LIVESTOCK IMPACTS ON THE HERBACEOUS COMPONENTS OF SAGE GROUSE HABITAT: A REVIEW

Glenn A. Hockett, Rangeland Ecologist, Bozeman, MT 59718

ABSTRACT

Sage grouse are a bird of climax vegetation. Productive sage grouse habitat is more than a "sea of sagebrush." The grass/forb understory supplies food and cover components seasonally. Within the sagebrush community, a dense, residual herbaceous understory increases the likelihood of sage grouse nest success. Forbs and insects are essential foods for sage grouse from early spring to early fall. Although riparian areas typically make up less than 2 percent of the sagebrush landscape, interspersed springs, streams, and meadows offer watering and feeding sites for sage grouse during summer and early fall. Livestock selectively remove grasses and forbs within the sagebrush landscape while showing a strong preference for riparian meadows once upland vegetation cures. Livestock use can impact the amount and composition of herbaceous understory depending on the class of livestock, season of use, and grazing intensity. I reviewed the literature regarding sage grouse habitat and livestock impacts to the herbaceous understory. Ungrazed comparison areas, based on the seasonal needs of sage grouse, are lacking. Controls are recommended to advance our understanding of grazing impacts.

Key Words: forb, grass, habitat, herbaceous, livestock, riparian, sagebrush, sage grouse

INTRODUCTION

Early sage grouse (*Centrocercus urophasianus*) research focused primarily on the conversion of sagebrush (*Artemisia* spp.) habitat to grassland or farm land (Braun et al. 1976, Braun et al. 1977, Braun 1987). Sage grouse are sagebrush obligates and their populations are closely related to the quantity and quality of sagebrush habitats (Connelly et al. 2000). Their long-term survival is dependent on the sagebrush habitat type (Braun et al. 1977).

In the late 1960s a consortium of State Fish and Game Departments, USDI Bureau of Land Management (BLM), the USDA Forest Service (USFS), and the Bureau of Sport Fisheries and Wildlife estimated that the integrity of about 2.4 million ha of western sagebrush range had been compromised by burning, spraying, plowing, disking, chaining, cutting, and beating (Guidelines for Habitat Modification in Sage Grouse Range, undated). Much of this conversion was designed to produce more forage for domestic livestock or convert sagebrush habitat to farmland (Dalke et al. 1963). Recently, Apa (2001) reported sagebrush communities have been further reduced, with only 2-10 million ha remaining from an historical range of 58.7-109.3 million ha.

Clearly, the need to address the outright conversion of sagebrush has dominated our thinking and remains a concern. However, I address the effects livestock grazing may have on remaining sagebrush habitat, more specifically, the interspersed meadow and herbaceous understory.

PRODUCTIVE HABITAT

Beyond Sagebrush Protection

Sage grouse are a bird of climax vegetation and mature land forms (Patterson 1952). Protection and management of the remaining sagebrush steppe (semi-arid grassland), including quantity and quality of herbaceous understory, is critical to seasonal habitat needs of sage grouse (Connelly et al. 1991, 2000, Gregg 1991, Barnett and Crawford 1994, Drut et al. 1994a, Gregg et al. 1994, Beck and Mitchell

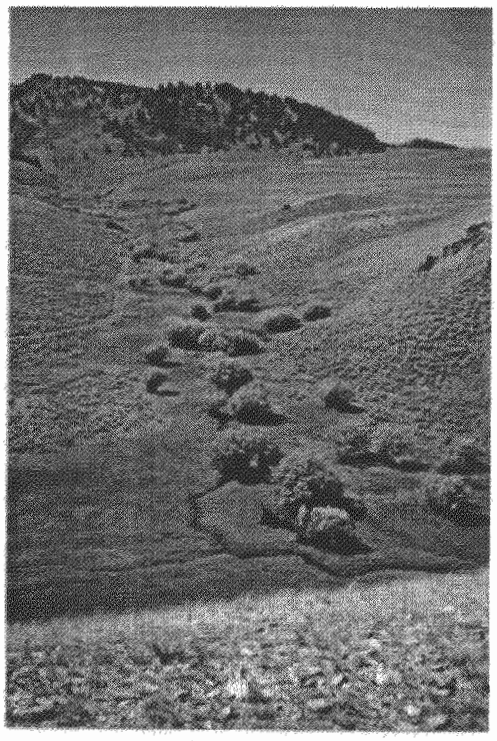

Figure 1. A riparian meadow interspersed within the sagebrush steppe offers important brood rearing habitat for sage grouse.

2001, Schroeder and Baydack 2001). Interspersed riparian meadows within the sagebrush steppe provide summer/fall habitat for brood-rearing (Dalke et al. 1963, Klebenow 1969, Call 1974; Fig. 1). Dunn and Braun (1986) suggested incorporating habitat heterogeneity and interspersion into management plans for sage grouse, noting meadows, sagebrush, and aspen should be in close proximity. However, the proper balance of these seasonal components required for optimal sage grouse reproduction is not fully understood (Gregg 2001).

The Proper Mix

Connelly et al. (2000) provided quantitative data supporting the importance of understory vegetation in sagebrush habitats to sage grouse. Breeding habitats should support 15-25 percent sagebrush canopy cover while providing at least 15 percent canopy of grasses and 10 percent canopy of forbs. The forb component should be diverse to provide adequate forage for nesting hens and young chicks. Sage grouse prefer an understory canopy height ≥18 cm for breeding, nesting, and early brood rearing (Connelly et al. 2000).

In Oregon, Barnett and Crawford (1994) suggested productive habitat for pre-laying includes new spring growth with a diversity of green, leafy forbs within the sagebrush habitat type. Forbs, along with insects, supply protein on which sage grouse chicks depend during their first weeks of life (Peterson 1970, Drut et al. 1994b, Connelly et al. 2000). Dunn and Braun (1986) suggested preserving important forb producing areas, especially meadows in close proximity to sagebrush. Klebenow (1969) found grasses and forbs adjacent to shrubs were important cover for sage grouse nests. However, grouse moved to mesic sites in search of green food plants when forbs under adjacent sagebrush uplands cured. Riparian arteries and wet meadows dissect sagebrush steppe communities forming a web of life that supports brood-rearing hens and their chicks throughout summer and early fall (Dalke et al. 1963). Sagebrush provides food and cover throughout the year, accounting for 100 percent of the sage grouse diet during winter (Connelly et al. 2000). This landscape of seasonal habitat components must be protected and managed to ensure the long-term survival of sage grouse (Connelly et al. 2000).

Seasonal Habitat Fidelity

Sage grouse show fidelity to seasonal ranges (Berry and Eng 1985, Fischer et al. 1993), and seasonal movements tend to be traditional (Connelly et al. 1988). Females return to the same general areas each year to breed, nest, raise broods, and winter (Berry and Eng 1985) although annual movements and home ranges may be quite large (Connelly et al. 2000). Patterson (1952) documented hens returning to the same areas year after year to nest. Two hens he studied located nests within 60 m of previous year's nests, and he commonly found new nests within meters of old nest sites.

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The Herbaceous Component

Nesting Habitat

Most sage grouse nest under a canopy of sagebrush (Connelly et al. 2000). However, herbaceous cover is an important factor in nest site selection (Connelly et al. 1991). Nest success is positively correlated with the presence of big sagebrush (*Artemisia tridentata*) and relatively thick grass and forb cover (Beck and Mitchell 2000, Connelly et al. 1991, Greg et al. 1994, Schroeder and Baydack 2001). DeLong et al. (1995) recommended management practices that increase cover and height of native grasses in sagebrush communities to enhance sage grouse productivity. Additionally, adequate availability of forbs during the pre-laying period may affect nutritional status of hens and reproductive success (Barnett and Crawford 1994).

Brood Rearing Habitat

Early brood rearing occurs in sagebrush habitats that are relatively open, relatively close to the nest, and support a diversity of grasses and forbs (Patterson 1952, Connelly et al. 2000). Sveum et al. (1998) recommended increasing the cover of native perennial forbs and grasses within sagebrush types to enhance sage grouse nesting conditions and food and cover for broods. Young chicks depend on lush green forbs and insects during their first few weeks of life (Drut et al. 1994b); availability of primary foods directly affected diets of sage grouse chicks. Forbs and invertebrates comprised >75 percent of chick diets where forbs and arthropods were more available, whereas chicks consumed 65 percent sagebrush on less productive habitat. A strong relationship also existed between diversity and abundance of forbs and availability of insects. Drut et al. (1994b) concluded a useful goal for chick survival and recruitment was to employ practices resulting in abundant forb and insect foods while simultaneously providing grasses and sagebrush needed for cover. Consequently, our understanding of grazing impacts to grass/forb diversity and height and arthropod habitat should be further investigated (Sneva 1979).

Security Cover

Herbaceous cover is important for concealment, security, and shelter from weather and predators (Schroeder and Baydack 2001). Burkepile et al. (2001) found that >85 percent of chick mortality occurred in the first two weeks with predation a likely cause of 90-100 percent of the deaths. Schroeder and Baydack (2001) point out, however, that indirect management of the grouse-predator relationship is usually best accomplished by manipulating habitats and not by direct reduction of predator numbers. Patterson (1952) suggested concealment rather than flight was the primary escape method for both young and adult birds. Flight was utilized only when birds were closely pressured or danger was imminent (Patterson 1952).

Livestock Grazing Impacts

Livestock have grazed most habitats occupied by sage grouse, typically in a repetitive, annual or biennial grazing period of varying timing and length (Braun 1998). Connelly and Braun (1997) and Beck and Mitchell (2000) have identified livestock grazing as an important factor associated with the widespread decline and degradation of sage grouse habitat. Patterson (1952) recognized livestock grazing as an important factor affecting quantity and quality of the grass-forb component of sage grouse habitat in Wyoming. Belsky et al. (1999) found livestock grazing has damaged approximately 80 percent of stream and riparian ecosystems in the western United States, and Fleischner (1994) outlined additional economic and environmental costs associated with livestock use.

Overall, grazing appears to most affect productivity of sage grouse populations by removing grass/forb cover that helps conceal sage grouse nests from predators (Beck and Mitchell 2000, Schroeder and

Baydack 2001). Burkepile et al. (2001) suggested conservation efforts focus on increasing survival of sage grouse chicks during their first two weeks of life. Klott et al. (1993) found areas with livestock present in Wyoming big sagebrush (*A. t. wyomingensis*) and low sagebrush (*A. arbuscula*) communities had less grass height and grass cover, fewer herbaceous species, less litter and lower Robel pole readings. However, forb cover and bare ground were greater in areas where livestock were present. The Wyoming Game and Fish Department (WGFD) found cover was the most important factor limiting upland game bird populations in Wyoming (WGFD undated [a]).

On the Upper Snake River Plains in Idaho, Mueggler (1950) found grazing in the spring (May) and late fall (November-December) by sheep severely reduced grass-forb production while increasing the abundance of shrubs, as compared to late fall grazing only. Spring-fall grazing treatments reduced forb production by 81 percent, grass production by 32 percent, and increased shrub production by 165 percent. Laycock (1967) expanded this study and found heavy spring grazing alone severely and rapidly deteriorated good condition range by reducing grass-forb production by > 50 percent while increasing abundance of sagebrush by 78 percent. However, complete protection from grazing or grazing when forbs and grasses were dormant, maintained the range in good condition and allowed deteriorated range to improve (Laycock 1967).

Patterson (1952) noted the reduction and elimination of perennial grasses and forbs due to drought and/or grazing imposed serious restrictions upon normal feeding habits of sage grouse females and young birds, particularly during the early stages of chick development. He observed young broods customarily dispersing from individual nest sites, concentrating in the vicinity of native meadows in search of insects and a variety of herbaceous plants. Grazing these traditional seasonal ranges, especially nesting and brood-rearing areas, can fragment and degrade sage grouse habitat by removing herbaceous vegetation sage grouse rely on for food and cover (Patterson 1952, Dalke et al. 1963, Call 1974, Klott et al. 1993, Connelly and Braun 1997, Beck and Mitchell 2000).

Holechek et al. (1999) in an extensive review of grazing studies found conventional wisdom suggesting 50 percent use actually resulted in range deterioration on semi-arid grasslands. Holechek et al. (1999) found light use (30-35%) consistently benefited forage production in dry years, and serious financial losses have occurred under heavy stocking (50-60%) and drought. Despite these findings, the USDA Natural Resources Conservation Service continues to recommend 50 percent use of forage resources (Holechek et al. 1999). Estimating impacts from average range utilization measurements is compounded by the tendency of livestock to selectively graze preferred habitats and preferred plants (Harrison and Thatcher 1970). Although they estimated overall use of key species within a landscape dominated by big sagebrush at 40 percent, Harrison and Thatcher (1970) documented a selective grazing pattern by sheep that left some areas used as much as 80 percent while other areas were not used at all.

Livestock and Sage Grouse Preferences Overlap

Livestock prefer succulent green plant material to dry vegetation, and generally select green leaves over stems (Reppert 1957). Consumption of forbs by livestock in spring and summer can be significant and may limit their availability for sage grouse broods (Call 1974). Livestock also tend to select the most lush, palatable, and nutritious forage species first (Reppert 1957).

Cattle generally show a preference for riparian habitats, especially once upland vegetation cures (Thomas et al. 1979, Gillen et al. 1984, Kauffman and Krueger 1984, Myers 1989, Clary et al. 1996). These mesic sites generally make up less than 1-2 percent of the overall sagebrush landscape

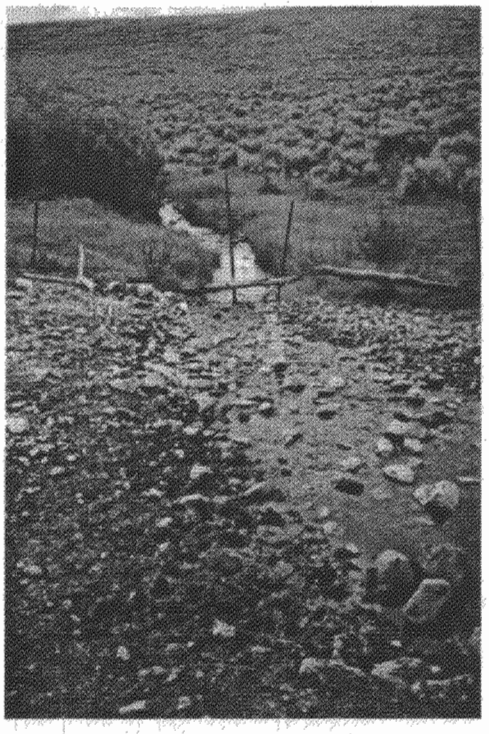

Figure 2. Severe livestock grazing and trampling can occur at watering sites. Compare the proected area in the background across the fence.

(Chaney et al. 1990, USDI Bureau of Land Management 1991, Chaney et al. 1993). Pyrah (1987) found plant succulence on upland sagebrush sites tended to decline after 15 June, while vegetation remained green longer in moist swales and meadows with deeper soils. On his study area in central Montana, mesic sites were actively selected by cattle and rapidly became unusable for antelope. Out-competed in swales and with upland vegetation desiccated, antelope moved to adjoining pastures not occupied by cattle (Pyrah 1987). Unlike antelope, however, sage grouse may not readily adapt to annual variations of livestock use on traditional seasonal habitats (Klott et al. 1993).

Connelly et al. (1988) suggested seasonal movements by sage grouse tend to be traditional, and migratory populations should be defined on a temporal and geographic basis that identifies important seasonal ranges and migration routes. Klott et al. (1993) detected no movements by sage grouse with broods away from areas with livestock, suggesting direct competition in isolated meadows may exist (Call 1974). As with cattle, mesic sites become especially important to sage grouse when upland sagebrush habitats desiccate (Patterson 1952, Dalke et al. 1963, Klebenow 1969, Wallestad 1971, Dunn and Braun 1986, Connelly et al. 2000). Livestock grazing in summer and early fall can degrade riparian areas (Kauffman and Krueger 1984, Clary and Webster 1989, Myers 1989). Grazing within the sagebrush steppe has frequently resulted in "sacrifice areas" and the loss of wetland plants associated with isolated riparian habitats (Thomas et al. 1979, Kauffman and Krueger 1984, Clary et al. 1996). These traditional brood-rearing areas (Patterson 1952, Dalke et al. 1963, Klebenow 1969, Call 1974, Dunn and Braun 1986, USDI Bureau of Land Management 1993, Connelly et al. 2000, WGFD Undated [b]) are particularly susceptible to livestock concentrations and grazing damage (Kauffman and Krueger 1984, Clary et al. 1996) , especially near open water sources (Clary and Webster 1989; Fig. 2).

Gillen et al. (1984) and Myers (1989) found late-season grazing increases cattle preference for meadows. Phillips (1965) documented cattle selectively overgrazing mesic areas (75-80% utilization) while slopes only 150 m away received ≤ 5 percent use. Given the opportunity, cattle will spend a disproportionate amount of time in riparian areas as compared to adjacent uplands, and this may be 5-30 times more than expected based on the extent of the riparian habitat (Clary and Webster 1989). Clary and Webster (1989) found no grazing system that ensured proper use of small riparian meadows within extensive upland range units. They concluded the most important consideration when managing livestock, was to site-specifically limit the level of utilization.

Although livestock usually consume little if any sagebrush (<10% of their diet) (Harrison and Thatcher (1970), Ngugi et al. (1992), and Call (1974) found some areas

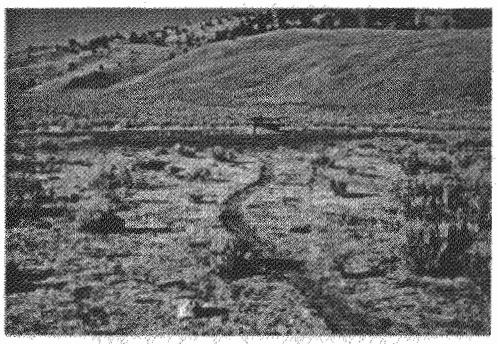

Figure 3 and 4. Livestock water developments and salt grounds fragment sagebrush uplands by creating "sacrifice areas" of bare ground and compacted soil through increased grazing use, trampling and trailing.

so heavily grazed by livestock in winter that most sagebrush plants were nearly killed. If such use occurs on sage grouse winter range, sage grouse may have difficulty obtaining sufficient forage (Call 1974). Range management practices designed to improve livestock distribution, such as artificial stock water developments or salt licks, may lead to trailing, trampling and localized overgrazing of preferred upland sage grouse habitat (Klott et al. 1993; Figs. 3 and 4). Habitat degradation can occur on other sites, where for whatever reason, livestock congregate in sagebrush uplands (Patterson 1952). Sage grouse are more vulnerable to environmental stresses and predation under these deteriorated habitat conditions (Beck and Mitchell 2000, Schroeder and Baydack 2001).

Control Areas

Most livestock exclosure studies suggest livestock operate as a keystone species in rangeland ecosystems (Bock et al. 1993). Bock et al. (1993) suggested livestock frequently determine which species thrive and which will diminish when they share the same landscape. However, ungrazed comparison areas, based on seasonal needs of sage grouse, are lacking (Braun 1998). The lack of large representative tracts of ungrazed habitat makes it nearly impossible to determine and monitor the actual consequences of livestock grazing (Bock et al. 1993). Controls address the ambiguity surrounding actual ecological consequences of livestock use (Bock et al. 1993).

Beck and Mitchell (2000) have recommended replicated field experiments be designed and compared to ungrazed areas to determine the widespread, relative effects of grazing treatments and stocking intensities on sage grouse nesting and brood rearing areas. Controls, encompassing seasonal habitats for any given sage grouse population as defined by Connelly et al. (2000), will provide baseline scientific data relevant to the effects different classes of livestock, season of use, and/or grazing intensities have on sage grouse habitat and productivity over time (Beck and Mitchell 2000). These comparison areas may also prove effective, low input management strategies for riparian habitat recovery within the semi-arid sagebrush-steppe (Rickard and Cushing 1982).

Conclusion

The sagebrush steppe is the critical foundation of productive sage grouse habitat (Patterson 1952, Wallestad 1975, Braun et al. 1977, Connelly et al. 2000). Protection and management of the sagebrush community, including the grass/forb understory and the interspersed riparian meadows are all essential to provide important seasonal habitats for sage grouse (Dalke et al. 1963, Klebenow 1969, Peterson 1970, Wallestad 1971, Call 1974, Connelly et al. 2000). Connelly and Braun (1997) and Beck and Mitchell (2000) have identified livestock grazing as a key factor

affecting sage grouse habitat productivity. Ungrazed comparison areas are lacking on sage grouse habitat (Braun 1998) and should be established (Beck and Mitchell 2000) to gather baseline data relevant to the effects different classes of livestock, season of use, and/or grazing intensities have on sage grouse habitat and productivity over time. Since domestic livestock currently graze the majority of sage grouse habitat (Braun 1987), I provide the following recommendations for consideration by livestock, land, and wildlife managers.

1. For migratory populations focus livestock grazing activities during the growing season on sage grouse winter range. Sage grouse are 100 percent dependent on sagebrush for forage during winter (Connelly 2000). The removal of herbaceous understory plants preferred by domestic livestock during the growing season can lead to an increase in the density of sagebrush stands over time (Mueggler 1950; Laycock 1967; Beck and Mitchell 2000). Livestock and sage grouse would be separated temporally under this scenario although impacts to other wildlife species may be significant.

2. Protect sage grouse nesting and brood-rearing habitat from livestock use to encourage climax vegetative conditions. If this is not feasible, limit grazing to the month of July with the exact timing of grazing varying with local conditions. Defer grazing until after the peak of the growing season with the intent of providing herbaceous cover and forage for the majority of the nesting, hatching, and early brood-rearing. Cessation of grazing by 1 August is designed to minimize livestock concentrations in wet meadows and riparian areas with open water by avoiding "hot season" use and to allow a 30-day regrowth period before the first killing frost as recommended by Myers (1989). Additionally, late summer-early fall regrowth is important for carbohydrate storage in roots and stem bases of cool season grasses (Stoddart et al. 1975) that enhances plant vigor while allowing residual vegetation to accumulate cover for nesting and early brood-rearing the following spring.

3. Protect sage grouse spring, summer and fall ranges during periods of drought. Drought alone has been identified as a major factor contributing to the range-wide decline of sage grouse (Connelly and Braun 1997). Design adaptive management strategies to protect against the cumulative effects of grazing use on sage grouse forage and cover during drought.

4. Manage 25-33 percent of the sagebrush-riparian landscape for climax species and processes using concepts outlined by Bock et al. (1993). This can be done while still providing for deferred or rest-rotation grazing over the remaining 66-75 percent of the sagebrush landscape. Target key nesting and brood rearing habitat for climax vegetation to increase sage grouse productivity. Sage grouse nest densities increase along sagebrush riparian corridors (Patterson 1952). Therefore, manage for climax vegetative cover and forage along primary sagebrush-riparian interfaces including ≥0.8 km of sagebrush habitat type on either side of riparian corridors. Unless local data indicates additional protections are necessary, this partial climax conservation strategy on grazed sage grouse habitat offers some perpetual mitigation against the inevitable effects of drought while still allowing grazing over the majority of sagebrush landscape.

5. Avoid livestock water developments and salt grounds in traditional sage grouse spring, summer, and fall habitats. These developments significantly concentrate livestock and increase forage use, trailing, and soil compaction that fragment sagebrush habitat (Stoddart et al. 1975). These heavy-use areas may extend up to 0.8 km away from the site (Valentine 1947) providing a niche for noxious weeds and other undesirable or unpalatable vegetation to take hold. Such developments should only be considered if accompanied with climax management areas as outlined in recommendations 2 and 4 above.

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