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# Managing livestock grazing for mule deer (*Odocoileus hemionus*) on winter range in the Great Basin

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# MANAGING LIVESTOCK GRAZING FOR MULE DEER (*ODOCOILEUS HEMIONUS*) ON WINTER RANGE IN THE GREAT BASIN

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ABSTRACT.—History and technical literature describing potential effects of livestock grazing on mule deer (*Odocoileus hemionus*) populations and winter range habitat are reviewed. Recommendations for livestock grazing on winter ranges within the Great Basin are advanced.

*Key words: mule deer,* Odocoileus hemionus, *livestock grazing, plant succession, Great Basin, winter range, habitat management, grazing management.*

Accounts of trappers and pioneers in the early to mid-1800s provide a clear record of the presettlement relationship between habitat and mule deer (*Odocoileus hemionus* Rafinesque) populations in the Great Basin. Prior to settlement, beginning about 1850, perennial grasses, representing climax plant communities, dominated foothill ranges (Simpson 1876, Stewart 1941, Leopold 1950, 1959, Passey and Hugie 1962, Christensen and Johnson 1964, Hull and Hull 1974, Vale 1974, 1975, Urness 1976, and others). *Odocoileus hemionus*, requiring shrub forages on winter ranges (Stoddart and Rasmussen 1945, Dietz and Nagy 1976, Willms et al. 1976, Carpenter et al. 1979, Austin and Urness 1983a, and others), were found in low densities and scattered populations (Leopold 1933, 1959, Hancock 1981, Rawley 1985, and others). On most mule deer management units populations are limited by forage resources on winter ranges (Hancock 1976, Clements and Young 1997).

Livestock grazing, usually season-long and with little regard to levels of utilization, shifted plant succession toward seral shrub communities on *O. hemionus* winter ranges (Stewart 1941, Cottam and Evans 1945, Reynolds 1960, Julander 1962, Christensen and Johnson 1964, Plummer et al. 1968, Thomas 1970, Urness 1981, Harniss and Wright 1982, Urness 1990, and others). Changes in plant communities were followed by dramatic increases in mule deer populations (Leopold 1950, Julander and Low 1976, Hancock 1981, and others). Conversely, cessation of livestock grazing, which often overutilized grasses and forbs and lightly utilized shrubs, ended the growth advantage of shrubs. This led to increased fuel loads and subsequent fire susceptibility of winter ranges. These 2 factors, lack of livestock grazing and fire, resulted in many *O. hemionus* winter ranges shifting from seral shrub communities back to grasslands followed by declines in mule deer populations (Costello and Turner 1941, Cottam and Evans 1945, Laycock 1967, Anderson and Holte 1981, Austin et al. 1986, Austin and Urness 1998, and others).

This paper presents a synopsis of research conducted on mule deer–livestock grazing relationships and advances recommended strategies for future livestock grazing on winter ranges where *O. hemionus* are an important product of the land.

## SYNOPSIS OF MAJOR BIG GAME–LIVESTOCK RELATIONSHIPS AND VEGETATION STUDIES ON MULE DEER WINTER RANGES

Cottam and Evans (1945) compared 2 adjacent watersheds near Salt Lake City, Utah. Red Butte Canyon had been protected from livestock grazing from 1905 to 1935, while Emigration Canyon had been annually and heavily grazed by both sheep and cattle. By 1935 total vegetative canopy cover in Red Butte Canyon was approximately double that of Emigration Canyon, including *Quercus gambelii* Nutt. (Gambel oak). In a reexamination of the site after 22 yr of reduced grazing followed

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by 26 yr of grazing protection in Emigration Canyon, and continuous protection in Red Butte Canyon, Austin et al. (1986) showed no differences in total vegetative cover between canyons. Stands of *Q. gambelii* had increased in size and recovered from the heavy livestock grazing prior to 1935.

Smith (1949) compared adjacent winter ranges used by *O. hemionus* in northern Utah. In this important paper, 1 range was heavily grazed by livestock during spring and early summer while the 2nd had been protected from livestock grazing the previous 11 yr. On the range protected from livestock grazing, native and perennial forbs and grasses had increased 141%, but big sagebrush and other shrubs had decreased 85%. In a reexamination of the sites following 34 yr of protection from grazing on both ranges, Austin and Urness (1998) showed both ranges had shifted to a grass-forb community with no big sagebrush plants remaining.

Mueggler (1950) reported on 2 paddocks grazed yearly between 1923 and 1948 by sheep at the U.S. Sheep Experiment Station near Dubois, Idaho. Paddock 1 was grazed only in the fall at the moderately heavy rate of 29 sheep-days per acre, whereas paddock 2 was grazed both spring and fall at the total moderate rate of 43 sheep-days per acre. After 25 yr of grazing, total herbage production was within 5% between pastures. However, the spring-and-fall-grazed paddock showed an increase of 73% in shrub production from the 9 native shrub species available, and decreases of 80% and 31% in native perennial forbs and grasses, respectively. Annual nonnative *Bromus tectorum* L. (cheatgrass brome) was unavailable in 1923, but by 1948 small quantities of 2 and 6 pounds per acre were available in paddocks 1 and 2, respectively. Laycock (1967) reported on long-term sheep grazing studies at the U.S. Sheep Experiment Station. Results indicated heavy grazing by sheep in spring on range in good condition increased production of *Artemisia tripartita* Rydb. (three-tip sagebrush) 78% and decreased perennial herbaceous production 53%. Conversely, fall grazing by sheep decreased *A. tripartita* production 11% and increased production of perennial grasses and forbs 14%. *Bromus tectorum* increased about equally under fall grazing and within exclosures, but more rapidly under spring grazing.

Julander (1955, 1962) described the expansion in Utah of deer populations on ranges overgrazed by livestock. He explained that livestock grazing causes large increases in shrubs and trees, but serious depletion of nutritious herbaceous forages of grasses and forbs preferred by livestock operators. Nonetheless, these changes resulted in greatly expanded *O. hemionus* populations.

Smith and Doell (1968) defined the period of cattle grazing to maintain productive shrub communities. This study, conducted in Cache County, Utah, showed summer and fall grazing decreased browse production for use by mule deer in winter. The study concluded that on mixed browse–herbaceous ranges used by mule deer in winter, grazing by cattle should be completed prior to 1 July.

Shepherd (1971) studied the effects of clipping selected browse species in Colorado over 12 seasons. He concluded that of the species studied, *Artemisia tridentata* Nutt. (big sagebrush) was the most susceptible to overutilization. Consistent overutilization for several years led to decreased productivity, plant decadence, and death. However, *A. tridentata* clipped at about 50% utilization showed sustained production. Similarly, Cook and Stoddart (1963) over a 6-yr study determined that overwinter use of *A. tridentata* and other desert shrubs should not exceed 60% if production is to be maintained. For antelope bitterbrush (*Purshia tridentata* Pursh, DC.), Shepherd found 50% utilization would be sustainable, but 80% would damage or eventually kill plants. Garrison (1953) recommended 50–65% utilization for *P. tridentata*. For *Amelanchier alnifolia* Nutt. (saskatoon serviceberry), *Cercocarpus montanus* Raf. (true mountain mahogany), *Q. gambelii,* and other deciduous shrubs, Shepherd (1971), in his literature review, suggested 60–75% utilization was acceptable.

Jensen et al. (1972) and Jensen and Urness (1976) investigated seasonal grazing on big game winter ranges with domestic sheep to ascertain seasons and intensity of forage use that would maximize use of grasses and forbs and minimize use of associated shrubs. Results from this study at Hardware Ranch in northern Utah showed grazing by sheep on big game winter ranges could be accomplished without significant utilization of *P. tridentata* and other shrubs. However, grazing should be terminated between 15 June and 1 July, or at

the time *P. tridentata* sets seed. Sheep grazing after 15 July resulted in considerable loss of current year's production of *P. tridentata.*

Smith et al. (1979) and Fulgham et al. (1982) determined spring grazing by sheep affected subsequent fall and winter diets of *Odocoileus hemionus*. No nutritional differences in mule deer diets were found between grazed and ungrazed sheep pastures. Because regrowth following fall precipitation increased the proportion of herbaceous forage in the grazed pasture, deer selected more herbaceous and less shrub forage in the grazed pasture during early winter, thereby saving browse forage for periods when snowcover limited herbaceous forages. They concluded that sheep grazing in spring was compatible with *O. hemionus* utilization on winter ranges in northern Utah, and furthermore, animal production, mule deer plus domestic sheep, was greatly increased through multiple use.

Harniss and Wright (1982) monitored changes in vegetation in sagebrush-grass range grazed by sheep between 1965 and 1974. Moderate grazing had no effect on vegetative composition or production. However, heavy grazing in early summer decreased production of grasses and some forbs, but increased production of *A. tridentata.*

Reiner and Urness (1982) grazed big sagebrush–grass big game winter range in northern Utah with domestic horses. Pastures were grazed during June and July at grass-removal intensities of 41–79%. Results indicated all pastures grazed by horses resulted in increased twig production of *P. tridentata* over nongrazed pastures.

Austin et al. (1983) studied overwinter use by *O. hemionus* on a big sagebrush–seeded crested wheatgrass range in northern Utah. They reported fall regrowth and spring growth of grasses was nutritionally important to mule deer and recommended using a rest-rotation grazing system.

Riggs and Urness (1989) and Riggs et al. (1990) studied the effects of domestic goats grazing in the *Q. gambelii* community in northern Utah. Summertime goat grazing was used during high-intensity, short-duration periods designed to maximize utilization of *Q. gambelii.* In this study Gambel oak production was reduced and big sagebrush was increased. The authors concluded that generally grazing with goats on *Q. gambelii* winter range enhances the quality of deer diets in winter, especially under snow-covered conditions.

Austin et al. (1994a) studied the effects of horse grazing in spring on a shrub revegetation project using transplanted seedling Wyoming big sagebrush (*Artemisia tridentata* Nutt. *wyomingensis* Beetle and Young). The foothill winter range contained a variety of native and introduced grasses and forbs and no shrubs prior to treatment. Results following 6 growing seasons with herbage utilization ranging from 34% to 71% showed forage production of big sagebrush in paddocks grazed by horses in spring and protected from winter browsing by mule deer had increased 83% in browse production per plant compared to protected paddocks. Use by both horses in spring and mule deer in winter resulted in 13% increase in big sagebrush production per plant over protected paddocks. Conversely, browsing by deer in winter without horse grazing in spring resulted in a 40% decrease in big sagebrush production per plant compared to protected paddocks. Results concerning seedling survival during the first 3 yr following planting, as affected by horse use in spring and mule deer use in winter, were inconclusive. However, the effects of horse or mule deer grazing on survival on shrubs aged 4 to 6 yr were nil.

Austin and Urness (1995) investigated the effects of livestock grazing in spring on individual shrubs and seedling recruitment. Over 6 growing seasons mean herbaceous utilization was 59%. Results indicated survival rates of mature mountain big sagebrush (*Artemisia tridentata* var. *vaseyana* Rybd., Beetle) and *Cercocarpus montanus* shrubs were increased 119% and 25%, respectively; seedling recruitment of *A. tridentata* var. *vaseyana* was increased 130%, and winter injury to *C. montanus* was decreased 43%. Jensen and Urness (1979) reported similar results.

Clements and Young (1997) reviewed the history of the Lassen interstate mule deer herd in the far western Great Basin. They identified extensive and excessive livestock grazing as a major factor in establishing mixed shrub stands on *O. hemionus* winter range, and stated removal of livestock grazing from winter ranges would greatly increase difficulties in maintaining mule deer habitat.

Influences of livestock grazing and *O. hemionus* browsing are well defined on rangelands containing only native vegetation. The presence of introduced weedy species (Whitson et al. 1991) complicates and perhaps alters those influences as suggested by Mueggler (1950), Laycock (1967), and others. Palatability, season of growth, reproductive mechanisms, grazing sustainability, and competitive advantages and disadvantages compared to native species are some factors involved in evaluating grazing management systems complicated by introduced weedy species. Nonetheless, for many palatable weedy species, such as ubiquitous *Bromus tectorum* (Austin et al. 1994b), which was present on many of the study sites cited, livestock grazing in spring will sustain shrub productivity and decrease fire potential. However, the composition of herbaceous species may be altered in favor of those introduced species. Unfortunately *B. tectorum* and many other aggressive weedy species often increase regardless of rangeland protection. Although treatments designed for specific species, such as herbicidal spraying, hand removal, biological controls, and rangeland disking and reseeding, are utilized, currently a comprehensive solution is not available to address introduced weedy species on rangelands. Site-specific management using available research on the invading species must be evaluated.

## RECOMMENDATIONS

The preceding studies, reports, and literature have led to the following recommendations for livestock grazing to maintain or increase browse production on *Odocoileus hemionus* winter ranges in the Great Basin. Considering the typical *O. hemionus* winter range, it must be recognized these guidelines are somewhat idealistic and few ranges could adapt all recommendations. Classes of livestock availability, pasture fences, variability in mule deer numbers, and personnel available to monitor utilization are some of the limiting factors.

**1. Graze livestock between 1 May and 30 June.** Livestock grazing should be conducted during spring only. During years with early green-up, grazing may begin as early as 1 April, and grazing may be extended into early July during years of high moisture in May-June. Grazing must be completed when livestock begin to switch diets from grasses and forbs to shrub species.

**2. Alternate between classes of livestock.** Sheep and goats consume higher proportions of forbs, while cattle and horses consume higher proportions of grasses. By shifting classes of livestock, if available, between years, or grazing simultaneously with 2 or more classes, a better balance of grasses, forbs, and shrubs can be maintained.

**3. Use a rest-rotation system, yearly grazing about 2/3 of the rangeland available.** Because regrowth in fall and new growth of grasses in spring are important components to deer diet and nutrition, each year part of the winter range should be rested from livestock grazing. However, on ranges largely dominated by annual grasses and weedy forbs, and/or ranges highly susceptible to fire, livestock should annually graze the entire area.

**4. Graze livestock at an intensity to remove 50% of understory grasses and forbs.** A grazing removal of about 50% will maintain a mixed community of grasses, forbs, and shrubs and greatly reduce fire risk. Grazing at ≥70% removal will increase the proportion of shrubs, while grazing at ≤30% will slowly shift winter range plant communities toward more grasses and forbs.

**5. Balance deer browsing in winter and livestock grazing in spring.** Excessive utilization of browse by deer in winter over several years will gradually reduce shrub vigor and result in decreasing shrub density, regardless of the intensity of livestock grazing. Effects of drought or wet cycles confound the issue. However, to maintain browse vigor, utilization by *O. hemionus* should be restricted to 50% use of *A. tridentata* and other nondeciduous and evergreen species, and 65% use of *P. tridentata* and other deciduous species.

**6. Monitor utilization using permanent plots.** Vegetal utilization and community composition should be evaluated using permanent plots on critical or key areas of each deer unit. Spring utilization of grass and forb forages by livestock and overwinter utilization of browse forages by mule deer should be determined yearly. A minimum of twenty 100-$m^2$ plots per deer unit using ocular estimates is recommended. See DeVos and Mosby (1971), Rutherford (1979), Austin and Urness (1983b), and Austin (1987) for suggested methods. Trends in community composition must be evaluated

by detailed sampling at 5-yr intervals. See Poulton and Tisdale (1961), Davis et al. (1990), and Elzinga and Evenden (1997) for methods.

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