Northwest Science Forum

Northwest Science Forum provides an opportunity to articulate and discuss scientific issues in a less structured format than peer-reviewed articles. The Forum publishes short articles, opinion pieces, and letters with a focus on science and natural resource issues in the Pacific Northwest. Although the Forum is not peer-reviewed, it is edited for format and clarity. Articles should generally be less than 2000 words and contain minimal literature citations. Letters in response to articles are particularly encouraged; the original author will normally be given a chance to respond to the letter as well. There are no page charges or reprints associated with the Forum, and participants need not be members of the Northwest Scientific Association. Please send all submissions, including two hard copies and an electronic copy (any recent version of Word or WordPerfect) to the Editor.

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Requiem for a Sagebrush Ecosystem?

Early settlers crossing the Intermountain West described the Snake River Plain as covered by a vast sea of sagebrush, or wormwood (*Artemisia* spp.), as far as the eye could see (Frémont 1845, Yensen 1982). Today, anyone crossing that same area will find sagebrush in fragmented remnants and the vast sea is instead a grassland of an exotic annual, cheatgrass (*Bromus tectorum*). In little more than a century, the form and function of an entire landscape have been altered, perhaps irreversibly.

Fires, heavy grazing that severely disturbed soils and promoted cheatgrass invasion, and intentional eradication by "range improvement" programs had eliminated approximately 10% of the almost 60 million ha of big sagebrush (*Artemisia tridentata* spp.) communities by the mid-1970's (Vale 1974, Braun et al. 1976). If anything, the rate at which sagebrush is lost from these lands is increasing in recent years. In 1979, big sagebrush and native salt desert shrub communities in the Snake River Birds of Prey National Conservation Area, in southwestern Idaho, covered approximately 100,000 ha and comprised 51% of the total area. Because of fires and other disturbance, only 58,000 ha of shrubland remained in 1994 (U.S. Dep. Inter. 1996) (Figure 1). Another 12,000 ha of shrublands burned by 1998. Within the tenure of many land managers and biologists, the total grassland area had increased from 17 to 53% and more than half of the existing shrublands were lost. Shrubland losses in the National Conservation Area are typical of many sagebrush ecosystems in lower elevations and in xeric climates throughout the Columbia River Basin and Great Basin (Noss and Peters 1995). The changes are largely unnoticed among other more glamorous natural resource issues in the Pacific Northwest.

The Process of Losing an Ecosystem

Historically, fire was an important disturbance that maintained the dynamics between native grass and big sagebrush dominance in the ecosystem. Frequent small fires opened the shrub canopy and aided establishment of native perennial grasses at small scales, and created a mosaic of grass and shrub communities in different stages of development at large scales. Large catastrophic fires and reburning events, although present, were rare enough that shrub recolonization maintained the appearance of a vast shrubland landscape to early explorers and immigrants.

The dynamics of the system changed when cheatgrass invaded the sagebrush ecosystem in

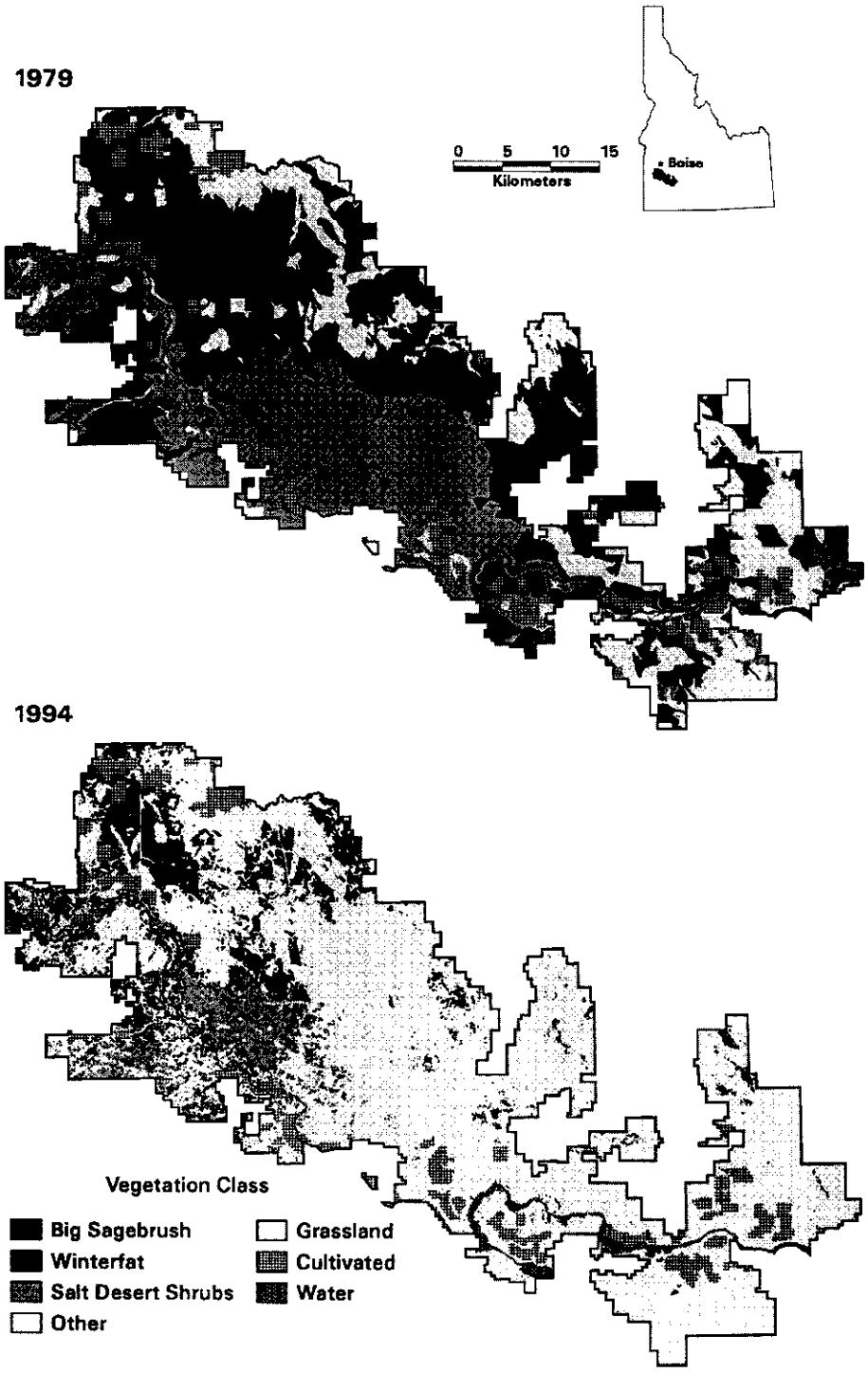

Figure 1. Habitat change and loss of shrublands in the Snake River Birds of Prey National Conservation Area, southwestern Idaho from 1979 to 1994. The 1979 map was delineated from aerial photography. The habitat map for 1994 was classified from Landsat thematic mapper satellite imagery.

the early 1900's. Cheatgrass expansion was aided by overgrazing, drought, agricultural practices, and natural and human-caused fires (Yensen 1981). The continuous fuels provided by cheatgrass, compared to more patchily distributed native bunchgrasses, facilitated fire spread and subsequent loss of shrubs (Klemmedson and Smith 1964). Large shrublands were fragmented and eliminated by an accelerating process of cheatgrass invasion and subsequent fire spread from grasslands into the shrub patch. Fires fragmented large shrubland areas into smaller patches, which increased the amount of grass and shrubland boundaries as well as the spaces between patches, and the patch ultimately was destroyed (Whisenant 1990, Knick and Rotenberry 1997). Thus, the role of fire has changed from maintenance to destruction.

Current Management

Managers currently emphasize fire prevention, suppression, and rehabilitation because fire is the most dramatic and visible factor changing these ecosystems. However, land uses that disrupt soils, increase erosion, and help establish cheatgrass synergistically increase the consequences of fire. In the National Conservation Area, regions that had combined fires, livestock grazing, or military training also had the most severe changes from shrubland to annual grasslands (U.S. Dep. Inter. 1996). We need to better understand how other disturbances interact to set up the system for greater consequences to fire.

The philosophy of "fuels management" and a strategy for prescribed fires is rapidly invading rangeland management from forestry dogma. These management actions must then be followed by efforts to control weeds, usually by herbicides, and reseeding. Without subsequent weed control, the process is doomed because we are using an intensive disturbance to eliminate or reduce vegetation that thrives on conditions following disturbance. Rehabilitation of burned areas will not be successful when weeds can compete with native vegetation.

Can We Restore the Form and Function of Sagebrush Ecosystems?

Resource managers are faced with the question "What do we want this area to look like and can we achieve that goal?" Restoration of sagebrush ecosystems is limited by ecological and climatic dynamics that influence processes such as fire frequency, fire fuels, and rates of shrub regeneration. Financial costs for fire suppression and vegetation restoration, tempered by political concerns for use of our public rangelands, further complicate the issue.

We may need to accept that the future landscape dominating much of the Intermountain West will be an exotic annual grassland. Unlike old-growth forests that need only time, exotic annual grasslands may represent a habitat sink from which no alternative state is possible because of changes in soils, lack of seed sources for shrubs and perennial grasses, or frequent burning or disturbance (Westoby 1980). Using a computer simulation based on spatial and temporal dynamics of shrubland regeneration, we predicted that over a century of fire control, favorable climate, and optimum conditions for seed dispersal were required to replace the shrublands lost in just 20 years in the National Conservation Area (U.S. Dep. Inter. 1996). Even if restoration was a function of simply fire control and reseeding, the horizon is much longer than a typical resource management plan of 5 or 10 years. Existing fire rehabilitation programs provide only opportunities for a short-term response immediately following fires and not for the long-term support needed for restoration.

The perceived need to use nonnative plants to restore the form, even if the resulting function is unknown, further complicates restoration agendas. Native seed usually is expensive and often is available only in limited quantities compared to a more commercially feasible equivalent. However, I would rather invest our efforts into learning how to restore a functioning system with native components, even if initially constrained to small areas. Patchwork tinkering with cheaper, more readily available exotics, even if possible over larger areas, risks the consequences of yet another unknown commodity in the system. This "purist" philosophy carries a risk. We may not be at the bottom of the ecological barrel. New invasions of even more deleterious noxious perennial weeds could cause even greater ecological damage. If funding is an indication of the prevailing sentiment, only one United States federal program is devoted specifically to restoration of native vegetation in the Intermountain West despite the magnitude of the problem.

Finally, I will not ignore the impact of livestock grazing on future management directions. Although most of these lands never supported heavy grazing pressure, we continue to accommodate large domestic ungulates in our management and restoration plans. Restoration with native vegetation implies that a lower vegetation biomass will be available for grazing, that the ability to reseed overgrazed areas will be more costly, and that restrictions on livestock grazing will increase relative to use of nonnative species (grazing would not be allowed on seeded lands for a minimum of 5-8 years compared with 2 years for a crested wheatgrass seeding). These represent very real concerns to a livestock industry that has supported large-scale shrub eradication and reseeding with crested wheatgrass.

Consequences for the Loss of Sagebrush Ecosystems

The task of restoration is daunting and the outlook is discouraging because of the rapid deterioration of the system. Compared to the relative ease at which this ecosystem has changed and might still change into a system dominated by perennial noxious weeds, the cost and energy to return the system from a grassland-dominated state back to one dominated by a shrublands appears almost insurmountable. However, I think that the costs are even greater if the system remains in an exotic annual system from which we gain nothing and risk further deterioration from invasion of perennial noxious weeds.

Managers will not have the relative stability of a system dominated by native perennials because exotic annuals are more sensitive to climatic fluctuations. As a result, fires will be larger and more frequent, and costs for fire suppression and rangeland rehabilitation will be greater. The fire frequency on average for any place within the Snake River Birds of Prey National Conservation Area decreased from 80.5 years between 1950 to 1979 to 27.5 years from 1980 to 1994. For the National Conservation Area, an annual cost of $175,000 plus an initial expense of $650,000 will be needed to increase the control response and reduce fire size by 90% (U.S. Dep. Inter. 1995). We also can expect an increase in the current annual average of 90,000 ha of shrubsteppe that are burned each year and $10-15 million that are spent on fire fighting and rehabilitation in southern Idaho. In addition, the social cost can include loss of life for firefighters, property damage, and change in livelihood when traditional grazing lands are altered.

Loss of shrubs from these ecosystems is no less dramatic than clearcutting a forest. Managers now ask, "How much shrubland is enough?" The answer is complex, but like real estate, location is everything. A remnant shrub patch surrounded by large grasslands is less important than multiple shrub patches embedded within a larger mosaic of shrub and grasslands. Distribution and abundance of Brewer's (*Spizella breweri*) and sage sparrows (*Amphispiza belli*), having individual home ranges less than a hectare, are influenced by landscape configurations and habitat changes at scales greater than a kilometer (Knick and Rotenberry 1997, In press). Many other birds, such as sage grouse (*Centrocercus urophasianus*), associated with sagebrush habitats are undergoing significant population declines likely associated with local and large-scale loss of sagebrush and are listed as species at risk.

Requiem?

Documenting the changes from sagebrush to exotic annual grassland systems has been relatively easy. Turning that understanding into the solution is difficult and complex. However, we need to ask what we want our shrublands to look like and what we can achieve. Can we also accept that a full restoration will not be likely in our lifetime? I remain optimistic that we possess the capability to restore sagebrush ecosystems. But unless we develop an appreciation for an entire ecosystem, a large part of our landscape in the Intermountain West will sink into a different form and function in a relatively short time.

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