Vegetation Changes on a Rest-Rotation Grazing System

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Planned grazing systems such as rest-rotation have received mixed support from wildlife interests because they have commonly been designed to improve livestock forage, presumably at the expense of wildlife values (Western Assoc. State Fish and Game Commission 1974). The suitability of these grazing systems for improving rangeland conditions in steep, mountainous terrain has been questioned. Over 300 allotment management plans are in effect on Bureau of Land Management lands in Idaho. Most of these incorporate some type of rest-rotation system (R. C. Mitchell, Range Program Leader, Bureau of Land Management, Boise, pers. comm. 20 Jan. 1987). In 1975, the U.S. Forest Service, Bureau of Land Management, Idaho Department of Fish and Game, and the Idaho Cooperative Wildlife Research Unit, University of Idaho, initiated a study of the rest-rotation grazing system on the Herd Creek Allotment, East Fork Salmon River in east-central Idaho. This area, a part of the Challis Range Stewardship Program, is typical of many in the region. It has significant elk and mule deer populations in combination with a major grazing allotment. The interactions between precipitation, utilization, and coverage of dominant forbs, grasses, and sagebrush during the first three complete cycles of the grazing system and their implications for wildlife and livestock forage were evaluated.

Study Area

The allotment lies approximately 25 miles south of Challis, in east-central Idaho. The 54,000-acre allotment is steep, mountainous terrain with elevations ranging from 5,800 to 11,000 feet. Slopes are commonly 20–30° (Fig. 1).

Annual precipitation averaged 7.6 inches for the past 30 years at Challis (National Climatological Data Center 1974–1986). Precipitation on the study area was monitored at 23 intervals from May 1976 to December 1979. Total precipitation on the allotment was higher than at Challis. A regression analysis indicated a correlation with the Challis data for that period, so the Challis records were used in the evaluations. Precipitation affecting plant growth was assumed to occur from October through June. Plants are ordinarily dormant in late summer. Rainfall in July, August, and September which stimulates regrowth of plants was assumed not to influence next year's growth because severe winter conditions cause the fall regrowth to desiccate. Winter precipitation in this arid region prior to the growing season probably serves to recharge soil moisture and aid in plant growth. The average precipitation was 4.2 inches for the October to June period ranging from 3.3 inches in 1976–1977 to 7.6 inches in 1983–1984. Precipitation during April 1976 and June 1977 was much lower than the average while March 1979 and October 1985 was much higher than the average for those months.

Sagebrush-dominated communities occupied 82% of the allotment. A Wyoming big sagebrush/bluebunch wheatgrass community occupied 32% of the allotment at lower elevations. On southerly aspects, bluebunch wheatgrass is a codominant but other grasses and forbs are sparse. Sandberg's bluegrass is absent.

On northerly aspects, Wyoming big sagebrush and bluebunch wheatgrass occur with Sandberg's bluegrass as a codominant. Forbs are more common than on the southerly aspects.

A three-tip sagebrush/Idaho fescue

Fig. 1. Herd Creek allotment in foreground with East Fork Salmon River and Sawtooth Mountain in background illustrating the steep terrain typical of this region in central Idaho.
community occurs as a mid-elevational band on northerly aspects above the Wyoming big sagebrush/bluebunch wheatgrass. Mountain big sagebrush occupies the higher elevations of non-forested habitat. Understories provide a rich diversity of forbs and grasses. Mountain big sagebrush co-dominates with bluebunch wheatgrass and bluegrasses on southerly aspects while on northerly aspects it occurs with bluebunch wheatgrass and Idaho fescue. At the highest elevations, bluebunch wheatgrass is no longer present. Complete floristic descriptions of these communities were reported by Wittinger (1978) and Yeo (1981).

The basin big sagebrush/bluebunch wheatgrass community occurs in major draws and adjacent to riparian communities. Low sagebrush/Idaho fescue communities are found on flat, gravelly ridges but comprise only 2% of the study area and were not included in the evaluations.

**Grazing History**

The grazing history of the study area is typical of many federal rangelands. Sheep, cattle, and horses were grazed in the area starting around 1880 on an unrestricted basis until National Forest Lands were created in 1928 and the passage of the Taylor Grazing Act in 1934. Common use was continued by permittees having base property and prior use rights. Sheep use progressively decreased and cattle use increased until 1960 when all the sheep allotments were converted to cattle. The period of use remained season-long (May to October), with some efforts to rotate entry points to the allotment and defer use of some drainages. In 1975, a three-pasture rest-rotation system with 666 cow-calf units was established with a common entry date of June 15.

**Methods**

To determine the cattle grazing patterns, the distribution of forage utilization was recorded along 10 transects in each grazed pasture in summer and fall, 1978 and 1979. Transects run from bottoms directly upslope to ridgetops. At 200-ft intervals, presence or absence of use of current annual growth was recorded on species occurring within 20, 8 × 20-in, frames laid at three-pace

**Fig. 2.** Distribution of utilization of bluebunch wheatgrass, Idaho fescue, milk-vetch, and lupine related to slope steepness, Herd Creek allotment, Idaho, summers 1978 and 1979.

**Fig. 3.** Distribution of utilization of bluebunch wheatgrass, Idaho fescue, milk-vetch, and lupine related to slope position, Herd Creek allotment, Idaho, summers 1978 and 1979.

Variance was used to determine relationships between distribution of use and environmental parameters. Two to four permanently marked
sites were established within representative stands in each community. Permanently marked starting points for 50-ft transects were located at random distances on either side of the site marker. Transect lines ran upslope, with 20 systematically placed 8×20-in plots at 5-ft intervals, 10 along each line and were used to determine canopy coverage (Daubenmire 1959) for all species present. Density of sagebrush was tabulated on six 30-ft² circular plots placed at 10-ft, 25-ft, and 40-ft points, three along each line.

Differences among years for canopy coverage of bluebunch wheatgrass, Idaho fescue, bluegrasses, lupine, and basalt milk-vetch were assessed by site using analysis of variance. The relationship between October–June and May–June precipitation and canopy coverage of those species that changed significantly over the 10-year period was determined with simple regressions. Relationships between sagebrush stem density and year by community type were determined using analysis of variance. All results reported here are significant at 95% level of confidence.

Results

Occurrence of forage utilization in plots generally increased as slope steepness decreased (Fig. 2), as bottom slope positions or ridgetops were approached (Fig. 3), and as distance to water decreased (Fig. 4). Wyoming big sagebrush communities received less utilization than mountain big sagebrush and threetip sagebrush communities. Dominant forbs generally received less and more variable use than grasses. Use was greatest primarily on slopes less than 20° and on areas within 75 ft of water and cover. Community type and individual site affected canopy coverage more than precipitation. The relationship between canopy coverage of lupine and October–June or May–June precipitation was significant within most communities, although the number of years sampled (5) were few. Cover of bluebunch wheatgrass was poorly correlated with precipitation within Wyoming big sagebrush communities and highly correlated with precipitation within threetip sagebrush communities. Cover of Idaho fescue was also poorly correlated with October–June precipitation within mountain big sagebrush communities.

![Fig. 4. Distribution of utilization of bluebunch wheatgrass, Idaho fescue, milk-vetch, and lupine related to distance to water, Herd Creek allotment, Idaho, summers 1978 and 1979.](image)

![Fig. 5. Average canopy coverage (%) of bluebunch wheatgrass within Wyoming big sagebrush, threetip sagebrush, and mountain big sagebrush communities and annual October–June precipitation (inches), Herd Creek Allotment, 1977–1986.](image)
Bluebunch wheatgrass occurred on 14 sites that were sampled, 5 in Wyoming big sagebrush, 4 in threetip sagebrush, and 5 in mountain big sagebrush. Coverage values for this species during the 5 years sampled were significantly higher in Wyoming big sagebrush and mountain big sagebrush communities than in threetip sagebrush. Bluebunch wheatgrass cover increased 42% on Wyoming big sagebrush sites from 1977 to 1986 with the most significant increases showing during 1985 and 1986 (Fig. 5). Changes in canopy coverage of bluebunch wheatgrass over the 10-yr period were evident on 7 sites which occurred on lower slopes, flat ridgetops, and generally near water, corresponding to sites receiving most intensive forage use (Table 1).

Idaho fescue occurred on 7 sites that were sampled, 3 in threetip sagebrush and 4 in mountain big sagebrush. Coverage values were higher in mountain big sagebrush than threetip sagebrush. Cover of Idaho fescue increased 51% and 27% in threetip sagebrush and mountain big sagebrush communities, respectively. Significant differences among years of Idaho fescue cover occurred on 4 sites: 2 threetip sagebrush sites within 100 yards of each other and 2 mountain big sagebrush sites also within 100 yards of each other. These sites were on lower or mid slopes, 150 yards to 1,400 yards from water, and less than 20°.

Dominant forbs included pussytoes, capitate sandwort, and lupine in threetip sagebrush; rosy pussytoes, basalt milk-vetch, lupine, and cinquefoil in mountain big sagebrush; and capitate sandwort in Wyoming big sagebrush. Mean canopy coverage values of forbs were highest in mountain big sagebrush but were not significantly different from values in threetip sagebrush and Wyoming big sagebrush. There were significant differences in canopy coverage among species in threetip sagebrush and mountain big sagebrush community types, but not in Wyoming big sagebrush where only one forb, capitate sandwort, was consistently present.

Milkvetch cover increased 34% within mountain big sagebrush communities. Sites were situated 2,600 ft from water, on lower to middle slope positions with slopes 10–20°.

Sagebrush densities decreased significantly on all sites. The greatest change occurred on Wyoming big sagebrush sites, where densities decreased from approximately 0.13 stems/ft² to less than 0.04 stems/ft² over the 1977–1986 period. The decrease in sagebrush was negatively correlated with the increase in bluebunch wheatgrass coverage. The decreases in other communities, while significant, were less than on the lower, more xeric sites occupied by Wyoming big sagebrush. A negative correlation between sagebrush density and coverage of Idaho fescue on threetip sagebrush sites was significant, but not between grasses and sagebrush on mountain big sagebrush sites.

Discussion

Vegetation change on sagebrush dominated uplands in this allotment consisted primarily of changes in vigor rather than composition over the 10-yr period, with changes being most pronounced at the lower elevations. The indication is that condition of herbaceous forage has either been maintained
or improved, suggesting the grazing system was an appropriate management practice (Eckert and Spencer 1986). However, precipitation is often more important in affecting vegetation change than grazing pressure (Branson and Miller 1981, Branson 1985, Clary and Holmgren 1987). Challis precipitation during the 1975–1979 period for October–June averaged 3.4 inches, and for the 1980–1986 period, 5.9 inches. Thus, increases in canopy coverage of herbaceous vegetation, especially forbs, during the 1977–1986 period must be attributable in large part to the improved precipitation pattern during the latter years as compared to the former years.

However, correlation between bluebunch wheatgrass and precipitation for Wyoming big sagebrush sites was the lowest of all sites examined, while increases in bluebunch wheatgrass were most pronounced on Wyoming big sagebrush sites at the lowest elevations on the allotment. These sites were grazed annually by cattle during May prior to implementation of the grazing system (Wittinger 1978, Yeo 1981). After the grazing system was established, cattle grazing occurred after June 15, every third year on these areas. Plants are most susceptible to grazing during the growing season (Mueggler 1975), and bluebunch wheatgrass, the major cattle forage on low elevations, was actively growing in May and tends to be in post-anthesis stage by mid-June (Kvale 1981). Vigor of bluebunch wheatgrass in this most xeric community was low prior to the implementation of the grazing system, and thus would be expected to show the greatest response to alteration of grazing pressure (Fig. 6). Utilization patterns for cattle described here follow those reported by Mueggler (1965), and are consistent with the conclusion that alteration of the grazing regime on low elevation sites would induce change in vigor. Watts et al. (1987) reported different patterns of vegetation change in three vegetative types following establishment of a rest-rotation system as compared to a continuous grazed system.

Table 1. Topographic features of permanent vegetation sampling sites on which bluebunch wheatgrass canopy coverage changed significantly (p ≤0.05) during 1977-86, Herd Creek allotment, Idaho.

<table>
<thead>
<tr>
<th>Slope</th>
<th>Slope Position</th>
<th>Distance to Water (yd)</th>
<th>Distance to Cover (yd)</th>
<th>Aspect</th>
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<td>900</td>
<td>900</td>
<td>NE</td>
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<tr>
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<td>150</td>
<td>150</td>
<td>SW</td>
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<tr>
<td>13</td>
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<td>SW</td>
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<tr>
<td>24</td>
<td>lower</td>
<td>400</td>
<td>400</td>
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<td>11</td>
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<td>150</td>
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<td>N</td>
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The decline in sagebrush can be attributed to two related phenomena, neither of which is directly associated with grazing. First, a major die-off of mountain big sagebrush occurred in 1976–1977, during an especially cold winter with light snowfall. Dead plants were especially conspicuous above 7,300 ft on northerly exposures in mountain big sagebrush and threepine sagebrush stands. These slopes are ordinarily covered with snow, but were bare most of that winter. Second, many of the sagebrush plants in this area exhibited high proportions of dead and decadent stems, indicating incipient mortality anyway.

We conclude that climatic trends have favored a decrease in sagebrush density and an increase in grass cover. The grazing system has likely augmented those changes on sites where topography is gentle and near water, particularly in Wyoming big sagebrush communities where precipitation trend is least well-correlated with the increase in grass cover, sagebrush densities are most changed, and changes in grazing pressure have been greatest.

While the decrease in sagebrush on lower elevation ranges may eventually prove to be detrimental to mule deer, since these species provide important forage in winter, we feel this would have happened whether the grazing system was implemented or not. The declines in sagebrush may be offset by reductions in livestock use of forbs on sites which are important deer foraging areas. Similarly, recent increases of elk in this area are unlikely the result of changes in vegetation on the grazing system.

Elk use higher elevations almost exclusively and these areas are where vegetation change was least. On balance, the grazing system appears to have augmented naturally occurring trends in vegetation on this allotment, and the observed livestock utilization pattern appears to provide more forage for big game than the former season-long grazing system did.

**Literature Cited**


Livestock Production Constraints in the Sahel

R.S. Senock and R.D. Pieper

The Sahel extends over an area of some 2.5 million km² on the southern fringe of the Sahara desert and stretches over 5,500 km from the Atlantic Ocean to the Red Sea, in a strip 450 km wide (Le Houerou 1979). The West African Sahel comprises a part of the countries of Mauritania, Senegal, Mali, Burkino Faso, Niger, Nigeria, and Chad (see map).

Livestock production in the central Sahel is largely based on pastoralist systems which are traditionally nomadic and transhumant. The major broad ethnic groups involved are the Twareg and WoDaabe Fulani, who practice animal husbandry in small-scale family groupings. Herd composition is typically a multi-species mix of cattle, sheep, goats, camels, and donkeys. The relative proportion of each species and the various breeds involved are dependent upon milk production characteristics such as seasonality, length of lactation, and perceived quality of the milk produced.

The supply of animal products in West Africa thus occurs as a result of the complex interrelationships composed of ecological, socio-economic and cultural-political factors. The relative degree of influence that each factor exhibits at any particular time is in constant flux and obstructs a simple classification of animal production factors.

Forage Resources

Quantity and quality of livestock feed supply are the most important factors in animal production. Three features of the natural rangelands in the Sahel are important in relation to the forage resource base: species composition, biomass quantity, and seasonal nutritive quality.

Species Composition

Sahelian rangelands are composed almost entirely of annual grasses which exhibit large variation in forage production over wide areas, both within and between years (Le Houerou 1979). Annual grass ranges may be very productive in years with average or above precipitation. They are less affected by heavy grazing, but exhibit higher yearly variability than perennial rangelands. The lack of forage species diversity and the relative contributions of different forages at different times of the year have nutritional implications for domestic livestock grazing natural rangelands (Holechek 1984). Except for limited interdunal areas where soil water content is slightly higher, occurrence of perennial grass and forb species is very low. Louis et al. (1983) found the frequency of occurrence of perennial grass species to be only 3% over the entire Nigerien pastoral zone. Species composition data from three consecutive years of multiple exclosure monitoring in central Niger showed the frequency of forb species never to be greater than 3 to 5% (Wylie et al. 1983). The forb species that do occur are annuals of small stature which contribute little to the animal feed base. Woody species typically cover less than 5% of the soil surface, but contribute significantly to livestock diets during the long, dry season period (Otsyina and McKell 1985). Animal diets for a large part of the year are limited to annual grasses and browse species.

Biomass Quantity

Superimposed on the annual rangelands is the regional