



Human Influences on the Northern Yellowstone Range

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On the Ground

- For thousands of years before Yellowstone National Park was created in 1872, hunting and burning by Native Americans were fundamental components of the natural ecological processes on the Northern Range.
- Impacts by Euro-American fur trappers, miners, ranchers, natural resource managers, tourists, and others have shaped the land and wildlife of the Northern Range for the past two centuries.
- More controlled burning is needed today to purposely mimic the low-intensity fires set by Native Americans in the prehistoric and historical past.
- Greater control of bison and elk populations is needed today to sustain the natural abundances of native plants and animals and sustain the natural functioning of ecosystem processes.
- More controlled burning and greater control of bison and elk numbers are actions consistent with National Park Service policy and consistent with current management of other U.S. national parks.

Keywords: Yellowstone, Northern Range, Native Americans, bison, elk, brucellosis.

Rangelands 40(6):177–188

doi 10.1016/j.rala.2018.10.004

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Introduction

Humans have continuously inhabited the Northern Yellowstone Range (hereafter referred to as the Northern Range¹) inside and outside Yellowstone National Park (YNP) for at least 11,000 years.^{2–5} Across these many years, humans have actively used, abused, and conserved the natural resources of the Northern Range. Human actions helped shape the vegetation and wildlife present on the Northern Range from prehistoric times to present day.

Many contemporary Americans have misunderstood the Northern Range, especially the portion inside YNP, to have been an untouched wilderness when YNP was created in 1872. However, the land and wildlife of the Northern Range have been actively and purposely affected by Native Americans for thousands of years. Euro-American expansion in the late 1800s displaced Native Americans from the Northern Range and limited their ability to continue predating wild ungulates and burning the forests and rangelands. Since 1872, land managers inside and outside YNP have discounted or misunderstood the ecological importance of Native American actions. Because Native Americans actively shaped their environment, and because their actions have been largely ignored, minimized, or eliminated during the past 146 years, the ecological health of the Northern Range today differs dramatically from the primeval Northern Range.

In this paper, we explore the prehistoric and historical role of humans in the ecology of the Northern Range. We begin with a historical examination of Native American impacts to better understand how the ecosystem has changed through time and how minimizing the role of burning and hunting by Native Americans has created unintended and undesirable outcomes. We then explore historical impacts by Euro-American fur trappers, miners, ranchers, and tourists. Next, we examine the history of management inside YNP and how implementation of modern-day management has had unintended consequences for the people and natural resources of the Northern Range. We conclude with several recommendations for future actions to improve natural resource stewardship of the Northern Range.

Native Americans

The Northern Range was the homeland of Native Americans for millennia (Fig. 1). Their actions helped shape the landscape and its ecology. Native Americans mined obsidian and chert, built structures, ignited fires, and killed wildlife for food, clothing, and shelter.

Obsidian is an igneous rock used by Native Americans for thousands of years to make tools, knives, spear tips, arrowheads, and other weapons. At least 50 prehistoric and historical obsidian quarries have been found inside YNP, and at least one has been found on the Northern Range outside YNP.^{3,6p16} The most

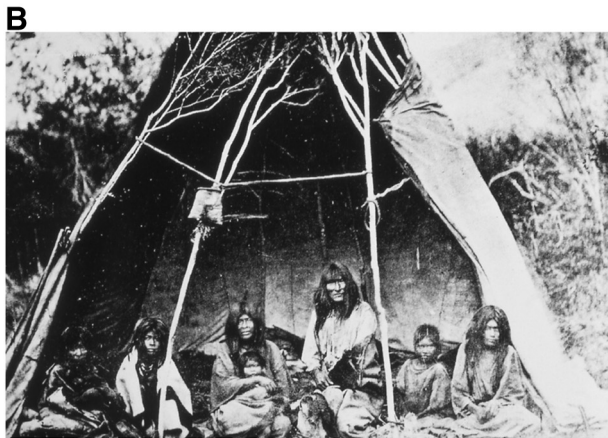


Figure 1. The Northern Range inside and outside Yellowstone National Park (YNP) had been the homeland of Native Americans for millennia when YNP was created in 1872. National Park Service photos by William Henry Jackson in 1871. **A**, Nez Perce encampment along the Yellowstone River. **B**, A lodge of Tukudika, the eaters of meat.

famous quarry is inside YNP at Obsidian Cliff where millions of stone artifacts attest to “the vast amounts of stone tools produced at Obsidian Cliff over the past 11 millenia.”^{4p84} Chert is another rock used by Native Americans to make stone tools, and a large chert quarry exists on the Northern Range inside YNP at Crescent Hill.^{4p94}



Figure 2. Wickiups (i.e., brush tipis) were commonplace throughout the Northern Range inside and outside Yellowstone National Park (YNP) when the park was created. **A**, National Park Service photo of a Bannock wickiup in 1871. **B**, A remnant wickiup inside YNP in 1970. National Park Service photo by William Dunmire.

Ancient and more contemporary Native American structures have been found on the Northern Range. A 5,000-year-old fire hearth has been documented at Rigler Bluffs near Corwin Springs, Montana, about 12 miles north of the YNP boundary, and a group of 5,000-year-old tipi rings has been



Figure 3. Euro-American explorers, and later visitors to Yellowstone National Park, frequently encountered Native Americans on the Northern Range during the 1800s. National Park Service photo of a Shoshone encampment in 1871.

documented closer to the YNP boundary at Cinnabar, Montana.^{6p26} Twelve additional sites with tipi rings have been documented on the Northern Range outside YNP, and several wickiups (i.e., brush tipis made from downed trees and branches, shrubs, and grass) also have been found on the Northern Range, inside and outside YNP (Fig. 2).^{2,7} In fact, Colonel Philetus Norris, second superintendent of YNP, reported in 1880, 8 years after YNP was established, that wickiups were abundant “in nearly all of the sheltered glens and valleys” of YNP.^{8p35} Native American pictographs, petroglyphs, burial sites, and hunting blinds also have been documented on the Northern Range.^{2,3,4p170–171,9p982}

The Northern Range lies within the historical territory of several tribes. For centuries, Bannock, Shoshone, Nez Perce, Blackfeet, Crow, Salish, Kootenai, and other tribes used the Yellowstone Trail or Bannock Trail to traverse the Northern Range. Early explorers found numerous Native American trails throughout the Northern Range,^{10p9} and modern highways closely follow many of these routes. Remnants of Native American trails remain clearly visible today in places on the Northern Range.^{6p95,11} One branch of the Northern Shoshone tribe, labeled “Sheepeaters” by Euro-Americans during the 1800s, permanently occupied the Northern Range inside and outside what is now YNP. As their name indicates, meat from bighorn sheep (*Ovis canadensis*) was a common food item.^{8p35} However, these people were actually known as the Tukudika or “eaters of meat” whose diets on the Northern Range also included meat from bison (*Bison bison*), deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and pronghorns (*Antilocapra americana*).^{12p179–180}

Early Euro-American explorers frequently encountered Native Americans on the Northern Range during the 1800s (Fig. 3). For example, in 1829 a Rocky Mountain Fur Company party of trappers led by Captain William Sublette battled a band of Blackfeet near Cinnabar Mountain and two trappers were killed.^{10p36,13p9} Fur trapper and explorer

Osborne Russell encountered a friendly band of Tukudika in the Lamar Valley in 1835, and mountain man Jim Bridger spent the winter of 1844 to 1845 with a band of Crow at the north end of the Northern Range.^{2p24,14p26} In 1869, a three-man party made up of Charles Cook, David Folsom, and William Peterson encountered Native American women gathering and drying chokecherries at the mouth of Tom Miner Creek on the Northern Range outside of what was to become YNP. A short distance away, near the Devil’s Slide, they encountered another group of Native Americans and their herd of 20 or 25 horses.^{15p16&19,16p13&15} In 1870, the Native American presence remained prevalent inside what was soon to become YNP, so much so that alarms of impending attacks by Native Americans caused most civilian recruits of the Washburn-Doane Expedition to resign before the expedition left Fort Ellis near Bozeman, Montana to explore the Northern Range.^{10p72} Fortunately for all, the Washburn-Doane Expedition encountered only two friendly bands of Crow, one near the northern boundary of the Northern Range near Emigrant Gulch and one near Tower Falls inside what was to become YNP.^{5p104,13p114,17p3&7} Native Americans continued to traverse the Bannock Trail through YNP at least as late as 1877 when a dozen Bannock traveled past a group of Euro-Americans camped along Hellroaring Creek.^{18p237–238} In 1878, YNP Superintendent Norris’s road-building crew retreated from south of Mammoth owing to fear of Native American attack, and raids by Native Americans impeded construction of the superintendent’s headquarters at Mammoth.^{9p981&987}

Native Americans often ignited low-intensity forest and rangeland fires, typically at the end of summer. These fires suppressed conifer encroachment into grasslands and sagebrush steppe, thereby sustaining abundant forage for wild ungulates.^{19p15,20p44} Native Americans also ignited fires to promote the growth of green grass to attract bison and other

animals for hunting, and Native Americans killed more bison than did wolves or any other predator.^{6p112,20p44,21,22} At least 3 bison kill sites have been documented on the Northern Range.^{2p3&91,18p112-113} Kill sites for elk, deer, and bighorn sheep also have been documented.^{4p170-171,6p62,8p34-36,18p170-173} Native Americans retained the right to hunt within YNP by the Fort Bridger Treaty of 1868, and Native Americans were still hunting inside YNP as late as 1889.

The first military superintendent of YNP, Captain Moses Harris, did not recognize this right, calling Native American hunting inside and adjacent to YNP “unmitigated evil.”^{19p15} Captain Harris prohibited Native Americans from igniting low-intensity fires to purposely burn the forests and rangelands, and he dispatched the first federal wildland firefighters in US history to extinguish lightning-caused fires as well.^{23p7,24p7} Captain Harris also complained that the presence of Native American hunters inside YNP “gave rise to much alarm and uneasiness among the tourist visitors.”^{19p14-15}

To reassure and attract tourists who might fear Native Americans, especially after two YNP tourists were killed by Nez Perce while Chief Joseph and his band were fleeing the US Army in 1877,^{10p148} early YNP administrators began a public relations campaign that promoted an untrue, ethnocentric myth that Native Americans avoided YNP because they feared its geysers and hot springs. This well-orchestrated deception led many people to conclude that Native American influences on the habitat and wildlife inside YNP had been minimal, when in fact the influences had been considerable throughout history and prehistory.^{25p22-23}

Euro-American Fur Trappers and Miners

The first Euro-American confirmed to arrive on the Northern Range was fur trapper and explorer John Colter in the winter of 1807 to 1808, more than two centuries ago.^{10p20} He had passed about 30 miles north of the Northern Range boundary in 1806 when he served as a private soldier with Lewis and Clark’s Corps of Discovery on its expedition to explore the Louisiana Purchase. Fur trapping was a significant activity on the Northern Range from the 1820s through the 1840s.^{2p24,12,13,26p11} The Gardiner River (originally known as Gardner’s River) and Gardner’s Hole, a mountain valley at the river’s headwaters, were named by fur trappers for Johnson Gardner who hunted and trapped the area in 1831 to 1832.^{12p10,27p18} The spelling of Gardner inadvertently was changed years later to Gardiner, which according to local lore was due to difficulty understanding the thick southern drawl of mountain man Jim Bridger. In 1878, YNP Superintendent Norris found several places on the Northern Range inside YNP that bore the mark of trappers who inhabited the area 40 to 60 years earlier, including foot bridges across Crevice Creek and Hellroaring Creek, a corral near Amethyst Mountain, and stumps of large trees cut for breastworks (i.e., fortifications to protect defenders firing weapons from a standing position).^{9p989}

As discussed earlier, Native Americans were the original miners inside what was to become YNP, mining obsidian and

chert for thousands of years. Between 1864 and 1870, at least three large groups of Euro-American miners, one comprised of 40 men, prospected much of the Northern Range within what was to become YNP.^{8p44-45,10p66&135-136,13p34&39} During the Wasburn-Doane Expedition of 1870, US Army Lieutenant Gustavus Doane noted many prospect holes that had been dug by miners in prior years.^{17p5,27p116} The miners also left their mark by naming several Northern Range streams inside what was to become YNP, including Cache Creek, Slough Creek, Hellroaring Creek, and Soda Butte Creek.^{10p66&135-136,13p31,34&39} Crevice Creek was named in 1867 by prospectors who found gold in a rock crevice near the mouth of the stream. In 1864, gold was discovered in Emigrant Gulch near the northern edge of the Northern Range, and in 1866 gold was discovered on the Northern Range at Jardine, Montana (formerly known as Bear Gulch). Jardine is a small unincorporated town that remains today, located 6 miles north of YNP. A large underground gold mine operated at Jardine from 1917 to 1948 and again from 1989 to 1996.

Coal mining occurred from 1872 to 1910 at Aldridge, Montana, now a Northern Range ghost town located 2 miles north of YNP. At maximum capacity in 1901, the Montana Coal and Coke Company employed more than 500 men. All of the coal was mined from about 3,000 acres of land surrounding Aldridge. In addition, a small coal mine operated on and off inside YNP from 1883 to 1920 to supply coal to the Mammoth Hotel. The mine was located on the northwest slope of Mount Everts (McMinn Bench) and was operated by Silas McMinn, who also had a ranch adjacent to YNP along Reese Creek from 1899 to 1901. Finally, a quarry of decorative travertine stone, located 1 mile north of Gardiner, Montana opened in the 1930s and portions of the quarry have operated on and off for the past 85 years.

Livestock Ranching

Early cattle ranching on the Northern Range focused on supplying food to miners in the mid-1860s. The cattle industry became firmly established when Nelson Story, the inspiration behind Larry McMurtry’s novel *Lonesome Dove*, conducted the first major cattle drive from Texas to Montana. Story, his crew, and 1,000 Longhorn cattle arrived at what is now Livingston, Montana in December 1866 and entered the Northern Range in 1867. Today, descendants of Nelson Story operate the ranch on the original Story homestead near the northern end of the Northern Range. Several other ranches were established on the Northern Range in the late 1860s and early 1870s, closer to what was to become YNP in 1872.²⁸ The Henderson Ranch was looted and burned in August 1877 by the Nez Perce while they were fleeing from the US Army. The OTO Ranch, the first dude ranch in Montana, operated 12 miles north of Gardiner, Montana from 1898 to 1932. At least one early rancher, James Beatty, was permitted by YNP to graze his cattle on the Northern Range inside YNP in the Lamar Valley in 1875, and livestock were allowed to graze inside YNP between Mammoth and the park’s northern



Figure 4. Cattle ranching contributes significantly to the economy and culture of the Northern Range, and numerous species of wildlife depend on privately owned ranchland for winter and summer habitat. In turn, hunters depend on traditional cattle ranchers for access to private ranchland for hunting, and ranchers and wildlife biologists depend on hunters to regulate elk and deer populations. National Park Service photo by Jim Peaco of a private cattle ranch near the northern edge of the Northern Range.

boundary until about 1905.^{28,29p41} One Northern Range rancher, Joseph Duret, allegedly allowed or encouraged his cattle to cross into YNP from his ranch on Slough Creek circa 1914 to 1922.²⁸ The area from the YNP boundary north to Yankee Jim Canyon was heavily grazed by cattle and horses until 1926.^{29p42}

From 1882 to at least 1905, concessionaires were permitted to graze dairy cattle, beef cattle, and sheep near hotels and campsites inside YNP to supply milk and meat to guests and employees. A dairy farm operated inside YNP in the 1890s on Swan Lake Flat four miles from Mammoth, and another dairy farm operated during the early 1900s on Primrose Creek near Mammoth. In addition, cattle and sheep were herded into YNP in the spring and pastured during summer to supply a slaughterhouse on Swan Lake Flat.^{30p42} In 1890, 200 cattle were harvested there.²⁸

Cattle ranches have remained an important part of the economy, culture, and wildlife habitat on the Northern Range for 150 years (Fig. 4). Full-time livestock producers dominated the ranching industry on the Northern Range for the first 100 years, through the 1960s, and many ranch families owned and operated the same ranchland for several generations. Change became noticeable in the 1970s when the majority of ranches sold were purchased by nonresidents rather than local ranchers. Buyers included developers who divided and sold the smaller parcels as ranchettes, while other buyers were investors who used their ranches for recreation and as tax shelters.³¹ Absentee ownership of Northern Range ranches accelerated in the 1990s and many absentee owners now focus on amenity values in addition to, or instead of,

livestock production.^{32,33} Absentee owners now own at least one-third of the larger ranches on the Northern Range.

Compared with traditional ranchers whose income depends on livestock production, many absentee ranch owners do not, and they have greater tolerance for elk and other wildlife and less tolerance for hunting, especially by public hunters seeking free access.^{31,34} As recently as the early 1980s, traditional ranches on the Northern Range commonly allowed free access to their private land for any hunters who asked. Today, about 25% of private ranchland on the Northern Range is closed to all hunting. It has become increasingly difficult to use regulated hunting to control elk and deer populations. Private ranchlands closed to hunting become refuges that influence elk and deer distribution. Elk and deer tend to move to these “safe havens” during the hunting season, then return to graze on nonrefuge private ranchlands when hunting season ends.³¹

Elk-cattle competition on private ranchlands of the Northern Range has increased steadily during the past 30 years.^{31,35} Elk and deer damage fences, depredate haystacks, and deplete pasture forage (Fig. 5A). Depredation is exacerbated on livestock ranches that adjoin private ranchlands closed to hunting. Impacts from excessive numbers of elk and deer challenge the financial sustainability of livestock ranches, making them more likely to be sold to amenity owners who will not allow hunting or sold for rural development (Fig. 5B). Increased development that decreases open space and increases habitat fragmentation is a serious threat to Northern Range wildlife that depends on privately owned ranchland for winter and summer habitat.³⁶



Figure 5. Impacts from excessive numbers of elk and deer threaten the financial sustainability of traditional cattle ranches, making them more likely to be sold for rural development or sold to amenity owners who prohibit hunting. **A**, Getty Images/Corbis News Collection photo by William Campbell of elk grazing private ranchland on the Northern Range. **B**, National Park Service photo by Jim Peaco of rural residential development on the Northern Range.

Recreation

Millions of tourists have visited and affected the natural environment of the Northern Range during the past 146 years. In 1872, the year YNP was established, an estimated 300 people visited YNP. By 1950, visitors numbered 500,000 annually, increasing to 2 million annually in the 1970s, and to 3 million annually in the 1990s. In 2015, 2016, and 2017, more than 4 million people visited YNP each year. Direct impairment of the Northern Range ecosystem, especially impacts to wildlife distribution and behavior, are unavoidable

given the large number of visitors.^{30p249–250} North of the YNP boundary, regulated public hunting is a popular activity in the forest and rangeland of the Northern Range, whereas kayaking, rafting, and world-class fishing are popular outside the park on the Yellowstone River and its tributaries.

Roads and bridges were first constructed on the Northern Range inside YNP in the 1870s. Visitors in the 19th century and early 20th century traveled by saddle horses, surreys, wagons, and stagecoaches (Fig. 6), and every summer thousands of horses grazed the Northern Range inside



Figure 6. Millions of tourists have visited and impacted the natural environment of the Northern Range during the past 146 years. Impairment of the Northern Range ecosystem is unavoidable given the large number of visitors, with nearly 4 million people in 2017 alone. National Park Service photo of stagecoaches bringing tourists from the Gardiner Train Depot to Mammoth in 1904.

YNP to facilitate transporting people and supplies.^{29p41} Automobiles were not allowed inside YNP until 1915, and stagecoaches were replaced with buses and cars in 1917.

The Northern Pacific Railway Company was a strong proponent of tourism development on the Northern Range. In 1883, the Northern Pacific completed the Park Branch that connected Livingston, Montana on the main transcontinental line to Cinnabar, Montana, a town located 3 miles northwest of Gardiner, Montana. Cinnabar was dismantled when the railroad was extended to Gardiner 20 years later. Regularly scheduled passenger rail service to Gardiner ended in 1948 and freight service ended in 1955. The rails and ties that formed the Park Branch were removed in the 1960s, but today the railroad bed continues to impair local hydrology. A section house built in 1910 to shelter railroad maintenance crews still stands about 20 miles north of YNP at Sphinx, Montana.

Yellowstone National Park Management

Congress formally established YNP, the world's first national park, in 1872. At the time, YNP was located in federal territories and became a national park, in part, because no state governments existed to manage the land. The states of Wyoming, Montana, and Idaho did not achieve statehood until 1890, 1889, and 1890, respectively.

During its first 14 years, YNP was administered by civilian superintendents appointed by the Secretary of the Interior. Some superintendents were effective, others were not, and still others were corrupt.^{10p108-114} When YNP was first established, public hunting was allowed and tourists hunted for their food while camping inside YNP.^{10p112} Public hunting of

most animals was prohibited inside YNP beginning in 1883, but public hunters were allowed to kill wolves, bears, mountain lions, and other predators until 1886. Wild ungulate populations expanded significantly in response to predator control and the elimination of hunting.^{37p4}

In 1886, Congress denied funding for YNP management owing to several years of poor performance.^{10p114} When the funds were denied, Secretary of the Interior Lucius Lamar reluctantly requested assistance from Secretary of War William C. Endicott.^{10p114} The Secretary of War deployed troops and assumed control of YNP in August 1886. Over the next 32 years, the US Army implemented a number of policies that improved conditions inside YNP. The Army built roads and trails, largely eliminated poaching, and began active wildlife management.

One of the Army's greatest management successes was saving YNP bison from extinction. By 1894, YNP bison were the last wild bison remaining in the United States. When bison numbers declined to only 25 animals in 1901, the Army introduced domesticated bison to bolster the herd, purchasing 18 cows and three bulls in 1902 from privately owned herds in Montana and Texas.³⁸ In 1907, captive bison on the Northern Range numbered 61 and the Army established the Buffalo Ranch (currently the Lamar Ranger Station) in the Lamar Valley to further increase the captive herd so that captive bison could eventually be released into the wild to augment the wild bison herd. By 1916, bison numbers on the Northern Range totaled 273 captive bison and 72 wild bison. However, the management policy had at least one unintended consequence, as the captive bison harbored *Brucella abortus*, a bacterium that causes brucellosis in bison, elk, cattle, horses, and humans. Brucellosis is a zoonotic disease (i.e., a disease that can be transmitted from animals to humans) that causes

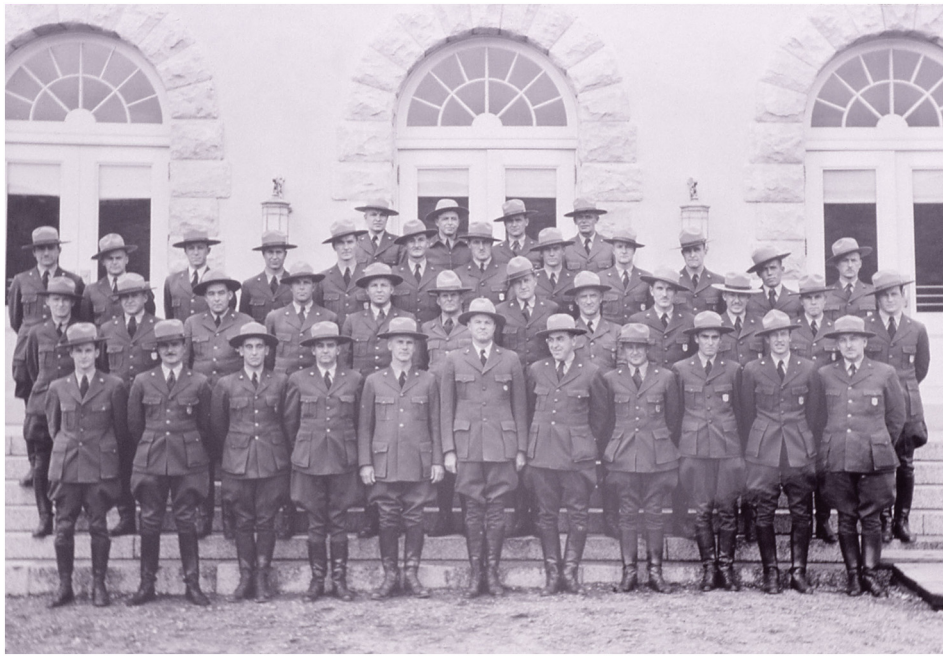


Figure 7. The National Park Service (NPS) was assigned responsibility for Yellowstone National Park in 1918 after 32 years of management by the US Army. The NPS continued many of the Army's wildlife management policies and even adopted a similar uniform, with park rangers then and now wearing a flat-brimmed hat modeled after the campaign hat of the post-Civil War Army. National Park Service photo of rangers in front of Mammoth Post Office, circa 1937.

spontaneous abortions, infertility, reduced milk production, and lameness (arthritis in humans).³⁹ The captive bison may have contracted brucellosis by commingling with cattle that were kept at the Buffalo Ranch to provide food and milk to Army personnel, or some of the imported bison may have been infected with *Brucella abortus* before they arrived in YNP.³⁶

The Army's management of YNP wildlife also led to other major problems, primarily the overpopulation of elk. The Army's success in enforcing hunting bans and stamping out poachers allowed elk populations to grow exponentially. The Army also systematically exterminated predators, which further allowed the elk population to increase. Coyotes, wolves, and mountain lions were shot, trapped, and poisoned. Wolves were largely eliminated from inside YNP by 1916.^{40p17} The unnaturally large numbers of elk depleted the amount of forage available in winter. To prevent mass starvations, Northern Range elk, deer, pronghorns, and bighorn sheep were fed hay, and sometimes cottonseed cake, during winter inside YNP from 1905 to at least 1935. Hay was harvested in the Lamar Valley inside YNP and purchased from neighboring ranches, and feeding grounds were located inside YNP in the Lamar Valley, at Mammoth Hot Springs, and near Gardiner, Montana.^{26p167,29p103,40p28&66,41p79&96&98,42p19&47} Bison were fed hay inside YNP every winter from 1902 to 1952, and hay was harvested in the Lamar Valley inside YNP as late as 1956 to provide feed for National Park Service (NPS) horses.^{30p146,43p31}

In the early 20th century, captive bison were herded around for the entertainment of YNP visitors.^{38p23} YNP also used fencing and herding to prevent wild ungulates from migrating outside YNP. From 1913 to 1932, a 6.5-foot high, 4.3 miles-

long woven wire fence was maintained along the northern boundary of YNP near Gardiner, Montana.^{26p119} In addition, elk, pronghorns, and other ungulates were hazed (i.e., herded) back into YNP during winter to keep them from being killed by hunters in Montana.^{26p167-168,41p97}

Congress created the NPS in 1916. This new agency was assigned responsibility for YNP in 1918, with its first rangers including many Army veterans. The newly minted NPS continued many of the Army's wildlife management policies inside YNP, including predator control and ungulate feeding during winter. The NPS even adopted a similar uniform (Fig. 7), with park rangers then and now wearing a flat-brimmed hat modeled after the "campaign hat" of the post-Civil War Army.^{24p8}

From its inception to present day, NPS policies and management decisions have been responsive to stakeholders.⁴⁴ Stakeholders include the general public, elected officials, other federal and state agencies, local governments, and special interest groups. Decision-making freedom is bounded by federal legislation, most notably the 1916 Organic Act (Title 16 United States Code [USC] Sec. 1-4 et seq), the General Authorities Act of 1970 and its "Redwood Amendment" of 1978 (Title 16 USC Sec. 1a-1), and the National Parks Omnibus Management Act of 1998 (Title 4 USC Sec. 401-419). These statutes direct the NPS to preserve the scenery, wildlife, and natural objects inside national parks and also to allow people to enjoy these resources in ways that leave the scenery, wildlife, and natural objects unimpaired for future generations. Congress provided further guidance specific to YNP in YNP's Enabling Act (Title 16 USC Sec. 22) to "preserve from injury or spoliation" the "wonders" of the park and ensure "their retention in their natural condition."⁴⁵



Figure 8. The Leopold Report, a document revered by the National Park Service and generations of conservationists, advised that active management (e.g., controlled burning, hunting, culling, etc.) was required to sustain wild ungulate populations and their habitat in Yellowstone and other US national parks. The report's senior author, Dr. Starker Leopold, shown with his dog in 1955 while hunting chukkar partridge in California. Photo courtesy of the Aldo Leopold Foundation (www.aldoleopold.org).

Cumulatively, federal statutes require the Secretary of Interior to take action to protect YNP resources, but the specific actions to be taken are at the Secretary's discretion.⁴⁵ Congressional budget-making and congressional oversight also influence NPS management.

In YNP, the civilian superintendents, US Army, and NPS have used widely differing fish and wildlife management strategies during the past 146 years. In 1890 for example, Captain F.A. Boutelle, the second military superintendent of YNP, requested the US Commission on Fish and Fisheries (currently US Fish and Wildlife Service) to begin stocking fish in YNP streams and lakes. This practice continued into the 1930s. Non-native fishes (e.g., lake trout [*Salvelinus namaycush*], brook trout [*Salvelinus fontinalis*], and rainbow trout [*Oncorhynchus mykiss*]) were stocked annually to support fishing by tourists.^{10p229,46p216} The non-native fishes were supplied by hatcheries constructed on the Northern Range inside YNP at Mammoth Hot Springs and Soda Butte Creek.^{40p229} Today, the non-native brook trout and brown trout outcompete native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*); the non-native rainbow trout interbreed with westslope cutthroats; and the non-native lake trout outcompete native Yellowstone cutthroat trout (*Oncorhynchus clarkia bouvieri*). NPS policy requires, whenever feasible, that non-native species be controlled or eradicated when they harm native species,^{47p48} and since 1994 the NPS has used gillnetting to lethally remove lake trout from YNP lakes and streams. Recreational anglers are required to kill all lake trout they catch in Yellowstone Lake and its tributaries. Since 2009, the NPS has contracted with a commercial fishing company to remove lake trout from Yellowstone Lake.⁴⁸

Wild ungulate management inside YNP provides another example of changing management strategies through time. As described earlier, the elimination of hunting and most poaching, predator removal, and winter feeding practices enabled wild ungulate populations to increase substantially from the 1880s to the mid-1930s. This had the unintended consequence of degrading the Northern Range ecosystem.⁴⁹⁻⁵² In response, elk, deer, and pronghorn populations were actively limited from 1935 to 1968 using a combination of regulated hunting outside YNP, live-capture inside YNP with transplant away from YNP, live-capture inside YNP with slaughter (with meat provided to Native Americans), and, when necessary, shooting inside YNP by NPS staff and authorized agents.³⁶ From 1964 to 1968, the NPS even used helicopters to herd elk long distances from inside YNP to public lands north of YNP.^{26p34}

In the early 1960s, mass media reported on the elk reductions that the NPS had undertaken inside YNP, sparking a public outcry against active population management. Secretary of the Interior Stewart Udall convened a committee, the Special Advisory Board on Wildlife Management, to study the issue. Dr. Starker Leopold, Professor of Zoology and Forestry at the University of California, Berkeley (Fig. 8), chaired the committee whose report later became known as "The Leopold Report".⁵¹ The report recommended that, "As a primary goal...a national park should represent a vignette of primitive America." To achieve that goal, Leopold and his colleagues advised that wild ungulate populations and their habitat could not be sustained "by passive protection alone." Rather, the report recommended active habitat manipulation, when needed, and recommended controlled burning as "the most 'natural' method" and "the only method

that may have extensive application.” The report also recommended that, “...populations of the animals themselves must sometimes be regulated to prevent habitat damage.” Excess ungulates that migrated seasonally outside park boundaries were to be removed by regulated hunting outside the park, whereas excess ungulates that did not leave the park were to be removed by either capture and transplanting or shooting inside the park by NPS personnel or their authorized agents.⁵¹

All recommendations of The Leopold Report were incorporated into official NPS policy in 1963.⁵³ Only 4 years later, in response to public and Congressional pressure, YNP abruptly changed its ungulate management paradigm to “natural control theory,” which asserted that predators and periodic adverse weather would sufficiently control wild ungulate populations without human intervention.⁵⁴ By 1971, the management paradigm had changed again to “natural regulation,” which asserted that predators were not the primary factor that limited wild ungulate populations. Rather, natural regulation theory asserted that wild ungulate populations were regulated by the availability of forage, and wild ungulate populations were incapable of attaining densities that would cause habitat degradation. Predators, if present, would only kill the animals slated by nature to die from other causes, primarily malnutrition or starvation.⁵⁵ During the past several decades, the term “natural regulation” has evolved into “ecological process management,” which advocates reliance on natural ecological processes and the absence of direct manipulation by humans.⁵⁶ However, wild ungulate populations on the Northern Range have never been “a clean example” of self-regulated populations because most of the ungulate species, including elk, are hunted when they migrate outside YNP. This fact was recognized long ago by YNP biologist Douglas Houston, one of the original proponents of the natural regulation paradigm.^{26p198}

From the late 1960s to about the year 2000, the Northern Range elk herd responded to natural control, natural regulation, and ecological process management in much the same way the elk herd responded to Army and NPS management in the late 19th century and early 20th century. Once again the elk population grew very large, to a size far beyond what existed in primeval times,³⁶ which once again caused habitat degradation in the late 20th century and early 21st century, just as it did in the early 20th century.^{49–52} Since 2000, greater predation by wolves, grizzlies, and mountain lions has significantly decreased the Northern Range elk population.³⁶

Compared with elk, Northern Range bison have been managed more actively by the NPS during the past 100 years.³⁶ From 1918 to 1968, the NPS periodically removed bison from the Northern Range, attempting to balance bison numbers with the amount of forage available. Bison removals averaged 133 animals per year during this 51-year period, with no removals conducted during many years, whereas as many as 1,000 bison were removed in other years (e.g., during the drought years of 1933 and 1935).^{43Appendix IV} The NPS did not remove any Northern Range bison from 1969 through 1990. Removals began again in 1991 and averaged 233 bison per year from 1991 through 2017.⁵⁷ Removals of Northern Range bison during the past 100 years were nearly all accomplished by live capture. The

NPS did use field shooting from the mid-1950s to mid-1960s to remove animals from other bison herds inside YNP.⁴³ After capture, most Northern Range bison were sent to meat processing (slaughter) and the meat distributed to Native Americans.^{43,57} Another 39 bison per year were live-captured and removed for research purposes from 2005 to 2017.

Modern NPS policy allows the use of lethal culling to accomplish resource management objectives,^{47p44–45} and lethal culling is actively applied in other US national parks to preserve natural conditions. For example, current management uses lethal culling to control elk numbers in Rocky Mountain National Park in Colorado and to control bison numbers in Grand Canyon National Park in Arizona.

In addition to fish and wildlife management, the NPS also actively manages the forest and rangeland habitat inside YNP. One example is the way that the NPS addresses non-native plants. The federal Plant Protection Act of 2000, and NPS policy, mandate that the NPS controls noxious weeds inside YNP.^{47p48} In response, the NPS uses hand pulling and grubbing, mowing, and herbicides to control numerous noxious weeds on the Northern Range inside YNP, including spotted knapweed (*Centaurea stoebe*), musk thistle (*Carduus nutans*), whitetop (*Cardaria draba*), oxeye daisy (*Leucanthemum vulgare*), field bindweed (*Convolvulus arvensis*), and Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*).⁵⁸

The NPS also uses controlled burning (also known as prescribed burning or prescribed fire) to actively manage forest and rangeland habitat of the Northern Range inside YNP. One goal is to mimic, under controlled conditions, the ways that fire naturally influenced the Northern Range ecosystem. Fire, both lightning-ignited wildfire and human-ignited fire purposely set by Native Americans, has been a natural part of the Northern Range ecosystem for 11,000 years.^{6p112,19p15,20p44,59,60} Consequently, fire is essential for sustaining the natural plant and animal abundances on the Northern Range and vital to sustaining the ecosystem’s natural ecological processes. Unfortunately, the NPS actively excluded both wildfire and controlled fire on the Northern Range from 1918 to 1987.^{59,61} This practice had, and continues to have, unintended negative consequences for the plants and animals of the Northern Range. However, current NPS policy allows wildfires to burn as long as they do not seriously threaten park infrastructure or human life.^{47p49} Modern NPS policy also allows the use of controlled burning to accomplish resource management objectives,^{47p49} and current management actively applies controlled burning in other US national parks to emulate burning by indigenous people, including Sequoia and Kings Canyon National Parks, Yosemite National Park, and Everglades National Park. The next step needed in the evolution of NPS fire management on the Northern Range is for the NPS to ignite more controlled burns to purposely mimic the low-intensity fires set by Native Americans in the prehistoric and historical past.

Summary and Conclusions

Humans have influenced the land and wildlife of the Northern Range for at least 11,000 years. Human impacts

from hunting, burning, fur trapping, mining, ranching, recreation, and fish and wildlife management have shaped the Northern Range ecosystem.

Native American activities such as hunting and burning sustained primeval native plant and animal abundances and ecological processes for thousands of years before YNP was created and for the first 17 years after YNP was created. As such, Native American hunting and burning are natural processes—a part of nature, not apart from it. A major flaw of modern-day management is failure to acknowledge the importance of these prehistoric and historical Native American actions and influences on the Northern Range ecosystem. Generations of wildfire suppression and too few controlled burns have allowed conifers to invade grassland and sagebrush steppe,^{26,30,42p92–93,60} thereby decreasing native plant and animal abundances and decreasing the amount of forage available to wild ungulates and livestock alike. Similarly, generations of limited control of elk and bison populations have allowed elk and bison grazing to decrease native plant and animal abundances, degrade rangeland ecosystem processes, and decrease forage abundance.^{36,49,50}

Current NPS policy directs the NPS to intervene with active management where observed differences between current and primeval conditions are human caused.^{47p36–37} In this case, unnaturally high densities of conifers and wild ungulates are caused by NPS management decisions during the past 146 years that largely ignored, minimized, or eliminated impacts from Native American hunting and burning. More human-ignited controlled burns and greater control of bison and elk populations are needed to restore and sustain the ecological integrity of the Northern Range. These strategies are consistent with NPS policy and consistent with the way indigenous people naturally influenced the Northern Range ecosystem for 11,000 years.

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