SRM Society for Range Management

An Ecological Assessment of the Northern Yellowstone Range: Synthesis and Call to Action

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

Rangelands 40(6):224–227
doi 10.1016/j.rala.2018.10.007
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The Northern Range (a.k.a., Northern Yellowstone Range) is a beloved icon to Americans and millions of others around the globe.[1] Its stewardship is watched, evaluated, and emulated by people worldwide. Advancements in the management and restoration of the Northern Range ecosystem would provide a helpful example for natural resource management elsewhere.

The land management goal for the Northern Range, or at least the 60% that is located inside Yellowstone National Park (YNP), is to sustain the primeval abundances of native plants and animals so that natural ecological processes can function sustainably, within their range of natural variation.[2p36–37,3,4] National Park Service (NPS) policy also mandates that if ecosystem function has changed over time, NPS must identify the reason(s) why. NPS will not intervene where observed differences between current and primeval conditions resulted from natural evolution. However, federal statutes prohibit human-caused resource degradation in our nation's national parks, and NPS is directed to use active management to restore ecosystem function where differences between primeval and present conditions are human-caused.[2p36-37&44&46]

The most widely accepted way to assess ecological integrity, or naturalness, is to compare the abundance of native plant and animal species currently in an area with their primeval abundances.[5] Using this metric, the authors in this Special Issue assessed the naturalness and ecological integrity of present-day wildlife populations and vegetation on the Northern Range.[6–9] Another widely accepted way to judge ecological integrity or naturalness is to assess the degree to which key ecosystem processes have been modified.[5] This metric also was used in this Special Issue to assess the naturalness of Northern Range grasslands and sagebrush steppe.[6]

The articles in this Special Issue provide an objective assessment of the current ecological health and trend of the Northern Range. The evidence is compelling and, unfortunately, the picture is not pretty, especially inside YNP. Current abundances of native plants and animals differ dramatically from the primeval landscape.[6–8] Compared with today, the primeval Northern Range ecosystem had more sagebrush, fewer conifers, fewer bison, fewer elk, more aspen, more willows, more cottonwoods, more beaver, more songbirds, more bluebunch wheatgrass, and more Idaho fescue. Although grasslands, sagebrush steppe, aspen, willows, and cottonwoods continue to thrive on most of the Northern Range outside YNP, their ecological health has declined precipitously inside YNP. The changes in flora, fauna, and ecosystem processes have not been caused by changes in climate.[6,7,10] Rather, unnaturally large populations of bison and elk have excessively grazed and browsed the Northern Range to the point that the health of the land and its natural ecological processes (e.g., water cycle, energy flow, and nutrient cycle) are significantly degraded, and the situation continues to worsen.[6–9] The current bison population is about 10 times larger than the natural primeval population and the current elk population is about 30% larger than the natural primeval population.[8]

Predation by wolves, grizzlies, and mountain lions has been insufficient to stop or reverse the negative impacts of grazing by too many bison and too many elk. And a significant future increase in predation by wolves, grizzlies, or mountain lions inside YNP is unlikely because their populations are unlikely to increase. Predator recovery appears complete. Their habitat inside YNP appears to be fully occupied.[11–13]

Articles in this Special Issue also document that the continuing degradation of the Northern Range is caused by humans. Modern-day management decisions have virtually eliminated frequent, often human-ignited, low-intensity fires

in spring or fall and replaced them with infrequent, high-intensity wildfires that occur when conditions are hottest in mid- to late-summer.[14] As a result, conifer densities are greater in forests, and forage is less abundant beneath dense forest canopies. Invasion of conifers into former grasslands and sagebrush steppe also has reduced forage abundance.

In addition to an altered fire regime, modern-day management has minimized prehistoric and historical impacts of predation by Native Americans,[9] resulting in unnaturally large populations of bison and elk, excessive grazing and browsing, and degradation of vegetation, streams, and soils.[6–8] In turn, the loss of suitable habitat has reduced the populations of songbirds, beaver, and other fauna.[7] Furthermore, the altered fire, grazing, and browsing regimes interact. Heavy modern-day grazing, browsing, and trampling by bison and elk depletes the herbaceous vegetation and shrubs that formerly fueled frequent, low-intensity fires.[14]

To restore and preserve the ways that the Northern Range ecosystem functioned sustainably since the last Ice Age, the natural abundances of native plant and animal populations must be present.[3] These ecosystem components work together to define how the water cycle, energy flow, and nutrient cycle function naturally on the Northern Range landscape. Modern-day management has altered the ecosystem's natural processes, largely by altering species population levels. Restoring plant and animal species abundances to primeval amounts, within ranges of natural variation, is fundamental to restoring how the ecosystem functioned sustainably for 11,000 years before Euro-Americans.

Euro-American management decisions also introduced the nonindigenous bacterium *Brucella abortus* and its zoonotic disease brucellosis to Northern Range elk and bison.[8] Today, brucellosis in elk and bison is another major challenge that needs more action on the Northern Range. Brucellosis is a serious human health issue that also threatens the financial sustainability of Northern Range livestock ranches, making ranchlands more vulnerable to human development.[15,16] Increased development threatens the existence of thousands of Northern Range wildlife that depend on privately owned ranchland for winter and summer habitat.[8] Furthermore, brucellosis in elk is expanding geographically beyond the Northern Range and the Greater Yellowstone Area at an alarming rate, threatening to infect wild elk throughout much of the Rocky Mountain West in the next 20 years.[17,18] Eradication of brucellosis from Northern Range elk and bison would not be easy. However, brucellosis has been eradicated from other national parks in the United States and Canada.[19,20] Lethal and nonlethal control measures have proven effective, without dramatic reductions in the numbers of wild ungulates (i.e., hooved mammals) at any one time.[19] Until eradication is achieved, management should minimize the transmission of *B. abortus* among bison, elk, cattle, horses, and people on the Northern Range. Active management should be used to reduce the size of the bison and elk populations, disperse large concentrations of elk and bison, and prevent elk and bison from commingling with cattle and horses.[21–23] Selective sterilization or selective culling of young, reproductively active, *B. abortus*-infected females are two other effective tools that can be used to reduce the risk of transmissions.[24]

In 2012, The Wildlife Society published a technical review of ungulate management in national parks of the United States and Canada.[20] One conclusion in The Wildlife Society report was that nonhuman, natural ecological processes alone cannot prevent YNP ungulate populations from reaching densities that degrade native plants, native wildlife species, and natural ecological processes. The Wildlife Society report also affirmed that ungulates inside YNP will always degrade their habitat before resource limitations reduce herd survival or reproduction. Finally, The Wildlife Society report concluded that: 1) ungulate removals by humans are necessary to preserve the primeval abundances of native plants and animals on the Northern Range, and 2) the best available methods for humans to remove ungulates from YNP are via regulated hunting in areas adjacent to YNP; hazing animals to exit YNP to make them more susceptible to regulated hunting; fertility control inside YNP; and shooting animals inside YNP. All of these methods are controversial, but all of these methods are allowed by federal statutes and NPS policy, and the NPS has used or is currently using all of these methods successfully in national parks across the United States.[9,20,25]

Elk numbers on the Northern Range are currently only controlled by hunting outside YNP, and the hunting is regulated by Montana Fish, Wildlife & Parks. In contrast, the NPS, state government agencies in Montana, and tribal nation partners currently work together to use lethal culling, capture and removal, and regulated hunting to control Northern Range bison numbers. Current application of these elk and bison population control measures needs to be intensified in order to restore the ecological health of the Northern Range. Going forward, we suggest that NPS personnel work collaboratively with federal, tribal, state, and private partners to develop an adaptive management strategy to purposely restore Northern Range bison and elk populations to their primeval sizes. We also suggest that this strategy be developed with an appreciation that lethal culling, capture and removal, and regulated hunting are useful surrogates for the dispersal-without-return that would otherwise be an expected part of natural population control in migrating bison and elk.[26] That is, dispersal is a natural process of population control in migrating wildlife, and it should be expected that some bison and elk would leave in winter and not return in summer to the higher-elevation portions of the Northern Range that are located inside YNP. Current management in other US national parks uses lethal culling to sustain natural conditions, including lethal culling of elk in Rocky Mountain National Park and lethal culling of bison in Grand Canyon National Park.

Hunting and burning by Native Americans were integral parts of the Northern Range ecosystem's natural processes that sustained native plant and animal abundances for 11,000 years before YNP was created.[9] Modern-day management has failed to incorporate fully the ecological role of Native Americans. At best, this failure is somewhat ironic, given that a primitive arrowhead is the official symbol of the NPS.

We also wish to point out that incorporating more fully the ecological influences of indigenous people is not a new idea. For example, in 1982 NPS ecologist Douglas Houston advocated experimental prescribed burns in aspen vegetation types inside YNP,[27p198] and in 1986 NPS ecologist Don Despain and colleagues stated, "One of the most intriguing missing elements on the northern range is the prehistoric native human."[28p68] Again, more fully incorporating the ecological role and influence of indigenous people is not a new idea, but it is an idea whose time we hope has finally arrived.

Millions of people love the Northern Range, in many different ways and for many different reasons, but their shared love is the common ground upon which shared solutions can be built. These solutions needn't dismiss the current management policies of the NPS. In fact, we wish to emphasize that the articles in this Special Issue do not advocate changes to NPS policy, but rather the articles highlight that implementation of existing NPS policy can be improved. Our suggestions for improved stewardship of the land and wildlife on the Northern Range build upon previous NPS advancements in the 20th century that restored four-legged predators (i.e., wolves, bears, mountain lions, coyotes, etc.) and incorporated let-burn wildfire policies. The next step in the 21st century is to more fully comply with existing NPS policy by restoring the natural ecological impacts of two-legged predators (i.e., humans) and controlled burning to mimic the natural influences of indigenous people. Greater recognition is needed that humans inhabited the Northern Range long before YNP was created, and current land management needs to make greater efforts to emulate the ecological impacts of indigenous people. Such efforts will help ensure that natural ecological processes can function sustainably for the next several thousand years. Such efforts can be the next significant step forward in the maturation of our nation's stewardship of the land, wildlife, and ecology of the Northern Range.

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