

Ecological Restoration of Degraded Wilderness Ecosystems: Removing Exotic Plants and Introducing Prescribed Fire to Restore Natural Diversity in Two National Park Wilderness Areas

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Abstract—In the United States, national parks were established mainly for their scenic qualities with an emphasis on how they looked rather than how their natural systems worked. Natural conditions in Theodore Roosevelt National Park and Buffalo National River had been degraded by decades of livestock ranching and timber harvesting prior to their designation as units of the National Park System in the late 20th century. These ecosystems remained degraded and showed no progress toward recovering on their own. It became unrealistic to assume that the landscape's natural diversity could recover without some purposeful ecological restoration. The removal of exotic plants and the reinstitution of fire have helped to set in motion the recovery of native plant communities in these two Midwestern wilderness areas.

Wilderness Management in the Past

Wilderness Designation

The Wilderness Act created a new management paradigm for some Federal agencies, but not for the National Park Service (NPS). The Wilderness Act calls for a level of natural area protection that can be higher, but not lower, than the protection afforded by the agency's legislation. The NPS Organic Act of 1916 created the National Park Service with a natural resource preservation purpose, "to conserve... natural objects...unimpaired." Likewise the Wilderness Act of 1964 created the National Wilderness Preservation System whose purpose is to preserve "natural condition... unimpaired" (Sec. 2(c)).

Practically speaking, both national parks and wilderness areas share a principle purpose of protecting natural conditions unimpaired. Because of this shared purpose, during the first decade after the passage of the Wilderness Act there was little need seen to seriously consider wilderness designation in park areas. Wilderness designation in parks moved slowly until

1976 and 1978 when 19 park sites were designated Wilderness, including the two discussed in this paper.

Wilderness Management

Many Midwestern national parks had been through periods of indiscriminate logging and livestock grazing. Early NPS management emphasis was placed on protection of existing landscape scenery, not on restoration of lost biological attributes. It was believed that simply protecting new parklands would allow nature's resiliency to reestablish ecological integrity. But it became apparent that "forces of nature" alone cannot naturally heal the most severely damaged ecosystems.

NPS Management Policies 2001 state that: "Management should seek to sustain the natural distribution, numbers, population, composition, and interactions of indigenous species." Further, these Policies direct the National Park Service to restore extirpated native plant and animal species whenever the species had disappeared, or was substantially diminished, as a result of human-induced change. Exotic species, (non-indigenous species) have opportunistically invaded disturbed native plant communities. At this time it is unrealistic to assume that natural diversity can recover in the most severely degraded wilderness areas without park managers undertaking restoration.

Wilderness Restoration

Should damaged ecosystems in wilderness be restored? One common view is that ecological restoration should not occur in wilderness since it should remain "untrammeled." Another common view is that ecological restoration should occur to reverse the downward trend created by fire exclusion and exotic species invasion. The need for action or non-action depends on the extent of damage to wilderness resources and whether those resources would likely continue to diminish under mere custodial management.

Restoration of wilderness to natural condition is not easy or quick and cannot exactly duplicate pre-disturbance condition. Although it is difficult to understand or be able to predict all the interacting ecological processes, it is critical that managers of national park wilderness explore appropriate ways to repair damage to prairie and forest ecosystems. Examples of wilderness restoration successes are discussed for two Midwest parks, Theodore Roosevelt National Park and Buffalo National River.

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In: Watson, Alan; Sproull, Janet; Dean, Liese, comps. 2007. Science and stewardship to protect and sustain wilderness values: eighth World Wilderness Congress symposium: September 30–October 6, 2005; Anchorage, AK. Proceedings RMRS-P-49. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Theodore Roosevelt National Park: Removing Exotic Plants to Help Restore Native Plant Communities

Background

The Theodore Roosevelt Wilderness consists of two separate units totaling 29,920 acres (12,108 ha) within the Great Plains of North Dakota. While most Western parks were carved out of vast public lands, Theodore Roosevelt National Park had to be pieced together in 1947 from former ranches. The prairie grasslands were invaded by exotic plants (non-native grasses and forbs), which had replaced native plants in some locations. The prairie bison had been replaced by domestic livestock, while elk and bighorn sheep were hunted to near extinction. The initial reintroduction of bison, bighorn sheep and elk into the wilderness improved its natural diversity.

Problem Statement

The wilderness character will degrade further without restoration of the natural condition of the prairie plant communities. In recent decades, exotic plants, particularly leafy spurge (*Euphorbia esula*), invaded indigenous biotic communities within the wilderness, altering the prairie ecosystem. Leafy spurge, an import from Eurasia, easily becomes the dominant plant in the native prairie plant communities. When the abundance of native plants declines, the animals that depend on them lack the food and habitat needed for their survival. Leafy spurge, with few natural enemies, is an aggressive plant capable of competing directly with native plants. Its woody roots are nutrient reservoirs that can sustain the plant during droughts. In patches of spurge the soil is altered, inhibiting many native plants from growing nearby. Leafy Spurge has invaded most of the suitable wildlife habitat across the Theodore Roosevelt Wilderness.

Solution Identified

The Northern Great Plains Exotic Plant Management Plan and Environmental Assessment stated that the “weed infestations left untreated would continue to degrade the park wilderness resource.” Unmanaged exotic plant infestations will change wilderness into a weed wasteland. The minimum requirement analysis provision will require some extraordinary measures to achieve the purposes of the Wilderness Act. Management actions should be undertaken only when the knowledge and tools exist to accomplish restoration goals. The preferred alternative precluded vehicle ground access in favor of aerial herbicide treatment and the dispersal of biological agents. The restoration of natural condition will ensure protection of ecological integrity and wilderness character.

Results

The hallmark of this Park’s restoration program is its exotic plant management team (EPMT), which has been successful in halting the spread of exotic plants with

judicious application of chemical herbicide and biological agents (insects). Within the 10,047 acres (4,066 ha) of the lower wilderness of Theodore Roosevelt National Park, there are approximately 2,800 acres (1,133 ha) dominated by leafy spurge plants. Essentially all of those acres infested were treated with aerial application of herbicide. Between 1994 and 1999, close to 1,200 acres (486 ha) were treated, while between 2000 and 2004 over 3,000 acres (1,214 ha) were treated. In addition, biological control agents, such as flea beetles (*Aphthona* spp.), were released at hundreds of sites in the wilderness (fig. 1) with over 16 million beetles released in the park.

Exotic plant distribution monitoring was conducted in the wilderness. This research relied on Geographical Information System (GIS) analysis to record the presence and relative density of the targeted species throughout the wilderness. The monitoring allows the EPMT to adapt to local conditions and needs. It appeared that areas of infestation have been reduced resulting in a return of plant diversity in some plant communities. The restoration of shortgrass prairie ecotype depends on successful control of leafy spurge and other invasive exotic plants. This would allow for the recovery of this prairie ecosystem, restoring the natural condition to wilderness lands.

Buffalo National River: Reinstating Prescribed Fire to Help Restore Native Plant Communities

Background

The Buffalo River Wilderness consists of three separate units totaling 34,933 acres (14,137 ha) in the central forested highlands (Ozarks) of Arkansas. Early 19th century land clearing followed by fire suppression unfortunately yielded an undesired consequence for the ecosystem. Fire suppression in the last century contributed to changes in composition and structure of the forest communities, resulting in overgrown thickets of oak, hickory and cedar. The extensive open forests with oak savanna and rocky glade plant communities that existed prior to European settlement were an artifact of American Indian use of fire. For thousands of years Native Americans played an essential role in significantly shaping plant diversity associated with shortleaf pine (*Pinus echinata*) and post oak savanna (*Quercus stellata*) communities. They used fire to promote ecological succession into what has generally been accepted as natural condition for wilderness.

Problem Statement

The wilderness character will degrade further without reintroduction of fire as a natural process in wildlands. New forest growth and years of fire exclusion allowed dense stands of trees to shade out grasses and other sun-loving plants, resulting in catastrophic changes to plant communities. Many specialized endemic plants are being shaded toward extinction and natural diversity is declining. Researchers had spent 14 years studying the disappearance of oak savanna and barren glade ecotypes within the Lower Buffalo Wilderness. Conservation biologists knew these important



Figure 1—Sixteen million flea beetles were released in Theodore Roosevelt National Park to reduce leafy spurge populations (National Park Service photo).

ecological communities needed help if they were to survive into the next century.

Solution Identification

Prescribed fire is the most natural method available to restore the plant communities' ecological integrity. The prospect of a prescribed burn in designated wilderness sparked philosophical debates. Thus, returning fire to this wilderness landscape was no simple matter. It was deemed necessary to reverse the ecological degradation, resulting from abuses and errors of human use in this forest. Fortunately, plant diversity still persists along forest edges, so they should respond by reseeding burned areas. A fire management plan was developed which included fire prescription to reverse the man-caused changes to this ecosystem.

Results

Restoring ecological integrity to the wilderness area required sophisticated knowledge of how natural systems work and the expertise to apply it. Applying the minimum requirement concept to wilderness fire prescription resulted in some localized, short-term impacts but also contributed long-term benefit. The long-term benefit to the wilderness character would be preventing the loss of rare open savanna ecotypes. Ecological restoration activities aimed toward long-term desired natural condition often required repeated applications of prescribed fire (fig. 2).

Following a series of smaller prescribed fires, an 11,284-acre (4,566-ha) prescribed fire was ignited in 2003. Conducting this prescribed fire in a remote and thickly wooded forest proved

to be no small undertaking. After years of planning, the entire unit was ignited by hand with no motorized equipment in deference to wilderness values. An underlying direction for wilderness stewardship policy was not to impede natural disturbances, such as fire. So, protecting ecological integrity was shifted from maintaining static natural conditions to allowing free play of natural forces. The restoration to natural condition of the open shortleaf pine forest and oak savanna depends on the successful introduction of prescribed fire.



Figure 2—Repeated application of prescribed fire at the Buffalo National River was needed for ecological restoration (National Park Service photo).

Wilderness Stewardship for the Future

A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. (Aldo Leopold)

As the half-century mark approaches for the National Wilderness Preservation System, many wilderness areas will be on the path to restoration. The goal of wilderness

stewardship is to preserve the natural condition of wilderness. Unfortunately, protection alone, which has been the hallmark of National Park Service resource management program, is not enough to achieve this goal. The restoration measure should be undertaken at the minimum extent necessary to restore wilderness resources. Once the recovery of natural diversity in wilderness is achieved, then the newly restored wilderness character can be maintained and preserved.