Habitat Demonstration Project Final Monitoring Report

Report Prepared for

Starr Valley Conservation District
NNSG Demonstration Plot

Report Prepared by

Great Basin Ecology, Inc.

December 2011

Habitat Demonstration Project Final Monitoring Report

Starr Valley Conservation District

P.O. Box 130
Wells, Nevada 89835

Great Basin Ecology, Inc.
225 Silver St., Suite 106
Elko, Nevada, USA 89801

Tel: 775.753.4234
Fax: 775.753.4020

Great Basin Ecology Project Number 15201

Great Basin Ecology Report Number: 11-033

December 2011

Author: Gary N. Back

Table of Contents

Tables

Figures

Appendices

1.0 INTRODUCTION

The Northeastern Nevada Stewardship Group, Inc. (NNSG) Habitat Management Demonstration Project (Project) was implemented to demonstrate the application of various vegetation treatments which can be used to rejuvenate sagebrush-bunchgrass rangelands from a shrub dominated state, while establishing a new age class of sagebrush and increasing the herbaceous composition within the plant community. The treatments included prescribed burning, aeration, disking, and herbicide application. Each of the treatments was intended to reduce shrub canopy cover by 70-80 percent to create habitat for sage-grouse and other wildlife species. The Project also served as a demonstration of how to improve watershed processes. Controls were also established as representative areas of pre-treatment habitat conditions.

All of the treatments were located on the Stormy Allotment on private lands and the controls were located adjacent to the treatments on public lands (Figure 1). The prescribed burn, aeration, and disking were conducted in the fall of 2002. The herbicide treatment was conducted in the fall of 2003. The demonstration area was located approximately 26 miles north of Deeth, Elko County, Nevada along the ONeil-Deeth County Road.

Great Basin Ecology, Inc. (GBE) was contracted by the Starr Valley Conservation District, through a grant from the Natural Resource Conservation Service Grazing Land Conservation Initiative to conduct the nine-year post-treatment vegetation monitoring and report preparation. Volunteers from the NNSG and GBE provided in-kind service for the match portion of the grant.

2.0 BACKGROUND

The Project area was selected based on the Order III Soil Survey (NRCS 1984), which indicated that the area was dominated by the Map Unit 480, Hunnton-Wieland-Gance association. An onsite soils investigation was completed for the NNSG Demonstration Project area by the Natural Resource Conservation Service (NRCS) (NRCS 2006). The soils investigation was performed by Paul Blackburn, Soil Scientist, with NRCS on October 18, 2006. There were five soil pits completed and waypoints of each taken. The soil and range onsite investigations were conducted on October 18 and November 7, 2006 by DA KA DOIYABE RC & D coordinator Gerald Miller and NRCS Soil Scientist Paul Blackburn.

Soil physical and chemical properties and diagnostic horizons observed in soil excavations and in road cuts, support those typical of the Hunnton and Wieland soil series, both of which are major soil components of Map Unit 480.

The soil components of Map Unit 480 that occur at the demonstration Project area are typified by plant communities that occur in an 8 to 10 inch precipitation zone (p.z.) and are correlated to the Loamy 8-10 inch p.z. ecological site (range site 025XY019NV) within Major Land Resource Area 25 (MLRA 25). However, the

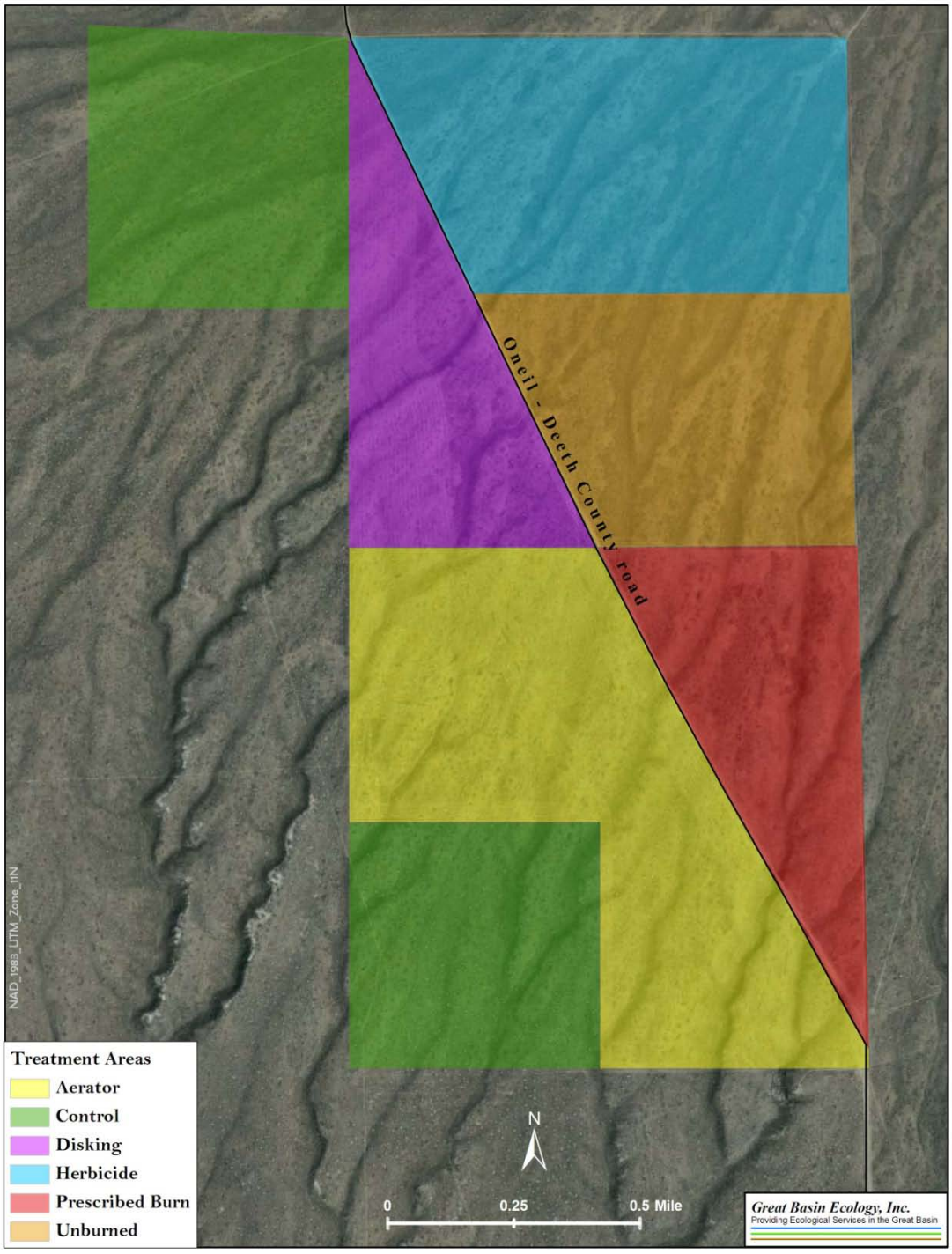

Figure 1: Layout of NNSG Habitat Demonstration Project

presence of Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and Basin wildrye, (*Leymus cinereus*) coupled with higher than typical production at some locations, suggests that this area is transitioning to ecological sites that occur in the 10 to 12 inch precipitation zone. To insure proper ecological site correlation of the soils in Map Unit 480, the reference area for the Loamy 8-10 inch p.z. ecological site was visited. It was determined that the ecological sites at the Project area correlate well with this reference area and are properly identified in Map Unit 480.

The soil map of the demonstration Project area is attached (Figure 2). It should be noted that the control area located in the northwest part of the demonstration Project occurs at least in part in soil map units other than 480.

Map Units 154 (Dewar-Chiara-Gance association), 480, and 631 (Hunewill-Bilbo-Devilsgait association) all support the same range site (025XY019NV), Loamy 8-10 inch p.z. Slopes range from 2 to 50 percent but slope gradients of 4 to 30 percent are most typical. Elevations are 4,500 to 6,000 feet. Potential Native Vegetation (PNV) is Thurber's needlegrass (*Achnatherum thurberianum*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Potential vegetative composition is about 65 percent grasses, 5 percent forbs and 30 percent shrubs. However, there was a small area within the prescribed burn site that expresses itself as a Shallow Loam which does not exist in the NRCS MLRA 25 reference guide at this time.

Waypoint 1 was located just north of the Project boundary. This soil was mixed alluvium on a fan remnant summit. It had a smooth relief with a slope of 2 to 4 percent. The surface was 15 percent gravel with no micro-flora evident in interspaces. Present vegetation was Wyoming big sagebrush, bluegrass (*Poa secunda*), bluebunch wheatgrass, rabbitbrush (*Chrysothamnus viscidiflorus*), and Thurber's needlegrass.

Waypoint 2 was located just north of the Project boundary. This soil was mixed alluvium on a fan remnant summit. It had a slope of 2 to 8 percent. The surface was 10 percent gravel. Present vegetation was Wyoming and Basin big sagebrush, bluebunch wheatgrass, squirreltail (*Elymus elymoides*), bluegrass, and Basin wildrye.

Waypoint 3 was located within the herbicide treatment area. This soil was mixed alluvium on a fan remnant shoulder. It had a slight convex relief with a slope of 2 to 8 percent. The surface was 10 to 20 percent gravels. Present vegetation was Wyoming big sagebrush and bluebunch wheatgrass.

Waypoint 4 was located within the prescribed burn treatment area. This soil was mixed alluvium on a fan remnant summit. It had a slope of 2 to 8 percent. The surface was 15 percent gravel. Present vegetation was Wyoming big sagebrush, bluebunch wheatgrass, Thurber's needlegrass, bluegrass, and Basin wildrye.

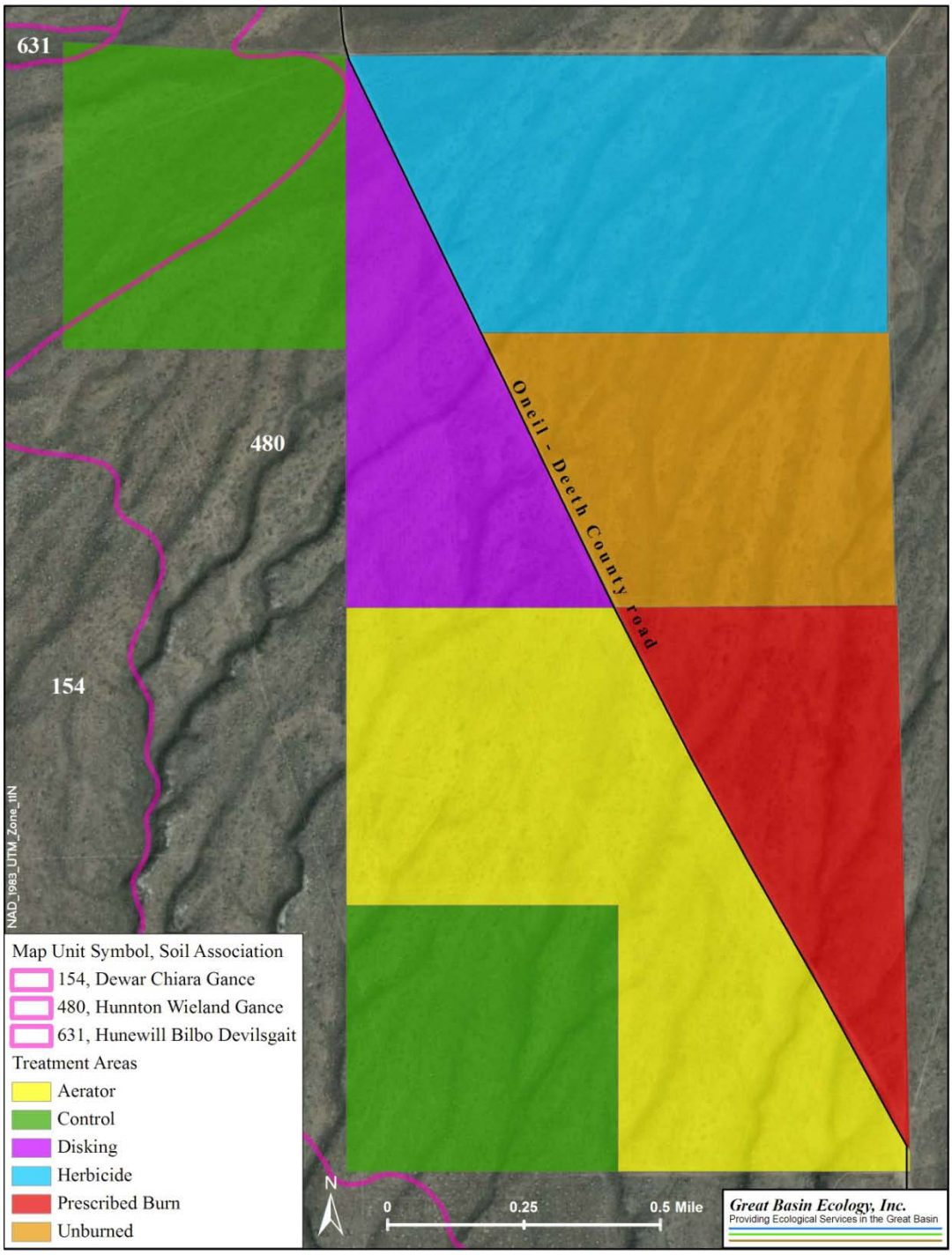

Figure 2: Soil Map Units at the NNSG Habitat Demonstration Project

Waypoint 5 was located within the aerator treatment area. This soil was mixed alluvium on a fan remnant summit. It had a slope of 2 to 8 percent. The surface was 10 to 20 percent gravels. Present vegetation was Wyoming big sagebrush, rabbitbrush, squirreltail, bluegrass, and bluebunch wheatgrass.

An initial summary of the monitoring was prepared in 2006 (SRK 2006). The 2006 summary provided the results of the first four years of monitoring. This report combines the data collected since 2006 with the data collected prior to 2006.

3.0 TREATMENT AND CONTROLS

3.1 PRESCRIBED BURN

The prescribed burn was conducted in the fall of 2002. Approximately 80 acres of the 160-acre planned burn area actually burned, leaving a mosaic of burned and unburned areas. The northern half of the planned burn area was not burned in 2002 with the intent of conducting a spring burn demonstration. However, the spring burn was never conducted.

The moderate complexity and intensity burn was intended to exhibit how such a treatment can increase the habitat suitability for wildlife species and act as a preventative fire protection measure by reducing fuel loading within the area, by reducing sagebrush cover.

The legal description of the Project area is Township 41 North, Range 60 East (R41N, R60E), S½ Sec. 12, and the E½ Sec. 13, Mount Diablo Base and Meridian (MDB&M). The Project area is triangular and bordered by the ONeil-Deeth County Road, as well as an unimproved dirt road (Figure 1).

The burn was planned for a mid-morning ignition when air temperatures were less than 50^{o} F, relative humidity was greater than 20 percent, and wind speed was less than ten miles per hour. However, a fire break had to be constructed to separate the fall burn area from the potential spring burn area. The construction of this fire break took several hours and the burn was ignited when temperatures were approximately 60^{o} F, relative humidity was less than 15 percent, and wind speed was variable between eight and ten miles per hour. Gusts during the burn period were up to 15 miles per hour. The Nevada Department of Forestry (NDF) conducted the prescribed burn.

The ignition sequence was planned so that no more than a 100-foot strip of vegetation would be burning at any one time and that subsequent burn strips would burn to the strips that had been previously burned. The purpose of this ignition sequence was to:

1. Limit the amount of fuel burning at one time to keep the intensity of the fire low to moderate; and

2. Increase the area of burned fuel with each subsequent burn strip to ensure that the fire would not escape the planned burn area.

Because of the delay in starting the burn, the ignition sequence was only followed for two burn strips. After which, the entire burn area perimeter was ignited and the fire burned to the middle of the planned burn area from all three sides. By approximately 5 pm the fire was beginning to lay down as wind speed and temperatures declined, and relative humidity increased. NNSG volunteer personnel stayed on site until 9 pm and returned at 7 am the next day to ensure the fire did not flare up and spread outside the burn perimeter.

3.2 AERATION

The aerator is a pair of large drums with offset blades that is pulled by a tractor over the landscape. In the process, the weight of the drums breaks the stems of the older, brittle sagebrush. Young sagebrush plants that are more supple return to an upright position after the aerator passes. Forbs and grasses are generally not impacted; however, the blades may damage a minority of the herbaceous plants. The blades imprint the ground to create protected areas for seed to collect and introduce organic material into the soil as well as facilitate water infiltration into the soil.

The aeration treatment was also conducted in the fall of 2002 to promote herbaceous production and vegetative species diversity, and consequently to increase the value of the subsequent lands for wildlife species. Certain areas were avoided during the aeration or were treated at lower intensities in order to achieve the objective of increasing herbaceous cover while still leaving seed producing areas intact throughout the treatment plot. This was accomplished by making three consecutive passes (approximately 36 feet of treatment) with the aerator and then leaving a strip (approximately 12 feet wide) of vegetation untreated. This pattern was repeated in the treatment area. In addition, larger blocks were left untreated to maintain winter cover for sage-grouse.

Upon initiation of the treatment, the soil moisture and clay content of the soil combined to create a situation that was unacceptable. The soil began to cling to the drums and resulted in the uprooting of many herbaceous plants. Therefore, the tractor operator volunteered to conduct the treatment at night. The temperatures were sufficiently low to freeze the upper layer of soil, preventing the soil from adhering to the drums. The aeration operation was conducted between the hours of 10 pm and 5 am. Under drier soil moisture conditions this night time operation would not be required.

The legal description of the Project area is T41N, R60E, NW¼, Sec. 13, and the SE¼ Sec. 13, west of the ONeil-Deeth County Road, MDB&M (Figure 1).

3.3 DISKING

Similar to the aeration treatment, the disking treatment was implemented to avoid certain areas or strips of vegetation to provide a shrub component within the treatment area which would serve as a seed source to the treated area following the treatment. The treatment was carried out in the fall of 2002.

The disking was conducted with an Amazon double offset disk. The offset was set for low impact. The operator made three passes with the plow (approximately 36 feet of treatment) and then one pass (approximately 12 feet) of untreated vegetation. This pattern was repeated in the treatment area. In addition, larger blocks were left untreated to maintain winter cover for sage-grouse. The disking operation was conducted without any modification from the original plan.

The legal description of the Project area is T41N, R60E, NW¼ Sec. 12 lying west of the ONeil-Deeth County Road, MDB&M (Figure 1).

3.4 HERBICIDE

Aerial application of the herbicide Tebuthiron was conducted in the fall of 2003 in the planned herbicide area. The herbicide was applied at a low rate which would allow a 20-30 percent canopy cover to remain within the treated area. The low rates were intended to thin the shrub species and increase the herbaceous composition within the treated area. The herbicide was contained within clay pellets that were applied by fixed-wing aircraft. The herbicide was water activated and absorbed by plant roots.

The application was conducted as a series of parallel strips approximately 80 feet wide. The pilot used onboard GPS to ensure uniform coverage of the area.

The legal description of the Project area is T41N, R60E, N½ Sec. 12 east of the ONeil-Deeth County Road, MDB&M (Figure 1).

3.5 CONTROLS

Two control areas were also established near the four treatments for comparison purposes. The controls were similar in habitat (i.e., same ecological range site, species composition, shrub dominance, etc.) to the treated areas prior to the application of the treatments. However, as noted above in Section 2, a portion of the control area in the northwest corner of the demonstration area included a soil map unit other than Map Unit 480. Therefore, there is some potential for this area to have some variation with respect to changes over time from the rest of the demonstration treatments.

The controls were monitored to determine if any change that was occurring in the treatments was also occurring in the control areas.

4.0 MONITORING GRANT

As part of the educational and research component of the demonstration treatments, funding was provided by an NRCS Grazing Land Conservation Initiative grant to the Starr Valley Conservation District to allow the NNSG to conduct post-treatment vegetation monitoring in conjunction with the Great Basin College Agricultural Program.

The first session of vegetation monitoring was conducted in the fall of 2006 by volunteers. Their efforts were focused primarily on shrub cover percentages due to the timing of the monitoring activities (grass and herbaceous plants were not identifiable during the time of monitoring).

Since 2006, the Great Basin College Agricultural Program students have conducted monitoring each fall at the site. This is used as a class assignment for the dual purpose of obtaining the monitoring data as well as training in the methods of data collection and data summary/analysis.

A grant was also received to allow for the final monitoring and preparation of the monitoring report. The monitoring in the spring of 2011 was conducted by Great Basin Ecology, Inc. and volunteers from NNSG and GBE. The final report was prepared by GBE.

5.0 METHODS

5.1 RANDOMIZATION

The sample locations were pre-determined in the office using a grid system and random number table to select grid coordinates. The map of the treatment areas was overlain with the grid system and as the random X,Y coordinates were identified, the locations were placed on the map and Universal Transmercator (UTMs) coordinates were determined from the map. The UTM coordinates were entered into the field Global Positioning System (GPS) units and the GPS units were used to locate the sample locations in the field.

The randomization procedure was conducted each year, which resulted in new transect locations at each sampling period.

5.2 POINT-INTERCEPT METHOD

The point-intercept method was used for vegetation cover estimation for each transect within the treatment sites and control areas. This monitoring method was conducted by establishing a 100-foot linear transect (starting at the reference waypoint) and using a laser projection at each one-foot interval to identify the presence or absence of vegetation as determined by the intersection of laser projection with either ground or vegetation. Each transect resulted in 100 laser "hits"

or sample points in each treatment or control. The percentage of each plant species and the percentage of bare ground were calculated.

5.3 TRANSECTS

The data associated with each transect included:

- Type of cover- grass, forb, shrub, bare-ground, litter, rock (shrub only for the fall sampling)
- Species of vegetation
- Percent of cover
- Location of the transect (UTM location; Easting and Northing)
- Monitoring Unit Name
- Date of monitoring
- Observers
- Photos of the transect with horizon in the background

6.0 RESULTS

The Great Basin College Agricultural Program range monitoring class was offered as a fall semester class. Therefore, the students focused on collecting shrub cover data as most forbs had desiccated and were not identifiable and grasses had been grazed. While some grasses were still readily identifiable, others were not. In addition, the primary objective of the treatments was to reduce the amount of shrub cover, thus this was the focus of the initial monitoring.

However, the final monitoring conducted in 2011 was conducted during the growing season and cover estimates of shrubs, forbs, and grasses were obtained.

For the purposes of comparison of pre-treatment conditions with post-treatment conditions, the data from the control areas represents pre-treatment conditions and the 2006 and 2011 data represent post-treatment conditions.

Photos of the pre- and post-treatments are included in Appendix A.

6.1 PRESCRIBED BURN

6.1.1 2006 MONITORING

Within the prescribed burn area, ten transect locations were monitored in 2006. Shrub species which occurred along the transects included Wyoming big sagebrush (0.8 percent cover), rabbitbrush (2.5 percent cover), and low sagebrush (1.3 percent cover). The total percentage of shrub cover observed in this area was 4.6 percent

(Table 1). Wyoming big sagebrush was recorded as either a seedling or mature shrub to indicate if a new age class of sagebrush was establishing in the treatment area.

Table 1: Shrub Sampling Results Within the Prescribed Burn Treatment Area, Fall 2006

GROUND COVER	Transect Number										Mean
	PBL	PBM	PBN	PBO	PBP	PBQ	PBR	PBS	PBT	PBU	
Bare Ground/ Litter/ Rock[1]	84	94	100	99	97	100	97	95	99	89	95.4%
Subtotal	84	94	100	99	97	100	97	95	99	89	95.4%
Shrubs[2]											
Wyoming big sagebrush	1	6	0	1	0	0	0	0	0	0	0.8%
Douglas rabbitbrush	2	0	0	0	3	0	3	5	1	11	2.5%
Low sagebrush	13	0	0	0	0	0	0	0	0	0	1.3%
Wyoming big sagebrush (Seedling)	0	0	0	0	0	0	0	0	0	0	0%
Subtotal	16	6	0	1	3	0	3	5	1	11	4.6%
Total Cover	16	6	0	1	3	0	3	5	1	11	4.6%
Total Shrub Cover	16	6	0	1	3	0	3	5	1	11	4.6%

[1]During the fall sampling, all non-shrub intercepts were recorded as bare ground, rock, or litter when in fact many of the intercepts were of grasses and forbs that were not identified. Thus, the bare ground/litter/rock category is overestimated.

[2]Because of the time of year, grasses, forbs, and undesirable annuals were not sampled.

6.1.2 2011 MONITORING

Within the prescribed burn area, three transect locations were monitored in 2011. Mean total cover was 67.3 percent. Shrub species which occurred along the transects included Wyoming big sagebrush (0.7 percent cover) and rabbitbrush (10.9 percent cover). The total percentage of shrub cover observed in this area was 11.9 percent (Table 2). The sagebrush plants encountered were seedlings.

Mean perennial grass cover was 14.0 percent and mean perennial forb cover was 23.3 percent. The mean annual grass and forb cover was 22.0 percent.

Table 2: Transect Data 2011 - NNSG Demonstration Plots - Prescribed Burn

Ground Cover	Transect			Mean	Rel. Comp.
	1	**2**	**3**		
Bare Ground	7	18	18	**14.3**	**NA**
Litter	16	19	13	**16.0**	**NA**
Rock	6	0	3	**3.0**	**NA**
Subtotal	**29**	**37**	**34**	**33.3**	**NA**
Perennial Grasses					
Sandberg bluegrass	14	11	12	**12.3**	**18.3%**
Bluebunch wheatgrass	3	0	0	**1.0**	**1.5%**
Thurber's needlegrass	1	0	0	**0.3**	**0.5%**
Basin wildrye	0	1	0	**0.3**	**0.5%**
Subtotal	**18**	**12**	**12**	**14.0**	**20.8%**
Perennial Forbs					
Mountain dandelion	5	12	0	**5.7**	**8.4%**
Phlox sp.	5	9	6	**6.7**	**9.9%**
Nevada desert parsley	1	1	0	**0.7**	**1.0%**
Lupine sp.	9	7	5	**7.0**	**10.4%**
Milkvetch sp.	2	2	1	**1.7**	**2.5%**
Allium sp.	0	0	3	**1.0**	**1.5%**
Fleabane sp.	0	0	1	**0.3**	**0.5%**
Unknown perennial forb	0	0	1	**0.3**	**0.5%**
Subtotal	**22**	**31**	**17**	**23.3**	**34.7%**
Shrubs					
Wyoming big sagebrush	2	0	0	**0.7**	**1.0%**
Douglas rabbitbrush	7	3	12	**7.3**	**10.9%**
Subtotal	**9**	**3**	**12**	**8.0**	**11.9%**
Annual Grasses and Undesirable Forbs					
Cheatgrass	9	3	12	**8.0**	**11.9%**
Clasping pepperweed	12	14	15	**13.7**	**20.3%**
Bur buttercup	1	0	0	**0.3**	**0.5%**
Subtotal	**22**	**17**	**27**	**22.0**	**32.7%**
Total Cover	**71**	**63**	**68**	**67.3**	
Total Perennial Cover	**49**	**46**	**41**	**45.3**	**67.3%**

6.1.3 DISCUSSION

The only comparison that can be made from the 2006 and 2011 data is with respect to shrub cover. Mean shrub cover increased from 4.6 percent in 2006 to 11.9 percent in 2011. The increase appeared to be the result of an increase in Douglas rabbitbrush, not sagebrush.

The relatively high value for the perennial grass and forb cover (37.3 percent) in 2011 is an indication that a prescribed burn treatment can be successfully completed in a Loamy 8-10" p.z. ecological site. However, the amount of annual grass and forb cover is higher than desired. This is discussed in detail in Section 7.0.

6.2 AERATION

6.2.1 2006 MONITORING

Within the aeration area, ten transect locations were monitored in 2006. Shrubs that were recorded along the transects included Wyoming big sagebrush (14.8 percent cover), rabbitbrush (3 percent cover), and low sagebrush (0.2 percent cover). The total percentage of shrub cover observed in this area was 18.0 percent (Table 3).

Table 3: Shrub Sampling Results Within the Aerator Treatment Area, Fall 2006

GROUND COVER	Transect Number										Mean
	AQ	AR	AS	AT	AJ	AI	AD	AA	AC	AF	
Bare Ground/ Litter/ Rock[1]	75	72	72	86	81	85	86	93	75	95	82.0%
Subtotal	75	72	72	86	81	85	86	93	75	95	82.0%
Shrubs[2]											
Wyoming Big Sagebrush	20	26	26	3	18	7	14	7	22	5	14.8%
Rabbitbrush	5	2	2	9	1	8	0	0	3	0	3.0%
Low Sagebrush	0	0	0	2	0	0	0	0	0	0	0.2%
Wyoming Big Sagebrush Seedling	0	0	0	0	0	0	0	0	0	0	0%
Subtotal	25	28	28	14	19	15	14	7	25	5	18.0%
Total Cover	25	28	28	14	19	15	14	7	25	5	18.0%
Total Shrub Cover	25	28	28	14	19	15	14	7	25	5	18.0%

[1]During the fall sampling, all non-shrub intercepts were recorded as bare ground, rock, or litter when in fact many of the intercepts were of grasses and forbs that were not identified. Thus, the bare ground/litter/rock category is overestimated.

[2]Because of the time of year, grasses, forbs, and undesirable annuals were not sampled.

6.2.2 2011 MONITORING

Within the aeration area, three transect locations were monitored in 2011. Mean total cover was 58.3 percent. Shrub species which occurred along the transects included Wyoming big sagebrush (12.3 percent cover) and rabbitbrush (6.0 percent cover). The total percentage of shrub cover observed in this area was 18.3 percent (Table 4). The sagebrush plants encountered were mature plants as well as seedlings.

Mean perennial grass cover was 11.7 percent and mean perennial forb cover was 22.3 percent. The mean annual grass and forb cover was 6.0 percent.

6.2.3 DISCUSSION

The percentage of shrub cover did not change between 2006 and 2011. Perennial grass and forb cover was relatively high (34.0 percent), and the annual grass and forb cover was less than 10.0 percent.

Table 4: Transect Data 2011 - NNSG Demonstration Plots - Aeration

Ground Cover	Transect			Mean	Rel. Comp.
	1	**2**	**3**		
Bare Ground	7	18	18	**14.3**	NA
Litter	16	19	13	**16.0**	NA
Rock	6	0	3	**3.0**	NA
Subtotal	**29**	**37**	**34**	**33.3**	NA
Perennial Grasses					
Sandberg bluegrass	14	11	12	**12.3**	**18.3%**
Bluebunch wheatgrass	3	0	0	**1.0**	**1.5%**
Thurber's needlegrass	1	0	0	**0.3**	**0.5%**
Basin wildrye	0	1	0	**0.3**	**0.5%**
Subtotal	**18**	**12**	**12**	**14.0**	**20.8%**
Perennial Forbs					
Mountain dandelion	5	12	0	**5.7**	**8.4%**
Phlox sp.	5	9	6	**6.7**	**9.9%**
Nevada desert parsley	1	1	0	**0.7**	**1.0%**
Lupine sp.	9	7	5	**7.0**	**10.4%**
Milkvetch sp.	2	2	1	**1.7**	**2.5%**
Allium sp.	0	0	3	**1.0**	**1.5%**
Fleabane sp.	0	0	1	**0.3**	**0.5%**
Unknown perennial forb	0	0	1	**0.3**	**0.5%**
Subtotal	**22**	**31**	**17**	**23.3**	**34.7%**
Shrubs					
Wyoming big sagebrush	2	0	0	**0.7**	**1.0%**
Douglas rabbitbrush	7	3	12	**7.3**	**10.9%**
Subtotal	**9**	**3**	**12**	**8.0**	**11.9%**
Annual Grasses and Undesirable Forbs					
Cheatgrass	9	3	12	**8.0**	**11.9%**
Clasping pepperweed	12	14	15	**13.7**	**20.3%**
Bur buttercup	1	0	0	**0.3**	**0.5%**
Subtotal	**22**	**17**	**27**	**22.0**	**32.7%**
Total Cover	**71**	**63**	**68**	**67.3**	
Total Perennial Cover	**49**	**46**	**41**	**45.3**	**67.3%**

6.3 DISKING

6.3.1 2006 MONITORING

Within the disking area, ten transect locations were monitored in 2006. Shrubs that were recorded along the transects included Wyoming big sagebrush (4.8 percent cover), with one observation of this species being a seedling, and rabbitbrush (2.7 percent cover). The total percentage of shrub cover observed in this area was 7.6 percent (Table 5).

Table 5: Shrub Sampling Results Within the Disking Treatment Area, Fall 2006

GROUND COVER	Transect Number										Mean
	DA	DB	DC	DD	DE	DF	DG	DH	DI	DM	
Bare Ground/ Litter/ Rock[1]	87	91	91	95	89	86	95	99	93	98	92.4%
Subtotal	87	91	91	95	89	86	95	99	93	98	92.4%
Shrubs[2]											
Wyoming Big Sagebrush	10	9	2	4	7	10	3	1	2	0	4.8%
Rabbitbrush	3	0	7	1	3	4	2	0	5	2	2.7%
Low Sagebrush	0	0	0	0	0	0	0	0	0	0	0%
Wyoming Big Sagebrush Seedling	0	0	0	0	1	0	0	0	0	0	0.1%
Subtotal	13	9	9	5	11	14	5	1	7	2	7.6%
Total Cover	13	9	9	5	11	14	5	1	7	2	7.6%
Total Shrub Cover	13	9	9	5	11	14	5	1	7	2	7.6%

[1]During the fall sampling, all non-shrub intercepts were recorded as bare ground, rock, or litter when in fact many of the intercepts were of grasses and forbs that were not identified. Thus, the bare ground/litter/rock category is overestimated.

[2]Because of the time of year, grasses, forbs, and undesirable annuals were not sampled.

6.3.2 2011 MONITORING

Within the disking area, three transect locations were monitored in 2011. Shrubs that were recorded along the transects included Wyoming big sagebrush (12.0 percent cover) and rabbitbrush (2.0 percent cover). Mean perennial grass cover was 12.3 percent and mean perennial forb cover was 25.7 percent. Annual grasses and forbs accounted for less than 10.0 percent cover (Table 6).

Table 6: Transect Data 2011 - NNSG Demonstration Plots - Disking

Ground Cover	Transect			Mean	Rel. Comp.
	1	2	3		
Bare Ground	22	20	29	**23.7**	**NA**
Litter	26	12	12	**16.7**	**NA**
Rock	0	2	0	**0.7**	**NA**
Subtotal	**48**	**34**	**41**	**41.0**	**NA**
Perennial Grasses					
Sandberg bluegrass	12	9	11	**10.7**	**18.1%**
Bluebunch wheatgrass	1	0	2	**1.0**	**1.7%**
Bottlebrush squirreltail	0	0	2	**0.7**	**1.1%**
Subtotal	**13**	**9**	**15**	**12.3**	**20.9%**
Perennial Forbs					
Penstemon sp.	1	0	0	**0.3**	**0.6%**
Lupine sp.	11	12	10	**11.0**	**18.6%**
Fleabane sp.	1	0	0	**0.3**	**0.6%**
Hawksbeard	3	21	3	**9.0**	**15.3%**
Phlox sp.	1	3	1	**1.7**	**2.8%**
Allium sp.	0	2	1	**1.0**	**1.7%**
Mountain dandelion	0	1	5	**2.0**	**3.4%**
Rock cress sp.	0	0	1	**0.3**	**0.6%**
Subtotal	**17**	**39**	**21**	**25.7**	**43.5%**
Shrubs					
Wyoming big sagebrush	10	6	20	**12.0**	**20.3%**
Douglas rabbitbrush	2	3	1	**2.0**	**3.4%**
Subtotal	**12**	**9**	**21**	**14.0**	**23.7%**
Annual Grasses and Undesirable Forbs					
Cheatgrass	0	0	0	**0.0**	**0.0%**
Mustard sp.	8	7	2	**5.7**	**9.6%**
Bur buttercup	0	2	0	**0.7**	**1.1%**
Unknown annual forb	2	0	0	**0.7**	**1.1%**
Subtotal	**10**	**9**	**2**	**7.0**	**11.9%**
Total Cover	**52**	**66**	**59**	**59.0**	
Total Perennial Cover	**42**	**57**	**57**	**52.0**	**88.1%**

6.3.3 DISCUSSION

This treatment demonstrated greater than two-fold increase in shrub cover between 2006 and 2011. Although annual grasses, such as cheatgrass (*Bromus tectorum*), were not monitored in 2006, the photos during the period 2002 through 2011 indicate that cheatgrass and other annual forbs were abundant in the first four years after the treatment and declined over the past five years. The perennial herbaceous plants have replaced the annual grass/forbs. This is probably directly attributable to the presence of Sandberg bluegrass (*Poa secunda*). This shallow rooted, cool-season, perennial grass directly competes with cheatgrass for fall and early spring moisture. The temperature and precipitation pattern in the spring of 2005 was favorable for Sandberg bluegrass and as a result the seed production from this species was extremely high. This may be the event that allowed Sandberg bluegrass to become the dominant perennial grass in this treatment.

6.4 HERBICIDE

6.4.1 2006 MONITORING

Within the herbicide area, ten transect locations were monitored in 2006. Shrubs that were recorded along the transects included Wyoming big sagebrush and Basin big sagebrush. These two sub-species were lumped together and recorded as big sagebrush for this monitoring event as a soil inclusion resulted in both species occurring on the site. The Wyoming and Basin big sagebrush constituted 6.5 percent cover and rabbitbrush provided 2.4 percent cover. Collectively, the total shrub cover observed in this area was 8.9 percent (Table 7).

6.4.2 2011 MONITORING

Within the herbicide area, three transect locations were monitored in 2011. Shrubs that were recorded along the transects included Wyoming big sagebrush (7.3 percent cover) and rabbitbrush (4.7 percent cover). Mean perennial grass cover was 13.7 percent and mean perennial forb cover was 24.7 percent. Annual grasses and forbs accounted for less than 10.0 percent cover (Table 8).

Table 7: Shrub Sampling Results Within the Herbicide Treatment Area, Fall 2006

GROUND COVER	Transect Number										Mean
	HA	HD	HE	HF	HG	HJ	HK	HL	HC	HB	
Bare Ground/ Litter/ Rock[1]	93	95	85	100	96	94	90	80	91	87	91.1%
Subtotal	93	95	85	100	96	94	90	80	91	87	91.1%
Shrubs											
Wyoming Big Sagebrush	6	0	15	0	0	0	10	20	5	2	5.8%
Rabbitbrush	1	3	0	0	2	3	0	0	4	11	2.4%
Low Sagebrush	0	0	0	0	0	0	0	0	0	0	0%
Wyoming Big Sagebrush Seedling	0	0	0	0	0	0	0	0	0	0	0%
Basin Big Sagebrush	0	2	0	0	2	3	0	0	0	0	0.7%
Subtotal	7	5	15	0	4	6	0	20	9	13	8.9%
Total Cover	7	5	15	0	4	6	10	20	9	13	8.9%
Total Shrub Cover	7	5	15	0	4	6	10	20	9	13	8.9%

[1]During the fall sampling, all non-shrub intercepts were recorded as bare ground, rock, or litter when in fact many of the intercepts were of grasses and forbs that were not identified. Thus, the bare ground/litter/rock category is overestimated.

[2]Because of the time of year, grasses, forbs, and undesirable annuals were not sampled.

Table 8: Transect Data 2011 - NNSG Demonstration Plots – Herbicide

Ground Cover	Transect			Mean	Rel. Comp.
	1	2	3		
Bare Ground	35	18	19	**24.0**	**NA**
Litter	17	18	16	**17.0**	**NA**
Rock	4	1	3	**2.7**	NA
Subtotal	**56**	**37**	**38**	**43.7**	**NA**
Perennial Grasses					
Sandberg bluegrass	9	14	11	**11.3**	**20.1%**
Bluebunch wheatgrass	0	0	2	**0.7**	**1.2%**
Bottlebrush squirreltail	0	3	0	**1.0**	**1.8%**
Basin wildrye	0	2	0	**0.7**	**1.2%**
Subtotal	**9**	**19**	**13**	**13.7**	**24.3%**
Perennial Forbs					
Hawksbeard	9	9	14	**10.7**	**18.9%**
Lupine sp.	8	9	4	**7.0**	**12.4%**
Fleabane sp.	3	1	3	**2.3**	**4.1%**
Mountain dandelion	1	0	0	**0.3**	**0.6%**
Phlox sp.	1	1	3	**1.7**	**3.0%**
Bluebells	0	2	0	**0.7**	**1.2%**
Nevada desert parsley	0	1	0	**0.3**	**0.6%**
Unknown perennial forb	2	0	3	**1.7**	**3.0%**
Subtotal	**24**	**23**	**27**	**24.7**	**43.8%**
Shrubs					
Wyoming big sagebrush	2	6	14	**7.3**	**13.0%**
Douglas rabbitbrush	3	9	2	**4.7**	**8.3%**
Subtotal	**5**	**15**	**16**	**12.0**	**21.3%**
Annual Grasses and Undesirable Forbs					
Cheatgrass	0	1	2	**1.0**	**1.8%**
Bur buttercup	5	4	1	**3.3**	**5.9%**
Mustard sp.	1	1	1	**1.0**	**1.8%**
Unknown annual forb	0	0	2	**0.7**	**1.2%**
Subtotal	**6**	**6**	**6**	**6.0**	**10.7%**
Total Cover	**44**	**63**	**62**	**56.3**	
Total Perennial Cover	**38**	**57**	**56**	**50.3**	**89.3%**

6.4.3 DISCUSSION

Shrub cover between 2006 and 2011 increased and this was due primarily because of an increase in rabbitbrush. The relatively high perennial grass and forb cover, combined with less than 10.0 percent annual grass and forb cover is an indication of the success of this treatment.

6.5 CONTROL

6.5.1 2006 MONITORING

Within the two control areas, a collective total of ten transect locations were monitored in 2006. Shrubs recorded for the monitoring transects at the two control areas included Wyoming big sagebrush (24.5 percent cover) and rabbitbrush (3 percent cover). The total shrub cover observed in this area was 27.6 percent (Table 9).

Table 9: Shrub Sampling Results Within the Control Areas, Fall 2006

GROUND COVER	Transect Number										Mean
	NCA	NCB	NCC	NCD	NCF	NCG	SCA	SCC	SCD	SCE	
Bare Ground/ Litter/ Rock[1]	58	71	71	80	64	60	80	81	83	77	72.5%
Subtotal	58	71	71	80	64	60	80	81	83	77	72.5%
Shrubs											
Wyoming Big Sagebrush	40	26	20	18	34	35	17	19	13	23	24.5%
Rabbitbrush	2	3	9	2	1	5	3	0	4	0	3.0%
Low Sagebrush	0	0	0	0	0	0	0	0	0	0	0%
Wyoming Big Sagebrush Seedling	0	0	0	0	1	0	0	0	0	0	0.1%
Subtotal	42	29	29	20	36	40	20	19	17	23	27.6%
Total Cover	42	29	29	20	36	40	20	19	17	23	27.6%
Total Perennial Cover	42	29	29	20	36	40	20	19	17	23	27.6%

[1]During the fall sampling, all non-shrub intercepts were recorded as bare ground, rock, or litter when in fact many of the intercepts were of grasses and forbs that were not identified. Thus, the bare ground/litter/rock category is overestimated.

[2]Because of the time of year, grasses, forbs, and undesirable annuals were not sampled

6.5.2 2011 MONITORING

Within the control areas, three transect locations were monitored in 2011. Shrubs that were recorded along the transects included Wyoming big sagebrush (22.0 percent cover and rabbitbrush (4.3 percent cover). Mean perennial grass cover was 11.3 percent and mean perennial forb cover was 15.3 percent. Annual grasses and forbs accounted for less than 5.0 percent cover (Table 10).

6.5.3 DISCUSSION

The control areas remained relatively static with respect to shrub cover between 2006 and 2011. Shrub cover was estimated at 27.5 percent in 2006 and at 26.3 percent in 2011. The shrub cover was reduced between 2003 and 2005 due to a regional infestation of Aroga moth (*Aroga websteri*) which occurred in the area and caused considerable mortality of Wyoming big sagebrush. Monitoring of the treatment sites prior to the 2002 treatments indicated that sagebrush cover was approximately 33 percent.

Table 10: Transect Data 2011 - NNSG Demonstration Plots - Control Plots

Ground Cover	Transect			Mean	Rel. Comp.
	1	2	3		
Bare Ground	18	31	23	**24.0**	**NA**
Litter	14	17	11	**14.0**	**NA**
Rock	10	2	4	**5.3**	NA
Subtotal	**42**	**50**	**38**	**43.3**	**NA**
Perennial Grasses					
Sandberg bluegrass	5	8	15	**9.3**	**16.5%**
Bluebunch wheatgrass	2	0	0	**0.7**	**1.2%**
Bottlebrush squirreltail	2	2	0	**1.3**	**2.4%**
Subtotal	**9**	**10**	**15**	**11.3**	**20.0%**
Perennial Forbs					
Phlox sp.	7	10	0	**5.7**	**10.0%**
Lupine sp.	1	2	11	**4.7**	**8.2%**
Mountain dandelion	1	0	0	**0.3**	**0.6%**
Milkvetch sp.	1	0	0	**0.3**	**0.6%**
Allium sp.	1	0	1	**0.7**	**1.2%**
Unknown perennial forb	4	4	3	**3.7**	**6.5%**
Subtotal	**15**	**16**	**15**	**15.3**	**27.1%**
Shrubs					
Wyoming big sagebrush	18	21	27	**22.0**	**38.8%**
Douglas rabbitbrush	10	3	0	**4.3**	**7.6%**
Subtotal	**28**	**24**	**27**	**26.3**	**46.5%**
Annual Grasses and Undesirable Forbs					
Cheatgrass	4	0	3	**2.3**	**4.1%**
Mustard sp.	2	0	0	**0.7**	**1.2%**
Bur buttercup	0	0	2	**0.7**	**1.2%**
Subtotal	**6**	**0**	**5**	**3.7**	**6.5%**
Total Cover	**58**	**50**	**62**	**56.7**	
Total Perennial Cover	**52**	**50**	**57**	**53.0**	**93.5%**

6.6 COMPARISON OF TREATMENTS AND CONTROLS

For all of the treatments, shrub cover was significantly reduced from the existing conditions prior to the treatments. The four treatments also varied from each other.

6.6.1 PRESCRIBED BURN

As compared to the total shrub cover in the control, the prescribed burn resulted in an 83 percent decrease in total shrub cover where the fire actually occurred. The islands of unburned vegetation remained similar to the control areas. Wyoming big sagebrush was reduced by almost 97 percent. Additionally, rabbitbrush showed an almost 17 percent decrease in shrub cover. Low sagebrush represented 1.3 percent cover in the post-treatment monitoring, but was not found within the control areas due to lack of this specific soil inclusion within the control area. Therefore, there is no comparison of cover for this species between the prescribed burn area and the control areas.

By 2011 the perennial grass component of the prescribed burn was essentially the same as the control plots. Sandberg bluegrass was the dominant perennial grass in both areas (9.3 percent cover in the control and 12.3 percent cover in the prescribed burn area). All other grasses were less than two percent cover in both the prescribed burn and control areas. It is not uncommon for Sandberg bluegrass to dominate a site after fire when it was a major component of the grass cover prior to a fire.

In contrast, the perennial forb component was higher in the prescribed burn area as compared to the control. Several of the forbs in the treatment area were regarded as important sage-grouse (*Centrocercus urophasianus*) foods, especially during the early spring pre-laying period.

The major difference between the prescribed burn and the control areas was the increase in annual grass (cheatgrass) and annual forbs. The burned area had 22.0 percent cover of annual plants as compared to only 3.7 percent annual plant cover in the control plots. Based on the prescribed burn plan, this was unexpected. However, in retrospect, two factors likely contributed to the increase in annual plants. The first was the prescribed burn was not conducted according to the burn plan. The ignition pattern was not followed, which resulted in a higher intensity fire than was desired. Where fuel loading was greatest, such as in the swales, a high level of perennial grass mortality was observed. These areas were readily infested with cheatgrass and annual forbs. In the areas of lower fuel loading and consequently areas of moderate burn intensity, the annual species were not nearly as abundant.

The second factor was grazing. Although the grazing in this particular pasture is not generally an issue, the burned area was less than one percent of the pasture. Livestock required approximately two weeks to discover the burned area during the first growing season following the fire, but once it was discovered, the burn became the focus of the grazing. Water was available within one-half mile of the burned area,

which allowed the livestock to continually use the area. During the second growing season after the prescribed burn the livestock were on the burned area by the second day after being turned into the pasture five miles away.

Because of the small size of the treatment and the continual month-long use of the area each year, the perennial grass seedlings did not establish as well as had been anticipated. Photos of the area during the first two years following treatment a week before the livestock were turned in indicated that the perennial grass response was very positive throughout most of the burned area (except the swales where the burn was intense).

6.6.2 AERATION

The aeration treatment also resulted in a reduction of shrub cover relative to the control. Post-treatment monitoring results showed 35 percent decrease in total shrub cover relative to the control. The aeration treatments reduced Wyoming big sagebrush by approximately 40 percent. Sagebrush seedlings were abundant in the 2011 monitoring, indicating that sagebrush was reestablishing in less than ten years after treatment.

This treatment appeared to be the best treatment early on in the Project. The debris created by the shrubs that were broken off at the stem during the treatment seemed to deter livestock grazing for the first three years. The cows avoided the area and the perennial grasses and forbs responded well to the treatment. The perennial grass and forb cover on the aeration site were comparable to the prescribed burn area, and overall perennial herbaceous cover was greater in the aeration area than the control areas (34 percent and 27 percent, respectively). However, the aeration had about two-thirds less annual grass and forb cover than the prescribed burn. The aeration area had more annual grass and forb cover than the control area, but the annual vegetation was not dominant on the site. The amount of annual herbaceous vegetation in the aeration area is of little concern given the much higher percentage of perennial grasses, forbs, and shrubs present (total of 52.3 percent perennial cover).

6.6.3 DISKING

Post-treatment monitoring showed the disking treatment to be extremely effective at reducing the shrub cover percentage. An 80 percent reduction in Wyoming big sagebrush relative to the control occurred following disking. Rabbitbrush only showed a decrease of 10 percent from that of the control areas. The disking treatment resulted in an approximately 72 percent reduction in total shrub cover.

This treatment was the most intrusive treatment as the soil surface was disturbed and plants were uprooted. Cheatgrass and annual forbs appeared to dominate the site for the first two growing seasons. In 2005 the temperature and precipitation during April and May were suitable for Sandberg bluegrass and this species was abundant on all sites – treatments and control. But this species was even abundant in the disking area.

By 2011 the perennial grass cover in the disked area was comparable to the control area, as well as the prescribed burn, aeration, and herbicide treatment areas. Cheatgrass was not observed in the 2011 monitoring transects.

6.6.4 HERBICIDE

The herbicide treatment also showed a decrease in the total shrub cover. The shrub cover was reduced by 68 percent relative to the control areas. Monitoring results indicated that Wyoming big sagebrush accounted for most of this reduction with a decrease of nearly 74 percent. Rabbitbrush showed a decrease of 20 percent when compared to the control.

This treatment requires more time to observe the results. The herbicide was applied in the fall of 2003 and there did not appear to be much shrub reduction in 2004. In 2005 the shrub reduction was apparent, but still did not appear to have significantly changed the stand structure. By 2006 the amount of dead standing sagebrush was quite apparent and the increase in perennial herbaceous cover was also evident.

This treatment was comparable to the aeration treatment with respect to the response by annual herbaceous plants.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The goals of the demonstration plots were to demonstrate that there were several tools that could be used to:

- reduce sagebrush cover and increase perennial herbaceous cover; and
- reestablish a new age class of sagebrush in the treated areas.

These goals were also intended to improve sage-grouse habitat by increasing the amount of herbaceous forbs used by sage-grouse and to demonstrate that sagebrush habitat could be renewed.

With respect to these goals, all of the treatments were a success. The Loamy 8-10" p.z. ecological site is the dominant ecological site in Elko County. Thus the potential for this site to provide habitat for sage-grouse is critical if sage-grouse populations are to be maintained. Much of this ecological site acreage, especially along the Interstate 80 corridor, has burned and been converted to cheatgrass-dominated vegetation. This condition is not sage-grouse habitat. Therefore, demonstrating that the vegetation on this ecological site can be manipulated to improve conditions for sage-grouse is significant in the efforts to manage sage-grouse populations.

The minimal increase in annual vegetation following the aeration, disking, and herbicide treatments, and moderate increase following the prescribed burn treatment indicate that there may be some "fine-tuning" required before these treatments are

conducted on a large scale; however, withholding the treatments on this ecological site, and other ecological sites at greater precipitation zones, is irresponsible given the amount of acreage that is at risk for converting to cheatgrass after wildfires.

7.2 RECOMMENDATIONS

The original intent of the Project was to serve as an education and demonstration project, and in accordance with this the monitoring program should continue to provide data with respect to the time required for shrubs to again dominate the vegetation and to document any changes of each of the treated and untreated plots over time. Great Basin College Agricultural Program students should also continue to conduct the monitoring activities as part of a hands-on training portion of their education. The NNSG should be the repository of this data so that another summary of the treatments can be conducted in ten or 20 years.

In addition to the shrub, grass and forb monitoring, an effort should be started to monitor sage-grouse use in the treatments. Sage-grouse, their droppings, and a sage-grouse nest have all been observed in the past nine years. However, a systematic monitoring system should be established to document the use of the treatments and the controls. By collecting and analyzing sage-grouse fecal droppings, season of use, type of use (e.g. roost or feeding), and amount of use can be determined. The aforementioned components may provide insight to sage-grouse habitat preference and/or habitat requirements.

While the demonstration plots have provided insight into the four treatments, there are some caveats that must be remembered.

First, annual grasses and forbs were a minor component of the area prior to the treatments. The application of these treatments when annual vegetation comprises more than ten percent cover should only be conducted if there is budget for control of annual vegetation the in first growing season following treatment. A herbicide treatment is recommended if cheatgrass or other annual vegetation is abundant the first growing season after treatment.

Second, the 8-10" p.z. is the lowest precipitation zone for which these treatments are recommended. Anything less than 8-10" of annual precipitation will convert to annual vegetation with most of these treatments.

Third, application of the treatments should consider soil and topographic conditions. Prescribed burning and herbicide treatments are the only treatments available for steep terrain or rocky terrain. The disc plow and aerator cannot be used on steep or rocky terrain. Where the terrain is steep, additional considerations are necessary for prescribed burning to control fire intensity.

Fourth, the size of the treatments needs to be planned with respect to the size of the pasture in which the treatments will be applied. At least 25 percent of the pasture should be treated, and treatments should be spaced within the pasture. Treatment

areas should vary in size between 400 acres and 1,200 acres when possible. Treatment blocks greater than 2,000 acres should be avoided.

Fifth, treatments should be distributed over time. Treating approximately 25 percent of a pasture every 10 to 25 years will create a mosaic of age classes/cover classes that is conducive to sustaining sage-grouse habitats and livestock forage, creating discontinuity of fuel conditions, and maintaining important watershed functions.

Sixth, a mosaic of soils and ecological sites already exists on the landscape. Working with the potential of this mosaic is important. Each of the ecological sites will have different recommended disturbance intervals. Monitoring to determine when to apply treatments is a critical step in the vegetation management process.

Seventh, not all sagebrush plant communities will respond similarly to the treatments. The demonstration plots were conducted on one ecological site, the Loamy 8-10" p.z. Other sites will respond differently and some of the treatments should be avoided on some ecological sites or some conditions of the ecological sites. New tools are being developed, such as State and Transition Models for the various ecological sites, which can guide the landowner/operator as to when and how to apply management tools.

8.0 REFERENCES

Natural Resources Conservation Service (NRCS). 1984. Soil Survey of Elko County, Nevada, Central Part. Reno, Nevada.

_____. 2006 Letter Report to SRK Consulting from Paul Blackburn, Soil Scientist, NRCS. Elko, Nevada.

Prepared by

Gary N. Back
Ecologist

Reviewed by

Stefanie T. Adams
Technical Editor

APPENDICES
TREATMENT PHOTOS