Vegetation Management for Sagebrush-Associated Wildlife Species

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Abstract: It is obvious that the diverse array of wildlife species using sagebrush habitats has a similarly wide range of habitat requirements. Vegetation management for biological diversity on a landscape scale should take these diverse habitat requirements into consideration. Management for any one species may or may not provide the habitat requirements for other species. Creating a mosaic of habitats with multiple-aged stands of sagebrush and varying degrees of herbaceous and shrub cover would provide the diverse vertical and horizontal vegetation composition and structure required by diverse wildlife species.

Introduction

The sagebrush (*Artemisia* spp.)-dominated area of the West encompasses approximately 155.5 million acres (Paige and Ritter 1999). More specifically, there are two major regions of sagebrush dominance (West 1983a,b): (1) the "sagebrush steppe" that covers the northern portion of the Intermountain Region from eastern Washington and northern Nevada to the western two-thirds of Wyoming and northwest Colorado, and (2) the "sagebrush semidesert," the drier Great Basin sagebrush region that includes most of Nevada, parts of Utah and northern Arizona, and some areas of southwestern Colorado and northern New Mexico. The sagebrush semidesert is significantly drier and warmer than the sagebrush steppe and occurs between the sagebrush steppe and the drier salt-desert shrub region. Although sagebrush communities have undergone much change in modern history, the boundaries of sagebrush distribution have remained fairly constant.

In: Hild, Ann L.; Shaw, Nancy L.; Meyer, Susan E.; Booth, D. Terrance; McAruthur, E. Durant, comps. 2004. Seed and soil dynamics in shrubland ecosystems: proceedings; 2002 August 12–16; Laramie, WY. Proceedings RMRS-P-31. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

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Authors' note: Portions of this paper have been previously presented and included as an expanded abstract in the non-peer-reviewed proceedings of the Restoration and Management of Sagebrush/Grass Communities Workshop, November 4–8, 2002, Elko, NV.

Vale (1974) examined 29 historic journals and diaries from the early 19th century and concluded that presettlement vegetation in much of the Intermountain West was visually dominated by shrubs, with much of the area covered by thick brush stands. However, according to Miller and Eddleman (2001), fire influences caused plant composition to vary from dominant stands of sagebrush to grasslands. The authors speculated that much of the sagebrush steppe ecosystem during pre-settlement times was composed of open shrub stands with a substantial herbaceous cover component. Extreme weather conditions and insect outbreaks also affected the historic patterns of vegetation composition in sagebrush habitats.

Sagebrush-grass communities within these sagebrush regions vary markedly (Miller and Eddleman 2001; Tisdale and Hironaka 1981; West 1983a,b), but to one degree or another provide food, thermal cover, escape routes, and rearing sites for a variety of vertebrate wildlife species (McAdoo and Klebenow 1979). Some of these species inhabit sagebrush habitats year round, while others use them only seasonally or occasionally. Species that require sagebrush for some part of their life cycle are "sagebrush obligates." According to Paige and Ritter (1999), at least eight vertebrate species are considered to be sagebrush obligates: sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), sage thrasher (*Oreoscoptes montanus*), sage grouse (*Centrocercus urophasianus*), pygmy rabbit (*Sylvilagus idahoensis*), sagebrush vole (*Lagurus curtatus*), pronghorn antelope (*Antilocapra americana*), and sagebrush lizard (*Sceloporus graciosus*). However, the latter species is also found in greasewood (*Sarcobatus* spp.) habitats (McAdoo and Klebenow 1979) and may not be a true "obligate." In parts of their range, gray flycatchers (*Empidonax wrightii*) and least chipmunks (*Eutamias minimus*) may also be considered sagebrush obligates. A number of other species have a broader amplitude of habitat adaptation, occurring not only in sagebrush but in other vegetation types as well. Sagebrush communities provide habitat for approximately 100 bird species and 70 mammal species (Braun and others 1976). Several species of lizards and snakes also inhabit these sagebrush areas (Fautin 1946).

Grazers, browsers, and seedeaters foraging within sagebrush- grass communities use the grasses, forbs, sagebrush, and/or other shrub species found there. In turn, many of

these species, including ungulates, rodents, hares and rabbits, small birds, reptiles, and insects are important as prey for predatory species living in or near sagebrush-grass communities.

Habitat Requirements of Sagebrush Obligates

Because of a West-wide decline in sage grouse populations and habitat, the sage grouse has been petitioned for listing as threatened or endangered, and much political attention has therefore been focused on this species. Sage grouse historically inhabited much of the western United States, including portions of 16 States and along the southern border of three western Canadian Provinces. This distribution closely parallels the range of sagebrush communities. The current core of sage grouse populations includes areas of Nevada, Oregon, Idaho, Colorado, Wyoming, and Montana, with remnant populations in other States. These birds require sagebrush for food and/or cover during each stage of their life cycle (Connelly and others 2000; Klebenow 2001). Although sage grouse depend on sagebrush vegetation for survival, they thrive best in areas with a mixture of sagebrush species, varying in age and cover classes. Optimal habitat includes a heterogeneous combination of diverse sagebrush communities, in other words, sagebrush stands with varying shrub heights and canopy cover and a diverse understory of perennial grasses and forbs. The proportion of sagebrush, perennial grasses, and forbs in an area varies with the species or subspecies of sagebrush, the ecological potential of the site, and condition of the habitat (Klebenow 2001). During the course of a year, sagebrush is quantitatively the most important component in the diet of sage grouse, comprising 60 to 80 percent of all food consumed. However, during spring and summer these birds (especially the juveniles) shift from a sagebrush-dominated diet to one of forbs and insects (Klebenow and Gray 1968).

Habitat requirements differ among the other sagebrush obligates. Sage sparrows, Brewer's sparrows, and sage thrashers all require sagebrush for nesting, with nests typically located in the sagebrush canopy. Sage thrashers usually nest in tall dense clumps of sagebrush within areas having some bare ground for foraging. Sage sparrows prefer large continuous stands of sagebrush, and Brewer's sparrows are associated closely with sagebrush habitats having abundant scattered shrubs and short grass (Page and Ritter 1999).

Pygmy rabbits live in areas with clumps of tall sagebrush in friable soils, whereas pronghorn antelope prefer lower growing sagebrush, presumably because of their keen eyesight adapted for detecting danger at long distances. Like sage grouse, both pygmy rabbits and pronghorns typically eat sagebrush almost exclusively during winter (Page and Ritter 1999). However, pronghorns depend primarily on forbs during much of the year. Sagebrush voles feed on green herbaceous plants in summer. They use the shredded bark of sagebrush to line their burrows and eat the bark and twigs of sagebrush during winter. Sagebrush lizards prey on insects found in sagebrush habitat, often climbing the shrubs in search of their prey.

Habitat Requirements of Other Sagebrush-Associated Species

Habitat requirements differ widely among other bird species associated with sagebrush grass communities. Some species, such as loggerhead shrikes (*Lanius ludovicianus*), nest primarily in the canopy of sagebrush and other shrubs. Others are primarily open ground and/or grass nesting species, requiring varying amounts of herbaceous cover. Such species include horned larks (*Eremophila alpestris*), vesper sparrows (*Pooecetes gramineus*), and western meadowlarks (*Sturnella neglecta*). Other species, like lark sparrows (*Chondestes grammacus*), are typically most abundant in areas with a diverse mixture of sagebrush and bunchgrass (McAdoo and Klebenow 1989). Horned larks and burrowing owls (*Athene cunicularia*) are adapted to more open areas, and both species often increase after wildfire or other disturbances that reduce dense sagebrush canopies.

In addition to pronghorn antelope, other ungulate big game species are dependent on sagebrush-grass communities to some extent. Mule deer (*Odocoileus hemionus*) are closely associated with sagebrush-grass communities in much of their range. Being primarily browers, any successional vegetation changes favoring shrubs may benefit mule deer populations. Many forbs and shrubs associated with sagebrush communities are important in mule deer diets, with grasses used primarily in spring. Forb use is highest in summer, and on many mule deer ranges, big sagebrush is the staple component in winter and early spring (Kufeld and others 1973). Elk (*Cervus elaphus*) generally depend on grasses for forage throughout much of their range, but they also eat shrubs, including big sagebrush, especially during fall and winter (Kufeld 1973). In parts of the Great Basin, elk use sagebrush-dominated habitats in other seasons as well. Bighorn sheep (*Ovis canadensis* spp.) also use sagebrush-grass communities in some areas, especially as winter range. Although grasses are typically the major component in the bighorn sheep diet, shrubs are important, and big sagebrush is a preferred shrub (McQuivey 1978).

Five species of hares and rabbits may occur in sagebrush-grass communities. The most common species in most areas is the black-tailed jackrabbit (*Lepus californicus*), an opportunistic feeder that selects for succulence. Blacktailed jackrabbits eat primarily grasses and forbs until winter, when they feed on shrubs, including the leaves and bark of big sagebrush. During population highs, this species can cause considerable damage to rangeland vegetation and cultivated crops (McAdoo and others 1987). Within sagebrush-grass habitats, blacktailed jackrabbits are typically associated with increasing shrub cover, whereas whitetailed jackrabbits (*L. townsendii*) are associated with increasing grass cover (Verts and Carraway 1998). Pygmy rabbits have already been identified (above) as sagebrush obligates. Two other rabbit species, desert cottontails (*Sylvilagus audubonii*) and mountain cottontails (*S. nuttallii*), are also found in some sagebrush-grass habitats.

Many rodent species (at least 28) inhabit sagebrush-grass communities, with the deer mouse (*Peromyscus maniculatus*) being typically most common. Unlike the sagebrush vole that was mentioned above as a sagebrush obligate, deer mice occur in a wide variety of vegetation types. Great Basin pocket mice (*Perognathus parvus*) are restricted primarily to sagebrush habitats in some areas (McAdoo and Klebenow 1979). Most rodent species are herbivores or granivores, but differ in specific habitat affinities. Rodents in general have a reputation for negative impacts on rangelands, but some species, such as kangaroo rats (*Dipodomys* sp.), can be quite beneficial in terms of seed dispersal and germination (McAdoo and others 1983).

At least nine bat species may be found within sagebrush habitats, but are more closely associated with caves, rock crevices, and water sources. The Merriam's shrew, an insect-eater, is sometimes a relatively common small mammal species in sagebrush basins (Ports and McAdoo 1986). Western rattlesnakes, gopher snakes, leopard lizards, horned lizards, and other reptiles also make their homes in sagebrush habitat, but amphibians are found only near water sources that may be surrounded by sagebrush or other upland habitat.

Although several mammalian predators use sagebrush habitats in search of prey, none are exclusively linked to sagebrush. The most common predator species using sagebrush habitats include coyotes, badgers, long-tailed and short-tailed weasels, bobcats, and mountain lions.

Vegetation Management Implications

Because habitat requirements for the many wildlife species in sagebrush-grass communities differ by species and even vary by season of use for many species, the spatial and temporal variability of sagebrush habitats becomes important in vegetation management. Before European settlement, "spotty and occasional wildfire probably created a patchwork of young and old sagebrush stands across the landscape, interspersed with grassland openings, wet meadows, and other shrub communities" (Paige and Ritter 1999). In drier regions, such as lower elevations in the Great Basin (that is, the sagebrush semidesert), fire probably had less influence. According to Miller and Eddleman (2001):

> The Wyoming big sagebrush and low sagebrush cover types, with less frequent disturbance events but slower recovery rates, and the mountain big sagebrush cover type, with more frequent disturbance but faster recovery rates, created a mosaic of multiple seral stages across the landscape. In addition, fire patterns were patchy, leaving unburned islands, particularly in Wyoming big sagebrush cover types because of limited and discontinuous fuels. Plant composition ranged from dominant stands of sagebrush to grasslands.

The authors went on to say that much of the sagebrush steppe ecosystem during presettlement times was probably composed of open shrub stands with a substantial component of long-lived perennial grasses and forbs.

The wildlife sightings by early explorers were a function of landscape ecology, the explorers' season of travel, and the time interval since the last fire. Based on anecdotal accounts, species like sage grouse seemed to be locally abundant, but regionally rare. According to Miller and Eddleman (2001), the range occupied by sage grouse is spatially diverse and temporally dynamic. By inference, since sage grouse distribution closely parallels the range of sagebrush communities in North America, the same principle holds for other sagebrush-associated vertebrate wildlife species. Inherent site potential, combined with such variables as the interspersion of varying shrub height and canopy cover, as well as herbaceous species composition, cover, and diversity, influence the regional diversity of wildlife species, the landscape level distribution of these species, and the local abundance of each species. Nothing, however, remains constant over time.

We can draw some inferences from the effects of sagebrush-grass community alteration on neotropical migrants (songbirds). Research conducted in northern and central Nevada (McAdoo and others 1989) showed that sagebrush removal from large acreages had initially negative impacts on shrub-nesting birds, especially sagebrush obligates such as sage thrashers, sage sparrows, and Brewer's sparrows. In those areas where crested wheatgrass (*Agropyron desertorum*) was planted after shrub removal, a corresponding increase was observed in ground and grass-nesting species like horned larks, western meadowlarks, and lark sparrows. However, as successional establishment of sagebrush occurred in these areas over time, shrub-nesting bird species returned and grass-nesting species remained. Bird species diversity increased as the complexity of the plant community increased (McAdoo and others1989). What are the implications of these bird population responses for wildlife species in general as related to sagebrush habitat management?

There exists an enormous challenge throughout much of the Intermountain West to revegetate large expanses of cheatgrass (*Bromus tectorum*) monocultures with native sagebrush-grass-forb communities that will support diverse wildlife communities. However, another habitat condition is perhaps being overshadowed by the cheatgrass problem. Namely, much of the Intermountain West contains large expanses of sagebrush habitat where shrub cover is so dominant that herbaceous cover is almost absent, with only sparse populations of remnant native grasses and forbs. To improve the site productivity of these areas for seasonal use by high profile species like sage grouse, proposals have been made to manage portions of these areas for reduced mature sagebrush cover, regeneration of young sagebrush, and increased native herbaceous cover. According to Klebenow (1969), reducing/thinning sagebrush cover in some areas can restore the balance of forbs and grasses, thereby enhancing sage grouse habitat. Connelly and others (2000) maintain that treatments such as prescribed fire, grazing, herbicides, and mechanical treatments may be used to restore sagebrush habitats, but caution that improper use of these tools can also result in the degradation or loss of such habitats.

Location, and especially size of treatments, must be carefully chosen, since wildlife species respond variously to scale of vegetation management treatments (Paige and Ritter 1999). For example, bird species in general are affected at the population level by vegetation management treatments covering thousands of acres, at the home range level by management of vegetation "stands" from 1 to thousands of

acres in size, and at the individual/pair level by treatments on areas from less than 1 to hundreds of acres (Paige and Ritter 1999). For sage grouse specifically, Klebenow (2001) does not recommend sagebrush eradication over large areas, but suggests thinning sagebrush to about 15 percent cover to enhance forb and grass production. He also suggests that small burns in mountain big sagebrush can create a mosaic pattern to enhance forbs and increase sagebrush height diversity.

In lower elevation sites (dominated by Wyoming big sagebrush) where recovery of herbaceous vegetation is slower, fire should be used cautiously to reduce the threat of cheatgrass invasion. Some of these areas may require seeding with adapted perennial species to compete with cheatgrass, followed after establishment by interseeding of native shrubs, forbs, and grasses (Klebenow 2001). Connelly and others (2001) similarly recommend the seeding of "functional equivalents" (non-native plant species) where native forbs and grasses are unavailable. They also caution that prescribed fire (and fire surrogate treatments like herbicides) be used cautiously in Wyoming big sagebrush habitats, realizing that 30 years is the approximate recovery period for Wyoming big sagebrush stands. For populations of diverse bird species, Paige and Ritter (1999) recommend that prescribed burns to enhance vegetation diversity be kept relatively small (with patchy distribution), reseeded where necessary, and protected from livestock grazing until seeded species become established.

We propose that if such management strategies were properly implemented, a continuum of herbaceous, herbaceous-shrub, shrub-herbaceous, and shrub-dominated habitats could be created. We think that most wildlife species on a landscape scale would be largely benefited. Because of the diverse habitat requirements of various wildlife species, habitat for all sagebrush-associated wildlife species would be present in varying amounts on a landscape scale. In other words, creating landscape heterogeneity with multiple-aged stands of sagebrush and varying degrees of herbaceous and shrub cover would provide both the vertical and horizontal vegetation components of vegetation diversity required by diverse wildlife species. The value of each landscape parcel for various wildlife species would change over time with the dynamics of the initial natural or prescribed disturbance, environmental variability of secondary plant succession, and post-disturbance management.

State and transition models, imbedded into ecological site descriptions, offer the best tool for analyzing vegetation management hazards and opportunities, and determining management options and priorities (Bestelmeyer and others 2003; Laycock 1991, 1995; West 1999). Simply put, state and transition models reflect the idea that rangeland vegetation exhibits several "states" (recognizable complexes of soil and vegetation structure that are resistant to change and resilient to impacts). These models also present the idea that the various states have ecological phases through which the states progress over time, by pathways consisting of changes in plant species composition or community structure. On the other hand, almost irreversible "thresholds" or boundaries between states can be crossed in "transitions." These transitions are reversible through reasonable management actions until an undesired threshold is crossed. Once such a threshold is crossed, change back toward a more desired state is irreversible unless extensive time, effort, and money are available to effect a change. For example, after a sagebrush-grass community has crossed the ecological threshold to dominance by cheatgrass or noxious weeds, the transition is virtually irreversible. But carefully built and easily understood state and transition models can help identify such ecological transitions at earlier stages, allowing appropriate changes in management actions to prevent the crossing of ecologically damaging thresholds.

The highest priorities for habitat treatments should be driven by the risk of crossing an ecological threshold (such as weed invasion) and the opportunity to apply an effective management treatment. Only adaptive management strategies (Macnab 1983) that follow up active vegetation management with monitoring and adjustment of strategies, if necessary, will ensure the perpetuation of a diverse and productive landscape. Success in establishing a heterogeneous mosaic of native plant communities across any rangeland landscape also complements sustainable rangeland management for multiple uses in addition to wildlife.

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