Progress Report: Stratton Ecological Research Site—An Experimental Approach to Assess Effects of Various Grazing Treatments on Vegetation and Wildlife Communities Across Managed Burns and Habitat Controls

By Heidi J. Erickson, Cameron L. Aldridge, and N. Thompson Hobbs

Open-File Report 2009-1016

U.S. Department of the Interior
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Front cover. Clock-wise from top left: Brewer's sparrow nest, riparian grazing cages, badger, red-tailed hawk flying over Stratton Sagebrush Ecological Research Site, July 2008 (photographs taken by Sarah Barga and Heidi J. Erickson, Colorado State University, Natural Resource Ecology Laboratory).

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Progress Report: Stratton Ecological Research Site: An Experimental Approach to Assess Various Grazing Treatments on Vegetation and Wildlife Communities Across Managed Burns and Habitat Controls

By Heidi J. Erickson[1,2], Cameron L. Aldridge[1,3], and N. Thompson Hobbs[1]

Abstract

Understanding how management practices affect wildlife is fundamental to wise decisions for conservation of public lands. Prescribed fire and grazing timing are two management tools frequently used within publicly owned sagebrush ecosystems. We conducted a variety of surveys in order to assess the impacts of grazing timing strategies (early summer before peak green-up, mid-summer at peak green-up, and late summer after peak green-up) in conjunction with prescribed fire on avian and small mammal populations in a high-elevation sagebrush ecosystem. Avian surveys resulted in a large detection sample size for three bird species: Brewer's sparrow (*Spizella breweri*), horned lark (*Eremophila alpestris*), and vesper sparrow (*Pooecetes gramineus*). Brewer's sparrows had the lowest number of detections within the mid-summer grazing treatment compared to early and late summer grazing treatments, while horned larks and vesper sparrows had higher detection frequencies within the late summer grazing treatment. Summer and fall sage-grouse (*Centrocercus urophasianus*) pellet counts revealed that the greatest over-winter and over-summer use by sage-grouse occurred within the early summer grazing treatment with minimal use of burn treatment areas across all grazing treatments. Deer-mice (*Peromyscus maniculatus*) represented approximately 90 percent of small mammals captured and were most prevalent within the mid-summer grazing treatment. Sagebrush cover was greatest within the mid-summer grazing treatment. We monitored 50 and 103 nests in 2007 and 2008, respectively. The apparent success rate for shrub-obligate nesting species was 58 percent in 2007 and 63 percent in 2008. This research will support management of sagebrush ecosystems by providing public land managers with direct comparisons of wildlife response to management regimes.

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Introduction

Nearly half of all native sagebrush habitats in North America have been lost as a direct result of land-use change following European colonization (Knick and others, 2003). Habitats that remain have demonstrated changes in vegetation community composition resulting from grazing regimes (McArthur and Plummer, 1978), management initiatives such as prescribed fire and sagebrush removal (Young and others, 1981), intensified drought conditions (climate change), invasive species (Miller and Eddleman, 2000), and habitat fragmentation (Vale, 1974; Nielson and others, 2005). As a result, sagebrush-obligate species, such as sage-grouse (*Centrocercus* spp.), have undergone dramatic range and population declines (Braun and others, 1976; Schroeder and others, 2004). The Bureau of Land Management (BLM) manages roughly half (about 45 million hectares [111,197,422.28 acres]) of all remaining sagebrush-steppe habitat in the western United States, compelling the development of long-term research that directly addresses public land management objectives that consider ecosystem stability through adaptive management processes.

The U.S. Geological Survey's (USGS) Fort Collins Science Center (FORT) and the Bureau of Land Management's (BLM) Rawlins Field Office (RFO) began a cooperative effort in 2004 to re-establish the Stratton Hydrology Study Area (hereafter Stratton Ecological Research Site, or Stratton), with the goal of making it a site for long-term research on sagebrush (*Artemisia* spp.) ecology. Burning is a tool used by BLM managers to increase forage for livestock grazing within sagebrush habitats. There is limited information, however, on the timing and intensity of post-fire grazing that is most appropriate for suitable recovery and re-establishment of vegetation communities within these fragile systems. Thus, we recently implemented an experimental design at Stratton (October 2005) to assess wildlife response to burns and post-fire grazing. The study design includes replicate burns across three different pastures encompassing 295.42 ha (730 acres; 10 percent) of the study area. The post-fire timing of grazing within each pasture has been manipulated so that grazing every year since the burns occurs within each pasture either in early summer prior to peak green-up, mid-summer at peak green-up, or late summer after peak green-up. Peak green-up is defined as the time period with the largest standing crop of green vegetation. We are monitoring both sagebrush and wildlife responses to the prescribed burn and grazing treatments to appropriately evaluate both burning and grazing as adaptive management tools for the BLM. A concurrent grazing exclosure study, overseen by FORT Research Scientist, Kate Schoenecker, is designed to quantify forage offtake by cattle and investigate treatment effects on vegetation communities within the study site.

Objective

Our objective is to assess wildlife species abundance and habitat associations related to changes in the timing of grazing following a prescribed fire within a high-elevation sagebrush ecosystem. We will assess responses to treatments for songbirds, small mammals, greater sage-grouse (*C. urophasianus*), and sagebrush vegetation characteristics. Songbird nesting success across habitat types and treatments will also be investigated. The results of this research will give local land managers information useful for developing management strategies that are beneficial for sagebrush steppe vegetation and associated wildlife species. Subsequently, these results could potentially be used as management tools within sagebrush habitats throughout the west.

Methods

Study Site

Stratton Sagebrush Ecological Research Site is approximately 2,832 ha (7,000 acres) managed by the BLM. Located 29 km (18 miles) west of Saratoga, Wyoming (fig. 1), the terrain within the study site is characterized by gently rolling hills, with 100 m (328 ft) of relief occurring between ridge tops and valley bottoms. The average elevation is 2,400 m (7,874 ft). The area receives 500 mm (19.7 in) of precipitation annually, two-thirds of which falls as snow. Dominant shrub vegetation includes mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), black sagebrush (A. nova) and Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) with pockets of sparse bitterbrush (*Purshia tridentata*) within many of the areas dominated by mountain big sagebrush. These shrubs predominate on the slopes, interspersed with herbaceous vegetation. Several creeks run through the study area with grass-forb vegetation components

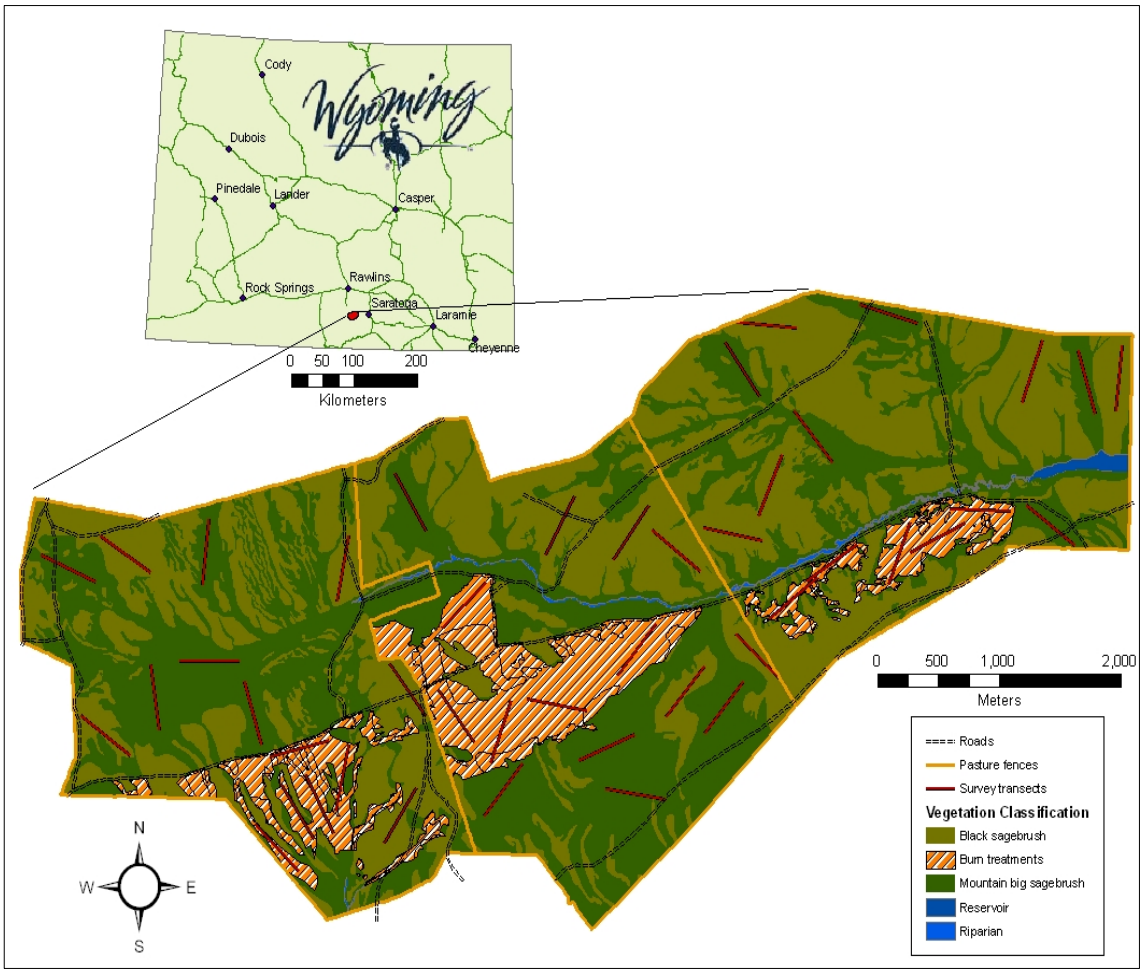

Figure 1. Location map for Stratton Sagebrush Ecological Research Site, in south-central Wyoming. Line-transect locations (indicated by red lines) were pre-stratified using a generalized vegetation classification (burn treatments, black or mountain sagebrush) within each of the three grazing pastures (early to late summer from east to west on the map).

along stream sides. The study area is grazed by cattle and native ungulates, which include pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and occasionally elk (*Cervus elaphus*).

Approximately 295 ha (730 acres; approximately 10 percent of the analysis area) was treated (primarily within the mountain big sagebrush community) with a prescribed burn in the fall of 2005. Prescribed burns took place in three different pastures (three separate burns). Burns were fairly complete (about 85 percent), but were patchy in nature. In 2006, we began manipulating the timing of post-burn grazing within the three pastures.

Transect Sampling

We conducted a variety of wildlife/vegetation surveys along 500-m (546.8-yd) line transects to assess songbird and small mammal abundance, seasonal sage-grouse habitat use, avian nesting success and sagebrush cover/structure. Transects were pre-stratified by the three grazing treatments and three habitats (mountain big sagebrush [MO], black/Wyoming sagebrush [BL], and burn areas [MB]) within each of the grazing treatments. Each of our nine habitat/treatment pairings contained five line transects for a total of 45 transects across the entire study site.

All transects were surveyed for songbirds twice by one (2006), two (2007) or three (2008) different observers at regularly spaced intervals between May 15 and June 25. Observers used a compass and range finder to quantify the direction and distance from the transect line for all birds detected during the survey, ultimately allowing for the estimation of detection probabilities and true densities using distance sampling (Buckland and others, 2001).

In order to quantify nesting success, we added a nest searching and monitoring effort to our 2007 sampling protocols. Our primary nest searching method was "rope dragging." Two observers, each holding an end of a 30-m (32.81-yd) rope, walked parallel to a given transect using the rope to flush adult birds off nests to identify nest locations. We covered an area of 60 m (65.62 yd) on either side of each transect. We then attempted to monitor each located nest on a two- to three-day interval to determine the fate of each nest (fail versus fledge). Nest fates were determined based on nest condition, age/stage of nest contents at last visit and (or) direct observation of fledglings (Manolis and others, 2000).

We quantified sage-grouse seasonal habitat use by conducting pellet counts within one meter of each 500-m (546.8-yd) transect. Pellet counts were conducted in late-May or early-June each year in order to characterize winter habitat use and in mid-October to characterize summer use. During each transect count we collected all pellets within the survey area and removed them from the study site.

We sampled small mammal abundance and distribution using two arrays of 20 Sherman live traps (40 per transect) placed 10 m (10.94 yd) apart running parallel to the center of both sides of each transect. In 2007 each trap line was sampled twice (once in late July and once in early August) with two nights of pre-baiting before traps were set for capture on the third night. We modified our sampling method in 2008 by increasing the number of trap nights to three consecutive nights per transect with a single night of pre-baiting. We also added a mark-recapture element to our sampling using semi-permanent hair dye applied to the bellies of captured animals, allowing us to estimate population density at each site.

We used the line-intercept method to estimate the amount of green (leafy material) sagebrush cover along four 30-m (32.81-yd) sagebrush transects running perpendicular to each permanent transect at the 100-, 200-, 300-, and 400-m (109.36-, 218.72-, 328.08-, and 437.35- yd, respectively) marks along the transect. We also took a representative height measurement for each sagebrush species occurring within 2 m of the 0-, 10-, 20-, and 30-m (0-, 10.94-, 21.87-, 32.81-yd, respectively) marks along each intercept line.

Preliminary Results and Discussion

Songbird Surveys

For our first year of songbird surveys (2006) all transects were surveyed twice by the same observer, while a limited number of transects (20) were surveyed an additional time by a second observer. These surveys resulted in the detection of 29 avian species (table 1) with a total of 1,883 detections. Three species were detected more than 400 times each: Brewer's sparrow (*Spizella breweri*), horned lark (*Eremophila alpestris*), and vesper sparrow (*Pooecetes gramineus*). Seven other species were detected between 35 and 95 times each: Canada goose (*Branta canadensis*), cliff swallow (*Petrochelidon pyrrhonota*), western meadowlark (*Sturnella neglecta*), sage thrasher (*Oreoscoptes montanus*), green-tailed towhee (*Pipilo chlorurus*), greater sage-grouse, and Brewer's blackbird (*Euphagus cyanocephalus*). All other species had fewer than 35 detections each.

During the second year (2007) of the 4-year data collection effort we detected 38 species during avian surveys (table 1) for a total of 4,588 bird detections over four surveys. Brewer's sparrow, horned lark, and vesper sparrow were again the most common species with greater than 1,000 detections each. Sage thrasher, green-tailed towhee, greater sage-grouse, and Brewer's blackbird were detected 100–200 times each. All other species had fewer than 100 detections per species (table 2).

Data collected in the 2008 season resulted in the detections of 44 avian species over the six survey periods. As in 2007, the three most common species in 2008 were Brewer's sparrow, horned lark and vesper sparrow, followed by the moderately common Brewer's blackbird, green-tailed towhee and sage thrasher. The only difference in proportion of detections per species between 2007 and 2008 was a marked reduction in greater sage-grouse detections in 2008 (table 2).

Focusing on the most common sagebrush obligate bird species within the study site we see that the number of detections for Brewer's sparrows in all sample years was highest in MO habitat (which contains taller vegetation structure more appropriate as nesting substrate for this species), with the number of detections decreasing from the early grazing to the late grazing treatments in 2007 and 2008 (fig. 2). There were few horned lark detections within MO habitat but nearly an equal number of detections within BL and MB habitats, which contain more of the low shrub cover that this species requires for nesting. Across grazing treatments the greatest number of horned larks occurred within the mid-summer grazing treatment. However there has been decreasing trend for horned larks across the entire study area over the three years of data collection (fig. 3). Vesper sparrows were detected more frequently in MB and MO than in BL habitats in 2007, but were detected at similar frequencies across all habitats in 2008 (fig. 4). However, the greatest number of detections for this species was in the late grazing treatment, whereas we had similar, but lower, detections in early and mid-summer treatments.

Nest Success Monitoring

Our first year of nest success monitoring resulted in the discovery of 50 nests during the 2007 nesting season; 23 of these nests were found as a result of "rope dragging" and 27 were incidentally flushed while observers were collecting other data. Twenty-three of the 50 nests belonged to Brewer's sparrows, 14 nests to vesper sparrows, four nests each to greater sage-grouse, sage thrashers, and horned larks, and one to green-tailed towhee (fig. 5). We were able to increase our sample size in 2008 to 103 nests with similar proportions of Brewer's sparrow (52), vesper sparrow (37), sage thrasher (4), horned lark (2) and green-tailed towhee nests (6). We also found one nest each for two additional species, Brewer's blackbird and lark sparrow. However, we did not find any nests for greater sage-grouse in 2008. Although we were not always able to monitor all nests on the ideal three-day interval, we did obtained nest fates for the majority of nests. In 2007 there were 6 of the 50 nests whose fate remained unknown;

Table 1. Species captured (small mammals) or detected during surveys (birds) at Stratton Ecological Research Site, Wyoming, during the 2006, 2007, and 2008 data collection seasons.

Species Information			Year		
Species Code	**Common Name**	**Scientific Name**	**2006**	**2007**	**2008**
		Small Mammals			
LECU	Sagebrush Vole	*Lemmiscus curtatus*	NA	√	√
MIMO	Montane Vole	*Microtus montanus*	NA		√
MIOC	Prairie Vole	*Microtus occhrogaster*	NA		√
MUER	Ermine	*Mustela ermine*	NA	√	√
ONLE	Northern Grasshopper Mouse	*Onychomys leucogaster*	NA	√	√
PEFA	Olive-backed Pocket Mouse	*Perognathus fasclatus*	NA	√	√
PEMA	Deer Mouse	*Peromyscus maniculatus*	NA	√	√
SPEL	Wyoming Ground Squirrel	*Spermophilus elegans*	NA	√	√
TAMI	Least Chipmunk	*Tamias minimus*	NA	√	√
ZAHU	Meadow Jumping Mouse	*Zapus hudsonius*	NA	√	√
		Birds			
AMKE	American Kestrel	*Falco sparverius*	√	√	√
AMRO	American Robin	*Turdus migratorius*	√	√	√
AMWI	American Wigeon	*Anas americana*			√
AWPE	American White Pelican	*Pelecanus erythrorhynchos*		√	√
BARS	Barn Swallow	*Hirundo rustica*	√	√	√
BHCO	Brown-headed Cowbird	*Molothrus ater*	√	√	√
BRBL	Brewer's Blackbird	*Euphagus cyancephalus*	√	√	√
BRSP	Brewer's Sparrow	*Spizella breweri*	√	√	√
BTLH	Broad-tailed Hummingbird	*Selasphorus platycercus*	√	√	√
CANG	Canada Goose	*Branta canadensis*	√	√	√
CLSW	Cliff Swallow	*Petrochelidon pyrrhonota*	√	√	√
COLO	Common Loon	*Gavia immer*			√
CONI	Common Nighthawk	*Chordeiles minor*	√	√	√
CORA	Common Raven	*Corvus corax*	√	√	√
COSN	Common Snipe	*Gallinago gallinago*	√	√	√
FEHA	Ferruginous Hawk	*Buteo regalis*		√	√
GBHE	Great Blue Heron	*Ardea Herodias*		√	
GOEA	Golden Eagle	*Aquila chrysaetos*	√	√	`√
GRSP	Grasshopper Sparrow	*Ammodramus savannarum*	√		√
GRSG	Greater Sage-Grouse	*Centrocercus urophasianus*	√	√	√
GTTO	Green-tailed Towhee	*Pipilo chlorurus*	√	√	√

GWTE	Green-winged Teal	*Anas crecca*			√
HOLA	Horned Lark	*Eremophila alpestris*	√	√	√
KILL	Killdeer	*Charadrius vociferous*	√	√	√
LARB	Lark Bunting	*Calamospiza melanocorys*		√	√
LASP	Lark Sparrow	*Chondestes grammacus*	√	√	√
MALL	Mallard	*Anas platyrhynchos*		√	√
MERL	Merlin	*Falco columbarius*			√
MOBL	Mountain Bluebird	*Sialia currucoides*	√	√	√
MODO	Mourning Dove	*Zenaida macroura*	√	√	√
NOFL	Northern Flicker	*Colaptes auratus*	√	√	√
NOHA	Norther Harrier	*Circus cyaneus*	√	√	√
PRFA	Prairie Falcon	*Falco mexicanus*		√	
NOPI	Northern Pintail	*Anus acuta*			√
RTHA	Red-tailed Hawk	*Buteo jamaicensis*		√	√
RWBL	Red-winged Blackbird	*Aqelaius phoeniceus*		√	√
SACR	Sandhill Crane	*Grus canadensis*			√
SAGS	Sage Sparrow	*Amphispiza belli*	√		√
SATH	Sage Thrasher	*Oreoscoptes montanus*	√	√	√
SAVS	Savannah Sparrow	*Passerculus sandwichensis*	√	√	√
SWHA	Swainson's Hawk	*Buteo swainsoni*	√	√	√
TRES	Tree Swallow	*Tachycineta bicolor*		√	√
VESP	Vesper Sparrow	*Pooecetes gramineus*	√	√	√
VGSW	Violet-green Swallow	*Tachycineta thalassina*		√	√
WEME	Western Meadowlark	*Sturnella neglecta*	√	√	√
WILL	Willet	*Catoptrophorus semipalmatus*		√	√

Table 2. Number of avian survey detections across treatments and controls at Stratton Sagebrush Ecological Research Site, Wyoming. Numbers are based on two to three surveys per transect in 2006, four surveys per transect in 2007, and six surveys per transect in 2008. Species codes from table 1.

		Early			Mid-summer			Late			
Year	Species	Black	Mountain	Burn	Black	Mountain	Burn	Black	Mountain	Burn	Total
2006	BRBL	7	19	7	1	53	6	0	0	0	93
	BRSP	22	182	54	42	64	23	47	118	74	626
	GRSG	0	8	0	0	1	5	0	49	4	67
	GTTO	1	22	1	0	10	0	2	1	0	37
	HOLA	142	32	115	84	42	108	134	82	101	840
	SATH	9	18	10	5	13	5	9	2	13	84
	VESP	25	56	51	50	84	17	48	42	45	418
2006 Total		206	337	238	182	267	164	240	294	237	2165
2007	BRBL	7	40	43	1	12	20	1	2	3	129
	BRSP	42	279	157	62	227	58	74	213	118	1230
	GRSG	19	16	2	0	11	0	27	36	3	114
	GTTO	3	82	10	11	43	1	2	7	4	163
	HOLA	188	32	160	145	61	224	189	111	140	1250
	SATH	14	25	26	15	20	14	22	28	26	190
	VESP	77	125	122	98	120	95	93	140	149	1019
2007 Total		350	599	520	332	494	412	408	537	443	4095
2008	BRBL	22	124	179	8	23	28	1	1	19	405
	BRSP	88	347	165	130	337	70	167	295	152	1751
	GRSG	0	3	4	0	5	3	2	4	0	21
	GTTO	27	143	43	45	98	11	25	43	24	459
	HOLA	258	70	182	240	87	230	287	155	132	1641
	SATH	34	55	38	37	59	20	38	41	28	350
	VESP	148	131	151	151	123	154	143	183	160	1344
2008 Total		577	873	762	611	732	516	663	722	515	5971

however, with increased effort in 2008 we were able to obtain fates for all but 3 of the 103 nests. Apparent nest success for shrub obligate species was 58 percent in 2007 and 63 percent in 2008.

Seasonal Sage-grouse Habitat Use

Based on our pellet counts, winter habitat use by sage-grouse was greatest in the BL habitat (fig. 6), particularly in the early summer grazing treatment while the late summer grazing treatment had the fewest pellets. Summer habitat use was again greatest in the early grazing treatment, with minimal evidence of habitat use within the prescribed fire treatments across all grazing treatments.

Small Mammal Trapping

Our small mammal trapping effort in 2007 resulted in 593 captures over a total of 3,598 trap nights (16 percent trap success; fig. 7A). The increase in captures in 2008 (773) is attributed to our change in methodology between years from 2 to 3 trap nights per transect (5397 trap nights) as the trap success rate

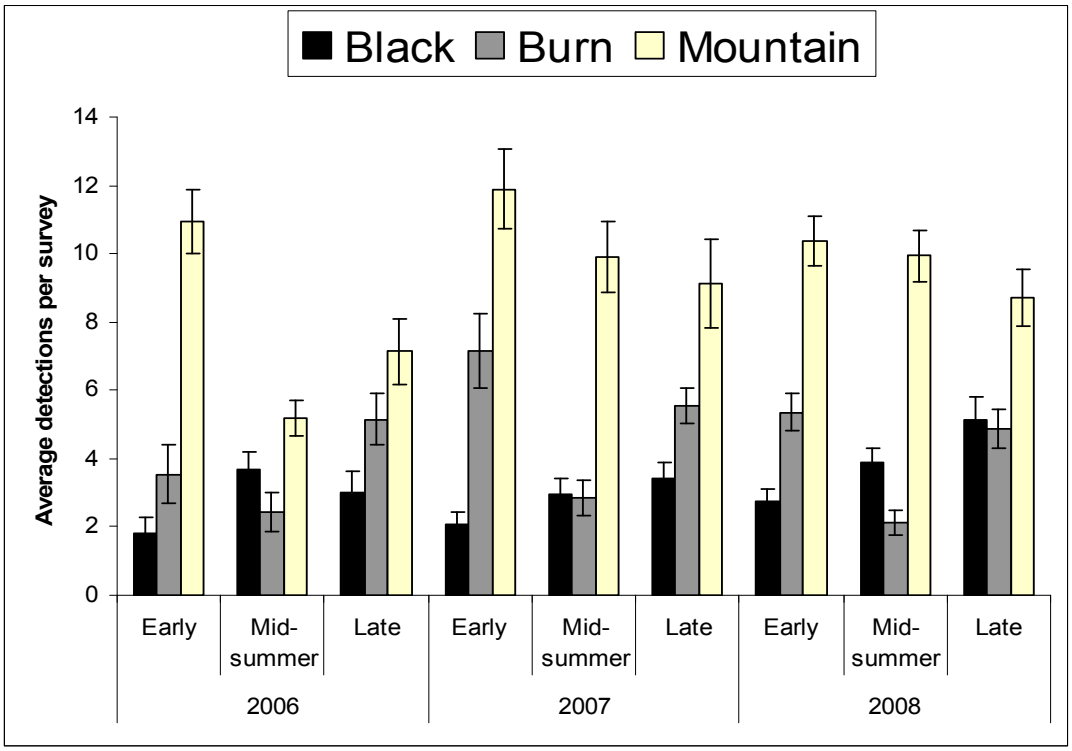

Figure 2. Average yearly Brewer's sparrow detections per survey within grazing treatments and habitat types at Stratton Sagebrush Ecological Research Site, Wyo.

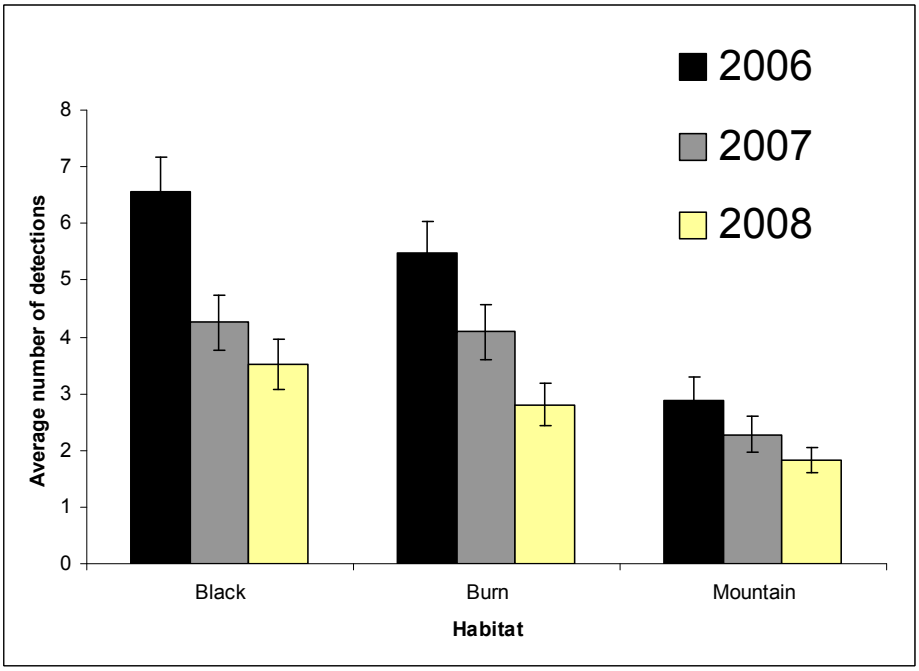

Figure 3. Average yearly horned lark abundance across habitats and burn treatments within the Stratton Sagebrush Ecological Research Site, Wyo, from sample years 2006–2008.

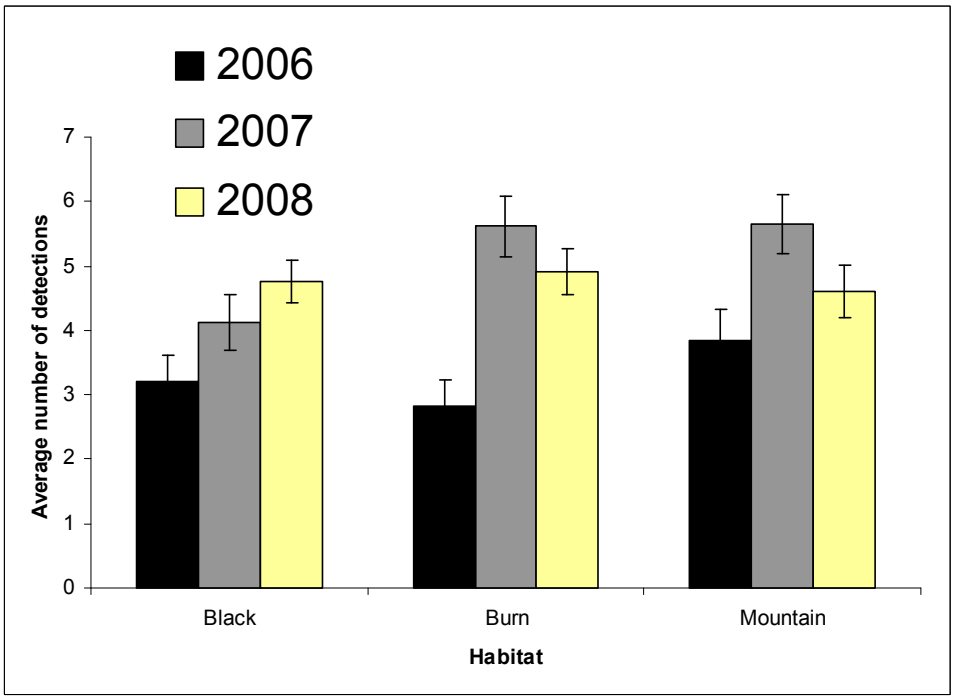

Figure 4. Average yearly vesper sparrow abundance across habitats and burn treatments within the Stratton Sagebrush Ecological Research Site, Wyo., from sample years 2006–2008.

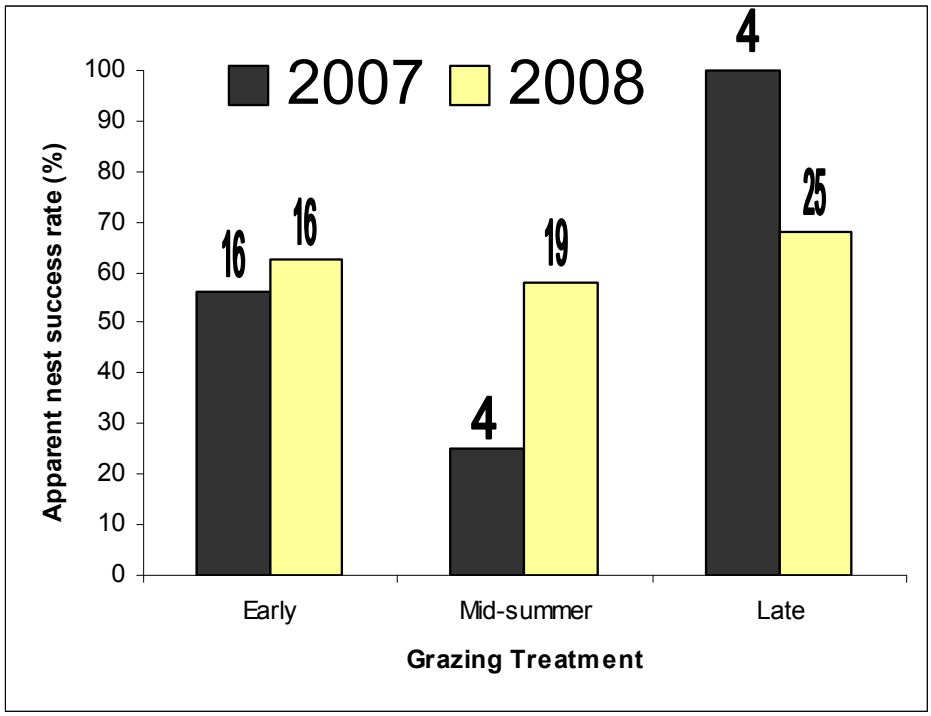

Figure 5. Apparent nest success rates for all shrub obligate bird species across grazing treatments at Stratton Ecological Research Site, Wyo., from 2007 and 2008. Sample size listed above each bar (sample size for 2008 was approximately twice that for 2007).

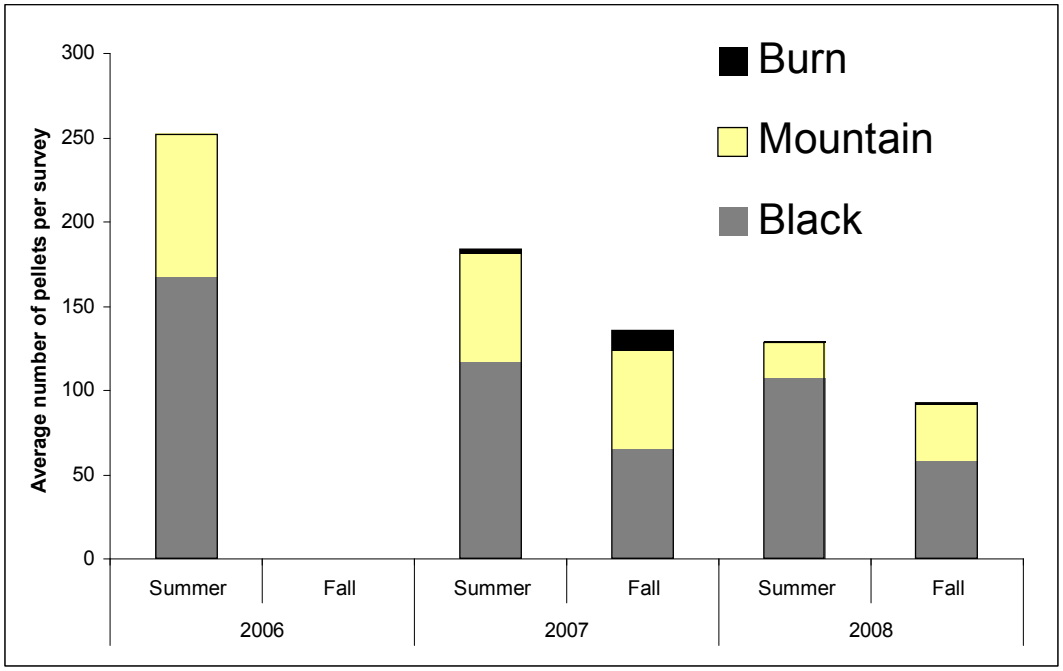

Figure 6. Sage-grouse pellet counts by season and year within habitat treatment and controls at Stratton Sagebrush Ecological Research Site, Wyo. Fall 2006 count not conducted due to unfavorable weather conditions; thus, Summer 2007 count includes 1 year of pellet accumulation.

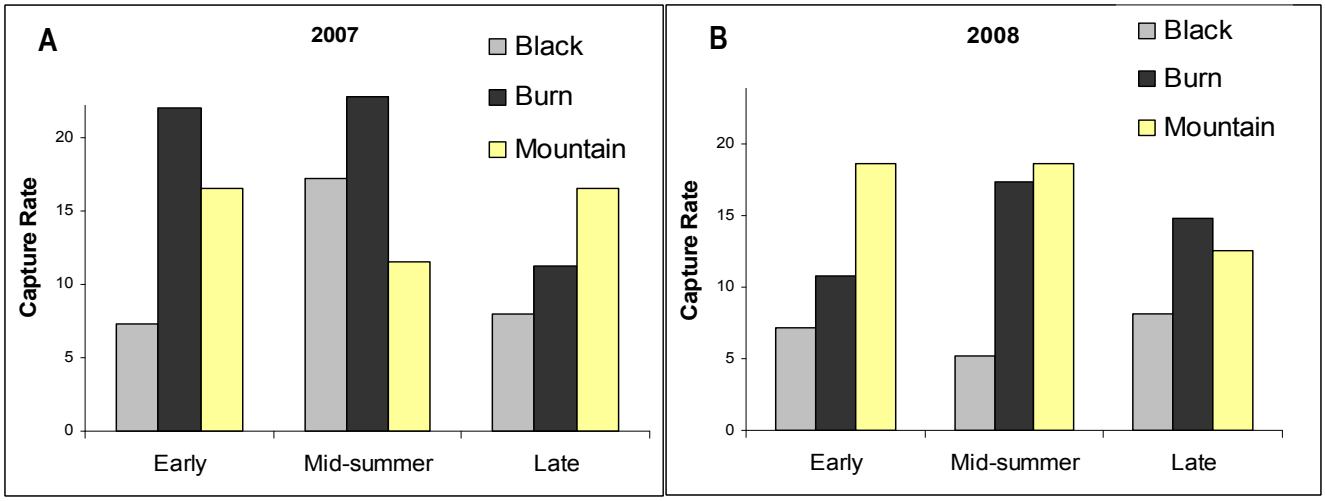

Figure 7. Capture rates (percent) for *Peromyscus maniculatus* across grazing treatments within habitat treatments and controls in 2007 and 2008 at Stratton Ecological Research Site, Wyo. Capture rate is calculated by dividing the number of captures by the number of trap nights.

was actually slightly lower (14 percent; fig. 7B). We captured 8 species in 2007 and 10 species in 2008 (table 1), although for both sample years the majority of captures were deer mice (*Peromyscus maniculatus*, about 90 percent). In 2007 nearly half of all captures occurred within the MB habitat, with decreasing frequency in MO and BL respectively. However, in 2008, while the captures in the BL habitat remained the lowest, captures in the MO habitat were higher than in the MB (fig. 7B). In both years the largest number of deer mice captures occurred in the mid-summer grazing treatment.

Sagebrush Transects

The greatest sagebrush cover was measured within the MO habitat within the mid-summer season grazing treatment. The amount of sagebrush cover in the MB habitat (burned fall of 2005) was low across all grazing treatments (fig. 8) with only a 0.2 percent increase in both black and big sagebrush cover between 2007 and 2008. Percent cover for big sagebrush and antelope bitterbrush within MO habitats was highly variable across subplots with a range from 0.0 percent to 32 percent big sagebrush and 0.0 percent to 44 percent for antelope bitterbrush.

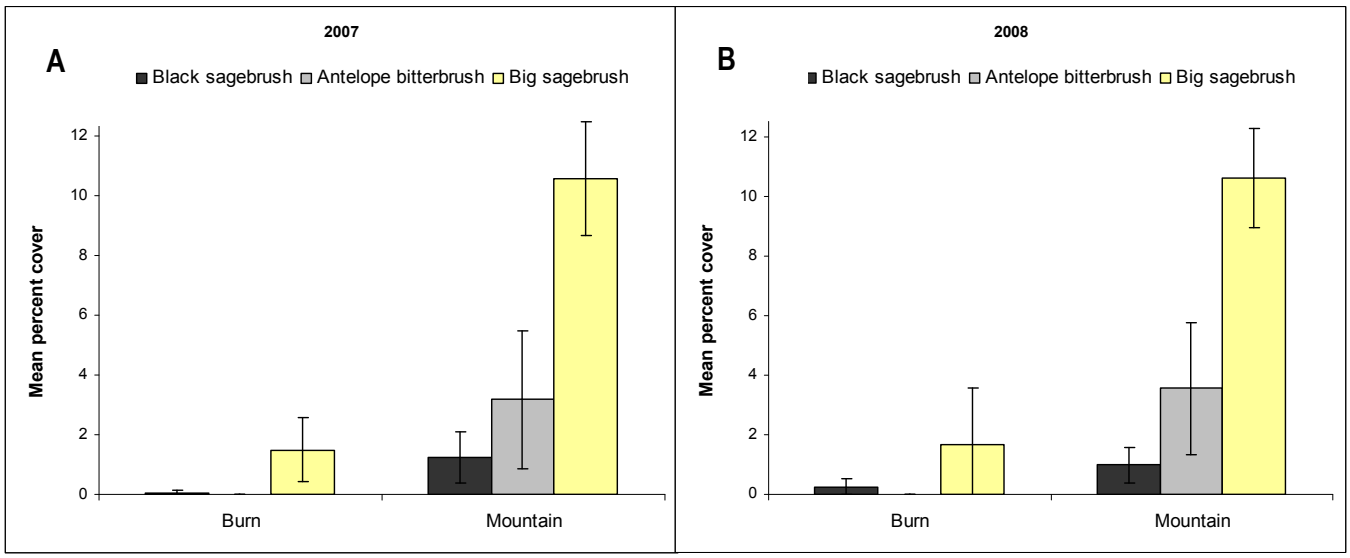

Figure 8. Mean percent shrub cover within burn treatments and intact Mountain big sagebrush habitats for sample years 2007 and 2008 at Stratton Ecological Research Site, Wyo. Big sagebrush includes both subspecies (mountain and Wyoming) of big sagebrush combined.

Future Efforts

The data summarized in this report includes data from the first three years of our study. Prior to data collection in 2009, we will perform preliminary analyses of the 2006, 2007 and 2008 data. Using distance sampling techniques, we will estimate bird densities from our survey data across treatments, accounting for differences in observer bias and detectability for each species. We will apply a modified Mayfield estimation to our nest data in order to avoid the over estimation of nest success associated with the rate of apparent nest success (Manolis and others, 2000). We also will perform some initial trend analysis for our pellet count, small mammal, and sagebrush-cover data.

During the 2007 field season we were able to conduct four avian surveys per transect. With the incorporation of additional field assistance for the 2008 season we were able to increase this effort to six surveys. We have secured funding for the 2009 data collection season which should allow us to maintain a similar avian survey effort level, as well as maintain sagebrush line-intercept transects, sage-grouse pellet counts, and nest monitoring data collection. In addition to these primary duties, we hope to assist with continued vegetation data collection associated with the grazing exclosure project run by a collaborating FORT scientist. Funding for future work, beyond the initial four-year study, will be driven by the results of these analyses.

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