Pre- and Post-burn Cattle Distribution Patterns in Sagebrush Steppe

Dave Ganskopp, Dave Bohnert, Dustin Johnson, and Kristen Munday

SUMMARY

Grazing management of rangelands exposed to either wild or prescribed burns is a challenging issue, and post-burn grazing patterns of stock are not well quantified in the sagebrush steppe. We tracked the grazing patterns of cattle with GPS collars in pastures during growing seasons prior to and after prescribed burns. In growing seasons after fires, burned sites that had historically been avoided by cattle became preferred foraging areas with 7 to 30 times more use than would be expected from chance alone. If grazing is deferred until August when all herbage is cured, cattle will focus less intensively on burns and use more of the adjacent unburned terrain. Nutritional advantages still accompany use of burned sites in August, however, and stock will still make greater than expected use of those areas. If managers plan to use prescribed fires, we suggest entire pastures be burned to avoid undue concentrations of foraging stock. Pastures with burns of limited scale may still be grazed in subsequent years, but managers need to be astute to avoid irreversible damage to recovering herbage.

INTRODUCTION

Both controlled burns and wildfires are prominent components in the history and management of sagebrush-steppe rangelands. Controlled burns may be used to retard competitive woody plants like sagebush (*Artemisia* spp) or western juniper (*Juniperus occidentalis* Hook.), enhance the nutritional value of herbaceous plants, or add diversity to the landscape by altering plant community structure and composition. While controlled burns are applied with specific objectives in mind, wildfires may be accidents or products of Mother Nature, and they may or may not have a desirable effect on the landscape.

With our ever increasing presence of invading weeds and annual grasses, post-burn landscape management efforts should insure that existing herbage recovers fast enough to block invasion of sites by undesirable species. We know that wildlife and livestock are attracted to recently burned locales, and that untimely and/or excessive grazing can hinder vegetation recovery. The relative appeal, however, of burned and unburned sites to foraging cattle has not been well quantified in sagebrush-steppe communities. The objectives of this research were to monitor use of burned and unburned sites by grazing cattle and to assess several forage quality attributes that may contribute to their uneven distribution across the landscape.

METHODS

Research was conducted in two 2,000 acre pastures on the Northern Great Basin Experimental Range 30 miles west of Burns, Oregon. Woody vegetation included a sparse western juniper overstory and a shrub layer dominated by Wyoming (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) or mountain (*A. tridentata* Nutt. ssp. *vaseyana* (Rydb.) Beetle) big sagebrush or low sagebrush (*A. arbuscula* Nutt.). Prominent grasses included bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A. Löve), Idaho fescue (*Festuca idahoensis* Elmer), Sandberg's bluegrass (*Poa secunda* J. Presl), or bottlebrush squirreltail (*Elymus elymoides* (Raf.) Swezey) depending on locale and soils.

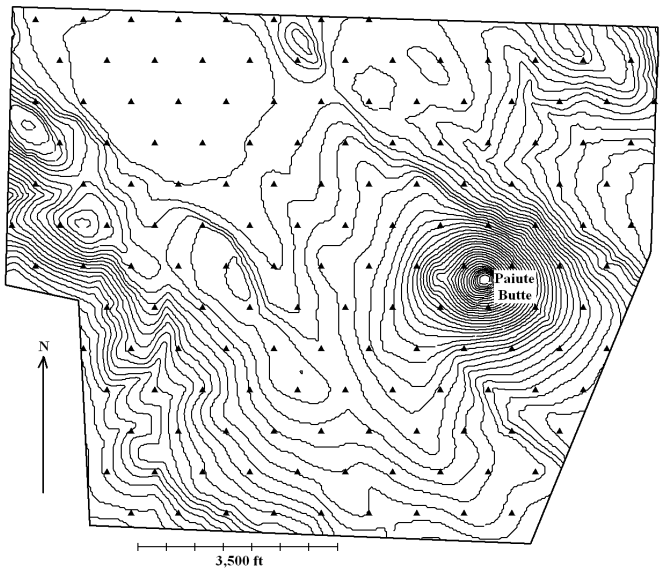

Figure 1. Twenty-ft contour lines and the locations of forage sampling sites (black triangles) in a 2,105-acre pasture in a study evaluating grazing cattle responses to prescribed burns on the Northern Great Basin Experimental Range during four grazing seasons from 2004 through 2007.

Beginning in early June 2004 herbage was sampled from 150, 10.7-ft^2 plots arranged in an offset grid pattern in each pasture (Fig. 1). At each location, a frame was dropped and all grasses and forbs rooted therein were clipped to a 1-inch stubble, the material was bagged, and bags were labeled with an identifying number. Subsequent forage quality assays for each sample included crude protein (CP), neutral detergent fiber (NDF), and digestibility as indexed by *in situ* dry matter disappearance (ISDMD). Immediately after clipping, 15 cow/calf pairs were released to each of the 2 pastures. Four cows in each pasture were equipped with GPS collars to monitor their whereabouts and establish their activities at 5-min intervals over the next 15 days. Motion sensors within the collars that were sensitive to the animal's head movements let us determine when cattle were foraging. Grazing coordinates were retained, and coordinates where cattle were resting or walking were not included in these analyses. Also, with an assumption that water was the primary attraction near stock tanks, grazing coordinates within 50 yards of the single tank servicing each pasture were excluded.

With one exception, these same June herbage sampling and cattle stocking regimes were sustained through 2005, 2006, and 2007. The exception occurred in August 2007 when herbage was re-sampled and pastures stocked a second time to assess cattle distribution after all forage was dormant and cured.

In September 2004 approximately 63 acres were burned in our first pasture and in September 2006, 120 acres burned in our second pasture. With this regime, we obtained one season of pre-burn cattle distribution data and three measures of post-burn cattle use from our first pasture. The second pasture provided three seasons of pre-burn cattle distribution data and one summer (June and August) of post-burn monitoring.

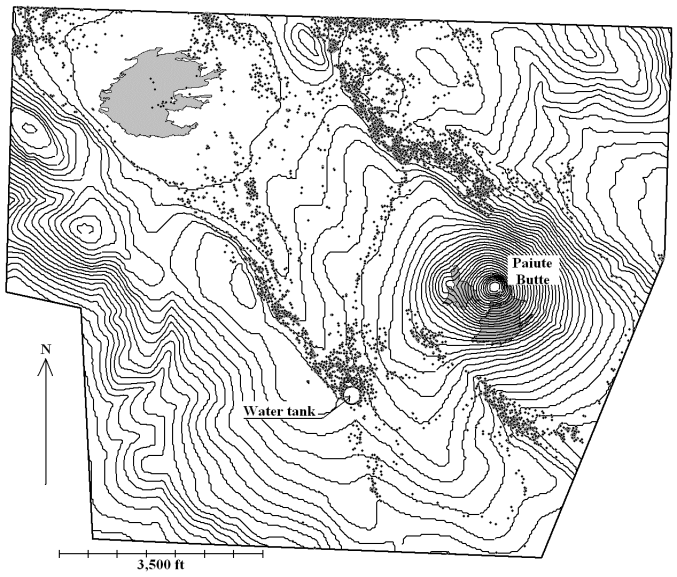

Figure 2. The locations of 5,296 grazing coordinates (small black dots) obtained from four GPS- collared cattle grazing on the Northern Great Basin Experimental Range for 15 days in June 2004 in a study evaluating pre- and post-fire cattle distribution. Coordinates within 50 yards of water (N= 946) were excluded from these analyses. The three gray areas denote locations that were subsequently burned in September 2004.

Cattle use of sites was quantified with an occupancy : availability ratio. For instance, if 20 percent of our cattle grazing records occurred in an area constituting 10 percent of the pasture, our occupancy : availability ratio of 20 : 10 would reduce to a value of 2.0. We would infer that area was preferred by cattle. An occupancy : availability ratio with 10 percent of our cattle grazing records in an area constituting 30 percent of the pasture would reduce to 0.30, and we would suggest that area was avoided by stock. In an ideal situation where cattle were uniformly dispersed across a pasture, an occupancy : availability ratio of about 1.0 would indicate cattle used the area roughly in proportion to its presence.

RESULTS

Areas that were eventually burned in our two pastures initially attracted very few grazing cattle (Fig. 2) prior to the burns. Only about 1.6 percent of the grazing coordinates occurred in the 4.1 percent of the pastures that eventually were burned. This generated an occupancy : availability ratio of 0.39, suggesting those areas were generally avoided by stock prior to our prescribed fires.

In June of the first growing season after our fall burns, cattle focused much of their foraging attention on the burned areas. About 31 percent of our grazing cattle records occurred within the burn boundaries (Fig. 3). With the burns making up 4.1 percent of the pasture area, an

occupancy : availability ratio of 7.6 suggested those locales had become highly preferred grazing sites.

Cattle did not discover the burned areas for the first 2 days of use in 2005 and never used the burned areas on the steep south and west slopes of Paiute Butte during the 2005, 2006, or 2007 grazing seasons (Fig. 3). Grades in those areas approach 45 to 80 percent, and cattle typically avoid terrain where slopes exceed 20 percent. If we discount the burned areas ignored by the cattle on the steep hillsides in Figure 2, 31 percent of our grazing records were actually contained by the 2 percent of the pasture that was burned in the more level north-west corner. This elevates our occupancy : availability ratio to a more valid 15.5. That same burned area supported 39 percent of the grazing coordinates in 2006, and 62 percent of the grazing records in June 2007.

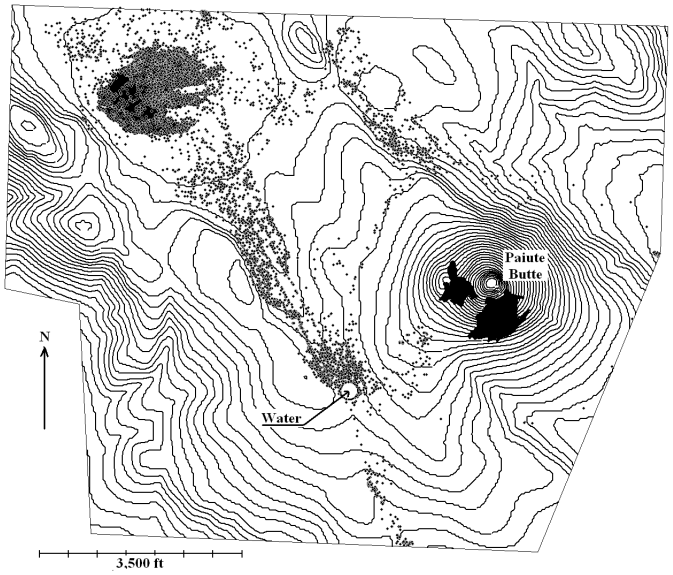

Figure 3. The locations of 6,274 grazing coordinates (small black dots) obtained from four GPS collared cattle grazing on the Northern Great Basin Experimental Range for 15 days in June 2005 in a study evaluating pre- and post-fire cattle distribution. Coordinates within 50 yards of water (N= 946) were excluded from these analyses. Blackened areas denote sites that were burned the prior September.

We stocked our pastures with GPS-collared cattle again in August 2007 to see if cattle would exhibit the same grazing patterns when forages were dormant and cured. Cattle responded by exploring considerably more of their pasture in August (Fig. 4) than in June, but they were still attracted to the burned area. About 15 percent of their total grazing efforts were contained by the 2 percent of the pasture area that was burned. See the north-west corner of the pasture in Figure 4. Again, an occupancy : availability value of 7.5 suggested the burned site was still a highly preferred foraging area.

Nutritional analyses of forage samples found no differences between standing crop or forage quality between the burned and unburned sites prior to our prescribed fire applications (Table 1). In the first growing/grazing season after the burns, CP was almost 3 percentage points and digestibility about 13 percentage points higher within the burns than in surrounding areas.

Conversely, NDF, which is negatively correlated with forage intake and digestibility in cattle, was about 9 percentage points lower within the burned locales than in unburned areas.

Due to the prior use in June, our August 2007 forage samples revealed less available herbage in our burned than unburned areas (244 vs. 347 lbs/acre, respectively). Crude protein, digestibility, and NDF assays, however, still suggested cattle could harvest a nutritionally superior diet within burned sites (Table 1) even though all herbage was cured and dormant.

DISCUSSION

Grazing cattle were attracted to small burned areas within larger unburned environments. Previously avoided locales were converted to highly preferred grazing sites with grazing intensities 7 to 30 times greater than expected with a uniform distribution. Other research on the Northern Great Basin Experimental Range has shown that well managed post-fire grazing by cattle during the growing season does not retard vegetation recovery in healthy communities,

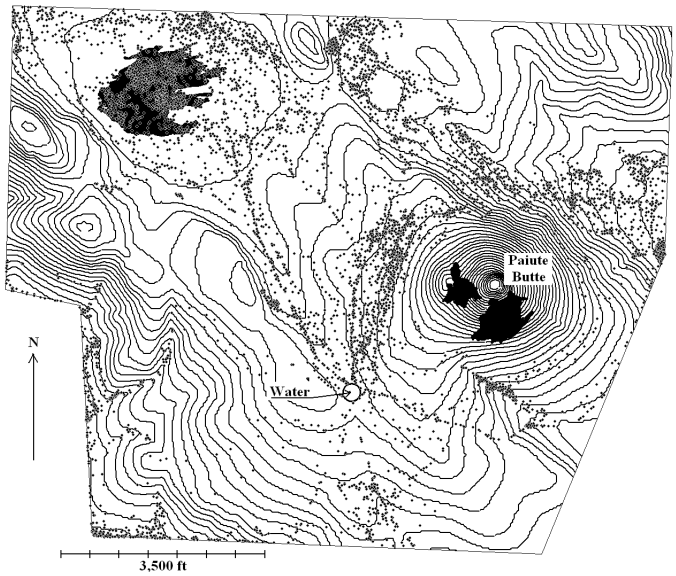

Figure 4. The locations of 7,146 grazing coordinates (small black dots) obtained from four GPS- collared cattle grazing on the Northern Great Basin Experimental Range over 15 days in August 2007 in a study evaluating pre- and post-fire cattle distribution. Blackened areas denote sites that were burned in September 2004.

and that by the second or third year after a fire, herbaceous cover, standing crop, and seed production in burned pastures can exceed that of unburned pastures (Bates et al. 2009). That study, however, was conducted in pastures that were uniformly burned, uniformly grazed by cattle, and herbage utilization closely monitored to assure use did not exceed 50 percent by weight.

Our central issue in this study was that grazing cattle could not be managed in our extensive pastures, and they had a choice of using either burned or unburned sites. Cattle elected to concentrate their grazing on burned locales with herbage utilization levels likely exceeding 70 percent of standing crop. This level of use leaves little residual herbage on the burned sites and a wealth of standing cured straw in the neighboring unburned and ungrazed areas. In subsequent

years, cattle again focused their attention on the burned locales. This likely occurred because burned areas repeatedly generated a wealth of high quality herbage, and stock did not need to sort through a mix of old and new growth like that found on neighboring unburned sites.

Post-grazing site surveys of herbage use showed that cattle grazed burned sites with almost surgical precision. Grass tussocks within the confines of a burn were always grazed, while unburned tussocks only inches outside of burn boundaries were untouched. Grazing distribution patterns exhibited this same effect (see Fig. 3) with the preponderance of grazing restricted to the burn and the direct route to and from stock water.

Deferring the grazing season until August, when all herbage has cured, may provide some relief for burned areas. Cattle still used burns at greater than expected frequencies, but they also explored and used a greater proportion of their pastures than earlier in the season (Figs. 3 and 4). There were still nutritional advantages to be had by grazing the burns in August with elevated crude protein and digestibility and reduced neutral detergent fiber in the burns (Table 1).

Table 1. Forage quantity and quality attributes sampled before and after prescribed fires in two pastures on the Northern Great Basin Experimental Range during studies evaluating the grazing distribution of GPS-collared cattle for 15-day June grazing trials in 2004-2007 and a 15-day August grazing trial in 2007. Sample location values listed in bold font are statistically different ($P < 0.05$).

		Sample location	
Sampling period	Forage attribute	Outside burned area	Inside burned area
June, pre-burn	Standing crop (lbs/acre)	393	407
	Crude protein (%)	8.2	8.2
	Digestibility (%)	64	61
	Neutral detergent fiber (%)	66	65
June, 1-year post-burn	Standing crop (lbs/acre)	445	500
	Crude protein (%)	**8.0**	**10.8**
	Digestibility (%)	**58**	**71**
	Neutral detergent fiber (%)	**62**	**53**
August, post-burn	Standing crop (lbs/acre)	**347**	**244**
	Crude protein (%)	**7.3**	**11.1**
	Digestibility (%)	**64**	**76**
	Neutral detergent fiber (%)	**62**	**52**

We may have partially created these advantages with our prior June grazing that removed growing herbage and stimulated production of new and more nutritious regrowth than was found in surrounding areas. Conventional wisdom suggests that removal of cured herbage when grasses are dormant has little effect on the health or subsequent vigor of the remaining plant tissues.

Steep slopes (Fig. 3 and 4) or excessive distances from water that typically retard cattle use, *may* provide some protection from grazing for recently burned areas. In the second pasture used in this study, a burn about 0.8 mi from stock water was not discovered in the first post-burn grazing session. This happened because cattle restricted their use to the two burns closest to the tanks. In both the slope and distance instances, we emphasize the word "may", because those areas might have garnered more attention if they had simply been discovered.

MANAGEMENT IMPLICATIONS

Post-fire pasture management has and will likely continue to be a great frustration for rangeland and livestock managers under both prescribed and wildfire circumstances. If the inordinate concentration of stock that occurred in this study was allowed to continue, the vigor and species makeup of those burned sites would most assuredly deteriorate. A reduced stocking rate would not rectify the issue, because the remaining cattle would still focus their grazing efforts on the nutritionally superior burned locales. With these thoughts in mind, we offer a few suggestions.

1. If prescribed burns are employed, attempt to burn all or as much of a pasture as possible. If a complete burn is attained, the entire pasture will subsequently support high-quality herbage, and stock will have little reason to focus their attention on limited portions of the landscape. Other aspects affecting livestock distribution though, like extreme slopes or excessive distance from water will still exert their influence.

2. When limited portions of pastures do burn, astute management may still allow some grazing without deleterious effects if the sites were initially in good condition. Stocking rate and duration should be adjusted to assure conservative use (less than 50 percent removal) of herbage from burned sites. With grazing efforts concentrated in burned areas, stocking rate and duration should reflect the carrying capacity of the burn rather than the full potential of one's pasture. Another option is to fence burned sites or limit stock access to the area by providing water in some distant portion of the pasture. If water manipulations are used, herbage use in burns should still be monitored, because cattle may travel further than normal to access newly discovered high-quality forage.

3. Deferring grazing until all herbage has cured should reduce but not eliminate livestock focus on burned areas. Burned locales will still support nutritionally superior herbage because only current year's growth is available. With greater dispersal of stock, deferred grazing should yield more harvested animal unit months, have little effect on plant vigor with only dead herbage being used, and perhaps help trample in shattered seed.

4. Concentrated grazing patterns will likely persist for at least 2 to 3 years, so post-burn herbage recovery and grazing management should be closely monitored in subsequent

years. Wildlife, like deer, elk, or pronghorn may also focus on small-scale burns. Therefore, utilization monitoring should not be solely synchronized with the turn-in and turn-out of stock.

5. One positive aspect of these cattle responses to burns is that prescribed fire could be used to attract cattle to historically unused portions of pastures. If that is an objective, and the areas are well out of their habitual haunts, stock may need to be trailed to those sites for an introduction. The same management issues and concerns listed above will still apply.

REFERENCES

Bates, J.D., E.C. Rhodes, K.W. Davies, and R. Sharp. 2009. Postfire succession in big sagebrush steppe with livestock grazing. Rangeland Ecology and Management. 62:98-110.