Remote Sensing as a Tool for Observing Rock Glaciers in the Greater Yellowstone Ecosystem

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Abstract

Rock glaciers are found in and adjacent to Yellowstone National Park, primarily in the high elevation regions of the Absaroka and Beartooth mountain ranges. One rock glacier that has been intensely studied is the Galena Creek Rock Glacier, located on the east boundary of the park in the northern Absaroka mountain range. A rock glacier's movement and behavior is characterized by rock and other debris overlying and embedded within the ice mass. These glaciers are found in alpine regions at the foot of rock faces with large supplies of talus and debris. The debris acts as insulation for the ice and prevents solar radiation from ablating the ice surface, allowing rock glaciers to exist at lower elevations and latitudes than regular glaciers. Rock glaciers deform and flow similarly to ice glaciers, but possess some unique characteristics. They are an important mechanism for transporting masses of rock debris in cold, continental, non-glacierized mountain environments. They are also natural storage mechanisms for water, providing watershed runoff in late summer months. Locating and studying these features can be arduous due to their positions at high elevations and rugged terrain. As a result, remote sensing is a superb tool for observing and studying these glaciers. Hyperspectral and multispectral imagery are used to delineate their geographic extent as well as the composition of the debris overlying the ice mass. The distinct spectral signature of ice can be used to extract regions of bare ice at the head of a glacier. Radar images can also be used to reveal rough surface texture and create DEMs for delineating cross-glacier profiles as well as terminal and lateral moraines. Using the geographical extent and height of a glacier (from the topographic profiles), volumes are calculated to deduce water storage. Rock glaciers can also be used as climatic indicators for long-term monitoring.

Glaciers are rivers and sheets of ice that shape the world in which we live. They carve beautiful landscapes and deposit huge boulders and remarkable hills of sediments. Glaciers in all of their forms presently cover approximately 10% of the land on the surface of Earth. This value was once much greater; approximately 30% of the land surface was covered during the last ice age, which ended only 11,000 years ago (Marshak 2001). There are two major types of glaciers, continental and mountain (alpine), and one lesser-known type, the rock glacier.

A glacier is a body of ice formed by the compaction of snow and ice, or an internal recrystallization of water that is thick enough to internally deform and thus flow. The minimum thickness of snow and ice needed for internal deformation is approximately 60 meters. A snowfield that is less than 60 meters thick is considered stagnant, and thus is not a true glacier (Marshak 2001). In the Greater Yellowstone region, many snow and ice bodies are commonly referred to as glaciers, and once were, but today are melting patches of stagnant ice and snow.

In order for a glacier to form and exist, three basic criteria must be met. First, the temperature must be cold enough for winter snow and ice to survive the warm summer months. If the temperatures are too warm, not enough snow will amass to compact into ice and form the glacier. Second, there must be a location where mass can accumulate. Landforms that are too steep (greater than 27°) lose their snow via avalanches; therefore, glaciers usually cannot form on these slopes (Fairweather 2003). Third, there must be addition of mass to the glacier via snowfall, refreezing of water, or avalanching of snow from above. If the glacier fails to receive mass inputs, it deforms to a thickness of less than 60 meters and stops flowing, losing its status as a glacier (Figure 1).

Glaciers move by two main processes: basal slip

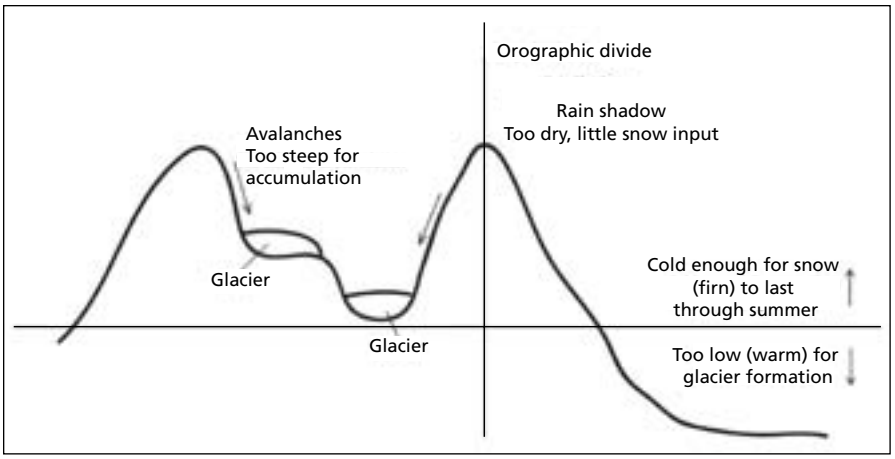


Figure 1. Diagram displaying criteria needed for glacier formation.

and internal deformation. Basal slip movement occurs when the entire glacial mass moves together on a thin layer of water, or a mixture of sediments and water, on the basal (bottom) surface of the glacier. The water, or sediment water mixture, lowers the friction between the glacier and the surface on which it rests (the substrate). Internal deformation occurs when the internal structure of the glacier slowly deforms without breaking apart or completely melting. This internal deformation can be visualized as crystals slowly deforming and sliding by one another. The crystals change their shape, and old crystals are destroyed while new ones are created (Tarbuck and Lutgens 1996). A glacier is technically called a visco-plastic, not a solid, for this reason (Patterson 1996). Glaciers typically move at velocities of between 30 and 100 meters per year, although some surging glaciers have been clocked at velocities of up to 54 meters per day (Kamb et al. 1985).

Continental glaciers are the vast ice sheets that presently cover the surface of Antarctica and Greenland. They covered most of northern Europe and North America during the ice ages. Mountain glaciers are much smaller than these ice sheets. They presently exist in all major mountain ranges at a variety of latitudes around the world. They are even found on the equator in the high Andes Mountains of South America. These glaciers are also responsible for creating dramatic landscapes in our own backyard. The Beartooth, Absaroka, Wind River, and Teton mountain ranges have all been sculpted by these powerful rivers of ice, and all of these ranges presently contain remnant glaciers from the past ice age.

Rock glaciers are less commonly known than ice glaciers. They are very similar to ice glaciers in that they are composed of thick, internally deforming ice, but rock glaciers have a layer of rock debris or talus measuring one meter or more on the surface of the ice (Figure 2). The debris layer acts as an insulator for the ice and reflects incoming solar radiation, allowing rock glaciers to exist at elevations and latitudes lower than those at which ice would typically survive if it were not insulated. We find many of these features in and around the Greater Yellowstone region. Many people have probably hiked on a rock glacier without even realizing that they were walking on a moving and deforming body of ice.

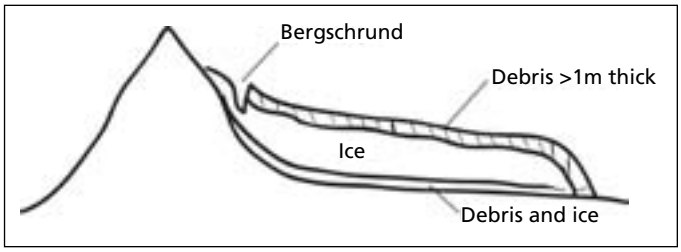


Figure 2. Cross-section view of a rock glacier.

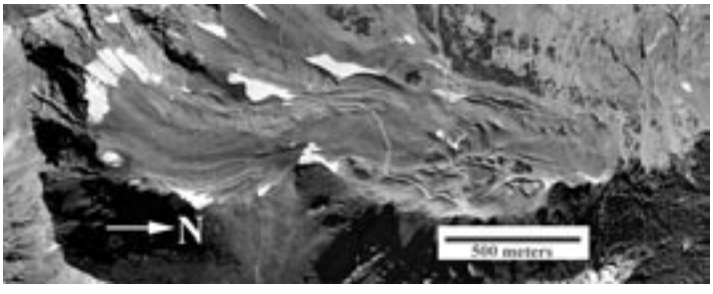
Rock glaciers are presently formed in glacierized mountain ranges with extremely high erosion rates. The large amount of eroding debris covers the ice surface, and some rock debris becomes incorporated into the upper layers of the ice mass by the refreezing of melt water. Rock glaciers are also formed in regions with ordinary erosion rates. In this case, a slowly receding glacier is inundated with rock debris and becomes covered. Eventually, enough material accumulates on the surface and becomes incorporated into the ice for geomorphologists to label it a rock glacier (Marshak 2001). This second type of rock glacier is the kind we presently find in Greater Yellowstone.

Debris-covered glaciers have not been studied as extensively as ice glaciers in the scientific community, but limited research has been performed. The majority of this research has been conducted in the field, on the surface of rock glaciers. Geographers have mapped the geographic extents of these

features with Global Positioning Systems (GPS) and by map and compass. Geologists have conducted seismic profiles to calculate the thickness of ice and debris and drilled holes through them to view their internal structure. Hydrologists have poured dye into rock glaciers to discover their internal drainage patterns and studied their seasonal drainage patterns. The difficulty of this research is that most rock glaciers are in remote, rugged, wilderness areas. As a result, only a handful of rock glaciers have been extensively studied, including the Galena Creek rock glacier in the Absaroka mountain range, seven kilometers east of Yellowstone National Park. This rock glacier has been heavily researched because there is a road leading to it, and switchbacks cross the glacier itself numerous times (Konrad and Humphrey 2000; Konrad et al. 1999; Potter 1972).

Remote sensing is a tool commonly used to study ice glaciers in many different regions around the world, utilizing many platforms and techniques (Bishop et al. 2003; Duncan et al. 1998; Fairweather 2003; Østrem 1975). Rock glaciers rarely have been studied with these methods for reasons unknown to this author. There are several benefits and also difficulties to studying rock glaciers with remote-sensing techniques.

Remote sensing is the study and observation of the surface of Earth using reflected or emitted electromagnetic energy, captured remotely via satellite or an airborne platform. There are two major types of remote sensing: active and passive. Passive remote sensing uses electromagnetic radiation produced by the sun as the energy source for the imagery. The main types of passive remote sensing are optical imagery and hyper/multispectral imagery. In optical remote sensing, photographs of Earth's surface are taken from aircraft flying at various altitudes using the visible or the near-infrared parts of the electromagnetic spectrum. The spatial extent of rock glaciers can be delineated from the photographs, but this is the limit of information that can be extracted from optical imagery. Figure 3 is an aerial photograph of the Galena Creek rock glacier.



COURTESY S. K. KONRAD

Figure 3. Aerial photograph of Galena Creek rock glacier, Absaroka Mountains, Wyoming.

Multispectral and hyperspectral remote sensing images are captured by sensors that detect visible light as well as UV and infrared sections of the electromagnetic spectrum. Multispectral imagery typically consists of 3–10 wide bands (0.6 to –0.02 um in width), including the three in the visible spectrum. This type of sensor can be mounted on an aircraft, but is typically mounted on a satellite platform. Landsat, SPOT, and ASTER are some examples of multispectral satellite platforms. The benefits of this type of imagery are that image acquisition is relatively cheap compared to other remote sensing images, capture is not weather-dependent (although cloud cover can obscure an image), the spatial extent is very large (Landsat image is 31,450 km^2, and ASTER image is 3,600 km^2) and the return time is generally around 10–20 days. These benefits can also be drawbacks to multispectral imagery. Because the satellites are in a programmed orbit, capturing images at specific times (for sun angle) and dates can be difficult if not impossible. Another limit to this imagery is the spatial resolution of the images. Space-borne platforms typically have coarse spatial resolution: 30 m for a Landsat image and 15 m for a SPOT or ASTER image. This coarse spatial resolution can make distinguishing rock glaciers very difficult. This type of imagery would be useful for geologists who already know the location of their region of interest, or are working at locations that support spatially large rock glaciers such as Alaska, the Himalayas, and the Karakoram. This type of imagery is not very useful for the researcher studying rock glaciers in the Greater Yellowstone region.

Hyperspectral imagery can consist of hundreds of very narrow bands (.01 um separating bands) that provide spectral information valuable to researchers. Not only can the spatial extents of rock glaciers be discriminated, but data that are invisible to the naked eye also can be extracted from the captured wavelengths. For example, bare ice can be discriminated due to its unique spectral signature. Freshly broken rock debris covering a rock glacier will also have a different spectral signature than in-place, weathered bedrock surrounding the glacier. These unique spectral differences may increase the ease of detection and characterization of these features.

Active remote sensing platforms broadcast

directed patterns of electromagnetic radiation to illuminate Earth's surface, then receive the portion scattered back to the instrument to capture an image (Campbell 2002). RADAR (RAdio Detection And Ranging) and LiDAR (Light Detection And Ranging) are the forms of active remote sensing commonly used today. RADAR sends pulses of microwaves and radio waves to the ground surface. The velocity of these waves is known, so the distance to an object or surface can be calculated by measuring the time it takes for a pulse of energy to be sent, hit an object, and return to the sensor. LiDAR is similar, but it sends a laser pulse to measure the distance to the ground surface. Because this form of remote sensing uses its own energy and is not dependent upon variations in solar radiation, it can be used in less-than-optimal weather and daylight conditions.

LiDAR data can be used to create high resolution DEMs (digital elevation models) of Earth's surface. These DEMs can be used to discriminate rock glaciers due to their surface characteristics. In a mountainous area such as the Greater Yellowstone region, a valley that does not contain a glacier or a rock glacier will have a U-shaped profile. If a rock glacier exists in this valley there will be a bump, or an irregularity to the U-shape. With RADAR or LiDAR, a rock glacier that is difficult to detect visually or spectrally can be detected by viewing the topographic profile of a valley. This technique can also be used to estimate the volume of a rock glacier. The spatial extent of a rock glacier can be determined from optical imagery, and the thickness can be inferred from the cross-valley profiles. Using these inputs, a rough estimate of ice volume and thus water storage can be calculated.

Rock glaciers are fascinating features present in mountainous regions. These features erode mountains and move sediment. They are also an important water storage mechanism in some environments. Remote sensing is a tool commonly used to study geologic features and detect changes on the surface of Earth. Scientists have not used this technology in the past to study rock glaciers, but it is a new and promising method for studying these features in the Greater Yellowstone region and in mountainous regions around the world.

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Yellowstone: A Model for Ecosystem Research

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Abstract

Studies on the various aspects of an ecosystem rely heavily on prior research. Because research has been part of the mission of Yellowstone National Park for many years, there is myriad information upon which scientists can rely. For example, a study of the northern elk herd 30 years prior to my own work on a fungal association permitted me to address a problem that would not have been imagined otherwise. In addition, studies of ecosystems often focus on natural environmental conditions, and it is becoming increasingly difficult to locate areas that are not greatly impacted by outside influences. Within the Yellowstone ecosystem, it is possible for scientists to have relatively free access to large geographic areas containing several different ecosystems that are mostly untouched by human interference. It is important that the research function of Yellowstone be recognized as a powerful influence that can make a great difference in the direction of ecosystem research now and in the future. As more and more areas are subdivided to provide for sprawling human communities, large areas of unaltered land with uncultivated plants and free-roaming animals are becoming increasingly limited. In the future, Yellowstone will play an even more critical role in the study and description of North American ecosystems.

I have been doing research on the distribution of fungi in the Yellowstone ecosystem for many years (Foos 1989; Foos and Royer 1989; Foos 1993; Foos 2001). These fungi have been reported in different geographic locations around the world; found growing in several different climates; and associated with a number of different hosts. In this study I wanted to determine whether the various climates, ecosystems, and hosts affected the growth of the fungus—that is, whether different strains or species of the organism could be found in different ecosystems, or whether it was merely happenstance when different strains of organisms were found in different geographic areas.

As I began to develop this project, I tried to determine where to conduct the study. The criteria I used were the following: (1) I sought an area that consisted of several hundred square miles, with many different communities within the greater ecosystem. (2) The environment had to be relatively natural, that is, it should be an unaltered environment with as few signs of human intervention as possible. (3) It needed to have a range of climatic conditions. Particularly, the annual rainfall should vary from one location to another to ensure variation in the vegetation within the study area and that temperature variations would be sufficient to mimic the range of conditions within wide areas of the temperate zone. (4) Because the fungus of interest is associated with animal hosts—specifically herbivores, and I restricted this study to ungulates—I sought an area that was an open system with free-ranging, native ungulates. At the same time, I wanted to exclude domesticated animals. (Domesticated animals might receive feed supplements from other areas, which would, in part, negate any attempt to correlate native vegetation with the distribution of the fungus.) (5) To be confident that the above conditions were met, I needed to identify an area that had been studied over time where records of climate, vegetation, and grazing patterns were well-documented and readily available. (6) Further, it would be necessary to find an area in which oversight would ensure the possibility of long-term research without appreciable changes to the ecosystem. There are not many areas that meet these criteria.

So I chose Yellowstone as the area in which to do my ecosystem study. Not because it was a national park. Not to help park managers make better decisions from the data I might provide. I chose this area because I needed to learn about the distribution of a fungus, and this place was unique in its ability to meet my needs. So while much of the research conducted in the national parks focuses on management issues, my project was intended to improve understanding of the relationships of organisms. However, I would like to emphasize that studies begun as pure research often provide information that can be applied to decisionmaking processes. Studies of several organisms here in Yellowstone National Park, particularly of the habitats of "charismatic megafauna," have driven a number of management decisions; however, I suspect that research on fungal distribution will

not have much of an impact on park policies.

The reason for relating these details of my own work is to lay a foundation for making some remarks about ecosystem studies and the needs that scientists engaged in ecosystem research have when selecting study areas. Often among these needs are large areas of land with unrestricted access. If you were to imagine the needs of an individual engaged in migration studies, studies of plant succession, or studies of animal territoriality, it is easy to see why large areas might be required. Further, these areas must be open systems; they can not be fenced or developed as urban areas with high-density human populations. Just the vastness of Yellowstone alone invites ecosystem studies. Studies of bears and fish provide well-known examples of research that requires open systems and long-term commitments (Craighead et al. 1995; Varley and Schullery 1996). Currently there is much discussion of the reintroduction of wolves to this same ecosystem. We might ask, "Why was Yellowstone selected as an area to reintroduce wolves?" There are a number of national forests and national wildernesses that might have been suitable. The answer to this question includes the criteria I listed earlier. Yellowstone provides a large, open-system natural area, with a complex ecosystem and an abundance of long-term research studies (Smith et al. 2003). Further, it is an area under strict supervision, managed by individuals with a mandate to preserve the area in its natural state for generations to come.

When Yellowstone was created on March 1, 1872, "for the benefit and enjoyment of the people", it was necessary to engage research to determine what was here. The Hayden expedition of the summer of 1872 (supported by a government grant of $75,000) was established to complete a thorough exploration of the Yellowstone region. In addition to being charged with mapping the area, this was a scientific research expedition that included geologists, mineralogists, botanists, and photographers (Haines 1977). These were individuals who could describe many of the abiotic as well as the biotic factors found within the area. Their early characterizations of the area have acted as foundations upon which later research has been based, and they are benchmarks against which later descriptions can be compared. So in many respects, this expedition laid the foundation for ecosystem study in this region. Other studies were begun shortly after the creation of the park. For example, a major fish population study was completed in the late 1880s (Jordan 1891), less than two decades after the park's founding.

Over the years, organisms residing in the area have been studied extensively. These records have been kept and are available to the public, so today's scientists have years of data from prior studies to use as foundations for current studies. This is one of the characteristics of the Yellowstone ecosystem that makes it a model for ecosystem study. Background study is necessary to studies of interactions of organisms in communities or ecosystems, and in Yellowstone, geological, climatic, and biological records are available to provide the necessary background upon which to engage in further research. For example, while pursuing a fungal distribution study, I came across information about an endemic disease in Yellowstone's northern elk herd (Worley and Barrett 1964). Lungworm disease had been studied extensively in this elk herd more than 20 years before I began my study of fungi. Upon learning of the elk lungworm studies, I redirected my study to the northern elk herd and demonstrated that the conditions were right for the fungus I was studying to function as a vector for spreading the etiological agent of this disease within the northern elk herd (Foos 1997). The earlier research had provided information to suggest that another study would be appropriate. It is often the case that earlier studies suggest additional research. One of the very important things that makes Yellowstone a model ecosystem is that there have been so many earlier studies that the background is here as a foundation upon which new research can be set.

Much research in national parks, and indeed, in Yellowstone National Park, is instituted by park administrators to help in making decisions about park management. Christie Hendrix (pers. comm.) reports that of approximately 240 researchers who have permits to engage in research in Yellowstone right now, 104 of the studies could be applied to making management decisions within the park. The other 136 studies are not designed to provide information for management applications. Clearly, research is important to help develop park policy. At the same time, I want to suggest that the Greater Yellowstone Ecosystem is an area in which ecosystem research can and should thrive regardless of the area's status as a national park. I'd like to stress the importance of pure research relative to applied research. While the distinctions are sometimes difficult to make, it is clear that some research can be directed toward current decisionmaking situations and other research is designed to help us understand the world around us. Pure research may not have any direct

bearing on park management; on the other hand, it might. Further, if it does not have a bearing on park management now, it may in the future. A couple of years ago, Kathy Sheehan and others were engaged in ecosystem research studying the microorganisms that live in acidic thermal streams within Yellowstone to see if they contained pathogenic amoebae (Sheehan et al. 2003a). During this study, they found a microbe that sometimes causes meningitis in a hot spring where tourists often swim. The results of this study—designed to determine the composition of microbial communities in the hot springs—have been used to make management decisions. This project that began as pure research to help describe the world around us led to an investigation of an aspect of the original work that has had a direct bearing on the management of the park (Sheehan et al. 2003b). The results of this study led park managers to place signs near thermal swimming areas to warn swimmers of the risk.

Individuals who conduct research in Yellowstone National Park must have a research permit. The use of research permits is a valuable part of research oversight in Yellowstone, and the process by which permits are awarded influences the role of research in the park. Recently, Alice Wondrak Biel (2004) published a detailed historical account of the practice of issuing research permits and the ways in which this practice has changed over the years. Presently, requests for permits to do scientific research in Yellowstone call for a peer review and provide conditions under which research materials may be collected and maintained. There is also a requirement to submit an annual report of research progress. These requirements do several things that make Yellowstone a model area for ecosystem research. First, an assessment of the proposal and the peer review process help ensure the quality of the research. This, in turn, increases the likelihood that the results of the research, upon which others may base their future research, will be valid. The requirement for an annual report encourages those engaged in the research to complete and document their work. It lets others know what research is being done and makes the scientific community aware of the research environment. The initiation of a study on one aspect of an ecosystem might suggest additional studies to others in the same area.

Research builds upon prior research in virtually all areas of science. However, this seems particularly true of ecosystems research, where the many varied organisms in a community interact with each other in one way or another. An example of research encouraging research can be seen in the work initiated by Thomas Brock when he first systematically studied microorganisms in Yellowstone's hot springs (Brock 1995). Prior to the 1960s, there was little awareness of the various forms of life in the park's thermal springs. After Brock's initial work on the organisms found in hot springs, however, a whole new generation of scientists began research on the microbes in the communities found in these features. (Of course, it probably helped that a protein from one of the bacteria that Brock found provided a key enzyme that is required for entire areas of molecular biology.) Now, dozens of scientists study the microbes of Yellowstone's hot springs, and the information about these communities and the various aspects of their ecosystems is being generated very rapidly (Brock 1998; Ward 1998). Much of this research can be generalized to make assumptions about hot springs worldwide. Also, much of the research—while initially ecosystem work—has provided techniques and information that can be used in molecular techniques and lead to new discoveries about a wide range of organisms everywhere.

We often read reports that emphasize the particular importance of protecting ecosystems of the Amazon and other rainforests because they might contain undiscovered organisms that could provide new medicines, or may in some other way affect quality of life. The same can be said about the Yellowstone ecosystem. But just as the ecosystem must be protected, research in the ecosystem must be encouraged. Just because *Taq* polymerase, isolated from *Thermus aquaticus* found in Mushroom Spring, revolutionized molecular biology and introduced the possibility of DNA sequencing and the multitude of practical applications resulting from that discovery, it does not mean that Yellowstone's gifts to the world have all been given. There will be other discoveries as research continues in the Yellowstone ecosystem. Some will be remarkable and others will be of little note, but we cannot know which aspects of ecosystem research will be most important before the research is initiated. I can't image that Dr. Brock was thinking about revitalizing the entire area of molecular biology when he was collecting bacteria from Yellowstone hot springs nearly 40 years ago.

The vital role of the national parks as sites for ecosystem research has been supported by many individuals for years. In the 1990s, there were many calls for research not only in Yellowstone, but as a mission for all the national parks (Parsons 1989;

National Research Council 1992; Risser and Lubchenco 1992; Zube 1996; Sellars 1997). It seems that scientists were not the only ones who thought that research in national parks would be valuable. In 1998, Congress mandated research as a component of the missions of national parks (Harmon 1999). Yellowstone has been at the forefront of providing support and encouragement to research in the park. Perhaps it has to do with the mission or policies of the park, or perhaps it has to do with the people. Yellowstone has been very lucky to have had a cadre of visionary individuals who have overseen research in the park and supported the many scientists who have engaged in research here.

I have always received a warm welcome and a helpful exchange of ideas while in Yellowstone doing research. In addition, over the years, the systematic review of applications for permits and process of submission of annual reports has become easier to maneuver. There is a history of science here, with all of the documentation that one may want, now housed in a magnificent new facility in Gardiner, Montana. There are people who are interested and willing to help. And there are a multitude of research questions to be answered in Yellowstone. Nowhere else is there an open ecosystem so vast and so varied that provides an opportunity for long-term ecosystem research.

Ecosystem research can and should thrive here in the Greater Yellowstone Ecosystem. It is an open, natural area with a wide range of climatic conditions in which native plants and animals live and grow relatively unhampered by the environmental changes that have occurred in other parts of the world over the past decades. It is the kind of place that can provide insight into the environment as it was in the past far better than almost anywhere else. It is important that ecosystem research be nurtured in Yellowstone. Much research may not be useful to help make park management decisions. However, even if the research does not provide information that is useful to park management, it is essential that the mission and policies of Yellowstone encourage ecosystem research now and into the future to help describe the natural world as it is and, in some cases, as it was.

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Greater Yellowstone Wildlife in Science and Myth: We are from Mars; They are from Earth

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Abstract

The diverse wildlife management policies witnessed in Greater Yellowstone over the years reflect changes in both the scientific knowledge and the myths that affect how we relate to wild animals. During his 1903 visit, big game hunter Theodore Roosevelt found Yellowstone's "semi-domesticated" grizzly bears "delightful" and "quite harmless" if "reasonable precaution" was taken. The myth of the harmless Yellowstone bear was eventually overtaken by the belief that wildlife management should be based on ecological concepts rather than entertainment value, but advances in scientific knowledge did not mean that we abandoned myths altogether. On the contrary, the pursuit of scientific rationales for wildlife policies continued to feed existing myths and give rise to new ones, including the mythic ideal that values wildlife for its wildness. But not everyone agrees, whether the animals in question are bears, bison, wolves, or cutthroat trout. Is there anything inherently more "natural" about wildlife that is unaffected by humans, one of Earth's keystone species? In traditional views still held by many American Indians, the relationship between humans and other species is one of interdependence. All interest groups in a wildlife controversy are apt to claim that science is on their side, but what really fuels the debates are the myths that we want to believe about animals in Greater Yellowstone.

Introduction

Although myths are often thought of as traditional stories that came into being to explain some natural phenomenon, to call something a myth in modern parlance has become a way of dismissing it as a fallacy unsupported by scientific or historical fact. According to one dictionary definition, the term "myth" may refer to a "recurring theme that appeals to the consciousness of a people by embodying its cultural ideals or by giving expression to commonly felt emotions" (Woolf 1980). In that sense, a myth is not inherently false; what makes something a myth is its cultural resonance or emotional appeal. My use of the term "myth" therefore refers not just to specific stories, like how the pronghorn got its stripes; it's also a way of looking at different assumptions that affect how we live with wild animals in Greater Yellowstone.

John Gray, who wrote *Men Are From Mars, Women Are From Venus*, didn't literally believe that men are from Mars, but by framing the issue that way, he appealed to an emotion commonly felt by women (Gray 1992). For much of Euro-American history in the New World, we've treated wildlife as if we believed that we are from Mars—as if we were a species from another planet that extracts what it wants and can eventually close the door on Earth and leave the mess behind. As Aldo Leopold said, "we abuse land because we regard it as a commodity belonging to us" rather than "a community to which we belong" (Leopold 1949).

The pristine myth

Sometimes one generation's science is dismissed by the next generation as myth, but the gradually evolving story we tell about the past incorporates changing myths as well as new empirical evidence. A striking example of this is the myth that North America was "virgin" land until Europeans arrived to live here. Until relatively recently, it was widely assumed that the continent's aboriginal inhabitants were too few in number and too primitive in their civilization to have had any significant impact on their environment. For centuries this assumption has helped support myths that encouraged Euro-Americans to view themselves as a superior race, as discoverers with a manifest destiny. It also allowed Euro-Americans to view American Indians either as inconsequential heathens or as noble savages who lived in harmony with nature and left no mark upon the land. John Craighead (1991) has written that "pre-Columbian Yellowstone was indeed a pristine wilderness. . . . and native Americans were an important member of the biota," a view that seems to regard pre-Columbian American Indians as a species of wildlife.

But now the increasingly popular view is that

the North American population in 1491 was far larger and more technologically advanced than previously thought, and that European diseases swept through the Americas so much in advance of Europeans themselves that what the settlers discovered was a post-apocalyptic landscape in which American Indians were no longer present in sufficient numbers to engineer the landscape through hunting, fires, and agriculture as they had in the past. While this view can be supported by certain archeological and anthropological evidence, it also appeals to certain contemporary myths about the superiority of American Indian culture and the need for human manipulation of wilderness areas. Instead of trying to preserve some mythical Eden in such places, this reasoning goes, we should emulate traditional American Indian practices to make our environment a more accommodating home (Mann 2005).

The myth of species extirpation as a distinctively Euro-American transgression has also been overturned by scientific research. According to the overkill theory, human predation was at least partly responsible for the extinction of the largest mammals that were present about 15,000 years ago, including mammoths, mastodons, and cheetahs (Martin and Klein 1984). After learning at a tribal consultation how obsidian points are dated, Elaine Quiver, an Oglala Sioux elder, advised National Park Service archeologists to look for "a big sliver of obsidian" that was used, she said, to "take care of the dinosaur"; then, we could figure out "when the dinosaur disappeared" (Quiver 2003). The overkill concept has also been extended to Greater Yellowstone by those who cite evidence that hunting by American Indians kept pre-Columbian ungulate populations low (Kay 1994).

Historians like William Cronon have called the idea that humans can leave nature untouched by their passage "the myth of wilderness." Cronon claimed that the removal of American Indians to create an "uninhabited wilderness . . . reminds us just how invented, just how constructed, the American wilderness really is." Charles Kay has also referred to wilderness without human influence as a "myth," and believes that it was "created, in part, to justify the appropriation of aboriginal lands and the genocide that befell native peoples." In noting that the National Park Service has referred to Yellowstone as "America's Serengeti," Kay wrote, "It's true. They're both unnatural systems. The Serengeti is a romantic, European, racist view of what an ecosystem should look like. What's more unnatural than an ecosystem without human predators?" (Hanscom 1997).

In "Greater Yellowstone's Native Ungulates: Myths and Realities," Joel Berger regarded comparisons of Greater Yellowstone to the Serengeti as a myth because the Serengeti has 31 native ungulate species, whereas Greater Yellowstone has been "impoverished in terms of its ungulate fauna" since the Miocene epoch, having only seven ungulate species, five of which migrate to lower elevation areas beyond park boundaries where "enormous ecological changes have occurred." Berger pointed out that the conservation of Greater Yellowstone will be influenced more significantly by what occurs in areas outside its two parks than by what occurs within them (Berger 1991). Humans will continue to alter the ecosystem by interfering with wildlife in various ways. It's a question of which interferences are socially acceptable at a given point in time because they are compatible with the dominant myths.

Dancing flies and gentle bears

In the nineteenth century, images like those of the Grand Canyon of the Yellowstone created by Thomas Moran and William Henry Jackson helped shape the myth of the Yellowstone area as a primeval wilderness on which neither American Indians nor wildlife had left visible footprints. These paintings and photographs, from which wildlife were usually absent, do not qualify as scientific evidence that wildlife was rare when Yellowstone was established in 1872, but the way artists chose to represent the area does suggest that wild animals were not regarded as the iconic part of the landscape that they are now. Big game animals were still commonplace in much of the country as a source of food, fur, and hides, and carnivores were still commonly regarded as a source of trouble.

The first vision of Yellowstone as a wildlife refuge came primarily from hunters who wanted protection for game species in the park so that the animals would multiply and leave its boundaries. This desire led to certain myths about "good" and "bad" animals, but species have been switched back and forth between these categories as opinions have changed over time. When Secretary of the Interior Henry M. Teller prohibited the killing of certain animals in Yellowstone in 1883, bears and other predators were not included (*Forest and Stream* 1883). But as tourism increased, the emphasis shifted from protecting the animals most popular among hunters to those popular with park visitors. Even the wildlife species that were considered "good" were valued for

reasons that weren't entirely the same as those of today. Whatever John Muir's virtues as a naturalist and proponent of wilderness preservation, his anthropomorphic descriptions of nature may strike modern readers as a Disneyland-style Fantasia. "Gladly we see the flies dancing in the sunbeams," he said of Yellowstone in 1898, "while the whole wilderness is enlivened with happy animals." He described Yellowstone's bears as "gentle now, finding they are no longer likely to be shot," and claimed that "no town park you have been accustomed to saunter in is so free from danger as the Yellowstone" (Muir 1898).

The bears became "good" when they became habituated to the proximity of humans. Decades later, Yellowstone National Park naturalist Merrill Beal thought that one reason why the U.S. Army began enforcing the hunting ban in Yellowstone was that "lonely" soldiers "in remote stations had formed enjoyable companionships with wilderness creatures," and "were delighted by the universally charming wild life trait of responding with confidence and alacrity to friendly human advances." When park managers realized that "Yellowstone birds and mammals would quickly recognize overtures of friendship and protection," they thought that "nearly every species in the Park might become as tame as range cattle if given an opportunity to move safely within rifle shot for several years" (Beal 1946).

Wild animals as livestock

In early concepts of wildlife preservation, an animal's "wildness" was often regarded as an undesirable trait, an excusable reason for an animal's demise, and something to be overcome if possible. In 1902, when Secretary of the Interior Ethan Allen Hitchcock requested funding from Congress "for the purchase of buffalo and the corralling of them in Yellowstone Park," he pointed out that by keeping them "under government supervision, it is believed that a herd of pure-blooded American bison may be domesticated" (Hitchcock 1902). Yellowstone's acting superintendent Major John Pitcher thought that the small herd of wild bison remaining in Pelican Valley "may possibly die out completely," but he expected that the 17 bison obtained from ranchers could "become very tame" if kept fenced in Lamar Valley. It was his intention "to feed and handle the new herd of buffalo in the same manner that domestic cattle are handled in this country, and . . . to brand them U.S. in such a way that they can always be identified as United States property" (Pitcher 1904).

Even Theodore Roosevelt, who took pride in his adventures as a big game hunter, regarded the habituation of Yellowstone wildlife as synonymous with tameness and something to be encouraged. After his 1903 visit to the park, he wrote, "To any lover of nature it could not help being a delightful thing to see the wild and timid creatures of the wilderness rendered so tame. . . . At times the antelope actually cross the Park line to Gardiner . . . and feed unmolested in the very streets of the town; a fact which shows how very far advanced the citizens of Gardiner are in right feeling on this subject." He described bears "boldly hanging around crowded hotels for the sake of what they can pick up," and considered them "quite harmless so long as any reasonable precaution is exercised" (Roosevelt 1905).

Twenty years later, Yellowstone National Park naturalist Milton Skinner described the grizzly bear "as a peaceful, self-respecting animal," and claimed that "there is no danger of the Yellowstone bears attacking or hurting people," although he admitted that "we often have some very exciting encounters with them when they are after our food" (Skinner 1925). Horace Albright, who was Yellowstone's superintendent in the 1920s before becoming director of the National Park Service, also regarded the value of wildlife as being directly proportional to the delight the animals could provide park visitors. But for Albright, this meant disputing the notion that the bison in Lamar Valley were "tame," which sounded rather dull. He had the park rangers stage roundups, which he described as "about the last opportunities to see . . . the fearful and impressive buffalo stampedes." In this way, Albright used a large bison herd that was accustomed to being corralled to portray the myth that these were wild animals. The real herd of wild bison in Yellowstone wouldn't have been so cooperative. As Albright saw it, the Lamar bison herd was "not tame at all except that it was provided with hay in winter and was kept under control by the gamekeeper" (Albright and Taylor 1928).

Elsewhere in Wyoming, the only reason to feed and tolerate large herds of wild ungulates was so that the animals could be hunted. "The time has finally come, and I can see whereby it is necessary to handle our game herds the same as a stock man handles his stock," said Wyoming Fish and Game Commissioner Bruce Nowlin in 1927. "The stock man knows just the number of stock he must sell each year in order to make provision for the number he can care for during the winter months." Nowlin's successor, Robert Hocker, expressed the same view four years later: "Game management is identical with livestock man-

agement," Hocker said. "The number of animals you have winter range for, and . . . the number you can afford to feed, determines the numbers at which you wish to hold your herd" (Blair 1987).

By the 1930s, the growing opinion that wildlife management should be based on ecological concepts rather than public recreation was starting to affect some wildlife policies in Greater Yellowstone. But instead of lessening the hold of myths, the trend toward scientific rationales for wildlife policies continued to feed existing myths and give rise to new ones. Science has often been used to put old wine into new bottles—to help support archaic myths such as those about creationism, racial superiority, and the balance of nature.

Like the concept of intelligent design, the balance of nature idea is so appealing that it has continued to affect how people explain natural phenomena despite considerable evidence to the contrary. Under this model, design flaws or imbalances in the natural environment are often attributed to what humans have done or failed to do. In 1946, Yellowstone manager Rudolph Grimm stated, "It is our responsibility to maintain in a natural condition the range plant cover as well as the wildlife population of this range. In order to attain such a state, we must bring about and maintain an equitable balance between the amount of range forage produced and the number of animals using this range" (Grimm 1946). The expectation that "natural condition" and "equitable balance" could be achieved through the right human manipulations was evident as the National Park Service culled thousands of elk in Yellowstone until the late 1960s.

The 1963 Leopold Report (i.e., "Wildlife Management in the National Parks") agreed that the National Park Service should "manage the habitat to achieve or stabilize it at a desired stage," and that "population control becomes essential" when "animal populations get out of balance with their habitat and threaten the continued existence of a desired environment" (Leopold et al. 1963). However, the report recommended that the park service obscure in every possible way any "observable artificiality," because the goal was to create "the mood of wild America" and "a reasonable illusion of primitive America." That meant sustaining certain myths about what primitive America was like.

Natural regulation as a myth

The myth that Euro-Americans discovered a pristine wilderness in the New World may have expired, but the story of Greater Yellowstone told by most ecologists, historians, and American Indians continues to be one in which the Indians did not have a long-term effect on wildlife as we know it until they acquired horses. The favored story changed in the 1960s, however, after the only apparent effect of reducing the elk herds was to increase public resistance to the practice. Some biologists began to question whether elk could destroy their habitat through overpopulation, proposing that forage limitations and starvation in winter would keep the herd below the range's ecological carrying capacity, a process referred to as "natural regulation." According to this view, Yellowstone had only marginal habitat for aspen and willow, browsing by a large elk herd was to be expected, and any changes in Yellowstone flora and fauna that occurred in the twentieth century were primarily the result of climate variability and fire suppression (Yellowstone National Park 1997).

Ecological and historical evidence can be mustered to support this belief, but it also attracted those who, especially prior to the reintroduction of wolves, liked to think Yellowstone was "natural" just the way it was, as a wildlife sanctuary with large, unmolested ungulate herds. As one National Park Service naturalist explained, "the removal of the wolf probably didn't have much effect on the elk or deer, because in Yellowstone wolves seem never to have served the function of controlling populations" (Schullery 1984). The doubling in size of the northern elk herd after culling ended cast more doubt on the idea that the range was overgrazed, but the unexpectedly large fluctuations quashed the idea that natural regulation would lead to some kind of sustained balance. Wildlife managers began to realize that balance was a largely subjective matter; people were apt to consider a species out of balance if it caused property damage, if a favored species declined, or if some animals died because they could not survive the winter. But some critics of National Park Service policies continued to dismiss natural regulation as a myth—"nothing more than a policy of waiting for bad weather" (Chase 1986).

The concept of natural regulation as it's been used in Greater Yellowstone is also regarded as a myth by some American Indians. A Salish from the Flathead Reservation has said, "Although the park claims it is managing for natural regulation, it is not natural to shoot buffalo in the winter. It is necessary to harvest animals when they are in good condition" (Ravndal 1997). Winter is "the time the animals should be at rest," Haman Wise of the Eastern

Shoshone agreed. "The buffalo should have a rest period someplace to revise their spirituality" (Wise 2000). Historically, the Indians did sometimes hunt buffalo in the winter when they were hungry, or because they preferred fresh meat to dried pemmican, or because that's when the buffalo were wearing their warmest robes (Isenberg 2000). What matters about these Indians' beliefs is not their historical accuracy, but that they appeal to emotions commonly felt by Indians.

Some people believe that humans have altered Greater Yellowstone too much for park managers to realistically consider leaving nature to itself, and that without interventions to compensate for human disturbances, something "unnatural" or otherwise unacceptable happens to ungulate populations and their habitat. By the early 1990s, an increasing number of people believed that what Yellowstone really needed was human intervention in the form of wolf reintroduction.

The new wolf

The wolves of Greater Yellowstone have, at least in much of the mainstream press, undergone a complete image makeover since they were eradicated from the area in the 1930s. Once the embodiment of all that was bad about untamed wilderness, now they are widely regarded as the savior of the little wilderness that remains. In his 1978 book, *Of Wolves and Men,* Barry Lopez wrote, "biologists have given us a new wolf, one separated from folklore. But they have not found the whole truth. For example, wolves do not kill just the old, the weak, and the injured. They also kill animals in the prime of health. And they don't always kill just what they need; they sometimes kill in excess. And wolves kill each other. The reasons for these acts are not clear. No one—not biologists, not Eskimos, not backwoods hunters, not naturalist writers—knows why wolves do what they do" (Lopez 1978).

Although nearly 30 years have passed since Lopez wrote that, biologists still haven't found the whole truth, and some people believe that biologists are still trying to perpetuate old myths, like the one that regards the wolf as an endangered species, or that wolves never attack humans. Most wildlife managers have done their best to separate the wolf from its folklore, but because we still can't always explain why wolves do what they do, and because we don't always like the results, the folklore persists. The myths of wolf restoration in Greater Yellowstone in 1995 as either a great conservation triumph or a colossal blunder are still very much with us.

Although Rick Bass disdained Yellowstone as "prey-infested" in his 1992 book, *The Ninemile Wolves*, he opposed the release of wolves in the park. He believed it was as phony as the park's buffalo purchase of 1902—something done for the sake of tourism rather than for ecological integrity. In 1997, those willing to donate $5,000 to the cause could "become a full partner in Yellowstone National Park's historic wolf recovery program in a special and personal way." In an advertisement in *Wolf Tracker*, the Yellowstone Wolf Foundation offered to "inscribe your name—or the name of a loved one—onto a new radio-telemetry collar just before it is placed on a wild Yellowstone wolf." When the collar was "retrieved" in three years, it would be "shipped to you for your family's permanent safe-keeping and education." In *The New Wolves*, Bass compared the transport of wolves from Canada to a shopping trip undertaken "to fill in the emotional blanks of a fractured landscape" (Bass 1998), and he would probably feel the same way about spending $5,000 to get your name inscribed in a radio collar. Bass is loyal to the cause of wolves, which he regards as offering the best chance of erasing the boundary lines that fragment the West, but he wanted them to be allowed to return to Yellowstone on their own, without the intrusion of radio collars and intensive monitoring.

Rather than support John Muir's myth that national park boundaries provide a safety net for wild animals, wilderness advocates like Bass see the boundaries as strangling wildlife. Yet Bass has joined those who believe in the nearly miraculous transformation of Greater Yellowstone as a result of wolf reintroduction. As Bass saw it in 2005, the wolves "have reshaped huge sections of an awkwardly leaning ecosystem;" now "there is color in the land again" (Bass 2005). Those who thought there was color in the land before wolves returned must have been looking at it through rose-tinted glasses, and that would include the National Park Service staff who co-authored a 1986 book that stated, "it remains open to question whether the ecosystem 'needs' wolves in some absolute sense" (Despain et al. 1986). Less than two decades later, a park service biologist was claiming that "wolves are to Yellowstone what water is to the Everglades" (Thompson 2003).

Diligently protected species

The labeling of good and bad animals changes over time, and a species may continue to be favored in one part of Greater Yellowstone after it has be-

come a pariah in another. After 1994, when the National Park Service began spending millions of dollars to save the native Yellowstone cutthroat trout by removing non-native lake trout from Yellowstone Lake, the state of Wyoming continued to put thousands more lake trout into Jackson Lake every year. And when the Wyoming Game and Fish Department announced plans last year to phase out this stocking program, their primary stated reason was the apparently deleterious effect of the program on the lake trout, not on the native cutthroat (Wyoming Game and Fish Department 2004).

Although both elk and bison are native species, elk continue to be treated more like "good animals" throughout Greater Yellowstone. The recent *Draft Bison and Elk Management Plan for the National Elk Refuge and Grand Teton National Park* included a section that explained "The Role of Elk" in the Jackson area. Elk were described as "diligently protected," "important to residents and interest groups," "important to backcountry users as well as to people that never leave the road," and "at the mercy of sometimes severe winters" (U.S. Department of the Interior 2005). The document made no mention of elk's depredation of ranchers' haystacks, the cost of the feedgrounds and vaccination using biobullets, or the role elk presumably had in transmitting brucellosis to Wyoming livestock in recent years.

The next section of the plan, "The Role of Bison," described the problems caused by the Jackson bison herd, which has been at the mercy of more critical thinking than the elk. "All of the adults were destroyed" in 1963 because of brucellosis. Not only do these animals currently pose a "risk of disease transmission to elk and livestock," but they also "disrupt feeding operations" for the elk, "displace and injure elk," "eat supplemental feed provided for elk," cause "damage to habitats," "damage to private property," "conflicts with landowners," and pose a "risk to human safety."

American Indians have challenged the myth of bison as the bad guys at consultation meetings the National Park Service began holding in 1996 because of the tribes' objections to how bison were being treated at the Yellowstone boundary. Haman Wise from the Wind River Reservation has felt obliged to repeatedly explain what he calls "the part nobody understands." "You really don't know why the buffalo leaves, do you?" he says to park staff. "The buffalos leave the park because they have to eat that certain medicine plant. That takes care of all the ailments in their body. . . . That's why you don't see very much aborting in buffalo" (Wise 2000).

The park service believes it knows better, but "scientific" explanations for why bison leave the park can get as bogged down as a snowshoe in spring slush. According to one authoritative analysis, bison leave the park because of "population dynamics . . . influenced by density-independent winter stress conditions . . . social behaviors, . . . learned behaviors, . . . [and] a combined winter severity index including a weighted measure of snow (40%), temperature (40%), and rain (20%). . . . [O]ther variables seem to be dampened or compensatory with natural mortality. . . ." (Cheville et al. 1998). Another report concluded that "Bison move beyond park boundaries in winter in response to forage limitation caused by interactions between population density, variable forage production (driven by spring/early summer precipitation), snow conditions, and herbage removal primarily by bison and elk" (Gates et al. 2005).

As for abortions in Yellowstone bison, the scientific consensus is that they are infrequent because the abortion rate drops in any ungulate herd that has become chronically infected with brucellosis (Cheville et al. 1998). Yet until the 1990s, the National Park Service's defense of its bison management policy routinely suggested that abortions were infrequent because the bacteria may have co-evolved with bison in North America (Yellowstone National Park 1972). The park service's critics couldn't prove that *Brucella abortus* was an exotic species brought by European livestock, unless you believed American Indian reports that brucellosis and undulant fever were previously unknown on this continent. But the idea that the bacteria were native to Greater Yellowstone was appealing to people who didn't like the idea that Yellowstone bison were susceptible to some lowly livestock disease and who opposed taking drastic measures against the bison. As National Park Service Director William Mott explained in 1987, the agency's responsibility to future generations "extends to disease organisms such as those causing brucellosis . . . when they are a natural component of the park ecosystems we are mandated to protect" (Mott 1987).

Beyond scientific measurement

Some American Indians believe they have a special responsibility to a certain animal because its spirit appeared to them in a dream or during a vision quest and granted them a special power. An Indian visited by the pronghorn spirit, for example, might receive the power to call pronghorn and keep

them spiritually captive until they could be killed. But this partnership with animals comes with a set of obligations, including rituals to be performed. In Shoshone traditions, a slain pronghorn was placed with its head to the east and addressed with respect. The hunters would offer the animal's eyes and skull to the spirit world by suspending them from trees (Dramer 1997). In ceremonies to honor their guardian spirits, the Assiniboine bear dreamers may paint black circles around their eyes and mouths, wear necklaces made of bear claws, and tie their hair into two clumps to resemble bears' ears. In battle, these bear dreamers confronted the enemy holding knives made from a bear's jaw bone, and they imitated the sound of a bear, believing the power of the bear would protect them (Rockwell 1991).

When we hear stories that express the connection between people and wildlife in terms of sacred rituals, we may feel some condescension toward beliefs so lacking in any scientific basis, or we may envy the apparent intimacy of the relationship. But our view of wild animals continues to be colored by myths, even if we're unaware of them, and by taking the long view of human history in Greater Yellowstone, we can see that myths have served a purpose by enabling people to explain what cannot be satisfactorily understood or justified based on scientific evidence alone.

For example, consider the killing of bison by licensed hunters in Montana for the first time in 15 years that is scheduled to commence in less than a month [November 2005]. In its environmental assessment, Montana Fish, Wildlife and Parks described its proposed hunt as both a means of removing "persistent problem animals" and a "fair chase." Although the definition of fair chase lies largely with the hunter, it's generally understood to mean that the balance of power is such that the hunted animal has some chance of eluding the hunter. It's difficult to imagine that a system could be fair or at least logical in which long-range plans call for the bison to stand still and take their medicine when approached by a wildlife biologist shooting biobullets at them, but to run away and behave like wild animals when approached by a hunter. However, the idea of a fair chase bison hunt in Montana may be considered mythical not because it could never happen, but because the concept of fair chase has become "a recurring theme that appeals to the consciousness of a people by embodying its cultural ideals." Many people in Western culture, few of whom are hunters, have come to assume that when a game animal is shot on public land in circumstances that do not qualify as fair chase or self-defense, the killing is somehow unethical. As stipulated in the bill passed by the 2003 Montana Legislature, any hunting season for bison was to be "conducted under ethical hunting conditions, i.e., fair chase" (Montana Fish, Wildlife and Parks 2004).

The concept of a fair chase has some ecological basis, because the behavior of a prey species that knows it is prey and defends itself accordingly resembles the natural selection process in which the species has evolved. But from an ethical standpoint, the use of fair chase as the defining characteristic is quite arbitrary. Although opponents of hunting bison that have learned no fear of humans tend to claim the activity is "as sporting as shooting a parked truck" (McMillion 2005), for some American Indians it is sport hunting that is inherently unethical or even sacrilegious. From this perspective, what makes killing a wild animal ethical is not the difficulty of the pursuit, but the respect and relationship of mutual obligation that you share with the animal. According to many traditional Indian beliefs, an animal that is approached in the right spirit will give itself willingly to the hunter.

The flip side of the myth that we are separate from the rest of nature is the idea that we are just a species like any other or, as Aldo Leopold put it, that "men are only fellow-voyagers with other creatures in the odyssey of evolution" (Leopold 1949). J. Baird Callicott has suggested that if the "works of man" are "entirely natural and the products of evolutionary phenomena," then they may be "symbiotically integrated with other contemporaneous evolutionary phenomena; they may in principle be beneficial to the biotic communities" we inhabit (Callicott 1991). Seeing ourselves as part of the continuum of nature can give us a sense of kinship with other animals, but it can also offer a rationale for all our predatory behavior. Other animal species must adapt to their environment to meet their biological needs, whereas humans can far more rapidly and extensively alter their environment to meet both their needs and desires. Humans are also, as far as we know, the only species that can create myths about other animals rather than simply learn facts about them. As the philosopher Holmes Rolston III has pointed out, if we did not interfere with and rearrange nature, we would have no human culture (Rolston 1994). Instead of regarding ourselves as fellow voyagers with other creatures, or as their masters or stewards, Henry Beston suggested that we need "perhaps a

more mystical concept" of animals:

> We patronize them for their incompleteness, for their tragic fate for having taken form so far below ourselves. And therein do we err. For the animal shall not be measured by man. In a world older and more complete than ours, they move finished and complete, gifted with the extension of the senses we have lost or never attained, living by voices we shall never hear. They are not brethren, they are not underlings: they are other nations, caught with ourselves in the net of life and time, fellow prisoners of the splendour and travail of the earth (Beston 1928).

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Integrating Natural Resource Monitoring Across State and Federal Agencies

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Abstract

Opportunities exist for state and federal agencies in Greater Yellowstone to work together on monitoring natural resources where the populations of interest or monitoring objectives cross agency and state boundaries. In fact, the National Parks Omnibus Management Act of 1988 instructs the National Park Service to develop ". . . monitoring programs in cooperation with other Federal monitoring and information collections efforts to ensure a cost-effective approach." From a conceptual standpoint, coordinating monitoring programs with neighboring state and federal agencies is an essential step toward a more integrated approach. However, in reality, different budget cycles, planning schedules, and data management requirements can handicap the best of intentions. I will evaluate contemporary case studies in which ecological, spatial, temporal and/or programmatic integration of natural resource monitoring is working despite the differences in agency requirements.

Introduction

One of the more difficult aspects of designing a comprehensive monitoring program is integrating monitoring projects so that the interpretation of a whole monitoring program yields information more useful than that of individual parts (NRC 1995). The Greater Yellowstone Inventory and Monitoring Network has a unique opportunity to at least consider monitoring objectives that enhance our ability to interpret the condition and trend of natural resources across the Greater Yellowstone Ecosystem (GYE). It is an opportunity that warrants investigation into methods that integrate natural resource monitoring across state and federal agency boundaries.

There are many reasons to strive for better integration. First, integration can result in a more comprehensive monitoring portfolio, which in turn enhances our ability to interpret the condition and trend of natural resources and gives us the potential to yield information more useful than that of individual parts. Another important reason for better integration is the 1998 National Parks Omnibus Management Act (16 U.S.C. §5934 (2000)). This act instructed the secretary of the interior to undertake a program of inventory and monitoring of National Park System resources to establish baseline information and provide data on long-term trends in the condition of the National Park System. It also instructed the National Park Service (NPS) to develop monitoring programs in cooperation with other federal monitoring and information collection efforts to ensure a cost-effective approach.

What is meant by integration?

Integration is the act of bringing together disparate parts into a united, harmonious, or interrelated whole. As it applies to natural resources monitoring in the GYE, there are a number of ways for integration to happen. An obvious way is to interface and pool data across agency boundaries such that it is possible to interpret ecosystem health across a broad landscape.

Data collected in the NPS today need to meet national-level quality standards and need to be accessible for use in wise and defensible decisionmaking at all levels (Miller 2001). Land managers need to be able to share and aggregate their data with data from other adjacent agency lands to support landscape-level and national planning and policy formation. A primary basis of the NPS's Natural Resource Challenge (NPS 1999) initiative is the provision of scientifically credible information for informed decisionmaking.

However, pooling data into a common database does not in itself allow for meaningful interpretation. So what more should we consider when trying to integrate across boundaries?

Key factors to successful integration

Data management is a primary factor to consider when designing an integrated monitoring program. Steps can be taken to ensure that data collected by different agencies is comparable and that databases interface across agencies. There are also other important factors involving the ecological, spatial,

temporal, and programmatic aspects of a monitoring project. The NPS Inventory and Monitoring (I&M) Program (NPS 2005) has described the following forms of integration:

Ecological integration involves considering the ecological linkages among system drivers and the components, structures, and functions of ecosystems when selecting vital signs (a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources). An effective ecosystem monitoring strategy will employ a suite of individual measurements that collectively monitor the integrity of the entire ecosystem. One approach for effective ecological integration is to select vital signs at various hierarchical levels of ecological organization (e.g., landscape, community, population, genetics; see Noss 1990).

Spatial integration involves establishing linkages of measurements made at different spatial scales within a national park or network of parks, or between individual park programs and broader regional programs (i.e., NPS or other national and regional programs). It requires understanding of scalar ecological processes, the co-location of measurements of comparably scaled monitoring indicators, and the design of statistical sampling frameworks that permit the extrapolation and interpolation of scalar data.

Temporal integration involves establishing linkages between measurements made at various temporal scales. It is necessary to determine meaningful timelines for sampling different indicators while considering characteristics of temporal variation in these indicators. For example, sampling changes in the structure of a forest overstory (e.g., size-class distribution) may require much less frequent sampling than that required to detect changes in the composition or density of herbaceous groundcover. Temporal integration requires nesting the more frequent and, often, more intensive sampling within the context of less frequent sampling.

Programmatic integration involves the coordination and communication of monitoring activities within and among parks, among divisions of the NPS Natural Resource Program Center, and among the NPS and other agencies, to promote broad participation in monitoring and use of the resulting data. Finally, there is a need for the NPS to coordinate monitoring, planning, design, and implementation with other agencies to promote data sharing among neighboring land management agencies, while also providing context for interpreting the data (NPS 2005).

Bridging state and federal agencies

Integration should be considered early in a monitoring program to ensure full consideration of the ecological, spatial, and temporal aspects of a monitoring design. However, even when considered early, there are cases and situations in which integration is not reasonable due to differing agency objectives and funding cycles. Agencies must recognize their common objectives and reconcile their differences—not only in regard to ongoing monitoring programs but also during the planning phases of new monitoring. In either case, the NPS I&M program has endorsed the development of well-written monitoring objectives as a prerequisite to monitoring design. Olsen et al. (1999 *in* Jean et al. 2005) noted that "Most of the thought that goes into a monitoring program should occur at this preliminary planning stage. The objectives guide, if not completely determine, the scope of inference of the study and the data collected, both of which are crucial for attaining the stated objectives." Once monitoring objectives are defined, the feasibility of integration with other parks and with adjacent lands to support landscape-level monitoring can be evaluated. In the NPS I&M program, monitoring objectives are written into monitoring protocols (Oakley et al. 2003) that are shared with neighboring agencies.

Monitoring protocols are detailed study plans that explain how data are to be collected, managed, analyzed, and reported (Oakley et al. 2003). They are an important requirement that enhances the NPS's ability to integrate data across state and federal agencies. Oakley et al. (2003) articulated four important reasons for taking the extra effort to complete a monitoring protocol:

> Monitoring protocols are 1) a key component of quality assurance for monitoring programs to ensure that data meet defined standards of quality with a known level of confidence, 2) necessary for the program to be credible so that data stand up to external review, 3) necessary to detect changes over time and with changes in personnel, and 4) necessary to allow comparisons of data among places and agencies.

Overcoming pitfalls and obstacles

A number of authors have described pitfalls and obstacles to sharing data and offered recommendations for overcoming these problems (NRC 1995). Starting with the presumption that "data worth collecting are worth saving," the National Resource

Council (NRC; NRC 1995) suggested setting aside 10% of a project's total cost for data management. This cost estimate should include adequate funds for preparing thorough metadata that service the needs of all potential users. The NRC recommended that efforts to establish data standards focus on a key subset of common parameters whose standardization will best facilitate data interfacing. Additionally, the data requirements, data characteristics and quality, and scales of measurement and sampling should be well defined at the outset. The NRC's investigations led it to identify 10 keys to successful data interfacing:

1. Be practical;
2. Use appropriate information technology;
3. Start at the right scale;
4. Proceed incrementally;
5. Plan for and build on success;
6. Use a collaborative approach;
7. Account for human behavior and motivation;
8. Consider needs of participants as well as users;
9. Create common needs for data; and
10. Build participation by demonstrating the value of data interfacing.

In another example, Steve Hale (1999) presented a tongue-in-cheek case for "managing data badly" in which he offered database managers 10 techniques to guarantee that no one would ever use their data. For example, "to avoid bias, metadata (information about data) should be written by people not familiar with the scientific discipline." In a follow-up commentary, Hale (2000) outlined similar techniques specific to scientists responsible for managing data, including a tip on avoiding tedious work by not verifying the accuracy of the data and skipping metadata altogether. Hale concluded (in earnest) with three basic things that managers could do better. These were to (1) place good quality data sets where they can be obtained, (2) make entries in data dictionaries so data sets can be found, and (3) write metadata files so data sets can be understood.

In all likelihood, the need for integration across state and federal agencies will grow as scientists and managers demand landscape and regional status and trend monitoring. Well-defined monitoring objectives and good data management will allow for integration and serve both today's and future land managers.

For more information on National Park Service monitoring guidelines, visit the I&M website at <http://science.nature.nps.gov/im/monitor/index.cfm>.

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Progressivism Comes to Yellowstone: Theodore Roosevelt and Professional Land Management Agencies in the Yellowstone Ecosystem

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Abstract

This paper will examine Theodore Roosevelt's involvement in the creation of professional governing agencies to manage the Yellowstone ecosystem in the spirit of progressivism. Throughout the Progressive Era, many professional governing agencies were created to regulate the basic economic and social needs of the American nation. This movement was evident during the administration of Theodore Roosevelt and would have a lasting impact on the Yellowstone ecosystem. In 1905, Theodore Roosevelt and Gifford Pinchot created the U.S. Forest Service (USFS). The following year, Roosevelt appointed retired army general S. B. M. Young, the park's first civilian superintendent since the U.S. Cavalry assumed the management of Yellowstone. Roosevelt instructed Young to work on plans to create a civilian park guard; however, Roosevelt later rejected this idea, and with Pinchot's support, planned to place Yellowstone National Park under USFS control. This idea was unsuccessful, however, and Yellowstone remained under military supervision until the creation of the National Park Service in 1916 (an agency that Roosevelt fully supported). The attempt to organize land management agencies for Yellowstone reflects the efforts of Progressives to create professional agencies to handle governmental issues such as the management of federal lands. By examining the origins of the USFS and the National Park Service in relation to the Progressive Era and the Roosevelt Administration, we can understand the commonality of these two differing agencies that share the task of managing the Yellowstone ecosystem.

Introduction

Throughout the Progressive Era, many professional governing agencies were created to regulate the basic economic, social, and political needs of the American nation. This movement toward professional federal government agencies was evident during the administration of Theodore Roosevelt (1901–1909), and left a lasting impact on the Yellowstone ecosystem. In 1905, Roosevelt placed the nation's forest reserves under the direct supervision of Gifford Pinchot and created the modern U.S. Forest Service (USFS). In the following year, Roosevelt appointed retired army general Samuel Baldwin Marks Young to be the first civilian superintendent of Yellowstone National Park to serve in that position since the U.S. Cavalry had assumed the management of Yellowstone in 1886. Roosevelt instructed Young to work on plans for a civilian park guard that would manage the park; however, Roosevelt later rejected this idea and, with Pinchot's support, planned to place Yellowstone under forest service control. This idea was unsuccessful, however, and the park remained under military supervision after Roosevelt's term of office ended. Roosevelt's hand-picked successor, William H. Taft, continued to support the creation of a civilian park guard, but the park remained under military control until the creation of the National Park Service in 1916, under the administration of Roosevelt's political opponent, Woodrow Wilson. Roosevelt fully supported the creation of a civilian park guard, even if it was achieved during Wilson's term of office.

Roosevelt's efforts to create a civilian park guard, and his later support of the National Park Service (NPS), reveal a side of the president that is rarely revealed in the history of the environmental movement. Many historians and environmental writers have classified Roosevelt as a conservation-minded environmentalist who argued for scientific use of the land—not as a preservation-minded environmentalist who favored protection of the aesthetic landscape. Roosevelt's involvement in the creation of the NPS and USFS, however, clearly indicated that he supported not only the conservation movement as advocated by Gifford Pinchot, but also the preservation movement as advocated by John Muir. Theodore Roosevelt can not be characterized as a sole supporter of any side of the early environmental movement in the Progressive Era.

Urbanization and its impact on the West

The forces that would transform the administration of Yellowstone National Park did not emerge in the canyons of the Yellowstone River, but within the canyons of the tenements, factories, and mansions lining the streets of the nation's rapidly expanding eastern cities. In the aftermath of the Civil War, America's economy shifted away from rural agriculture and toward the industry concentrated in the nation's urban centers. Having profited from the production of munitions and other materials during the Civil War, small factories grew into major international corporations, trusts, and monopolies that dominated the American economy. The tentacles of these massive corporations, in the form of railroad tracks, reached deep into the American West to devour its vast natural resources (Cashman 1984; Painter 1987; Summers 1997; Trachtenberg 1982; Wiebe 1967).

Eventually, only small pools of America's wilderness remained, one of which was the Yellowstone ecosystem. Congress offered some protection to this area in 1872, by setting aside Yellowstone National Park as a "pleasuring ground for the benefit and enjoyment of the people." Congress took another major step toward saving the natural resources of the West with the passage of the Forest Reserve Act of 1891, which granted presidential authority to establish national forest reserves. That year, President Benjamin Harrison used this newly acquired power to set aside the Yellowstone Park Timberland Reserve, expanding federal protection of the Yellowstone ecosystem to the south and east of Yellowstone National Park.

Unfortunately, the new political status of these lands did not mean they were spared from demands on the resources within them. Timber disappeared in fires started by careless tourists and at the hands of timber thieves. Wildlife numbers declined from market hunting. Geysers and hot springs fell prey to visitors who collected natural specimens for souvenirs, soaped the geothermal features for entertainment, and slaughtered countless numbers of wildlife and fish for their meals. Developers claimed large tracts of land and constructed various grades of concessions to profit from the increasing numbers of visitors to the region. Due to the lack of a professional land management agency or police force, visitors, market hunters, and developers continued their despoliation of the lands for personal gain at great expense to the natural features of the region (Bartlett 1985; Haines 1977 v1; Schullery 2004).

Theodore Roosevelt fully understood the transformation brought on by the shift from agronomy to industry, as well as its impact on the demand for natural resources, writing:

> The growth of this nation by leaps and bounds . . . has been due to the rapid development, and alas . . . to the rapid destruction of our natural resources. Nature has supplied to us in the United States . . . more kinds of resources in a more lavish degree than has ever been the case at any other time or with any other people. Our position in the world has been attained by the extent and thoroughness of the control we have achieved over nature; but we are more, and not less, dependent upon what she furnishes than at any previous time of history since the days of primitive man (Roosevelt 1927 v16, 121–122).

Another emergent force from the eastern cities that would impact the management of the Yellowstone ecosystem was the political corruption and ineptitude arising from machine politics, known as the "spoils system." Before the age of civil service, government representatives did not hire or appoint employees on the basis of their skills, education, or previous employment; rather, it was a job candidate's political connections that were important. A lack of secret ballots clearly identified supporters and non-supporters, allowing the bosses to reward voter support with patronage positions. The spoils system also had a hold on the federal government—especially the executive offices (under presidential authority) that managed the newly created federal public land reserves—which helped ensure that the management of federal lands in the Yellowstone ecosystem would not be very effective. Presidents and their cabinet members rewarded their political supporters with patronage positions while non-supporters—even individuals within their own political parties—were fired regardless of their management skills, knowledge of the areas they were charged with protecting, or previous service.

Leaders of industry quickly realized how to use this system to their advantage, promoting their own economic goals via machine politics and increasing their monopolistic hold on the nation. For instance, Crédit Mobilier, a "dummy" construction company associated with the Union Pacific Railroad, was used to bilk millions of dollars out of the federal government coffers under the Pacific Railway Act. It became the center of public attention when a key stockholder, Congressman Oakes Ames, used Crédit Mobilier stock to influence the passage of

favorable legislation. The Crédit Mobilier scandal clearly reflected the power and control that large corporations wielded over both the legislative and executive branches of the federal government, and railroads used this influence to expand their hold on the West. This was never more evident than in the Northern Pacific Railroad's attempts to direct the creation and future of Yellowstone National Park and the surrounding region (Runte 1990).

Many of Yellowstone's early civilian superintendents, appointed by the secretary of the interior under the spoils system, came from territorial offices that were ripe with incompetent or corrupt appointees. Often, these appointees also had strong political and economic ties to the railroad corporations. Yellowstone's first superintendent, Nathaniel P. Langford, who enjoyed strong Republican connections and was a former territorial officer from Montana, clearly served the Northern Pacific Railroad's interest more than the public's interest. In fact, after the construction of the Northern Pacific stalled due to the collapse of Jay Cooke's finances (precipitating the Panic of 1873), Langford essentially abandoned his position as park superintendent. During his tenure, Langford visited Yellowstone only one time (Bartlett 1985; Haines 1977 v1; Langford 1972; Schullery 2004).

Patrick H. Conger, Yellowstone's third superintendent, reflected the ineptitude fostered by the spoils system. Early park historian Hiram Chittenden noted, "Of this Superintendent, it need only be said that his administration was throughout characterized by a weakness and inefficiency which brought the Park to the lowest ebb of its fortunes, and drew forth the severe condemnation of visitors and public officials alike" (Chittenden 1964, 112). Conger and the assistant secretary of the interior allowed the Northern Pacific (which finally completed its tracks in the early 1880s), operating under the guise of the Yellowstone Park Improvement Company, to claim thousands of acres in government leases and establish monopolistic control over the main attractions of the park. This company also began logging operations and slaughtered wildlife to feed its workers.

In 1884, Robert E. Carpenter replaced Conger as superintendent of Yellowstone through the political connections of his brother, who was the governor of Iowa. According to Chittenden, the new superintendent viewed Yellowstone National Park as "an instrument of profit to those who were shrewd enough to grasp the opportunity. Its protection and improvement were matters of secondary consideration" (Chittenden 1964, 116). Carpenter attempted to further the hold of the Northern Pacific Railroad on the park by lobbying for some of the lands within its boundaries to be opened for private occupancy by the railroad.

The forest reserves also suffered under the spoils system. In 1880, the Division of Forestry, led by Franklin Hough, was created under the Department of Agriculture with the purpose of making recommendations regarding the administration of the national forest reserves, which at that time were under the domain of the Department of the Interior (Steen 1991). Three years later, the capable Hough was replaced by Dr. N. H. Egleston, whom famed forester Gifford Pinchot described as "one of those failures in life whom the spoils system is constantly catapulting into responsible positions" (Pinchot 1947, 135).

Pinchot also noted many problems within the Department of the Interior, one in particular: "Since jobs on the Forest Reserves were for distribution to politicians, Commissioner Binger Hermann of the General Land Office was careful to get his while the getting was good. The average appointee was plenty bad enough, but Binger's personal appointments were horrible," he wrote (Pinchot 1947, 162). Pinchot went on to describe numerous instances of incompetent employees hired under the spoils system. Many forest supervisors, hired due to nepotism and patronage, were too old, frail, corrupt, and ignorant of forestry to perform the basic tasks required of their positions. "An elderly man," wrote Pinchot, "who had been cashier in a bank, was a close friend of the Commissioner. He frankly admitted he had no knowledge of forest conditions and didn't know one tree from another. But Binger made him Forest Inspector, the most important and responsible post of all" (Pinchot 1947, 163–164).

Influential congressmen also forced their appointees onto forest reserves. "Uncle" Joe Cannon, Speaker of the House, appointed several men whom Pinchot deemed ineffective; he described one individual as "a one-lunger with one leg" (Pinchot 1947, 164). Some appointees collected paychecks from the Department of the Interior without setting foot onto the forest reserves. Pinchot summed up the effect of these supervisors and rangers:

> Take it by and large, the Interior Department's field force on the Forest Reserves was enough to make angels weep. Naturally it aroused strong opposition to the whole Reserve System. However lightly the Western men

> of those days may have held the land laws, they had high standards of personal courage and hardiness, and they were not lazy. Such men could have nothing but contempt for a service manned by the human rubbish which the Interior Department had cheerfully accepted out of Eastern and Western political scrap heaps and dumped into the Forest Reserves (Pinchot 1947, 167) .

Surprisingly, some effective individuals were appointed to Yellowstone National Park and the Yellowstone Timberland Reserve. Famed artist and rancher A. A. Anderson, placed in charge of the Yellowstone Timberland Reserve, was one such supervisor. Anderson limited grazing on the forest lands, worked to enlarge the boundaries of the reserve, and established an efficient administrative organization to manage the vast lands under his control. Anderson later recalled,

> Gifford Pinchot, after accompanying me on a tour of inspection, reported to the President that the Yellowstone Reserve was one of the best organized, patrolled and managed forest reserves in the country. It was indeed gratifying to receive a letter from President Roosevelt saying in part: 'Mr. Anderson, I believe you have the right ideas in forestry matters. Go ahead and carry them out, knowing you have the Department of the Interior and the President solidly behind you' (Anderson 1927, 385).

Likewise, Philetus W. Norris served as an effective superintendent of Yellowstone. Norris explored and mapped new areas in the park, studied the park's geological and archeological resources, wrote the park's first detailed set of rules and regulations, and attempted to establish a functional administrative organization to manage the park. Norris's administration made significant strides in protecting Yellowstone; unfortunately, Norris soon ran afoul of the Northern Pacific Railroad's interests in the park, and of local residents who were angered by Norris's involvement in changing a mail route. Norris's political enemies moved quickly to replace him with Patrick Conger, who quickly demonstrated his intentions to promote the railroad's interests in Yellowstone.

It should be noted that both Anderson and Norris were unusual public servants for their time, being wealthy men who did not need a government salary in order to survive. Both were well-connected politically, although a political struggle cost Norris his job. Their most unusual characteristic, however, was that they both had a strong personal desire to protect the lands under their direct supervision. This was especially true of Anderson, whose ranch bordered the forest reserve—a fact that may have increased his motivation (Anderson 1933; Haines 1977; Schullery 2004).

Congress provided some legislative protection to the Yellowstone ecosystem under the spoils system, but it tended only to respond to blatant problems, rather than providing preventive measures to avoid future problems. This process was slow and relied on active individuals and organizations, such as the Boone and Crockett Club, to identify the problems and lobby for legislative action (Haines 1977 v1; Reiger 1975). For instance, when the Yellowstone Park Improvement Company moved to establish a monopoly over Yellowstone during Patrick Conger's administration, General Phil Sheridan generated enough publicity that Congress made provisions under the Sundry Civil Appropriations Bill of 1883 to limit the size of leases. More importantly, the bill contained a provision wherein the U.S. military could assume the management of Yellowstone upon the request of the secretary of the interior. When Congress subsequently failed to appropriate any funds for the management of Yellowstone in 1886, the U.S. Cavalry was sent to the park. When a writer from *Forest and Stream,* the literary voice of the Boone and Crockett Club, reported on a blatant case of poaching in Yellowstone, Congress responded with passage of the Lacey Act. The Lacey Act established fines and penalties to punish poachers in Yellowstone, as well as a court system to prosecute accused poachers and other criminals. In 1894, Congress created further provisions restricting leases and their operations within Yellowstone National Park with the passage of the Hayes Act (Chittenden 1964; Haines 1977 v1).

Machine politics impacted federal management of the Yellowstone ecosystem through the end of the nineteenth century. Fortunately, the U.S. Cavalry protected the park from most of its immediate threats. The Yellowstone Timberland Reserve, however, endured mismanagement under the spoils system until Theodore Roosevelt became president and expanded Pinchot's authority over the forest reserves.

The Progressives and the creation of professional government agencies

While the spoils system negatively impacted the Yellowstone ecosystem, another force from the cities brought positive change to the region:

Progressivism. The Progressive Movement emerged as a combination of a number of reform movements that were active in the 1870s and 1880s. These groups included urban reformers, women's suffragists, members of the Populist Party, and prohibitionists. Beginning in the 1890s, middle-class America fought to save American capitalism from the unregulated industrialists, the corrupt spoilsmen, and the radical labor union leaders who threatened social revolution. The Progressives adopted many reforms from earlier political movements—especially the Populist Movement—as their own and pushed them onto the national scene as a collective political movement (Cashman 1984; Chambers 1992; Cooper 1990; Diner 1998; Gould 2001; Hofstadter 1955; Link and McCormick 1983; McGerr 2003; Painter 1987; Summers 1997; Sullivan 1996; Trachtenberg 1982; Wiebe 1967).

Progressive reforms included the end of the spoils system and the tight control held by political bosses, through increased and uninhibited political participation of the electorate. Democratic reforms such as initiatives and referendums allowed more direct participation in the creation of legislation. The electorate was expanded through women's suffrage, and the use of the secret ballot prevented party bosses from knowing who voted for which party and which candidates. Progressives also hoped to replace the inept political officeholders appointed under the spoils system by creating both a merit system guided by a civil service process and strong executive federal powers that bypassed the kinds of legislative political squabbles that were responsible for slowing administrative responses to social problems. Progressives strongly advocated the creation of more professional government bureaucracies staffed with professionals appointed on the basis of their educational background and work skills instead of their political connections. Progressives hoped that these professional government employees would successfully manage much-needed social and economic reforms as well as the conservation of public lands.

Progressives successfully implemented many of these reforms at various local levels of government. After a major hurricane destroyed the city of Galveston, Texas, in 1900, killing at least 6,000 people, its citizens created a commission of professional city administrators to assume the duties and responsibilities of an elected mayor. The movement to create more professional governing agencies also took hold at the state level and became popularly known as the "Wisconsin Idea." The "Wisconsin Idea" was the brainchild of Wisconsin governor Robert "Battling Bob" LaFollette, who recruited a "brain trust" from the University of Wisconsin to help his administration address the new demands placed on the state by the rise of urbanization and industrialism.

At the same time when local and state governments desired to increase professional standards, many occupational fields increased their level of professionalism through licensing and self-regulation administered by professional associations. Doctors, for instance, began to rely more and more on the American Medical Association for licensing standards and guidelines. Lawyers, engineers, and other professionals also developed closer working relationships with their respective associations. By virtue of their licensing processes, those associations also assumed more authority within government. One association that greatly benefited from the closer relationship of government and professional agencies was the American Forestry Association (AFA), founded in 1875. The AFA enjoyed political influence throughout the Progressive Era by working with the forest reserves and later, the USFS (Diner 1998).

Theodore Roosevelt praised the Progressives and their efforts to alleviate America's political, social, and economic problems, likening them to America's pioneers. In a 1910 article for *The Outlook*, he expressed his hope that the spirit of Progressivism could also address resource conservation:

> The same qualities that have enabled Americans to conquer the wilderness, and to attempt tasks like the building of the Panama Canal and the sending of the battle fleet around the world, need to be applied now to our future problems; and these qualities, which include the power of self-government, together with the power of joining with others for mutual help, and, what is especially important, the feeling of comradeship, need to be applied in particular to that foremost of national problems, the problem of the preservation of our natural resources.
>
> The question has two sides. In the first place, the actual destruction, or . . . at any rate the needless waste, of the natural resources must be stopped. In the second place . . . these resources must be kept for the use of the whole people, and not handed over for exploitation to single individuals or groups of individuals (Roosevelt 1927 v16, 23–24).

Indeed, the conservation movement benefited

greatly from the end of the spoils system and the creation of professional land management agencies, brought about because many Progressives feared that continued waste and mismanagement of America's natural resources would spell an end to the United States. George Perkins Marsh's 1864 book, *Man and Nature,* strongly influenced this sense of doom, painting a gloomy picture for the future of the U.S. if its natural resources continued to disappear. The goal of Marsh's book was "to indicate the character and, approximately, the extent of the changes produced by human action in the physical conditions of the globe we inhabit; to point out the dangers of imprudence and the necessity of caution in all operations which, on a large scale, interfere with the spontaneous arrangements of the organic or the inorganic world." Marsh hoped his book would "suggest the possibility and the importance of the restoration of disturbed harmonies and the material improvement of waste and exhausted regions; and, incidentally, to illustrate the doctrine, that man is, in both kind and degree, a power of higher order than any of the other forms of animated life, which, like him, are nourished at the table of bounteous nature" (Marsh 2003). To demonstrate his points, Marsh examined the decline of ancient civilizations in connection with environmental destruction. He also compared these ancient civilizations to events that were occurring in modern nations across the globe.

Theodore Roosevelt: conservationist and preservationist

An assassin's bullet brought Progressivism to the federal arena. On September 6, 1901, President William McKinley, a conservative Republican with strong ties to the industrial giants of his age, was shot and fatally wounded by Leon Czolgosz at the Pan-American Exposition in Buffalo, New York. After lingering for a few days, McKinley passed away and Theodore Roosevelt became the next president of the United States. Roosevelt received the news of McKinley's declining condition during a hunting trip in the Adirondack Mountains—a portentous setting, given that his administration would do more to save the wilderness areas of North America than any presidency before or since. Unfortunately, Roosevelt's conservation record is often boiled down to numbers, and not enough historians have gone beyond those numbers to examine his other contributions to the movement. The numbers, however, are indeed impressive. During Roosevelt's term of office, 150 forest reserves, 51 federal bird preservations, 18 national monuments, 5 national parks, and 4 national game preserves were established—a total of more than 230 million acres. This amounted to 84,000 acres set aside per day of Roosevelt's administration (Gable 1984).

Roosevelt later reflected on the reasons why he supported conservation during his administration. His remarks reflected concerns similar to those of Marsh:

> I have always been fond of history and of science, and what has occurred to Spain, to Palestine, to China, and to North Africa from the destruction of natural resources is familiar to me. I have always been deeply impressed with [Justus von] Liebig's statement that it was the decrease of soil fertility, and not either peace or war, which was fundamental in bringing about the decadence of nations. While unquestionably nations have been destroyed by other causes, I have become convinced that it was the destruction of the soil itself which was perhaps the most fatal of all causes. But when, at the beginning of my term of service as President, under the influence of Mr. Pinchot and Mr. [Frederick H.] Newell, I took up the cause of conservation, I was already fairly well awake to the need of social and industrial justice; and from the outset we had in view, not only the preservation of natural resources, but the prevention of monopoly in natural resources, so that they should inhere in the people as a whole (Roosevelt 1927 v17, 317).

Roosevelt's conservation record has sometimes been unjustly characterized as demonstrating an attempt to instill conservation policies at the expense of preservation policies. The growing split between the two sides became evident during Roosevelt's administration, but was more reflective of the attitudes and beliefs of Gifford Pinchot and John Muir than those of Roosevelt, himself. These two men and their ideas came to the public forefront during a clash over the future of a reclamation project located within the boundaries of Yosemite National Park. As the city of San Francisco expanded, developers searched for ways to improve the water supply into the city. The major fire resulting from the San Francisco earthquake of 1906 greatly intensified the clamor to bring an effective water system to the city, even if it came at the expense of damming Yosemite's scenic Hetch Hetchy Valley. Roosevelt deeply believed in preserving the national parks, but also could not turn his back on San Francisco's water problem. He asked the city to search for another dam site, but when

none was found, Roosevelt hesitatingly indicated his support for the dam to be constructed in Yosemite. He later told Robert Underwood Johnson, editor of *Century Magazine* and a strong opponent of the dam, that the decision to support Hetch Hetchy was one that he extremely doubted. Still, the damage was done, and the conservation movement split into two opposing factions, the conservationists under Pinchot and the preservationists under Muir. The issue of Hetch Hetchy was finally settled when President Woodrow Wilson signed the bill authorizing the construction of the dam within Yosemite (Huth 1990; Nash 1967).

Theodore Roosevelt's involvement in the Hetch Hetchy controversy has clouded many interpretations of his conservation and preservation work. Often overlooked, for example, is that his administration brought progressive reform to the Yellowstone ecosystem by creating the professional land management agencies that continue to administer our public lands today. Roosevelt took considerable personal interest in the Yellowstone region, which helped motivate his desire to properly protect both the lands within the Yellowstone Timberland Reserve and Yellowstone National Park through professionalization of their management. He became acquainted with the problems impacting the region through his connections with famed naturalist writer George Bird Grinnell. Together, the two men formed the Boone and Crockett Club and dedicated its membership to the protection of the Yellowstone National Park. They campaigned to end poaching in the park and fought attempts by the railroads to build inside its boundaries.

Roosevelt visited the region on two separate trips in 1890 and 1891. The first trip was a sightseeing expedition with his wife and sister, both of whom he entertained by pretending to be a bear late at night. The second trip was an elk hunting expedition near the Two Ocean Pass area, south of Yellowstone National Park. Through his visits to Yellowstone and his work with the Boone and Crockett Club, Roosevelt came to see Yellowstone as a wilderness preserve and wildlife refuge (Benson 2003; Collins 1989; Cutright 1985; Cutright 1956; Johnston 2004a; Johnston 2004b; Johnston 1993; Parsons 1993; Reiger 1972; Reiger 1975; Schullery 1978; Ward 1993; Ward and McCabe 1988).

Roosevelt and the creation of professional land management agencies

To preserve the Yellowstone ecosystem and to protect and properly manage its natural resources, Roosevelt needed to create a professional government agency. Roosevelt realized that the military was not the appropriate organization for the task, and that the spoils system had led to ineffective land management. His background made him well suited to create an agency to remedy the situation. In the 1880s, President Harrison had appointed Roosevelt to the Civil Service Commission. Democratic president Grover Cleveland had kept Roosevelt, a Republican, working on the commission during his administration. This experience allowed Roosevelt a close view of the inefficiency of the spoils system and the benefits of a merit system accomplished by civil service reform.

After his stint on the Civil Service Commission, Roosevelt had served as New York City Police Commissioner. As commissioner, Roosevelt continued to advocate governmental reform and worked tirelessly to create a more professional standard of law enforcement for the New York Police Department. He advocated testing police candidates, pushed for the creation of an academy to promote specialized training in law enforcement, supported new technological advances in law enforcement, and recommended physical and pistol training for policemen. Roosevelt's efforts represented the beginnings of modern professional law enforcement.

Later, as governor of New York, Roosevelt pushed for the modernization of the New York Fisheries, Forest, and Game Commission. Working with Gifford Pinchot and Frederick H. Newell, future director of the Bureau of Reclamation, Roosevelt worked to preserve forests, game, and fish within New York State. He urged the recruitment of professional foresters and game wardens to achieve this goal (Roosevelt 1913, 323–325). In his 1900 annual address, Governor Roosevelt praised the commission for its achievements and urged the New York Assembly to continue its support, echoing the words of the Yellowstone National Park Organic Act: "The subject of forest preservation is of the utmost importance to the State. The Adirondacks and Catskills should be great parks kept in perpetuity for the benefit and enjoyment of the people" (Roosevelt 1927 v15, 54).

Roosevelt also recognized the connections between a strong "national character" and scientific conservation of water, game, and timber. A forest, for instance, was a

> . . . great sponge which absorbs and distils the rain-water; and when it is destroyed the

> result is apt to be an alternation of flood and drought. Forest-fires ultimately make the land a desert. . . . Every effort should be made to minimize their destructive influence. We need to have our system of forestry gradually developed and conducted along scientific principles. When this has been done it will be possible to allow marketable lumber to be cut everywhere without damage to the forests. . . .

Forests also offered valuable habitat for a variety of game, as well as opportunities for recreational activity:

> A live deer in the woods will attract to the neighborhood ten times the money that could be obtained for the deer's dead carcass. . . . Hardy outdoor sports, like hunting, are in themselves of no small value to the national character, and should be encouraged in every way. Men who go into the wilderness, [or] . . . who take part in any field-sports with horse or rifle, receive a benefit which can hardly be given by even the most vigorous athletic games (Roosevelt 1927 v15, 54).

To accomplish these goals, Roosevelt recommended that greater numbers of professional game wardens be trained and hired, and that "none save fit men must be appointed and their retention in office must depend purely upon the zeal, ability, and efficiency with which they perform their duties" (Roosevelt 1927 v15, 53–54).

Upon assuming the presidency, Roosevelt quickly began working on the creation of a professional land management agency for the conservation and preservation of the national forest reserves and their vast natural resources. He recommended the transfer of the forest reserves to the Department of Agriculture and requested that certain areas of forest reserves be set aside as game preserves. Roosevelt also recommended the promotion of public recreation within the forests and parks by establishing free campgrounds "for the ever-increasing numbers of men and women who have learned to find rest, health, and recreation in the splendid forests and flower-clad meadows of our mountains. The forest reserves should be set apart forever for the use and benefit of our people as a whole and not sacrificed to the short-sighted greed of a few," he wrote (Roosevelt 1927 v15, 102–104). In his second annual message, delivered on December 2, 1902, Roosevelt again recommended legislation for the protection of big game on forest reserves—especially for elk, which were being slaughtered for their antlers (Roosevelt 1927 v15, 161).

In 1903, Roosevelt visited Yellowstone National Park as part of a larger western tour. The few days he spent in the park offered Roosevelt the opportunity to examine its management under the U.S. Army. Famed naturalist writer John Burroughs, who accompanied Roosevelt on this visit, noted, "Near the falls of the Yellowstone, as at other places we had visited, a squad of soldiers had their winter quarters. The President called on them, as he had called upon the others, looked over the books they had to read, examined their housekeeping arrangements, and conversed freely with them" (Burroughs 1907, 72–73).

This may have been when Roosevelt became concerned regarding the future management of Yellowstone and began formulating ideas for replacing the military police force with a professional civilian agency. Perhaps Roosevelt noted in his visits the conditions that S. B. M. Young would note later, in 1907:

> [In Yellowstone,] regimental and squadron organizations are not only disturbed, but the troop organization is largely demoralized by subdividing the men into small parties far separated for indefinite periods of time without the personal supervision of an officer. . . . The enlisted men . . . are not selected with special reference to the duties to be performed in police patrolling, guarding, and maintaining the natural curiosities and interesting 'formations' from injury by the curious, the thoughtless, and the careless people who compose a large percentage of the annual visitors in the park, and in protecting against the killing or frightening of the game and against forest fires (Young 1907, 25).

In the national forests, Roosevelt recommended more professionalism from the rangers appointed to watch over them. In a letter to a former Rough Rider and newly appointed forest ranger, Roosevelt outlined the qualities he desired in such men: "You have been appointed a Forest Ranger," wrote Roosevelt.

> Now, I want . . . very seriously to impress upon you that you have got to do your duty well, not for your own sake, but for the sake of the honor of the [Rough Rider] regiment. I recommended you because under me you showed yourself gallant, efficient and obedient. You must continue to show these qualities in the government service exactly as you did [in] the regiment. You must let no

> consideration of any kind interfere with the performance of your duty. You are to protect the government's property and the forests and to uphold the interests of the department in every way. Now, remember that I expect you to show yourself an official of far above the average type; and you are to stand or fall strictly on your merits (Roosevelt 1951 v3, 130).

In Roosevelt's fourth annual message, December 6, 1904, the president praised the Department of Agriculture for its development into an educational institution with 2,000 specialists advocating forestry practices for the forest reserves, and stressed that the reserves, themselves, needed to be moved to Department of Agriculture, where the knowledge and skills were located. "I have repeatedly called attention to the confusion which exists in government forest matters because the work is scattered among three independent organizations. The United States is the only one of the great nations in which the forest work of the government is not concentrated under one department, in consonance with the plainest dictates of good administration and common sense," said Roosevelt (Roosevelt 1927 v15, 237). Roosevelt noted that the results of the transfer would be better forest work; forests would be handled by men in the field, and forests would become self-supporting. He also emphasized the need to maintain public lands as game refuges, recommended that continued support be given to preserving Yellowstone wildlife, and urged that the park's boundaries be expanded southward and that additional parks be added to the system to provide more protected habitat to wildlife.

As Roosevelt began his second term in office, he continued arguing for the professional management of federal lands. In his fifth annual message, December 5, 1905, Roosevelt commended the new U.S. Forest Service and noted that through this agency, the usefulness of the forest reserves greatly expanded. Roosevelt also suggested the transfer of the national parks to the new forest service, so the parks could benefit from the protection of the new agency (Roosevelt 1927 v15, 315). Roosevelt continued pushing for new national parks, arguing that Yosemite should be accepted from the state of California and the Grand Canyon should be set aside as a national park, and again argued that parks were necessary wildlife refuges. He proposed bringing back buffalo, through parks or refuges, for economic interests, and again called for the expansion of Yellowstone National Park's boundaries to the south and to the east for the protection of winter ranges for elk (Roosevelt 1927 v15, 326–327).

Congress finally responded to Roosevelt's wishes regarding the forest reserves by passing legislation that provided for the transfer of 63 million acres of forest land from the Department of the Interior to the Bureau of Forestry under Gifford Pinchot in the Department of Agriculture. The lands were officially transferred on February 1, 1905. Later that same year, the Bureau of Forestry changed its official title to the United States Forest Service, and Pinchot began expanding an agency staffed with professional foresters and rangers to carry out the responsibilities of managing the forest reserves:

> Supervisors and Rangers are appointed only after civil-service examinations. They must be residents of the State or Territory in which the National Forest is situated and between the ages of 21 and 40. . . . The life a man has led, what is his actual training and experience in rough outdoor work in the West, counts for more than anything else. Lumbermen, stockmen, cowboys, miners, and the like are the kind wanted. Forest Guards are appointed from those who have passed the ranger examination (Pinchot 1907).

Throughout the remainder of his term, Roosevelt continued calling for the increased protection of the forest reserves and national parks. In his sixth annual message, December 3, 1906, Roosevelt noted the progress being made to benefit the West with irrigation and forest preservation through his conservation programs, and called for the further expansion of forest reserves (Roosevelt 1927 v15, 376). In 1907, Congress responded negatively, with legislation preventing the president from setting aside any further forest reserves, now called national forests, in six western states. Roosevelt signed the legislation only after he set aside a great number of new reserves, many of which further protected the Yellowstone ecosystem.

In 1907, Major John Pitcher, who was Roosevelt's friend and Yellowstone's acting superintendent, retired from military service, thus creating an opening for the position of park superintendent. Roosevelt viewed Pitcher's retirement as an opportunity to create a professional agency, similar to the USFS, to manage Yellowstone National Park. To achieve this goal, Roosevelt appointed the first civilian superintendent of Yellowstone to serve since the military had begun to manage the park in 1886. Roosevelt's replacement was his old friend and fel-

low officer from the Spanish–American War, Samuel Baldwin Marks Young. In the Civil War, Young rose from the status of private in the Pennsylvania Infantry to general in the Pennsylvania Calvary. After the war, he was reassigned to military campaigns against American Indians in the West. Young was appointed acting superintendent of Yellowstone Park in 1897, but served in that position for only a few months (Haines 1977 v2). In 1904, Young retired from the military after a successful career. Because Young had previous experience with the position of superintendent, Roosevelt wanted him back in the park.

With Young's acceptance ("I am always ready to be of service to you and your administration," he told Roosevelt, "and the proper maintenance and protection of the Yellowstone park and wildlife is of much interest to me"), the position of park superintendent reverted back to civilian control (Roosevelt Papers, 3/28/1907). Choosing a former military man with previous experience in the position was wise on the part of Roosevelt, as it smoothed the transition from military enforcement to civilian control. Young was also a good friend of Roosevelt's, which made it possible for Roosevelt to influence park policy.

Young's main task as superintendent was to oversee the transfer of power from military to civilian control. In a letter to William Loeb, the president's secretary, Young presented his "scheme for the organization of a . . . 'National Park Guard'" (Roosevelt Papers, 9/7/1907). His proposal called for a chief inspector, four assistants under the inspector, and 20 full-time men, with an additional seasonal crew of 15 men in the summers. In addition, Young wanted to hire a clerk, a buffalo keeper and assistant, a blacksmith, and a driver. Young estimated the annual cost of the new civilian force to be $50,000. That figure excluded his salary as superintendent, which he agreed to waive, and Young called it a bargain: "the cost of maintaining the troops here far exceeds the amount estimated as the cost of maintaining a park guard," he wrote (Roosevelt Papers, 9/7/1907).

In December 1907, Roosevelt wrote to Young supporting his idea of an independent park guard, which Roosevelt wanted to be administered by the U.S. Forest Service (Roosevelt Papers, 12/11/1907). The president expressed regret that he could not make anything happen before the end of the year; he wanted to wait until he could find a congressman willing to sponsor the move—possibly Senator Thomas H. Carter from Montana (Roosevelt Papers, 12/11/1907).

During the following summer, an event transpired that caused Roosevelt and Young to press even harder for a civilian park force. On August 24, 1908, 17 stagecoaches were held up, and the passengers robbed. The perpetrator had waited until the cavalry patrol, traveling in front of a line of 25 stages, had passed, then proceeded to hold up stage after stage. The passengers, angered over their losses, met at the Lake Hotel to voice their concerns over the inability of the military to keep gun-toting bandits out of the park. They also expressed anger at the soldiers' inability to catch the criminal responsible for the act. In concluding the meeting, the victims drew up a petition demanding that the government reimburse them for losses of more than $2,100. They also criticized the army's effectiveness at policing the park; thus, the military came under close public scrutiny (Haynes 1959, 15–20). When Young informed the president of the situation, Roosevelt responded, "I am sorry to say that it simply strengthens the impression that I had already gained. I fear that the only solution is to take the army out of the Park and have rangers of the [James] McBride [a civilian park scout] type do all the work" (Roosevelt Papers, 9/12/1908). In a following letter, Roosevelt re-emphasized his desire to establish a national park guard under Young's command (Roosevelt Papers, 9/15/08).

In the end, Roosevelt's and Young's plan to create a civilian park guard did not succeed, and in 1908, Young left Yellowstone—not, as some historians have concluded, because of the stagecoach robbery, but rather to become governor of the U.S. Soldiers Home in Washington, D.C. Roosevelt, who accepted Young's resignation reluctantly, informed Young that he intended to replace all of the park's current army staff with new soldiers to ease public criticism and appoint Major Lloyd Benson to the superintendent position. With Benson's acceptance, the park was again placed under the control of an acting military superintendent (Roosevelt Papers, 10/16/1908).

Roosevelt did not give up his hopes for a civilian park guard easily. In his last annual message to Congress, he advocated placing all national parks adjacent to national forests under the exclusive control of the U.S. Forest Service, rather than maintain them under the current, disjointed management scheme:

> I urge that all our national parks adjacent to national forests be placed completely under the control of the forest service of the Agricultural Department, instead of leaving them as they now are, under the Interior Department and policed by the army. The Congress should provide for

> superintendents with adequate corps of first-class civilian scouts, or rangers, and, further, place the road construction under the superintendent instead of leaving it with the War Department. Such a change in park management would result in economy and avoid the difficulties of administration which now arise from having the responsibility of care and protection divided between different departments. The need for this course is peculiarly great in the Yellowstone Park (Roosevelt 1927 v15, 525–526).

With Roosevelt's request to place some of the national parks under the control of his friend Pinchot, preservationists feared they would lose out to the conservationists yet again. Although this plan would have accomplished Roosevelt's goal of placing Yellowstone National Park under the control of a professional land management agency to protect its resources, it would have greatly exacerbated the stress between advocates of differing management policies for national parks and national forests. Preservationists feared that national parks would come to be managed as national forests and, as such, preservation-based management of federal lands would be replaced by conservation-based economic development, which very well could destroy the sanctity of national parks as scenic playgrounds. Was that what Roosevelt wanted?

Roosevelt himself said no, clearly stating his desires to keep national parks in a natural condition: "[Yellowstone], like the Yosemite, is a great wonderland, and should be kept as a national playground. In both, all wild things should be protected and the scenery kept wholly unmarred" (Roosevelt 1927 v15, 525–526). In addition, with the parks controlled by Pinchot, Roosevelt was likely to retain his influence to direct park policies. However, Congress did not act on his request, and the national parks remained under the army's supervision until 1916, when the National Park Service was finally created.

Taft and Wilson under Roosevelt's shadow

As Roosevelt left the office of the presidency, he handpicked his successor, William H. Taft. Taft quickly alienated the former president by firing his star conservationist, Gifford Pinchot, in the aftermath of a historically notorious spat between Pinchot and Interior Secretary Richard Ballinger. Progressives concluded that Taft was returning control of the country to the conservative Republicans whom Roosevelt had kept at bay. In the area of preservation, however, Taft's administration continued to work to achieve Roosevelt's original goal of establishing a civilian park guard to oversee the national parks. In his annual message to Congress in December 1910, Taft explained his reasoning: "Our national parks have become so extensive and involve so much detail of action in their control that it seems to me there ought to be legislation creating a bureau for their care and control." He also reiterated Roosevelt's earlier call for the Grand Canyon to be given national park status (Taft 1910).

Based on the recommendation of J. Horace McFarland, president of the American Civic Association, Interior Secretary Ballinger called together a number of park supporters to meet in Yellowstone in 1911 to discuss the future of the national parks. On the basis of their report, Taft again requested Congress to create a civilian agency, or National Park Service, to oversee the parks. Roosevelt proffered a written treatise in support of the idea:

> There are in the United States thirteen National parks. . . . At present, as the Secretary of the Interior has pointed out . . . each of these parks is a separate and distinct unit for administrative purposes. Special appropriations are made for each park, and the employment of a common supervising and directing force is impossible. . . . A bill is before Congress for the creation of a Bureau of National Parks, the head of which shall have the supervision, management, and control of all the National parks and National monuments in the country, and shall have the duty of developing these areas so that they shall be the most efficient agencies possible for promoting public recreation and public health through their use and enjoyment by the people. . . . The new bureau should be called the National Park Service. . . . The establishment of the National Park Service is justified by considerations of good administration, of the value of natural beauty as a National asset, and the effectiveness of outdoor life and recreation in the production of good citizenship (Schullery 1986, 141–142).

Despite the support of Roosevelt and Taft, who had become political enemies due to an emerging split between progressive and conservative Republicans, Congress did not pass a bill creating a National Park Service. The new bureau would have to wait for a few more years. In the meantime, the presidential election of 1912 proved to be one of the most interesting elections ever held in the United States. The Democratic Party nominated the progressive Wood-

row Wilson, while Roosevelt and Taft campaigned against each other under the banners of the Republican Party and the newly formed Progressive Party (also known as the Bull Moose Party), as well as against their other rivals, Wilson and Socialist Party candidate Eugene V. Debs.

With the campaign focused primarily on economic reform, Roosevelt and Taft split the Republican vote, and Woodrow Wilson won the presidency. Wilson, who did not have much of a conservation record going into his presidency, did not contribute much to the conservation/preservation movement until he signed the National Park Service bill in 1916. It is worth noting that the agency's creation appears as little more than a footnote in many histories of the time; Wilson's biographers have tended to focus more on Wilson's economic reform and his international struggles, largely ignoring the creation of the National Park Service. Park service framer Horace Albright confirmed that Wilson himself did not consider conservation to be of primary import during his presidency:

> . . . President Woodrow Wilson was totally uninterested in conservation, national parks, or anything that pertained to the great outdoors. Whatever fine things occurred during his administration, like the creation of the National Park Service, came through [Interior] Secretary Franklin Lane. Neither of them should be counted as conservationists, but Lane let us [Albright and NPS Director Stephen T. Mather] have free rein for the most part and in general didn't care to interfere with our judgments. Wilson just wasn't a conservationist in any sense of the word (Albright and Schenk 1999, 301).

In fact, Albright actually claimed to have "snuck" the park service bill through for Wilson's signature by placing it in the same folder with an army appropriations bill, hoping Wilson would sign both:

> [At] . . . the Capitol . . . the enrolling clerk . . . said they hadn't had any call for th[e NPS] legislation and the President signed bills only on certain days. As we were talking, the phone rang. I gathered from the conservation . . . that it was the White House . . . and that they wanted some bill sent over to be signed. When the . . . clerk hung up, I asked politely if that was the White House, and the clerk said yes, adding they wanted the army appropriations bill sent over. I said, "Be a good fellow and stick the Parks Act in the same envelope." He did, and I hopped a street car and got to . . . [legislative clerk Maurice] Latta's office before the bill arrived. . . . Latta said he would see if he could get it to the President some time during the evening . . . so I gave him the phone number where I could be reached. About 9:00 P.M. the phone rang and it was Latta, who told me: "the President signed the bill." I went right down town to the postal telegraph office and sent Mather a night letter . . . : 'PARK SERVICE BILL SIGNED NINE O'CLOCK LAST NIGHT. HAVE PEN USED BY PRESIDENT IN SIGNING FOR YOU' (Albright and Cahn 1985, 42–43).

Despite Albright's account, it is hard to believe that Wilson would have signed any piece of legislation without knowing its details and implications—especially one that created a new bureaucratic agency. Given his scant interest in conservation affairs generally, one could surmise that Wilson signed the bill for political reasons. According to Wilson biographer Arthur S. Link, Wilson signed much of his progressive legislation in 1916 to win Progressives over to the Democratic Party (Link 1954). The timing was appropriate, for by that time Roosevelt had requested that Progressive Party members return to the Republican Party to defeat Wilson and the Democrats. Clearly the bill was supported by many Progressive conservationist and preservationists; first NPS director Stephen T. Mather, for instance, was a former Progressive Party member who supported Wilson after the signing of the bill. Signing the bill also gave Wilson a measure of accomplishment in the conservation arena. He may have seen it as a way to counter the environmental legacy of Roosevelt and the Republicans, thus reducing the possibility for criticism of his conservation record in the upcoming presidential election debates.

However, as in the 1912 election, conservation was not a major campaign issue in 1916. The Democrats re-nominated Wilson; Roosevelt agreed to campaign for Republican Party nominee Charles Evans Hughes. Both candidates focused more on international issues regarding the expanding war in Europe, with domestic policies remaining in the background and conservation receiving only brief mention. The Republican Party platform simply stated: "We believe in a careful husbandry of all the natural resources of the nation—a husbandry which means development without waste; use without abuse" (Republican Party platform 1916). The 1916 Democratic Party platform on conservation was almost as brief:

> For the safeguarding and quickening of the life of our own people, we favor the

> conservation and development of the natural resources of the country through a policy which shall be positive rather than negative, a policy which shall not withhold such resources from development but which, while permitting and encouraging their use, shall prevent both waste and monopoly in their exploitation, and we earnestly favor the passage of acts which will accomplish these objects, reaffirming the declaration of the platform of 1912 on this subject (Democratic Party platform 1916).

The nation re-elected President Wilson, perhaps in part because, according to Link, Wilson had adopted most of Roosevelt's Progressive platform and instituted its policies during his administration before the 1916 election in order to win over more votes from alienated progressives (Link 1954). Journalist William Allen White noted: "Naturally [the Progressives] turned to Wilson. He, at least, had Progressive achievement; not what they had hoped for, but something upon which to build. So the Progressives, looking at his liberal record, gave the election to Mr. Wilson" (White 1929, 316–317).

The Progressive Movement came to an end in the aftermath of World War I. By 1920, most Americans were willing to follow Warren G. Harding's "return to normalcy." Progressive reform remained idle until the Great Depression brought about the ascension of another Roosevelt, as well as progressive reforms under the New Deal. Yet the reforms enacted during the Progressive Era continue to impact the United States today. This is no more evident than in the Yellowstone ecosystem. The U.S. Forest Service and National Park Service, professional land management agencies conceived by Roosevelt, continue to monitor and protect this vast wilderness area. Although the evolution of both agencies would lead to the practice of different forms of land management, both remain a lasting monument to Theodore Roosevelt's conservation leadership and the Progressive Era.

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Conservation That Works: Yellowstone and the Future of Hope

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Closing Keynote, October 19, 2005

Richard L. Knight is interested in the ecological effects associated with the conversion of the Old West to a New West. A professor of wildlife conservation at Colorado State University, he earned his graduate degrees from the University of Washington and the University of Wisconsin. While at Wisconsin, he was an Aldo Leopold Fellow and conducted his research at Aldo Leopold's farm, living in "The Shack." Before becoming an academic, he worked for the Washington Department of Game, developing the non-game wildlife program. Presently, he sits on a number of boards, including the Colorado Cattlemen's Agricultural Land Trust and the Quivira Coalition. He is also on the board of directors for the journals *Conservation Biology* and *Ecological Applications.* He was selected by the Ecological Society of America for the first cohort of Aldo Leopold Leadership Fellows, which focus on leadership in the scientific community, communicating with the media, and interacting with the business and corporate sectors. His books include *A New Century for Natural Resources Management* (1995, Island Press), *Stewardship Across Boundaries* (1998, Island Press), *Ranching West of the 100th Meridian* (2002, Island Press), *Aldo Leopold and the Ecological Conscience* (2002, Oxford Univ. Press), and *Ecosystem Management: An Adaptive, Community-Based Approach* (2002, Island Press). With his wife, Heather, he works with his neighbors in Livermore Valley, Colorado, on stewardship and community-based activities.

> "All Americans, but especially Westerners whose backyard is at stake, need to ask themselves whose bureaus these should be. Half of the West is in their hands. Do they exist to provide bargain-basement grass to favored stockmen whose grazing privileges have become assumed, and bought and sold along with the title to the home spread? Are they hired exterminators of wildlife? Is it their function to negotiate coal leases with energy companies, and to sell timber below cost to Louisiana Pacific? Or should they be serving the much larger public whose outdoor recreations of backpacking, camping, fishing, hunting, river running, mountain climbing, and, God help us, dirt biking are incompatible with clear-cut forests, overgrazed, poison-baited, and strip-mined grasslands? Or is there a still higher duty—to maintain the health and beauty of the lands they manage, protecting from everybody—the watershed and spawning streams, forests and grasslands, geological and scenic splendors, historical and archaeological remains, air and water and serene space, that once led me, in a reckless moment, to call the Western public lands part of the geography of hope?"
>
> —Wallace Stegner, 1987, *The American West As Living Space*

Wallace Stegner appreciated that half of the geography of the American West is the birthright of all Americans. He also realized that these lands are under constant pressure for many uses, ranging from mining non-renewable resources to the sustainable uses of other services that wildlands provide. The challenge, Stegner realized, was to put land health above land use. Only then could humans truly have a long-term relationship with the land that sustains us. History has told the story over and over that when humans place land use, such as logging, grazing, mining, and outdoor recreation, ahead of land health, the result is something we don't like: a degraded environment. When land health, on the other hand, is given primacy, then land uses can be allowed, but only to the degree that that they don't affect the land principle. Healthy lands allow sustainable human uses; degraded lands give back less and less over time.

This challenge lies at the heart of sustainable human–land relationships in the Greater Yellowstone Area (GYA), a region that is both public and private, and that contains the richest portion of our natural heritage still found in the conterminous United States. The stewards of this region convened a meeting at Mammoth Hot Springs during October 17–19, 2005, to examine the "hard lessons and bright prospects" gleaned from a "century of discovery." I

was asked to summarize the contents of the presentations. I will begin by emphasizing the key points of the six keystone speakers: Harvey Locke, Jack Ward Thomas, Sarah E. Boehme, Dale N. Bosworth, Monica G. Turner, and Karen Wade. Enjoyably, these distinguished individuals from the realms of science, conservation, and art history all exemplified a message that offers hope for Yellowstone's future: conservation that works is conservation that works for both natural and human communities. Actions that benefit one at the expense of the other are not conservation.

Following this, I will discuss briefly two themes that emerged from the other presenters: (1) the importance of private lands in the GYA, and (2) that federal agencies will have to work differently to work better.

Keynote speakers

I have tried to capture the kernel of the speakers' comments. My most heartfelt apologies to them where I have gone astray. In acknowledging the inspiration I derived from listening to the speakers, I would be remiss not to praise as well the perceptive audience that fleshed out the speakers' intentions with wonderfully insightful questions.

Harvey Locke (Superintendent's International Lecture) described the ongoing efforts to ensure that wildlife will always have the opportunity to move freely through the vast region from the Yukon to the Yellowstone. It is a story of on-the-ground conservation, involving scores of human communities and spanning countless administrative boundaries, including the international border of the U.S. and Canada. Near the end of his presentation, Mr. Locke posed the question of whether Yellowstone-to-Yukon was possible. He answered his own question by reminding us that every generation has a dream. The dream of nineteenth-century America was Manifest Destiny—the conquering of land and nature in settling our western frontier and building a transcontinental nation. Why not, he asked, dream in the twenty-first century for [at least] a minimal amount of land left wild for animals and people to wander across? In so doing, we would ensure a movement corridor that keeps the northern Rocky Mountains more connected than fractured. A minimal amount of respect for minorities would surely cause us to agree, wouldn't it?

To the delight of everyone, Dr. Jack Ward Thomas (A. Starker Leopold Lecture) devoted his remarks to recapping 100 years of conservation history. Beginning with unregulated exploitation, which led to the Progressive Era of Theodore Roosevelt and the blossoming of the conservation movement guided by Gifford Pinchot, Dr. Thomas then traced the rise of John Muir and the preservation movement. Conservation—the wise use of natural resources—stood in opposition to unregulated exploitation and in contrast to preservation. Conservation and preservation parted ways over building the Hetch Hetchy Dam in Yosemite National Park. This was followed by the crisis of the Progressive Faith, which resulted in the environmental movement, crowning its emergence with Rachel Carson's *Silent Spring* in 1962 and Earth Day in 1970. Today, according to Dr. Thomas, we are witnessing the rebirth of conservation under the contemporary natural resource management paradigm christened Ecosystem Management. Dr. Thomas seemed to echo Wallace Stegner's admonition that ". . . the worst thing that can happen to a piece of land, short of coming into the hands of an unscrupulous developer, is to be left open to the unmanaged public." What we are seeing today is the abandonment of our management responsibilities to public lands. Shrinking the federal workforce has created a crisis for the one-third of America that comprises the federal domain. Is this what happens when, in the words of a popular conservative ideologue, "we shrink government to the size of a bathtub"? What America needs today are elected officials who, in the words of Theodore Roosevelt, believe, "I am the steward of the public good."

Dr. Sarah E. Boehme (Aubrey L. Haines Lecture) surveyed the work of artists Thomas Moran and Albert Bierstadt, as well as photographer William Henry Jackson in developing America's perception of its first national park. Art not only spurred the protection of this grand area but also promoted its economic development. Whereas a superficial examination of the role of art in the American psyche may limit its perceived importance, the Yellowstone idea clearly discounts this perception. Art, as much as science and economics, shapes how Americans and citizens of the world view the GYA and Yellowstone National Park. By understanding the relevance of art today in the American West, one is left with a three-dimensional appreciation that Yellowstone is a reflection not only of how we view ourselves but also of how art shapes our perceptions. To appreciate the grandeur of Yellowstone requires one to exercise not only the left side of his/her brain, but the right as well.

Due to a power failure, U.S. Forest Service Chief

Dale N. Bosworth gave his remarks by candlelight, without aid of notes or PowerPoint. As evidence of his eloquence, he was honored with a standing ovation! The chief discussed what have come to be called the "Chief's Four Threats" to our national forests: [poor] forest health, unmanaged outdoor recreation, invasive species, and the loss of open space on private lands adjacent to national forests. After reviewing these points, he stressed the importance of getting the issues right when designing conservation efforts to address these threats. For example, logging is not the issue we should focus on; the issue is forest health and whether we are logging on an ecologically sustainable basis (Knight et al. 2000). Motorized recreation is not the issue, it's unmanaged recreation (Knight and Gutzwiller 1995). Similarly, the issue we focus on should not be endangered species, it should, instead, be invasive species, the number-one threat to federally listed threatened and endangered species on all lands (Czech et al. 2000). And, lastly, it's not grazing on public lands that is the issue, it's the loss of private ranchlands to exurban developments that rim national forests that will make managing public lands ever more difficult in the years to come (Knight and Landres 1998; Czech et al. 2000; Knight et al. 2002). Chief Bosworth concluded by predicting that the twenty-first century will be the century of restoring lands that have been degraded through non-sustainable uses over the past two centuries. Stewardship, he believed, will be at the heart of conservation that works in the decades to come.

When Dr. Monica G. Turner took the podium, the audience was treated to what has, regretfully, become an exception: an academic who can clearly explain the relevance of her research. The salient point of Dr. Turner's prodigious research in the Greater Yellowstone Ecosystem was this: "When you've seen one ecosystem, you've seen one ecosystem." Likewise, using results that she and her colleagues have acquired over two decades of research, she illustrated the importance of conducting science at the appropriate spatial and temporal scales. Dr. Turner must be the delight of the media, as she is able to explain complexity in a way that our diverse publics can understand. Understanding how ecosystems work is, of course, not simple, but the media insists on telling the story in a simple way. Bending to this need, but not sacrificing the real-world difficulty of ecosystem complexity, Dr. Turner unraveled mysteries of fire, forests, and climate change with clarity and insights. Not only does her approach benefit the public, it also allows natural resource managers to use the "authority of the resource" to explain why management actions are necessary. When resource practitioners can justify their prescriptions with good science, the public is much more willing to agree and comply with limitations placed on their use of natural resources.

An old sage once commented that there are two kinds of people, "takers" and "caretakers." Ms. Karen Wade clearly belongs to the latter. An administrator, organizer, conservationist, land manager, and activist, Ms. Wade embodies all that is right with individuals who are more concerned with their responsibilities to land and people than their rights. She told a series of stories that served to illustrate all that is good about people who feel obligations to healthy human and natural communities. Importantly, she also disagreed with an earlier speaker who had said that "adventurism is not rewarded by bureaucracies." Ms. Wade went on record in opposition to this truism, and offered one of her own: "well-behaved managers seldom make history." In so doing, she mirrored the thoughts of Aldo Leopold (1947), who urged us to not be afraid ". . . to throw your weight around on matters of right and wrong in land-use." Leopold went on to say, "Cease being intimidated by the argument that a right action is impossible because it does not yield maximum profits, or that a wrong action is to be condoned because it pays. That philosophy is dead in human relations, and its funeral in land-relations is overdue." I suspect that Ms. Wade would agree.

Private lands in the Greater Yellowstone Area

The Yellowstone region comprises 36 million acres, of which 32% is privately owned. Importantly, this private land occurs at the lower elevations, is the best watered, and has the deepest soils (Hansen et al. 2002). A prominent participant at the conference commented that, "The private lands in the GYA are the biggest threat to the GYA." What he meant by this, of course, is that the region is experiencing unprecedented population growth, and private lands are disappearing as working ranches and reappearing as ranchettes that cover hillsides faster than Herefords can exit. When public land neighbors are measured by acre instead of by thousands of acres, how can managers manage public lands?

Critically, the acreage lost to housing developments is occurring at a more rapid rate than the population growth. For example, population growth in rural residential development from 1970 to 2000

in the Yellowstone area increased by 58%. The acres of rural residential development during this 30-year time period, however, increased 350% (Sonoran Institute 2005).

One of the speakers at the conference asked the question, "Are public lands adequate to keep wolves and grizzlies alive in the GYA?" He had the courage to answer his own question: no. Another speaker also spoke truth with courage when he said, "Social expectations are that we can build our homes anywhere and agencies will protect us from fire." These comments get to the heart of the role of private lands in the GYA. The natural heritage of the GYA cannot be saved without consciously protecting it; business as usual will bring ruin to the very attributes that presently make it one of our Earth's natural treasures.

Speakers and audience participants interacted well in regard to what can be done about this threat that is gobbling up the private land in the GYA. Four suggestions emerged. First, insist on smart growth. Without growth management and coordination between cities and counties in the GYA, local policies will simply shift unplanned growth from one area to the next. Thanks to the Sonoran Institute (2005), the region now knows that with smart growth procedures there will be only a 1% loss of agricultural lands and a 3% loss of natural areas in the next 15 years, whereas growth as usual will result in a 15% loss of agricultural lands and an 8% loss of natural areas.

Second, economic incentives need to be developed to ensure that private lands stay in open space and out of residential and commercial development. Sales taxes, tax credits, and other innovative methods can be used to place conservation easements on ranch and farm lands, or to purchase private lands for open space when they appear on the market.

Third, smart growth and the protection of open space is smart business and good for the bottom line. The GYA is more of an amenity-based economy today than a natural resource-extraction economy. People are not coming to the region to ranch, log, or mine; they are coming to "ranch the view." Elected officials need to be aware that by despoiling the beauty and natural heritage of the area, they are hastening the day when amenity refugees decide to take their money and go somewhere else (Power and Barrett 2001).

And fourth, keeping land in agriculture is fiscally prudent. Property taxes from ranchette developments do not even approximate the costs of county services and school districts. For example, in the state of Wyoming, for every dollar of property taxes that comes from ranchettes, the costs of county services and school districts are $2.40 (University of Wyoming 2000). Conversely, county services and school districts only cost $0.69 for every dollar of property taxes that comes from farm and ranch lands. Cows don't go to school, and sheep don't drive!

The final piece of wisdom came from a speaker who said, "We can take action now to reduce unplanned growth in the long run. Rather than be victims of change, we can plan for it, shape it, and emerge as a region known for its vibrant communities, prosperous economies, and open spaces. With effective planning, this can be our legacy for the GYA."

Federal agencies: working differently to work better

A surprising message that emerged from the conference was the realization that the days when agencies could make decisions in isolation are rapidly disappearing. Whether it is federal agency collaborating with federal agency or, increasingly, seeking to work with a non-governmental organization, state agency, American Indian tribe, or private landowner, federal agencies today are increasingly sharing their authority rather than being the sole disperser of it. The sentiment at the conference was that whether this approach was popular or not, it was inevitable. Due to the downsizing of the federal government, the increasing volume of unfunded federal legislation and resulting paperwork, and the changing sentiments of the American public, collaboration is the watchword of conservation that works today.

Historically, the Yellowstone conferences were largely about scientists talking to scientists. The 2005 meeting marked a turning point in which scientists found themselves talking with citizens, managers, non-governmental organizations, conservationists, and environmentalists. Perhaps this occurred because scientists are beginning to realize that science doesn't make policy but, when done well, it can help inform policy. This change in approach may have also occurred due to the increasing realization that whereas administrative boundaries are often straight lines, ecosystems are not. This truth is emphasized by the fact that issues affecting the GYA are as much social as they are natural. To work effectively across these boundaries requires a new way of doing conservation and acknowledging the inevitable: that our fates and the fates of our land are entwined and

indivisible (Knight and Landres 1998). So whereas many of the speakers admitted that the agencies are no longer in charge, they did agree that agencies can serve as critical levers in the transition of a society that takes its environment seriously.

Acknowledgments

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