



Management of Sand Sagebrush Rangelands

Eric Thacker

Post Doc Fellow, Wildlife Ecology and Management

Dwayne Elmore

Associate Professor, Wildlife Ecology and Management

Brandon Reavis

Rangeland Management Specialist
Natural Resource Conservation Service, USDA

Terry Bidwell

Professor, Extension Rangeland Ecology and Management

There are approximately 15 million acres of sand sagebrush rangelands in the southern Great Plains¹. Sand sagebrush is specific to sandy soil types and occurs on stabilized dunes of wind-blown sand 3 to 12 miles wide along river drainages² (Figure 1). Therefore, it is not a species that can readily expand its range or invade non occupied rangelands. While it has been suggested that sagebrush increases under heavy prolonged livestock grazing, research has shown otherwise³. The sand sagebrush plant community has been an important area for livestock production since the late 1800s. Further, this plant community supports many species of wildlife. The objective of this publication is to provide basic ecology of sand sagebrush and guidance on how management will impact sand sagebrush plant communities.

Oklahoma Cooperative Extension Fact Sheets are also available on our website at: <http://osufacts.okstate.edu>

Ecology

Sand sagebrush is a vigorous resprouter and is adapted to a wide range of ecological disturbances such as fire, grazing, and drought⁴. The sandy soils of sand sagebrush rangelands creates a plant community that is diverse, consisting of cool and warm season forbs and grasses; and other shrub species. Warm season grasses that coexist with sand sagebrush include blue grama, little bluestem, sand bluestem, Indian grass, sand lovegrass, sideoats grama, prairie sand reed, fall witch grass, and sand paspalum. Cool season grasses include sixweeks fescue, needleandthread, western wheatgrass, and Texas bluegrass. Associated shrubs include skunk bush (or lemon sumac), smooth sumac, and sand plum. Forbs important to sand sagebrush communities include western ragweed, crotons, buckwheats, sunflowers, lambsquarter, and scurf pea².

Major ecological drivers in sand sagebrush rangelands are weather/climate and the interaction of fire and grazing. Some research has concluded that weather can be a stronger

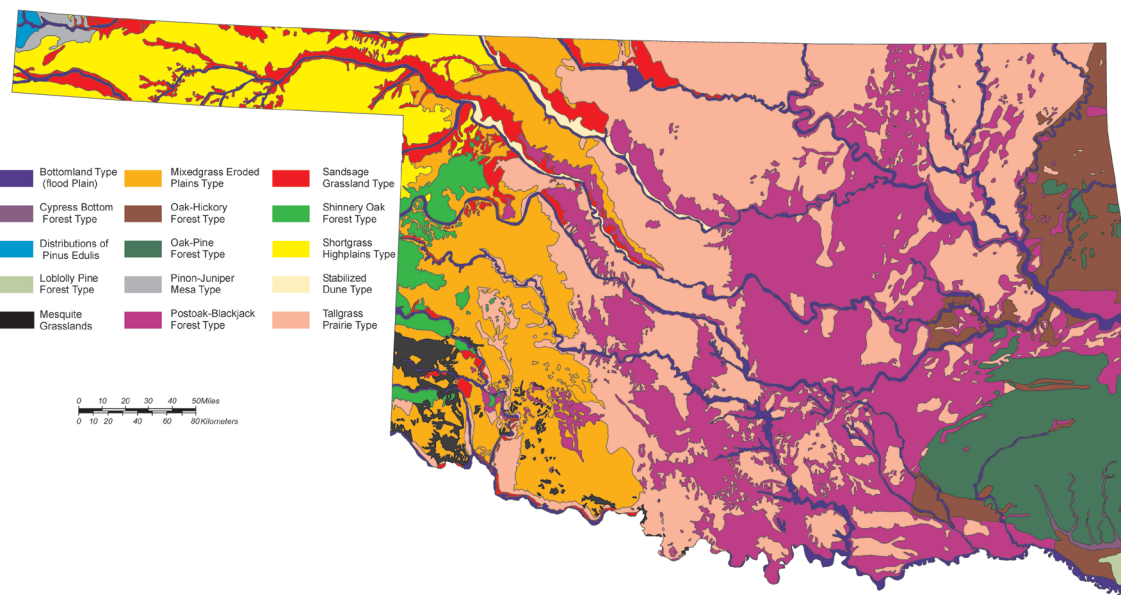


Figure 1. Distribution of sand sagebrush in Oklahoma. Dark orange areas represent sand sagebrush rangelands (Duck and Fletcher, 1943¹³).

driver of plant communities than most range management activities. Yet, fire and grazing and their interaction are very important and are within the control of land managers while weather is not.

Threats

By the 1950s, research and range management began to focus their efforts of improving livestock production on the sand sagebrush rangelands. The prevailing thought was that removing sagebrush would increase economic return from livestock production. Historically, range managers attempted mowing, raiing and burning to reduce sand sagebrush but had little success as the plant rapidly resprouts following disturbances. With the availability of 2,4-D managers found a tool that could effectively and easily remove sand sagebrush from large acreages. The U.S. Department of Agriculture's Southern Plains Range Research station developed sagebrush control strategies, which culminated in the use of fixed wing aircraft to apply 2,4-D to thousands of acres. This practice is still in use 50 years after its development.

Beyond eradication with herbicide, one of the primary threats to sand sagebrush rangelands is the encroachment of eastern redcedar (hereafter redcedar). This is due to the lack of fire as redcedar does not respout following fire as do most other woody plants in the Great Plains. The conversion of sand sagebrush to redcedar woodlands or to mixed grasslands results in a loss of species that require shrub structure. The sand sagebrush rangelands of the southern Great Plains are considered by many to be the last stronghold for populations of northern bobwhite and lesser prairie-chicken. Declines of the lesser prairie-chicken have recently brought a lot of interest in sand sagebrush rangelands. Lesser prairie-chickens are sensitive to changes in vegetation community structure and will avoid areas with redcedar. Additionally, the encroachment of redcedar reduces the carrying capacity of livestock by reducing forage production.

Management

Fire

Historically, fire has been important in structuring and maintaining sand sagebrush communities. Prior to European settlement, it is believed Native Americans were responsible for most fires within sand sagebrush rangelands. Research has indicated that sand sagebrush returns to pre-burn conditions within three to four years⁵. Fire can also influence grazing distribution on the landscape as ungulates are attracted to freshly burned areas. Historically, the dominant herbivore was bison, but domestic cattle behave similarly because they are also attracted to freshly burned areas. The concentration of herbivores on these freshly burned areas allows unburned areas to receive little grazing pressure allowing for accumulation of grasses and shrubs. Thus, fire and grazing interacted historically creating a shifting mosaic across the landscape which resulted in a variable plant composition and structure across sand sagebrush rangelands. Landowners can mimic this system today by rotationally burning portions of pastures. Increased diversity leads to more stable plant communities for livestock grazing, wildlife habitat, and other ecological services⁶. Additionally, periodic fires are important to restrict the encroachment of trees, particularly redcedar, into sand

sagebrush rangelands. Currently many of the ecological problems facing sand sagebrush rangelands could be resolved with the reintroduction of fire.

Unfortunately, fire has been infrequently used in most sand sagebrush rangelands in recent years and trees have begun to encroach. Culturally there are several reasons people have opposed fire. It is commonly thought that fire leads to loss of forage, soil erosion, and poses a threat to structures and livestock. Research has addressed these concerns by illustrating the forage quality can be enhanced, soil loss is minimal, and if fire is properly managed, it can be carried out safely. It is important to remember that fire is an ecological process that is essential to maintaining sand sagebrush rangelands.

Grazing

Domestic livestock grazing has occurred on sand sagebrush rangelands since the late 1800s. Sand sagebrush rangeland commonly supports stocker and cow calf operations. Livestock grazing in the late 1800s and 1900s was unmanaged and led to degraded rangelands. In the 1940s researchers at the Southern Plains Range Research Station began some of the earliest work on establishing stocking rates to ensure proper grazing of sagebrush rangelands. In a 20-year comparison of three different stocking rates researchers suggested moderate stocking rates of 43 to 53 animal unit days per acre (AUD-acre⁻¹) or 9 to 11 acres per stocker (~600 lbs stockers) for a 320 day grazing period⁷. The recommendations are similar for cow calf pairs with stocking rates of 45 to 60 AUD-acre⁻¹ or 15 to 20 acres per cow per year⁸. However, supplementation is often needed during dormant season grazing as these rangelands are dominated by warm season forage. Specifically, research has shown that cows need 2 lbs of 40 percent crude protein supplement daily⁹ while stocker cattle need 0.64 lbs per day of 40 percent CP supplement for adequate gains during the dormant season¹⁰.

Drought is a frequent event in the southern Great Plains. Therefore managers should have the expectation that drought will occur. The best management for drought is properly managing livestock before the drought begins. By using light or moderate stocking rates, managers can hold some grass back for dry years. If managers employ higher stocking rates, there are few options other than supplemental feeding during drought or destocking. Research in Harper County, Oklahoma found that it was more profitable to graze at moderate stocking rates rather than heavy, because financial losses during drought years on heavily stocked rangelands was much greater.⁸ In 2011, parts of western Oklahoma had less than 2 inches of rain through the growing season. Managers with heavily stocked ranges faced devastating economic losses that were exacerbated by increased supplementation costs due to the regional impacts of the drought. This also leads to loss of all vegetative cover that leads to a loss of wildlife habitat for species that require shrub cover.

Chemical Brush Control

The use of chemical herbicides to control sand sagebrush was developed at the Southern Plains Range Research Station in Woodward, Oklahoma in the late 1940s¹. Chemical control of sand sagebrush has dramatically impacted the sand sagebrush rangelands, because it allowed land managers a simple cost effective way to control sagebrush on thousands

of acres of rangeland. Results of early research suggested that sagebrush should be sprayed from April 15th to June 1st at a rate of 1 lbs per acre¹. This rate and timing will give 50-80 percent control of sand sagebrush. Application of 2,4-D has been effective with ground applications (boom sprayers) and aerial spraying. Since 2,4-D is a broad spectrum herbicide it also will suppress forbs.

Despite the thousands of acres of sand sagebrush treated with the intent of increasing livestock productivity, there is limited data on the impact that sand sagebrush control has on livestock productivity. Early research suggested that controlling brush produced more grass, allowing livestock producers to increase stocking rates by ~47 percent¹¹. Research conducted at the Southern Plains Range Research Station reported that reducing sagebrush between 5 percent to 10 percent canopy cover and increasing stocking rates by 47 percent yielded an increase in cattle gains per acre⁹. Yet there is no evidence that removal of sand sagebrush alone will increase individual animal gains. In fact, gains per animal were higher in untreated rangelands. Therefore, it appears that increases in livestock productivity were dependent upon increases in stocking rates.

Mechanical Brush Control

Mechanical treatment of sand sagebrush was also developed at the Southern Plains Range Research Station. Early experiments (unpublished studies) remain as the only data available on the effectiveness of mowing sand sagebrush. Research suggested double mowing sand sagebrush in the early spring when carbohydrate reserves were at their lowest would result in the best control⁸. These results showed that mowing could increase grass abundance, and in turn, allow managers to increase stocking rates. However, they concluded that mowing in the late 1940s was too costly and impractical for treating large acreages of sand sagebrush rangeland. These conclusions likely are more relevant in today's economy.

Wildlife Use

Sand sagebrush rangelands support and abundance and diversity of wildlife. Some of the most notable game species include white-tailed deer, wild turkey, northern bobwhite, and lesser prairie-chickens. White-tailed deer and wild turkey are habitat generalists and can adapt to a wide variety of habitat conditions and are not dependent on sand sagebrush, but it does provide habitat. Conversely, northern bobwhite and lesser prairie-chickens have more specific habitat requirements and their populations have been in a state of decline for the last several decades. The declines have been attributed in part to the loss of shrubs. Shrubs such as sand sagebrush, sand plum, and sumac are necessary for northern bobwhite to occur on a landscape and appear to be important to lesser prairie-chickens in some areas. One of the most important roles of shrubs is the vegetative structure they provide. Shrubs offer protective cover for evasion of predators, and mitigate extremes in weather events that frequently occur in the Southern Great Plains. There are also many nongame species of wildlife that have coevolved with sand sagebrush rangelands that are dependent upon the shrubs. A notable example is the Cassin's sparrow which is closely associated with sand sagebrush rangelands.

One of the most common range management techniques that is employed on sand sagebrush rangelands is the use of 2,4-D to remove sagebrush. While it has been suggested that the removal of shrubs may reduce competition with herbaceous species thus creating more resources for forbs, research has shown that it may take 5 to 10 years following application of 2,4-D for annual forb species to recover¹². Many of these annual forbs are important for species such as northern bobwhite, ring-necked pheasant, wild turkey, and lesser prairie-chicken. The forbs also provide critical habitat for insects that are important to many wildlife species. Overall, managing rangelands for multiple ecological services with the use of 2,4-D is not the best option for sand sagebrush rangelands. Therefore, if managers are interested in the integrity of rangelands from a wildlife perspective their management objectives should ensure maintenance of shrubs.

Conclusions

Sand Sagebrush rangelands in the southern Great Plains will continue to be important to livestock producers in the future. As concern for the lesser prairie-chicken and northern bobwhite continue to increase as populations decline, it is likely that sand sagebrush will become even more important to society in general. Therefore it is imperative that land managers use the best available science to plan long-term management strategies for sand sagebrush rangelands. Future management considerations may take into account what impact management strategies may have on the long-term stability of these rangelands. Fire is an important ecological driver, therefore the increase in the use of fire on sand sagebrush rangelands can benefit livestock production and ecological services such as wildlife habitat.

LITERATURE CITED

1. McIlvain, E. H. and D. A. Savage. 1949. Spraying 2,4-D by airplane on sand sagebrush and other plants of the Southern Great Plains. *Journal of Range Management* 2:43-52.
2. Berg, W. A. 1994. Sand sagebrush-mixed prairies. In: T. N. Shiflet [EDs]. *Rangeland Cover Types of the United States*. Society for Range Management. Denver, Colorado, USA.
3. Gillen, L. R., P. L. Simms. 2006. Stocking rate and weather impacts on sand sagebrush and grass: a 20-year record. *Rangeland Ecology and Management* 59:145-152
4. Winter, S. L., S. D. Fuhlendorf, C. L. Goad, C. A. Davis, K. R. Hickman, and D. M. Leslie. 2011. Restoration of the fire-grazing interaction in *Artemisia fillifolia* shrubland. *Journal of Applied Ecology* 49:242-250
5. Winter, S. L., S. D. Fuhlendorf, C. L. Goad, C. A. Davis, K. R. Hickman, and D. M. Leslie. 2011a. Fire tolerance of a resprouting *Artemisia* (*Asteraceae*) shrub. *Plant Ecology* 212:2085-2094
6. Fuhlendorf, Samuel D., and David M. Engle. *Restoring Heterogeneity on Rangelands: Ecosystem Management Based on Evolutionary Grazing Patterns* *BioScience* 51.8: 625-632.
7. Gillen, L. R., P. L. Simms. 2004. Stocking rate, precipitation, and herbage production on sand sagebrush-grassland. *Rangeland Ecology & Management* 57:148-152.

8. Shoop, C. W., and E. H. McIlvain. 1971. Why some cattlemen overgraze and some don't. *Journal of Range Management* 24:252-257.
9. Lalman, D. 2004. *Supplementing beef cows*. Oklahoma Cooperative Extension Service ANSI-3010.
10. Gunter, S. A., E. T. Thacker, T. L. Springer, and R. D. Jones. 2012. Effects of sand sagebrush control in southern mixed prairie rangeland on cattle performance and economic return. *The Professional Animal Scientist* 28:204-212
11. McIlvain, E. H. and D.A. Savage 1954. Progress in range improvement. *Advances in Agronomy Volume 5*. Academic Press, New York, NY, USA.
12. Thacker, E. T., S. A. Gunter, R. L. Gillen, T. L. Springer. 2012. Sand sagebrush control: implications for lesser prairie chicken habitat. *Range Ecology and Management*. 28:204-212
13. Duck, L.G. and J.B. Fletcher. 1943. A Game Type Map of Oklahoma. A Survey of the Game and Fur-bearing Animals of Oklahoma. Oklahoma Department of Wildlife Conservation, Oklahoma City.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0413 GH.