Sheep Grazing as a Brush and Fine Fire Fuel Management Tool

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Summary

Rangelands throughout the U.S., as well as the rest of the world, play a major role in supplying human populations with animal and plant products, recreation and water and habitat for wildlife. A pivotal element in determining the actual use for any particular rangeland resource is the vegetation composition (i.e., the structure and species composition of range vegetation is the primary driving force in land use and management). A vegetation shift from grassland to woodland has been documented in most rangelands of the U.S. Increases of woody plants reduces livestock production potential, greatly alters wildlife habitat, reduces water availability to both rural and urban uses, increases soil erosion potential and can lower the overall recreational desirability of a region. Although there is not unanimous agreement, most authors have attributed this woody plant increase to grazing disturbance (heavy stocking) which reduced both fire frequencies and the removal of competition from grasses. Even though excessive livestock grazing has contributed to the increase of woody plants on rangeland, proper management based on a knowledge of the foraging process can be used to direct plant succession towards an improved range condition. Using sheep to manipulate vegetation appears to be an important part of the grazing management needed to reach this goal.

Key words: biological, brush management, fire, grazing, sheep.

Introduction

The invasion and increase of woody plants into areas previously dominated by herbaceous vegetation has been a problem on rangelands since the development of the livestock industry. This vegetation shift from grassland to woodland has been documented on most rangelands of the U.S. (McPherson and Wright, 1990). Examples of this include the Great Plains where ponderosa pine *(Pinus ponderosa)* has invaded grasslands; the Great Basin where juniper species have spread into sagebrush-grass vegetation; the Southwest where *Juniperus* spp. and honey mesquite *(Prosophis glandulosa)* have invaded rangelands and in the desert plains of Arizona, New Mexico and western Texas where creosotebush *(Larrea tridentata)* and tarbush *(Flourensia cernua)* have invaded the desert grasslands.

Although there is not unanimous agreement why this change took place, most authors have attributed this woody plant increase to grazing disturbance (heavy stocking) which reduced both fire frequencies and the removal of competition from grasses (Archer, et al., 1988; Johnsen, 1962; Wright, 1972).

The detrimental effects of woody plant invasion generally include reduced perennial forage production, decreased water yield and increased erosion, increased labor costs associated with problems of livestock management and decreased income from recreational activities. Studies have been conducted on areas as diverse as the pinon/juniper types in the Great Basin (Tueller et al., 1979) and the grasslands of Texas (McPherson et al., 1988). These and other studies agree that herbaceous production is generally reduced as the woody plant community matures.

Herbaceous biomass is critical for livestock and wildlife production, watershed protection and to serve as fine fuels for prescribed burning. This vegetation shift from a grassland to a shrub/woodland ultimately results in a significant reduction in carrying capacity of the range (Taylor and Ralphs, 1992) and therefore, a significant reduction in the efficiency of the ranching enterprise.

Removal or reduction of woody plants to increase herbaceous production is a goal of many resource managers. Woody plant removal is usually expensive and success can be variable for most techniques. Therefore, preventive measures and future management of such lands first

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requires an understanding of the causes of the problem and then the implementation of economic methods to shift the vegetation complex in a desired successional direction.

Rangeland Plants

Plants on rangelands have evolved under natural selection. Those which are best able to survive and reproduce under existing natural conditions occupy the site. Because of this environmental selection (both biotic and abiotic), most native range plants have low production potential when compared to improved pasture forages. The low potential productivity of many ranges precludes the profitable application of expensive cultural inputs to maintain forage production at levels near site potential.

Vegetation on rangelands is comprised of a great diversity of species with broad genetic variation within most species. This diversity is an asset to both the stability of the plant communities and the animal as it selects its diet. The diversity in plant species adds stability to the nutrient intake of the grazing animals by allowing them to shift their diets from species to species as seasons change and as the degree of utilization increases.

On rangelands, the animal is the component of the system that is managed directly by manipulating the kinds and classes of animals, the seasons of grazing, the stocking rate and the design of the grazing system. However, the responses of vegetation to management decisions are not under direct control of management. This may be frustrating to persons who like to see a direct response to their actions. For example, they plant a grass and see it grow or they apply a herbicide and see brush die. In grazing management, you may change the number of animals, thus changing the forage-to-animal ratio; this, in turn, will change diet selection of the animals. This may change nutrient intake and animal production; meanwhile, the change in grazing pressure will result in a shift in the competitive relationships among plant species causing a change in the plant community.

Even though selective grazing by livestock has contributed to the increase in undesirable plants on rangelands, knowledge of this foraging process, when properly used, can enhance range condition; domestic livestock can be used as biological tools in brush management.

Biological Brush Management

Reducing woody plant density is generally the primary step toward improving hydrological conditions and increasing forage production on depleted rangelands. The two most widely-used approaches to brush management are mechanical treatment and the application of herbicides (Scifres, 1980). However, because of the rising costs of these treatments, real or perceived effects on environmental quality and a lack of satisfactory control in some instances, interest in the use of other brush management methods has increased (i.e., biological brush management).

Management of brush by grazing animals "is applied to achieve a desired directional succession in vegetation composition; it is one form of planned environmental manipulation by controlled grazing" (Vallentine, 1989). However, before effective brush management can be accomplished by grazing animals, a basic understanding of the selective grazing process must be understood.

Different species of grazing animals have different forage preferences. Cattle are primarily grass eaters but do consume some forb and browse species. Goats consume primarily browse and grass but they will also select forbs. Sheep generally consume mostly grass and forbs but under certain conditions will consume large amounts of browse. These are general statements; and it must be remembered that just because a particular grazing animal consumes and prefers a particular plant in one plant community does not necessarily mean that it will react in a similar manner in another plant community of differing botanical composition. Nevertheless, valuable information can be found regarding the potential of selective grazing for brush suppression in research describing seasonal food habits and dietary preferences of grazing animals.

Early animal foraging research on Texas rangelands was conducted on the Sonora Research Station (Texas Agricultural Experiment Station) located on the Edwards Plateau of Texas (Cory, 1927; Fraps and Cory, 1940). The researchers used study pastures of approximately 575 acres (230 ha) and concluded that the daily travel of cattle averaged 3.3 miles (5.3 km); sheep, 3.8 miles (6.1 km); and goats, 6.1 miles (9.7 km). The amount of time spent feeding on grass by cattle, sheep and goats represented 78, 53 and 50%, respectively. Forbs were grazed 21% of the time by cattle, 24% by sheep and 29% by goats while browse was grazed 1, 23 and 21% by cattle, sheep and goats, respectively. The authors reported that the stocking ratio for this study was approximately 44% cattle, 36% sheep and 19% goats, based on animal unit equivalents.

A later study conducted on the Sonora Research Station compared esophageally cannulated sheep diets from continuously grazed pastures at both light and heavy stocking with sheep only (Kothmann, 1968). Sheep diets from a lightly stocked pasture averaged 55% grass, 28% forbs and 16% browse compared to 39% grass, 5% forbs and 55% browse from diets in a heavily stocked pasture.

At the same location, but in a different pasture, Bryant et al. (1979) collected diets from sheep grazing in a four-pasture/three-herd grazing system moderately stocked with cattle, sheep and goats. Sheep diets averaged 60% grass, 18% forbs and 32% browse for the 12-month study. In another study in the same location, sheep diets were collected during the major part of the growing season for two different years (Robinson, 1990). The study pastures were part of a multi-pasture, one-herd grazing system stocked with cattle, sheep and goats. For this study sheep diets averaged 65% grass, 20% forbs and 15% browse.

For a northern Utah study conducted during the summer, sheep consumed

28% grass, 34% forbs and 38% browse under good range conditions and 25% grass, 33% forbs and 42% browse under poor range conditions (Cook et al., 1965). More browse was consumed by sheep in the poor range condition. In a later study in a Utah mountain aspen range, sheep consumed 43% grass, 49% forbs and 8% browse compared to 51% grass, 26% forbs and 23% browse in a sagebrush-grass rangeland (Cook et al., 1967).

A sheep and deer competition study conducted in central Utah reported sheep diets selected from various kinds of rangeland (Smith and Julander, 1953). Browse consumption by sheep varied from a low of 2% of the diet on a sagebrush-grass rangeland to a high of 51% for a sagebrush-chokeberry dominated range, an example of the variability that can occur in forage selection.

Because sheep prefer a variety of different plant species in their diet, suppression of target species depends on availability of other forages as well as density and size. A good example of this was the control of big sagebrush *(Artermisia tridentata)* with sheep (Frischknecht and Harris, 1973). The authors reported that sheep grazing in late fall controlled big sagebrush on artificially seeded cattle range if the sheep were introduced before the sagebrush became too dense.

Suppression of target species also depends on the season of use. At the U.S. Sheep Experiment Station near Dubois, Idaho, research revealed that heavy late-fall grazing by sheep following spring deferment improved sagebrush-grass ranges by reducing threetip sagebrush *(Artemisia tripartita)* and increasing the production of grasses and forbs (Laycock, 1967). Heavy grazing during the spring increased sagebrush and reduced herbaceous production. The authors concluded that sagebrush-grass ranges can be improved by proper sheep grazing rather than by costly spraying, burning or mechanical treatments.

Sheep have also been used to release young conifer trees from brush competition in the Pacific Northwest (Sharrow et al., 1988). Three four- to six-year-old plantations were grazed once each year from May to September. Utilization of brush by sheep was generally moderate to heavy. Sheep grazing effectively reduced the net current year's growth of both total understory plant growth and brush on all study areas. Three growing seasons after grazing treatments ceased, trees in grazed plantations were approximately 5% taller and 7% greater in diameter than were trees in ungrazed controls.

Sheep and goats have been used to reduce Senecio poisoning in cattle (Sperry et al., 1968). *Senecio longilobus* and *Senecio spartioides* cause cattle losses when the animals consume 1 to 5% of their body weight during a one-week period. On a body weight basis, about 20 times as much Senecio is required to poison a sheep as to poison a cow. Sheep will readily remove the plant by grazing, therefore, providing protection for cattle when properly used.

Sheep and goats are effective in reducing gorse *(Ulex europaeus)* on New Zealand pastureland (Radcliffe, 1985). Three years of grazing after a prescribed burn and oversowing resulted in reducing gorse to negligible levels under sheep and goat grazing with rotational grazing and set stocking.

Abandoned farmland overrun with brush is a major problem in the northeastern United States (Wood, 1987). This land has the potential to be very productive but because of the high costs of mechanical and chemical brush control these methods are frequently impractical, and often not long-lasting due to rapid regrowth. For this Vermont study, goats were more effective in reducing the brush problem but sheep also made a significant impact. The author concluded that mixed grazing (sheep and goats) would be the most efficient step in restoring and maintaining brush-infested land.

An evaluation of the success of brush management is mostly dependent upon the goals and objectives of management. If the goal is to severely reduce or eliminate a particular plant species, then time of grazing relative to phenological development and susceptibility of the target species to defoliation is important; stocking rate and duration of grazing are also very important. However, elimination or severe reduction of a particular plant species through animal foraging may not be either desirable or feasible. In this instance, selective animal grazing in combination with other brush treatments may become necessary (i.e., an integrated brush management system).

Integrated Brush Management System

Integrated brush management system (IBMS) is defined as a procedure in which applications of range, wildlife and livestock management methods are coordinated by the manager in an orderly fashion (Scifres et al., 1985). The objective is to optimize production from the rangeland resource, considering all potential uses of the resource, rather than to maximize returns from any specific unit. An effective system must be based on an understanding of the ecological potential of the land resource and must apply the principles of sound business and land management to achieve an economic result acceptable to the producer.

A thorough discussion of IBMS is beyond the scope of this paper; however, the integration of various brush management methods, including livestock as a biological brush control option, is the foundation of this concept. In most instances more than a single brush treatment is needed to meet management objectives, especially if two or more woody species sharing the same range site vary significantly in their response to any particular control method.

Management of Fine Fuels for Prescribed Burning

Economics and environmental concerns continue to increase in regards to the use of chemical and mechanical brush control methods. Fire is emerging as an integral part of vegetation management. Prescribed burning has been used on rangelands for the following: to increase herbage yields, to increase utilization of coarse

grasses, to increase availability of forage, to increase control of undesirable shrubs and cool season grasses, to reduce and control cactus species, to remove dead woody material, to improve wildlife habitat and to facilitate other management goals (Wright, 1974, 1986; Scifres, 1980).

The effectiveness of fire as a brush management tool is determined by many factors (Wright, 1974; Stoddart, et al., 1975; Scifres, 1980; Skinner and Wakimoto, 1989). Fuel characteristics – kind, amount, moisture content, coarseness, position, arrangement – are very important (Scifres, 1980). For example, fine fuels (amount of grass per unit area) are more easily ignited and have a faster rate of spread than coarse fuels (nonvolatile woody plant material). The minimum fine fuel load required for effective burning depends on the location, characteristics of the fuel and weather conditions. "Generally at least 2,500 pounds of air-dried fine fuel per acre, evenly distributed, are required for maximum burning effectiveness on most Texas rangeland" (Scifres, 1980). It is the pre- and post-grazing management of this fine fuel load that will mostly determine the success or failure of a burning program.

If management's goal is a hot fire to suppress woody vegetation, then livestock grazing will have to be managed to enhance or increase the fine fuel load. Because of our understanding of the unique forage preferences for domestic and wild ruminants (i.e., cattle are mainly grazers of grass, deer are mainly browsers and sheep and goats are intermediate feeders), it is anticipated that the strategic use of sheep and goats on a forage resource would ultimately promote grass production and suppress woody plant production, thus providing greater amounts of fine fuel for more effective burns. This hypothesis is currently being tested on brush-infested rangeland on the Texas A&M University Research Station at Sonora. Cattle numbers have been temporarily replaced with sheep and goats (less grass is harvested because of the absence of cattle and greater browsing pressure on the woody plants). Once fine fuel loads are built up to a critical level, prescribed burning will be implemented. After the vegetation complex has been shifted toward the production of more desirable species and a better mix of species, it is anticipated that an optimal mix of cattle, sheep and goats, each with a different set of forage requirements, will result in a more complete utilization of the available forage than would be obtained using a single-species; thus ranch productivity will be maximized.

Management of Fine Fuels on Fuel Breaks

Grazed fuel breaks provide forage for livestock and wildlife as well as a method of controlling wild fires. In the past, mature vegetation has been removed in strips and vegetation regrowth has been controlled primarily with herbicides. Because of the environmental concerns over the use of herbicides, using sheep to control this regrowth provides a promising alternative.

For fuel breaks to be effective they need to be dominated by low-growing ground cover characterized by low fuel loads. At the same time, they need to be protected against soil erosion. Native grasses or low-growing grasses are ideal cover for fuel breaks. The intermediate grazing capacity of sheep and goats allow them to harvest both grasses and brush regrowth and keep them cropped close through heavy stocking.

A major problem on fuel breaks is brush and tree regrowth (Green and Schimke 1971). This woody regrowth, plus grass, will produce a fuel mixture in which fire can spread rapidly. Sheep and goats offer a tremendous potential as vegetation management tools to suppress fuel loads on fuel breaks.

Conclusions

Lower prices for agricultural products and increasing input costs, in association with changes in the economic, political and social structure of the U.S., are making it difficult for ranchers, farmers and government agencies to invest in the conservation practices that are essential for sustainable agriculture.

Organizations with strong political clout, developed over the years, have significantly changed governmental policy concerning wetlands, highly erodible farmland, endangered species, use of pesticides and herbicides and underground water. Newspapers and magazines routinely carry articles expressing concern over these environmental issues. Unfortunately, some of these articles are written by biased people with their own agendas. Over time this has caused the erosion of public confidence in the ability of the rancher to optimally manage his resource for the betterment of society. Because of this, many people consider ranching an exploitative industry and, for this reason, neither the industry nor those engaged in it have received much favorable consideration at the hands of society.

For the U.S. to remain as a world leader in sustained food and fiber production, a proper balance between inputs, income and natural resources must be maintained. A viable sheep industry provides the opportunity for economic, social and cultural benefits from the use of natural resources. Sheep have unique foraging strategies as well as physical and behavioral characteristics that allow them to survive and produce in most regions of the world. Because of this adaptability, sheep are unique animals that can be effectively used to manipulate vegetation. Properly managed, sheep are excellent conservation tools that can be used to either shift or maintain vegetation in a desired successional direction, thus reducing costly inputs such as chemical and mechanical treatments while maintaining healthy functioning ecosystems.

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