose habitat. The moose population in Yellowstone has declined precipitously as a result of the 1988 fires and the loss of beavers and willows.\textsuperscript{186}

\textsuperscript{183} Ibid.
Photo Set 12. Lamar Valley and Lamar River. The Lamar River on the northern range shows evidence that the riparian habitat has been destroyed by overgrazing. On the banks of the Lamar River and its tributaries, willows and aspens are virtually non-existent. Cottonwoods also show few signs of regrowth in the valley. The only cottonwoods in Lamar Valley are mature. A similar river at the same elevation and the same climate should have extensive riparian systems of aspens, willows, and cottonwoods. No beavers or beaver dams are present in the valley.

At some places in Lamar Valley, there are small patches of willows. Willow regrowth is limited in the entire Lamar Valley. This photo shows a small group of willows at the confluence of Soda Butte Creek and the Lamar River, but the vast majority of the riverbanks lack any vegetation. Willows show some signs of regrowth in areas where wolves are especially active, but willows still do not show signs of widespread recovery throughout the park.

The top photo shows an official NPS sign in Lamar Valley titled “The Wolf Effect.” The NPS has posted a sign which explains how the reintroduction of wolves into Yellowstone has restored the ecology of the Lamar River. The sign says,

“The reintroduction of wolves brought change to an ecosystem that evolved without them for almost 70 years. Although wolves do not directly affect all life around them, their effects possibly tumble down the entire food chain. This hypothesis is called a trophic cascade. As predators disappeared from the landscape decades ago, the park’s elk population swelled. Unnaturally large herds were more likely to suffer from poor nutrition, and included many old, weak animals. Wolves and other restored predators preyed on the most vulnerable animals and quickly became a factor in creating smaller, stronger herds. Elk now linger far less along streams where they once browsed heavily. Willows, aspens, and cottonwoods are growing taller, providing habitat for a multitude of species at streamside areas. Taller willows allow for greater diversity of bird species. Birds nest and forage at different heights, making it possible for many species to coexist. Beavers colonizing the northern range feed almost exclusively on willow. They create ponds and channels, providing valuable habitat for waterfowl, amphibians, reptiles, and fish.”

This NPS sign is possibly the most misleading sign in all of Yellowstone. The bottom photo shows the Lamar River that is directly adjacent to “The Wolf Effect” sign. NPS officials thought that the reintroduction of wolves would create a trophic cascade that would allow the riparian habitats along the Lamar River to regenerate. The bottom photo, however,

---

clearly shows that the riparian habitat has not regenerated in Lamar Valley. The banks of the river for most of Lamar Valley lack willows, aspens, or cottonwoods. The contrast between the idyllic illustration on "The Wolf Effect" sign and the reality of Lamar Valley is stark. "The Wolf Effect" sign appears to be little more than NPS propaganda.
ADDRESSING THE ELK PROBLEM

As the Yellowstone elk population grew from 1968 through the early 1990s, park managers recognized the need for an apex predator. Although Native Americans likely acted as the dominant apex predator of the Greater Yellowstone Ecosystem, the loss of the gray wolf also removed predation pressure from elk. Gray wolves were listed as an endangered species after Congress enacted the Endangered Species Act of 1973, which encouraged the wolves’ subsequent recovery. The public also began to view wolves favorably towards the latter half of the century, creating a political incentive to pursue wolf reintroduction in Yellowstone.\(^{190}\) It was not until 1991, however, that Congress appropriated money for an Environmental Impact Statement of wolf recovery in Yellowstone, which was finally completed in 1994. In 1995 and 1996, 31 gray wolves from western Canada were relocated to Yellowstone.\(^{191}\) According to the NPS, there have been between 83 and 104 wolves in Yellowstone National Park each year from 2009 to 2014. In December 2014, there were at least 104 wolves living predominantly in the park.\(^{192}\) These numbers are only estimates because wildlife biologists are unable to track all wolves and because these biologists do not know whether any wolf actually lives in the park consistently.

Various scientists have conducted studies on how wolf predation has affected the elk population. These studies, however, have had conflicting results. Some studies find that reintroducing wolves to Yellowstone has added predation pressure to the large elk population. Douglas Smith, Yellowstone Wolf Project Leader of the Yellowstone Center for Resources, found that elk are by far the primary prey of wolves year-round. Of the 1,582 animals recorded as being killed by wolves from 1995 to 2001, 92 percent were elk.\(^{193}\) Not only do these wolf kills reduce grazing pressure, but they also benefit several other animals in the Greater Yellowstone food web. Carrion (animal carcasses) is an important food source for many animals including coyotes, red foxes, black and grizzly bears, ravens, magpies, and eagles.\(^{194}\) Scavengers benefit from wolves killing elk through new food sources and with the environmental benefits of reducing elk grazing pressure.

Other data show that wolves have not significantly impacted elk populations. L.L. Eberhardt, of Pacific Northwest National Laboratory, conducted a 1998 study called "Alternative Approaches to Aerial Censusing of Elk." This study is commonly referenced as evidence that elk populations have changed little since reintroduction of wolves to Yellowstone. Because this study was published just a few years after wolf reintroduction and only uses field data for the Madison-Firehole Elk Herd, it is an incomplete estimate of the overall effect of reintroducing wolves.\(^{195}\) Douglas Smith claims that data for the other six elk herds that occupy Yellowstone during summer are sparse, but do not suggest that herds have declined since wolf reintroduction.\(^{196}\) Smith suggested that, because of field evidence that wolves were approaching their carrying capacity, this trend would not change.

A 2005 study by P.J. White of the NPS and Robert Garrott of Montana State University found that pre-wolf elk counts from 1986-1996 were consistently high, ranging between 15,000 and 19,000 animals. The 2004 count of 8,335 animals


represents a 50-60 percent reduction from the pre-wolf period. White and Garrott claim that an increasing wolf population and decreasing elk numbers have increased predator-prey ratios from 2.73 wolves per 1,000 elk in 1998 to 12.7 wolves per 1,000 elk in 2004. New studies are required to determine the actual effectiveness of wolves in reducing elk populations, but the most recent winter count of northern Yellowstone elk estimates just under 5000 elk within the park, suggesting wolves may be reducing the elk population.

Figure 2 below shows the recent decline in elk following reintroduction of the wolf. Now, 20 years after reintroducing wolves in Yellowstone, Figure 2 shows that the effect of wolves on elk is still unknown. Although the elk population has declined following wolf reintroduction, a recent decline in the wolf population makes wolf predation’s effectiveness uncertain. The wolf population might stabilize at a smaller number with less ability to regulate the elk population, or it may rebound and prove effective at managing the elk population. It is impossible to know what will happen to the elk population now that the wolf population is declining because no one knows if wolves are as effective an apex predator as Native Americans. Future elk and wolf population interactions will determine whether wolves can reduce grazing pressure in the long-run.

Figure 2. Wolf and elk population levels on Yellowstone’s northern range.

Coinciding with a reduction in elk population, some aspens appear to be growing for the first time in nearly a century, mostly in riparian areas. A 2013 study by Robert Beschta and William Ripple of Oregon State University looked at the heights of the tallest young aspens in 98 stands in the eastern portion of the northern range. Beschta and Ripple found that many non-riparian stands were still suppressed by browsing, but riparian areas with complex terrain and stands with fallen trees show signs of recovery. Beschta and Ripple suggest that the complex terrain and downed logs might pose a greater risk of predation for elk, reducing browsing pressure in these areas. The Oregon State study followed a 2010 study that randomly selected stands of young aspens and found that there is no significant park-wide recovery trend. Although some aspens and willows are showing potential to grow to maturity following wolf reintroduction, there is not enough evidence to suggest that aspens are recovering fully throughout the park. Wolves may not be a sufficient means to reduce the elk population for a full restoration of Yellowstone’s willow and aspen communities.

ANALYSIS OF NATURAL REGULATION

Natural regulation fails to recognize that humans have been in the Yellowstone ecosystem for at least ten thousand years. By ignoring the impact of Native Americans, the NPS is creating new conditions in Yellowstone. Natives actively shaped Yellowstone for their own needs and did so for thousands of years. Before natural regulation was implemented, park managers realized the impacts of ungulate grazing on the park’s ecosystems, but political pressures forced a change in management. The Yellowstone ecosystem has been transformed by natural regulation, which was adopted primarily because of political incentives rather than scientific evidence.

Native Americans structured the Yellowstone ecosystem, along with many other ecosystems in North America, for thousands of years. By eliminating most active management, the productivity and biodiversity of rangeland and riparian habitats has declined. Yellowstone’s degradation does not promote conservation or recreation, which contradicts the congressional mandates in the Organic Act. NPS officials in Yellowstone and in Washington, D.C., have rationally responded to political incentives in the past. Natural regulation is another example of how political incentives can lead park managers to engage in harmful management practices.

CONTRADICTIONS TO NATURAL REGULATION

Although the NPS generally supports a hands-off management strategy, there are examples of active management in the park today. Some of these management strategies are beneficial, but others are not efficient or cost-effective. Contradictions to natural regulation are driven by political incentives in specific situations that outweigh the general incentive to promote hands-off management. These specific situations include active bison population management and invasive plant species management.

THE INTERAGENCY BISON MANAGEMENT PLAN

Unlike the elk population, which is not actively managed, bison populations are actively managed because political pressure has compelled the NPS to do so. Under the Interagency Bison Management Plan (IBMP), park officials cull excess bison from Yellowstone to prevent the spread of brucellosis, a disease that causes cattle to abort their fetuses, among other health problems.

After years of negotiations between Montana, Wyoming, the NPS, and local Indian tribes, the NPS adopted the IBMP in 2000. Local ranchers were concerned about the spread of brucellosis, and pressured their state governments to negotiate with the NPS. The IBMP is a cooperative effort to manage bison populations to prevent brucellosis from spreading in and around Yellowstone. The IBMP requires participating federal, state, and Indian agencies to meet three times a year to determine whether Yellowstone’s bison population should be reduced. Currently, IBMP constituents recognize 3000 bison at the end of winter as a reasonable bison population to prevent the spread of brucellosis.

Under the IBMP, the NPS encourages hunting outside of the park to reduce the bison population. When hunting is not enough to reduce bison populations to the proposed levels, the NPS captures bison near park boundaries to send to

---

slaughter. In 2015, the NPS sent 507 bison from the Stephens Creek Capture Facility for slaughter. Once slaughtered, the meat and hide of the culled bison is donated to nearby Indian reservations. Culling bison in Yellowstone is very controversial, similar to direct reduction of elk populations in the 1960s. Activists have filed a lawsuit against the NPS over this bison reduction program.

The IBMP contradicts the NPS’s natural regulation philosophy. Although the NPS supports natural regulation of wildlife, the IBMP gives the NPS direct control over bison populations. The NPS is currently spending about $1.2 million each year to implement the IBMP in Yellowstone, despite their management philosophy of hands-off wildlife management. The political pressures from surrounding states have made it politically viable for the NPS’s to support a plan that directly contradicts natural regulation philosophy.

The IBMP’s active management policy has successfully prevented the spread of brucellosis. Under the IBMP, there have been no reported cases of brucellosis spreading to local cattle. The unmanaged elk populations, however, have been reported to infect cattle with brucellosis more than twenty times since 2002. The difference between an unmanaged elk population and a managed bison population is a clear example of the importance of active management. Because the politics around elk and bison management are different, it is logical that the NPS manages the two differently.

Bison are still forage-limited in Yellowstone despite the NPS’s active management of the population, suggesting that bison may be overgrazing the northern range. A 2005 study from the University of Calgary found that Yellowstone’s bison are expanding their range in response to a decline in food availability. Bison on Yellowstone’s Central Range have been migrating to the northern range, and bison on Yellowstone’s northern range have been migrating outside of the park in search of food. Yellowstone’s bison population has been growing and expanding their range following the reintroduction of wolves, possibly because of reduced competition for forage with elk. As of July 2015, the NPS estimates that there were 4,900 bison in Yellowstone. Bison now browse willows in both summer and winter in Lamar Valley, also a part of the northern range, suggesting that they are unable to meet their dietary needs with preferred grasses and sedges alone. Bison are now turning to less-preferred food sources, and are suppressing willow growth in parts of Yellowstone.

NON-NATIVE PLANT SPECIES

When ungulates overgraze their range, non-native species are more likely to invade. The NPS estimates that there are about 200 non-native plant species located in Yellowstone National Park. Several mandates, including Executive Order 13112, NPS management policies, and the Federal Noxious Weed Act of 1974, require the NPS to prevent non-native species from being introduced and to control established non-natives. According to “Managing a Complex Exotic Vegetation Program in Yellowstone National Park,” a 2001 report by NPS officials, the total number of documented non-native plants in Yellowstone increased from 85 in 1986 to over 185 in 2001. Non-native plants alter soil

properties and plant community dynamics, as well as altering the distribution, foraging activity, and abundance of native ungulates. The report raises concerns about the long-term persistence of plants including ross bentgrass, a native plant found only in a few geothermal environments within the park. Non-native species like Kentucky bluegrass, desert alyssum, and annual wheatgrass often displace native species like ross bentgrass and restructure the ecosystems they occupy. Although some non-native plant species may increase rangeland production, NPS decision-makers prefer the historical plant community because of the Organic Act’s conservation mandates.

The NPS is trying to control the spread of non-native species but has had little success. Prevention efforts limit the number of new non-native species in the park, but total elimination of all non-native species is too costly to be a realistic goal. Instead, the NPS could treat some of Yellowstone’s non-native plants as an established part of the ecosystem. Even if aggressive control efforts could remove all non-native species in the park, the seeds of many non-native plants can potentially grow even after decades of dormancy. The abundance of non-native species in Yellowstone makes costly removal efforts unlikely to be effective in the long run. Recent efforts have been futile, as illustrated in Photo Set 16 and 17 below.

At Cinnabar, near the North Entrance of the park, the NPS has established four exclosures to regrow native grasses in former farmland that was annexed into the park in the 1930s. The annex was meant to provide low-elevation winter habitat for Yellowstone’s ungulates. White settlers moved into the Cinnabar area in the 1870s and used the land for agriculture. When the NPS acquired the small piece of land in the 1930s, the agency discontinued agriculture, but non-native crested wheatgrass (Agropyron cristatum) and non-native Eurasian annual weeds, mostly desert alyssum (Alyssum desertorum) and annual wheatgrass (Eremopyrum triticeum), dominated the area around the current exclosures. The largest exclosure is the Cinnabar Exclosure, which is accompanied by three smaller exclosures: Reese Creek North, Reese Creek South, and Stephens Creek. The Cinnabar Exclosure was built in 2008 at a total cost of $48,330 ($9.96 per linear ft).216

These exclosures require time-consuming and expensive processes to restore the native plantlife. The NPS uses a dryland native vegetation restoration approach with four distinct techniques.217

1. Using chemical, mechanical, and cultural weed control
2. Planting barley/winter wheat cover crop to improve soil quality and limit weed growth
3. Building fencing to keep ungulates out during site preparation through native seed planting/germination/establishment
4. Seeding native seeds at 16-22 lbs per acre.

The purpose of the native plant restoration project was to rebuild the native plant communities and improve wildlife habitat. These activities include federal and state agencies, as well as government contractors. All of these efforts cost hundreds of thousands of dollars each year. From 2008-2015, seed growing operations alone cost $397,023. The total cost of exclosure construction was $163,770. The NPS will likely keep the exclosure fencing at least through the summer of 2017 to ensure germination and establishment of the newly planted native grasses.218

The NPS and cooperating agencies have also treated the Cinnabar Exclosure with herbicide multiple times to kill off non-native species. The NPS began applying Roundup or a Roundup/Express mixture in May 2009 to control crested wheatgrass and alyssum in the Cinnabar Exclosure. The NPS has continued to use Roundup since 2009. Other weed

---

217 Ibid.
218 Ibid.
controls include hand pulling, burning, harrowing, and planting cover crop. In 2012, the Montana Conservation Corps (MCC) hand-pulled annual wheatgrass from the exclosures. 219

Photo Set 16. Official NPS signs near Cinnabar Exclosure. 220

---

219 Ibid.
Photo Set 17. Cinnabar Exclosure in August 2015. The two photos below show little progress in the restoration of native grasses after eight years.

---

Photo Set 18. Cinnabar Exclosure in November 2015.222 On the Cinnabar exclosure, an official NPS sign says, “These improvements are being completed using your fee dollars. Thank you for your support in making our national parks a better place for all.” The two photos below show the Cinnabar Exclosure covered in blue-green herbicide.

SOLUTIONS FOR NON-NATIVE SPECIES

Non-native species are not historical to Yellowstone, but they may be impossible to completely remove. Managers can choose to do nothing and accept non-natives as part of the new Yellowstone ecosystem, implement policies to prevent the spread of new and established non-native species, or aggressively try to remove non-natives in the park. Any management decisions will have ecological and economic consequences.

Accepting non-natives as established parts of the Yellowstone ecosystem is by far the least costly management option. Now that these non-natives are established in Yellowstone, permanent removal is extremely difficult. For example, the

Oxeye daisy (Leucanthemum vulgare) can drop seeds that remain viable for up to 39 years, making permanent removal extremely difficult.  

Another option is to encourage policies that reduce the risk of spreading non-native species. The NPS has guidelines for washing boats and other equipment, and requires certified weed-free hay and feed to prevent the spread of non-native species. Visitors who follow these guidelines are less likely to spread non-natives (although still possible), but without aggressive enforcement Yellowstone still risks the introduction of more non-natives.

Direct removal is another option to eliminate non-native species in Yellowstone, although it is also the most expensive option. Park managers can use mechanical or chemical controls to remove or kill non-native species.

Perhaps one of the best opportunities park managers have for restoring the historical Yellowstone landscape is to encourage controlled fires and reduce grazing pressure from wildlife. If the park service works toward returning the environment to historical conditions that native species are adapted to, non-native species are more likely to be outcompeted and die off. Some non-natives, however, might prove to be better adapted to a simulated historical ecosystem. In theory, if park managers allow more fires to burn, many non-native plants will be burned while native plants adapted to fire will regrow. A study from the University of Wisconsin found that non-native plants in Yellowstone do not tend to grow into burned areas, suggesting that non-native plants are not as fire tolerant as native plants.

All of these management options are costly, whether financially or ecologically. Park managers recognize the importance of removing or preventing non-native species, but the cost of removing already established non-natives is often too high to be practical. One of the most practical options for managing non-natives in Yellowstone is to prevent new non-natives from becoming established and to manage wildfires and grazing pressure to discourage non-natives from spreading.

Despite the good intentions of the NPS and cooperating agencies who are trying to restore the small plots of land near Cinnabar, the restoration process is an inefficient use of public funds in the larger scope of Yellowstone’s ecological issues. The four restoration exclosures near Cinnabar are only a tiny fraction of the area that used to be agricultural land. The amount of time and money that would be necessary to restore the entire annex would take many decades and millions of dollars. Restoring the entirety of Yellowstone’s rangeland to a native state is effectively impossible due to the size of the park and the scope of the non-native plant establishment. The most cost-effective management scheme is to accept that some of these plants have become part of the ecosystem. Every ecosystem constantly changes, and ecological change is a natural process.

**CONCLUSION**

The National Park Service has mischaracterized Yellowstone as a primeval wilderness to conform with the general public’s perceptions and has overlooked how Native Americans actively managed Yellowstone for thousands of years. Yellowstone co-evolved with humans, and Native Americans functioned ecologically as the apex predator. Diseases and European-American expansion displaced Native Americans from Yellowstone and limited their ability to burn forests and hunt animals. After Yellowstone was designated as a national park, the first visitors mistakenly thought...

---


that it was primeval place that had never been influenced by man. After the NPS began managing the park, they tried to keep animal populations low enough to maintain the ecological health of the park. During the 1960s, the public spoke out against active management of wildlife populations, and so the NPS responded to these political pressures by switching to hands-off management.

The combination of faulty perceptions and political pressures has led NPS officials to adopt natural regulation, impacting the rangeland and the riparian habitats in negative ways. By ignoring the impact of Native Americans, the NPS is creating new conditions in Yellowstone. Natural regulation assumes that nature will self-correct when ecological problems occur, but this philosophy does not reflect the actual history of the park.

The Organic Act charges the NPS to conserve Yellowstone’s scenery and wildlife while also regulating the park to provide for the public’s enjoyment.227 Although the mandate to promote conservation and recreation is internally contradictory, allowing the degradation of rangeland and riparian habitat violates both the provisions for conservation and recreation.

Without active management, bison and elk populations have grown artificially large. The large populations of ungulates are overgrazing rangeland and riparian habitats, which lowers the productivity of the land and harms other species. Aspen and willow stands within the park are also becoming smaller and less healthy because of overgrazing. Without aspens and willows, beavers are virtually extinct within the park. With no beavers to build dams, the biologically diverse ecosystems of beaver ponds have been diminished.

NPS officials, however, often contradict their own management philosophy when they engage in low-profile active management, such as bison culling and futile attempts at vegetation restoration. The Interagency Bison Management Plan (IBMP) shows that NPS officials engage in active management when it is politically viable. Non-native plant management has become an inefficient and ineffective use of tax and fee dollars. Native plant restoration and non-native plant abatement have been costly with minimal results. Park managers may need to consider and adapt their approach to non-native species rather than focusing on elimination. Because the NPS’s resources are limited, park managers will need to prioritize management issues.

Yellowstone remains as one of America’s most romanticized landscapes. NPS managers work to maintain Yellowstone according to rules encoded in law and the preferences of the public and legislators. The rules are contradictory and preferences change, allowing NPS officials to change management practices in the future, like they have in the past. NPS officials make management policies to fulfill the perceptions of what Yellowstone is and should be. Since many of these perceptions do not reflect historical or ecological truths, these management practices will not necessarily lead to the preferred outcomes of park managers or the public.