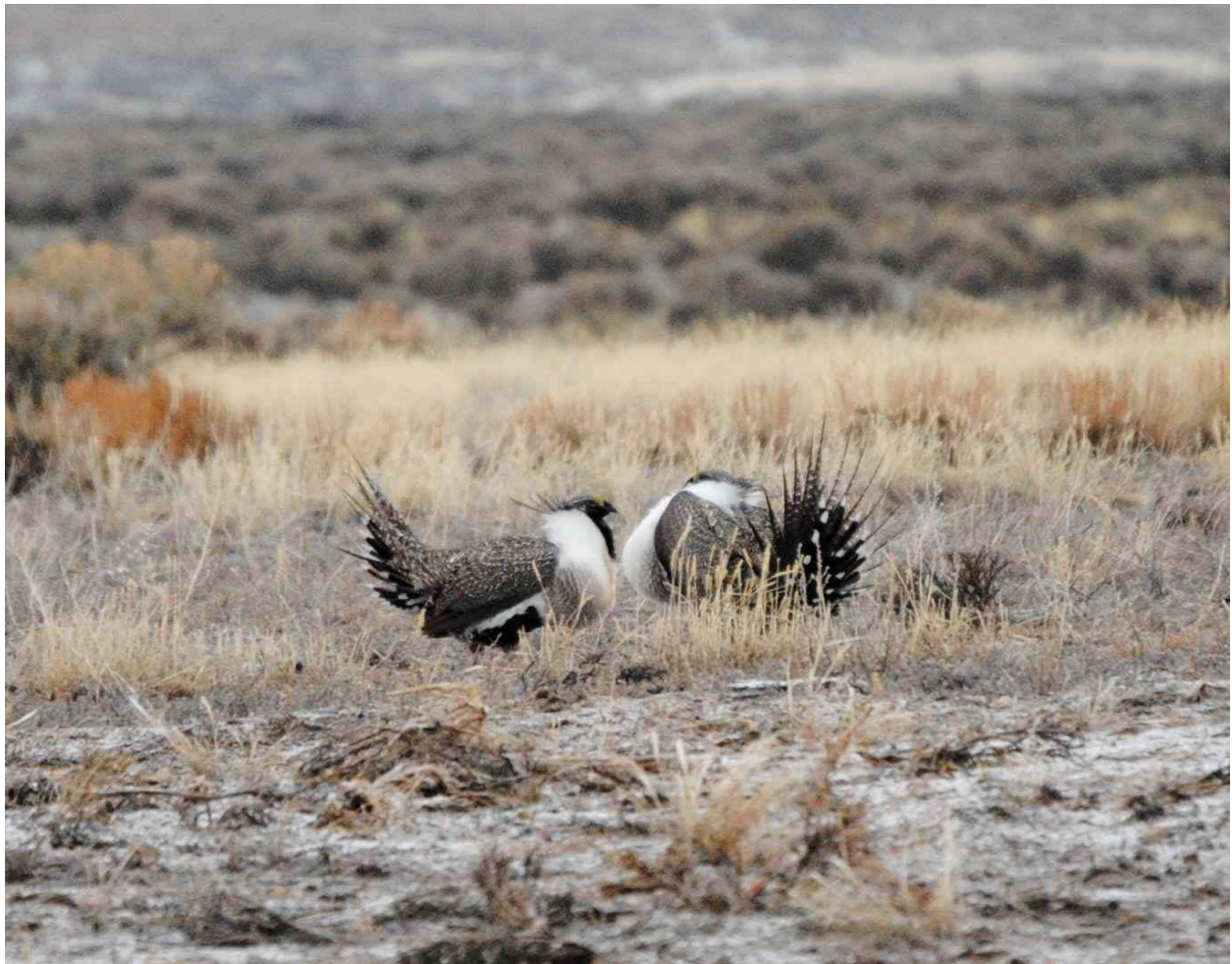


2011 Annual Report

Greater sage-grouse (*Centrocercus urophasianus*) habitat selection and use patterns in response to vegetation management practices in Western Box Elder County, Utah



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Cooperators

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Introduction

Greater sage-grouse (*Centrocercus urophasianus*, hereafter sage-grouse) populations in North America have been declining in recent decades (Connelly et al. 2004). Sage-grouse populations occupy an estimated 56% of the potential habitat of pre-European settlement (Schroeder et al. 2004). These declines in population are a concern to land and wildlife managers throughout the species' range (Schroeder et al. 1999). The declines have been largely attributed to loss and fragmentation of sagebrush (*Artemisia* spp.) habitats caused by anthropogenic disturbances (Connelly et al. 2011). These disturbances have contributed to the spread of invasive plant species and increased wild fire frequency and intensity, which can reduce sage-grouse brood-rearing, wintering, and nesting habitat (Young and Evans 1978).

State and federal agencies, such as the Bureau of Land Management (BLM), have responded to the decline through implementing sage-grouse conservation and management plans that contain strategies designed to protect and restore sagebrush habitats. Habitat restoration strategies include mechanical methods such as chain harrowing, re-seeding forbs and grasses, establishing green strips using species such as forage kochia (*Kochia prostrata*), and mastication of junipers (*Juniper osteosperman*) in combination with chemical treatments to mitigate the wild fire threats posed by invasive species. However, further research is needed to evaluate the effects of these treatments on sage-grouse and sagebrush habitats.

Project Purpose and Objectives

The purpose of this research is to evaluate the effects of chain harrowing, seeding of forage kochia in green strips, and mastication of juniper in concert with chemical treatments on vegetation composition and sage-grouse use among sagebrush habitats in northwestern Utah. The intent of both chemical and mechanical methods is to restore quality habitat conditions for sage-grouse and reduce the risk of wild fires.

The objectives of this study are:

1. To evaluate the effects of the treatment on vegetation composition. The treatment includes chain harrowing, juniper mastication, seeding forage kochia, and applying Plateau herbicide.
2. To determine the effect of the treatment and any observed changes in vegetation on sage-grouse habitat use patterns.
3. To evaluate herbivory of forage kochia by sage-grouse.
4. To assess sage-grouse ecology, including nesting and brood-rearing habit selection, survival, annual movement patterns, and habitat-use across the landscape relative to vegetation manipulations.

Study Area

The treatments were implemented on Badger Flat, just south of the town of Grouse Creek, West Box Elder County, UT. The primary study site on Badger Flat consists of 4,775 hectares (11,799 acres), of which 286 hectares were treated. Approximately 6% of the primary study site was

treated. The treatment of green strips are 300' (91.44 meters) wide (Figure 1). The study site for determining sage-grouse response included the 4,775 hectares on Badger Flat, as well as surrounding land that is bounded by Idaho as the northern border, Nevada as the western border, Toms Cabin Road as the southern border, and the Grouse Creek Mountains as the eastern border. Land ownership in this area is a mosaic of public and private blocks. The public land is managed by the U.S. Bureau of Land Management (BLM). The primary land use is alfalfa (*Medicago sativa*) production (primarily on private land) and grazing by domestic cattle on both BLM managed and private lands.

Most of the study site is categorized by a shrub-steppe ecosystem with surrounding woodlands and interspersed meadows. Elevations range from 1500-2300 m (4900-7500 ft). Primary shrub species include Wyoming big sagebrush (*A. tridentata*), black sagebrush (*A. nova*), shadscale (*A. confertifolia*), rabbitbrush (*Chrysothamnus* spp.), snowberry (*Symphoricarpos albus*), juniper (*Juniperus osteoperma*). Common grasses include sandberg bluegrass (*Poa secunda*), Kentucky bluegrass (*Poa pratensis*), cheatgrass (*Bromus tectorum*), and wheatgrasses (*Agropyron* spp.). Common forbs include blue-eyed mary (*Collinsia* Nutt.), wild onion (*Allium acuminatum*), phlox (*Phlox* spp.), astragalus (*Astragalus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), tansymustard (*Descurainia pinnata*), bur buttercup (*Ceratocephala testiculata*), halogeton (*Halogeton glomeratus*), and blue mustard (*Chorispora tenella*).

Methods

Pretreatment measurements were collected during late winter until the summer of 2010. Post treatment measurements were conducted beginning in 2011 from the winter through August. These measurements will also be conducted in 2012.

The chronology for treatments implemented in the fall of 2010 were:

1. August 1 - 15: mastication of juniper within greenstrip area
2. August 16 – mid September: chain harrow greenstrip (seedbed prep/removal of shrubs)
3. September 2-12: spray Plateau herbicide-5 oz Plateau/0.4046 hectares (5oz/1acre), 1 qt MSO/0.4046 hectares (1qt/1acre), Applied in 10 gal water/0.4046 hectares (10gal/1acre)
4. December 13: aeriually apply forage kochia seed 4.5 bulk/lbs/0.4046 hectares

Sage-grouse Trapping and Radio-telemetry

A polygon of the Badger Flat region was constructed using previous sage-grouse locations and BLM treatment sites. Using an all-terrain vehicle and spotlight, birds were captured November 2010-May 2011 with a long-handled hoop net. A small bag and scale were be used to determine the weight of each individual. The age class and sex of each bird were documented based on primary feather characteristics (Dalke et al. 1963). Battery-powered ATS radio transmitters (Advanced Telemetry Systems, Isanti, MN) were placed on adult and juvenile sage-grouse allowing relocation. Radio transmitters weigh 16 grams each. Birds were relocated throughout the breeding season and winter to determine use or avoidance of treatment areas. A Global

Positioning System (GPS) location within 5 meters accuracy was recorded at each capture location.

Birds were relocated using Communications Specialist receivers and Telonics hand-held Yagi antennae. All birds were monitored weekly from January until July 2011 within the primary study site. All hens and broods were monitored throughout the area from breeding season until fifty days post hatching for nesting and brood-rearing data.

Sage-grouse Habitat Use Patterns

Sage-grouse habitat use was monitored to document the change over time in response to treatments. From January-August 2011, I relocated radio-collared sage-grouse that were present on Badger Flat. I recorded a minimum of 20 use locations per month and plotted these locations using a GPS in NAD 83 and accuracy of less than 5 meters (Figure 2). These locations were used to determine habitat use and seasonal movement patterns. I used ArcGIS to select 20 random locations per month to compare habitat vegetation attributes between use and random sites.

Vegetation measurements were collected along 2 perpendicular 20-meter line transects for each of these 40 locations per month (Table 1). During the winter, GPS location, shrub and snow density, slope, aspect, and overall vegetation type were documented. During the summer months, GPS location, slope, aspect, shrub cover, ground cover, and overall vegetation type were documented. Shrub canopy cover was documented utilizing a line intercept method (Canfield 1941). From a central point, a 10-meter measuring tape was placed in 4 directions, all 90 degrees apart. Live shrub canopy was measured along the tape; gaps in shrub cover less than 5 cm were counted as continuous and gaps greater than 5 cm were excluded. Percentage of ground cover, including grass, forbs, bare ground, litter, and rock were measured using a 20cmx50cm Daubenmire frame (Daubenmire 1959). The Daubenmire frame was placed every 2.5m along each 10-meter transect. Comparison of measurements taken at use and random location points will demonstrate selection for vegetation species and structure as well as use of treatment or non-treatment areas.

Vegetation Trends and Pellet Counts

Eight paired plots (treatment-green stripping, tree mastication, spraying Plateau, and seeding forage kochia vs. control-no treatment) were selected at random from within the Badger Flat polygon (Figure 3). During the last week in May, I established sixteen 100-meter line intercept and point intercept transects (one in each paired plot) to determine species composition and shrub composition. Sixteen 500-meter pellet transects, eight in control and eight in treatments plots, were surveyed using distance sampling to determine use. Pellets are collected each year to assure that there is no recounting. The 100-meter vegetation transects and the 500-meter pellet surveys were randomly located. The pellet counts will be used to evaluate bird use of treatment and non-treatment sites. The vegetation surveys will document effects of the treatment and changes in vegetation structure over time (Table 2).

In July and August 2011 the forage kochia seedlings emerged. In the middle of August, eight 100-meter transects were placed at random locations within the treatment. A 1x1 meter frame

was placed on the ground every 5 meters of each 100-meter transect. All forage kochia plants within the 1x1 meter frame were recorded (Table 3). These measurements will be used to determine seeding effectiveness and change in cover over time.

Sage-grouse Nesting and Brood-Rearing Ecology

Sage-grouse hens were located bi-weekly throughout the breeding season. At each nest site, vegetation was measured along 2 perpendicular 30-meter transects. GPS location, slope, aspect, shrub cover, ground cover, and overall vegetation type were documented (Figure 4). Shrub canopy cover was documented utilizing a line intercept method (Canfield 1941). From a central point, a 15-meter measuring tape was placed in 4 directions, all 90 degrees apart. Live shrub canopy was measured along the tape; gaps in shrub cover less than 5 cm were counted as continuous and gaps greater than 5 cm were excluded. Percentage of ground cover, including grass, forbs, bare ground, litter, and rock were measured using a 20cmx50cm Daubenmire frame (Daubenmire 1959). The Daubenmire frame was placed every 3m along each 15-meter transect. Random sites 80 meters away in a random cardinal direction were designated and measurements of vegetation with replicated techniques were taken. A Robel pole was used to measure vegetation vertical obstruction (Robel et al. 1970). This information will be used to determine if nesting habitat used may differ in terms of vegetation structure and composition from adjacent randomly-selected areas (Table 4).

Broods were located bi-weekly for 50 days post-hatching. Brood-rearing habitat was measured along 2 perpendicular 20-meter transects (Figure 4). GPS location, slope, aspect, shrub cover, ground cover, and overall vegetation type were documented. Shrub canopy cover was documented utilizing a line intercept method (Canfield 1941). From a central point, a 10-meter measuring tape was placed in 4 directions, all 90 degrees apart. Live shrub canopy was measured along the tape; gaps in shrub cover less than 5 cm were counted as continuous and gaps greater than 5 cm were excluded. Percentage of ground cover, including grass, forbs, bare ground, litter, and rock were measured using a 20cmx50cm Daubenmire frame (Daubenmire 1959). The Daubenmire frame was placed every 2m along each 10-meter transect. Random sites 80 meters away in a random cardinal direction were designated and measurements of vegetation were taken with the same techniques as the brood-use sites. These data will provide information about brood-rearing habitats (Table 4).

Analysis of these data will provide information about effectiveness of the implemented management strategies on restoring the sage-grouse habitat potentials in West Box Elder County.

Results

Sage-grouse Captures, Survival, and Nesting

Between November 2010 and May 2011, 25 sage-grouse were captured and radio collared. Of these 25 birds, 6 were juvenile females, 3 were adult females, 2 were juvenile males, and 14 were adult males. All birds were trapped on the Badger Flat study site. Of the birds trapped throughout the past year, 9 birds were mortalities. Twelve new birds were trapped in 2010 and

eight birds were still alive from 2008. Six of the birds trapped in 2010 were still alive in 2011. Of these 6 birds, 4 were mortalities in 2011.

In 2011, 8 hens initiated nests of which 3 were successful (37.5%). Clutch size ranged from 3 to 7. The primary cause of nest failure was predation. Two broods survived to 50 days (66.0%).

In 2011, preliminary data shows that nest sites had greater shrub height, less forb cover and height, and greater percentage grass cover and height than random sites. Nest sites also had less rock cover, greater bare ground, and slightly less litter than at random sites. In 2011, brood sites had slightly less shrub cover and height, shorter forb and grass height, less rock and litter percentages, and more bare ground present than at random sites.

Habitat Selection and Changes in Vegetation

Based on preliminary data, sage-grouse selected areas exhibiting slightly less shrub cover, taller shrub height, shorter forb and grass height, a higher percentage of grass, and less rock cover than at random sites during summer 2010 (Table 1). In summer 2011, sage-grouse selected sites exhibiting less shrub cover, shorter shrub height, and slightly less grass cover. In winter 2011, sage-grouse selected for slightly more shrub cover, but slightly shorter shrubs compared to random sites.

Based on preliminary data, treatment sites had less average shrub width, average shrub height, and percent composition (Table 2). Pellets were present in all except for one of the 500-meter paired plots. Pellets were present in both treatment and control sites, but there was a higher density of pellets in control sites.

Forage kochia seedlings began to emerge in July 2011. Plants were measured every 5 meters along eight 100-meter transects with a 1m x 1m frame (Table 3). Of these frames, 45.6% exhibited forage kochia plants. We counted 573 forage kochia plants in the eight 100-meter transects. Based on the number of plants present within all frames, a calculated estimate is 358.125 forage kochia plants per 100 meters within treatment sites.

2012 Plan of Work

The research methodology previously described will be continued through 2012. We will attempt to radio-collar an additional 15 sage-grouse hens in the fall of 2011 and spring of 2012.

Table 1. Descriptive statistics for greater sage-grouse habitat use across the primary study site, Grouse Creek, West Box Elder County. Average vegetation percentages for *Summer 2010 data **Summer 2011 data ***Winter 2011 data

Use(1) Rndm(0)	%shrub cover	shrub ht	%forb	forb ht	%grass	grass ht	%rock	%bare	%litter
*1	11.35	34.75	4.27	4.08	14.29	12.07	16.75	30.42	34.34
*0	15.35	30.62	4.80	6.15	9.51	19.46	21.00	28.08	36.61
**1	8.96	29.99	3.70	5.91	13.72	12.20	21.32	34.33	26.91
**0	12.51	40.48	4.30	6.77	15.32	12.75	20.03	32.48	27.75
***1	12.62	30.66							
***0	11.47	34.39							

Table 2. Vegetation measurements recorded along line-intercept and point-intercept 100-meter paired plots and pellet counts along 500-meter paired plots, Badger Flats Study Area, 2011.

Trtmt (1) Control (0)	AvgShrubWidth	%ShrubComp	AvgShrubHt	NumPellets
1	10	0.5	23	10
0	15.7568	5.83	27.8378	56
1	13.8788	4.58	18.7576	5
0	11.9559	8.13	19.4265	6
0	15.0976	6.19	42.4878	6
1	17.8571	7.5	38.9762	11
1	12.7	1.27	17.6	1
0	17.4154	11.32	22.8923	22
1	14.5714	1.02	20.7143	4
0	24.913	5.73	28.6522	27
1	13.8	0.69	13.4	10
0	14.7717	13.59	32.4562	105
1	11.8333	0.71	22.8333	5
0	13.1471	8.94	37.6029	3
1	14.2	4.26	16.9333	0
0	16.3679245	17.35	33.5849	5

Table 3. 2011 Forage kochia plants across eight 100m x 1 m transects. Measurements were taken every 5m with a 1m x 1m frame, Badger Flats Study Area, 2011.

Total Frames with forage kochia	73
Total kochia plants within 1m x 1m frame across all plots	573
% of frames with kochia	45.625
Calculated potential plants per 100m x 1m plot	358.125

Table 4. Descriptive statistics for greater sage-grouse nesting a brood-rearing habitat use, Grouse Creek, West Box Elder County. Average vegetation percentages for *2011 Brood Sites **2011 Nest Sites

Use(1) Rndm(0)	%shrub cover	shrub ht	%forb	forb ht	%grass	grass ht	%rock	%bare	%litter
*0	16.99	40.76	5.92	23.10	10.84	27.81	19.55	25.68	39.73
*1	15.74	38.07	6.44	19.42	11.49	24.85	13.59	32.36	36.16
**0	24.64	33.30	15.94	14.20	9.38	20.12	17.37	17.64	39.99
**1	24.45	37.79	9.39	8.66	12.82	23.94	15.79	24.44	37.56



Figure 1. Aerial view of part of the treatment on Badger Flat, West Box Elder County, Utah. (November 2010).

Are sage-grouse selecting for particular locations and veg characteristics?

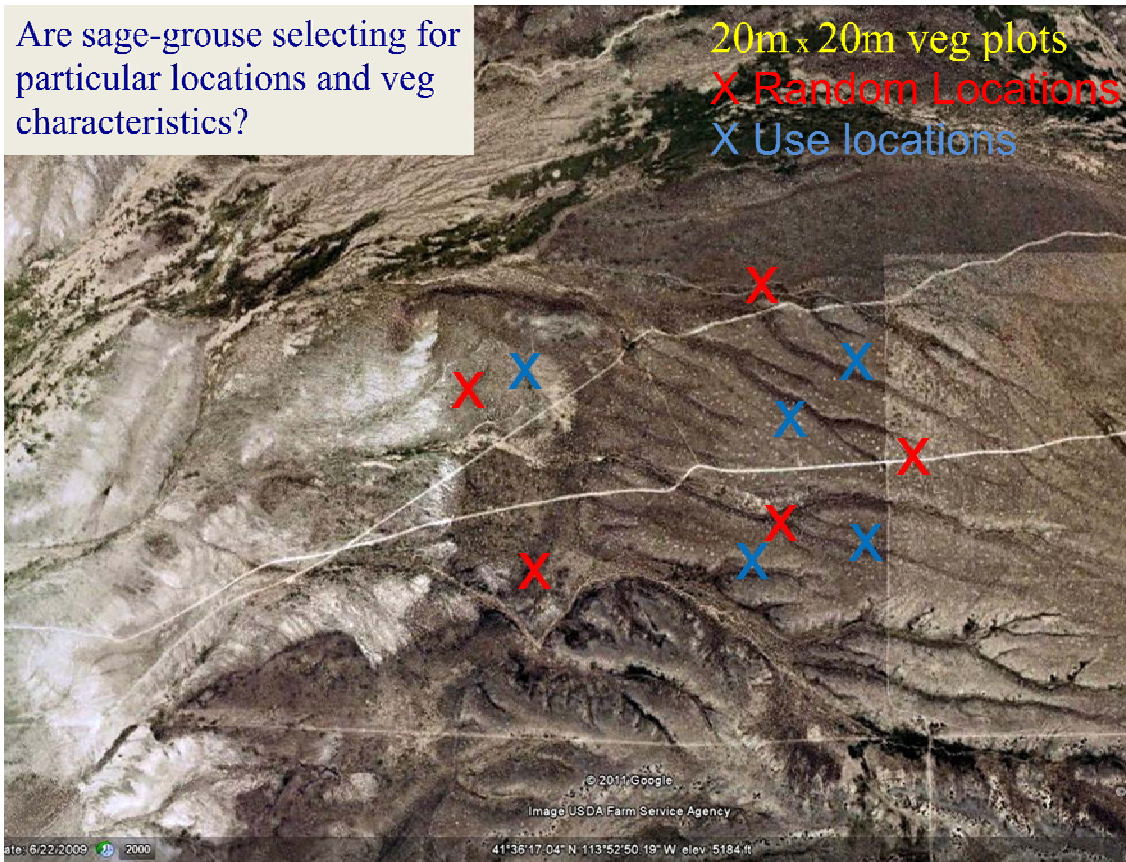


Figure 2. 20m x 20m habitat plots. Through telemetry, we gathered locations of sage-grouse on the primary study site. At 20 random locations that were collected through ArcGIS and 20 use locations per month, measurements were taken using line intercept for shrub cover and daubenmire method evaluated ground cover. This information demonstrates selection for specific habitat characteristics and presence or absence of birds on treatment sites.

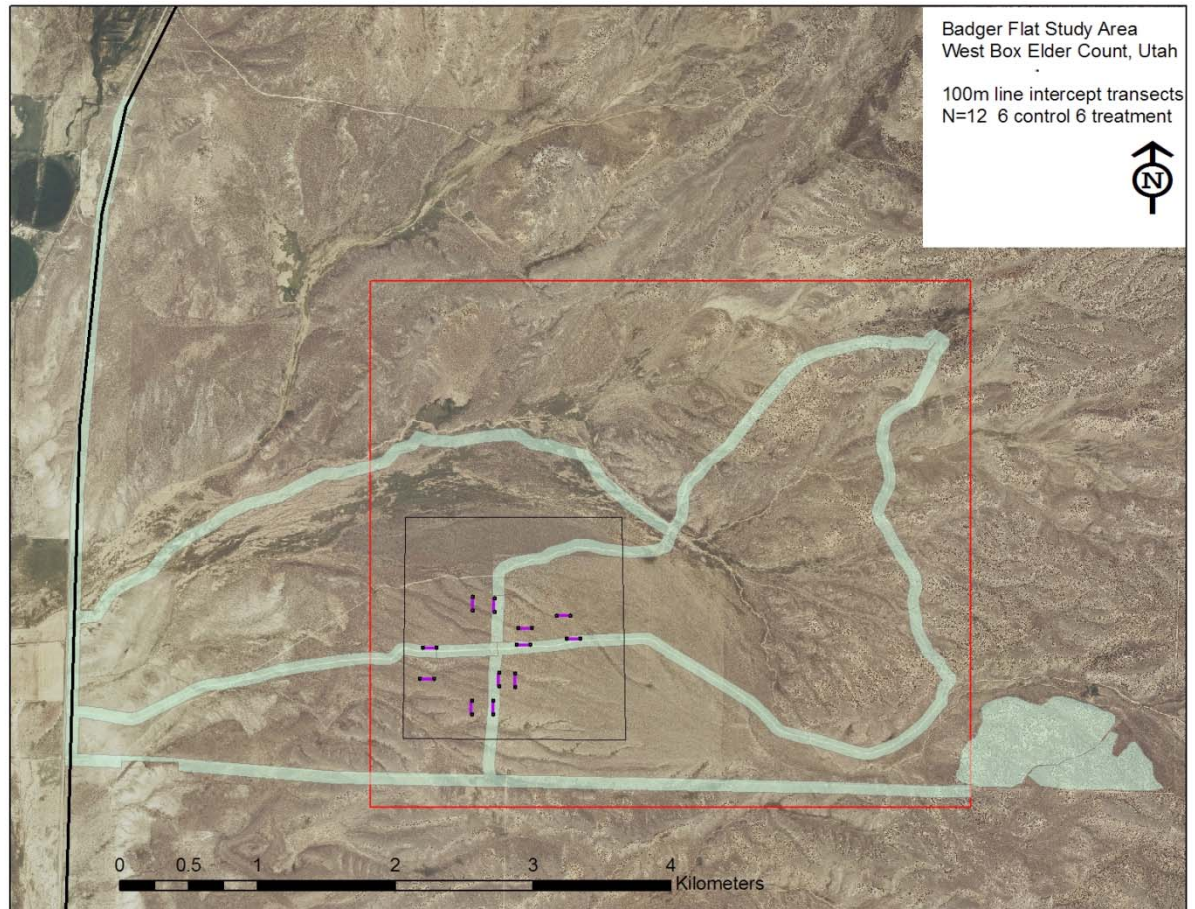


Figure 3. Total treatment of 286 hectares is shown in light blue. Six 100-meter paired plots are shown. In 2011, we added two more paired plots, to have a total of sixteen plots, 8 in treatment, 8 in control. Along these paired plots, line intercept and point intercept were used to determine changes in vegetation. In 2011 the pellet transects were extended to 500 meters, 100 meters of which is along each vegetation transect. This data collected from distance sampling will show effect of treatment on sage-grouse use and interactions with changes in vegetation.

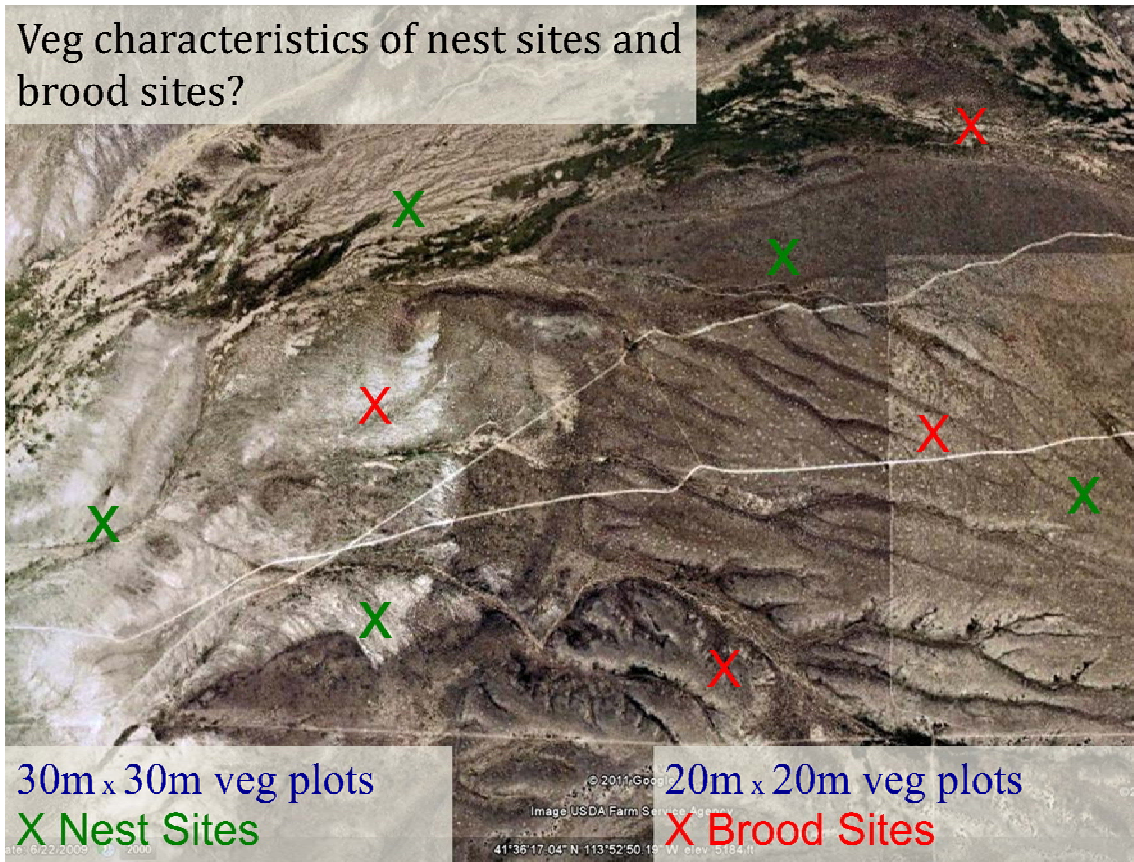


Figure 4. Nest site vegetation characteristics were measured with the daubenmire method, a line-intercept method, and a robel pole along 30m x 30m perpendicular transects. Brood site characteristics were measured with the daubenmire method and a line-intercept method along 20m x 20m perpendicular transects.

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