Development of a Sagebrush Habitat Improvement Guide for the Gunnison Sage-grouse by Evaluating Recently and Historically Treated Areas within the Gunnison Basin

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Project Summary

Funding was obtained from 3 grant sources (Gunnison County Sage-grouse Mitigation Fund, Colorado Division of Wildlife, and the Sage-grouse Restoration Project) to hire three 2-person sampling crews for the summer 2006 field season. The crews were able to sample 17 areas treated with 2,4-D (Figure 1), 17 areas treated with Spike (Figure 2), 16 burned areas (both wild and prescribed; Figure 3)), 9 areas treated by brushmowing (Figure 4), 3 areas treated with a Dixie harrow (Figure 5), and 3 long-term exclosures. These areas were located with the help of John Scott, NRCS District Conservationist for Gunnison County, and various personnel from the local BLM office. Age of the treatments was quite variable with an overall range from 1 (2005) to 22 years (1984) old.

Vegetation Monitoring

Vegetation measurements were taken in a manner that will allow comparison to the structural habitat guidelines as outlined in the Gunnison Sage-grouse Rangewide Conservation Plan published in 2005. Canopy cover of sagebrush and other shrubs was measured using the line intercept method (Figure 6) while cover of grasses and forbs was determined by placing 10, 0.1 m^2 Daubenmire quadrats along each transect (Figure 7). Additionally, sagebrush, grass, and forb heights were measured along each transect. Depending on the size of a given treated area, either 5 or 10, 30-m long transects were sampled in each area. If feasible, an equal number of transects were sampled in adjacent untreated sagebrush for use as controls.

2008 Plan of Work

A draft manuscript has been included in the 2007 report. This manuscript is being reviewed for publication. A final publication and NRCS Technical Note will be prepared in 2008.

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Status: On-going

Figure 1. Area treated with 2,4-D in 1995.

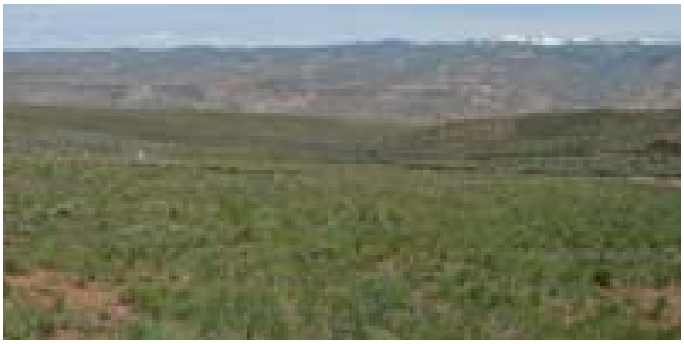

Figure 4. Area treated by brushmowing in 2003.

Figure 2. Area treated with Spike in 1994.

Figure 5. Area treated with Dixie Harrow in 2000.

Figure 3. Area treated with fire in 2000.

Figure 6. Line-intercept method measures shrub canopy cover.

Figure 7. Daubenmire quadrats measure herbaceous cover

DRAFT TECHNICAL NOTE

Sagebrush Habitat Improvement Guide with Special Emphasis on Needs of the Gunnison Grouse

Introduction

The Gunnison grouse requires sagebrush for its survival, so any treatments used to control sagebrush within its range should be applied with the habitat needs of the grouse in mind. The largest population of Gunnison grouse is located in the Gunnison Basin of western Colorado. Sagebrush has been treated in the Basin for many years using various techniques. Until recently when the needs of the grouse came to the forefront, the primary goal of these treatments has been to improve forage for livestock and big game such as deer and elk. Treating sagebrush may negatively impact habitat for the grouse in the short term, but in the long term, it has the potential to create sagebrush communities with healthy understories of grasses and forbs. These herbaceous species are critical for cover and food, especially during the nesting and early brood rearing phases of the grouse.

In order to better understand the successional processes occurring in the Gunnison Basin following implementation of various sagebrush treatments, we set out in 2006 to sample areas treated at different points in time and then relate our findings to the needs of the grouse for breeding habitat as outlined in the Rangewide Conservation Plan. Parameters measured included cover of sagebrush, standing dead woody material, other shrubs, grasses, and forbs as well as height of sagebrush, grasses, and forbs. Although there are no guidelines for standing dead woody material, we felt that it was important to measure because it can provide significant cover in areas treated with herbicides and is also an indicator of the amount of drought killed sagebrush at untreated sites.

Spike Herbicide

Spike is a granular herbicide that is used to control various brush species. For control to occur, the herbicide must first move into the soil where it is taken up by the roots and then translocated to aerial portions of the plant. When applied at low rates, it can have a thinning effect on sagebrush communities. Some plants will be totally killed while others will only be partially killed or left undamaged.

Spike has not been used much in the Gunnison Basin except in small scale demonstration trials and a few larger scale applications on private ground. The oldest treated areas were established by the BLM in 1994 at a number of locations throughout the Basin. At each location, they applied several rates of Spike ranging from 0.2 to 0.5 lbs a.i./acre. We sampled all application rates within 4 of their locations for a total of 10 treated and 4 untreated (control) plots. In addition, we sampled 6 locations on private ground that were all treated at the 0.2 lb a.i./acre rate. Year of application for these treated areas ranged from 1996 to 2002. Only for the 0.2 lb/acre rate were we able to determine the reestablishment rate of sagebrush cover. All areas treated with Spike were in xeric sites dominated by Wyoming sagebrush. We surveyed one mesic site in which Spike had been applied, but did not collect data because the treatment failed

to control the sagebrush. Soil organic matter tends to be higher at mesic sites and can bind up the herbicide, especially at the lower application rates.

Spike Comparison across Rates of Application

Using the 10 sample plots treated by the BLM in 1994, it was possible to determine the effect that rate of Spike application had on sagebrush cover. The mean canopy cover of untreated sagebrush at these sites was 14.6%. This level of sagebrush canopy cover was below the minimum of 15% recommended for breeding habitat on xeric sites. The drought of 2002 caused a significant amount of sagebrush die-off in the Basin, especially on these xeric sites. This fact was evidenced by the 14% average cover of standing dead woody material measured in the untreated controls at these sites. Twelve years following application of Spike, sagebrush canopy cover in plots treated with 0.2 lbs a.i./acre averaged 10.4% which was 4.2 percentage points lower compared to the untreated control. Treatment of sagebrush with higher rates of Spike prolongs recovery because cover values in plots treated with 0.3, 0.4, and 0.5 lbs a.i./acre 12 years earlier averaged only 4.6, 2.6, and 2.3%, respectively. These cover values were significantly lower than either the control or 0.2 lb rate. Cover of standing dead woody material was also high in all treated plots with an average of 12.8% across rates. Unlike the untreated control plots, it is difficult to separate out the effects of the herbicide versus the drought on cover of dead material.

For the other vegetation categories measured at the sites treated in 1994, there were no significant differences in canopy cover between any of the treated plots or between the treated and control plots. For shrubs other than sagebrush, the control and treated plots had canopy covers that ranged from 5-7.9% which was at or above the minimum guideline of 5% for breeding habitat. Grass canopy cover was above the recommended minimum of 10% in the control and all treated plots. Although grass cover in the control plots tended to be lower at an average of 15.2%, it did not differ from the treated plots that had an overall average of 20.7%. For forbs, only the control plots had canopy covers that averaged above the 5% minimum guideline at 7.5%. Comparatively, the sites treated with 0.2, 0.3, 0.4 and 0.5 lbs a.i./acre of Spike had mean forb covers of 3.8, 4.9, 4.8 and 4.0%, respectively. Though the control plots had adequate forb cover for breeding habitat for grouse, there was no statistical difference between the control and treated plots.

In addition to canopy cover, plant height is also an important component of suitable grouse habitat. Height of sagebrush plants in the treated plots was significantly lower than height in the control plots. Sagebrush height averaged 37 cm in the control plots compared to the treated plots which averaged 28 cm. There was no significant difference in sagebrush height between any of the plots treated with different rates of Spike. In all but two of the treated plots, sagebrush exceeded the minimum suggested mean height of 25 cm. Although treatment with Spike led to reduced sagebrush heights, it appears that the majority of plants had recovered sufficiently by 12 years after treatment to meet the minimum height guideline for breeding habitat of the grouse. Grass height also contributes to grouse breeding habitat by providing visual obstruction from potential predators. Height of grass in the controls averaged 22 cm which was significantly higher than in the treated plots. All treated plots exceeded the minimum height requirement of 10 cm for breeding habitat. The height of grass in the treated plots was between 16 and 18 cm

and there were no height differences between the plots with different rates of application. It would not be totally unexpected for mean grass height to be lower in the treated compared to control plots. As grass plants grow in the shade of dense sagebrush canopies, they tend to grow taller because they compete for light. Once the sagebrush canopy has been reduced by applying Spike, competition for light is reduced and the growth form of grass plants changes from tall and skinny with not much biomass to slightly shorter and more robust with more canopy cover and higher biomass.

There was no observable difference between the height of forbs in the treated and control plots. This could be due to the short lived nature of forbs and timing of sampling.

Comparison of Spike at 0.2 lb a.i./acre Rate over Time

A total of 8 sites were treated with Spike at the 0.2 lb/acre rate at different times, so it was possible to create a regression looking at the relationship between age of treatment and sagebrush cover for that rate of application. From this regression, it was determined that it would take 19 years for the canopy cover of sagebrush to return to the recommended minimum of 15% for suitable breeding habitat. No such analysis could be performed at rates of 0.3 lbs/acre and above since there were no areas at higher rates that were treated at different points in time. However, since canopy cover of sagebrush was still between 2.3 and 4.6% 12 years after treatment application, one can deduce that it would take longer then 19 years for the sagebrush canopy cover to return to 15%. Thus, Spike applied at 0.2 lbs a.i./acre is capable of thinning the sagebrush cover on these xeric sites without requiring an unreasonable amount of time for the plants to reestablish and/or recover to the point of meeting minimum standards. Although the canopy cover of sagebrush was reduced to a greater extent and would require longer periods of time to recover at the higher rates of application, one should not automatically dismiss their use. Since Spike is typically aerially applied, it would be very easy for the pilot to adjust rates and turn the applicator on and off as he flew across the landscape. By doing so, the potential exists to create a mosaic of dead, thinned, and untreated sagebrush with varying degrees of understory plants. A heterogeneous mix of vegetation with lots of edge is known to be beneficial for many species of wildlife.

2,4-D Herbicide

Since its introduction in the 1940s, 2,4-D herbicide has been used as a means of controlling sagebrush. Unlike Spike, 2,4-D is a foliar contact herbicide that is most effective when there is adequate soil moisture and plants are actively growing at time of application. Because of these requirements, effective control of sagebrush is often sporadic on the more xeric sites. Control is generally more consistent on the mesic sites dominated by mountain sagebrush because soil moisture is not limiting. In the Gunnison Basin, 2,4-D has been used to control sagebrush on both xeric and mesic sites and we were able to obtain data from both types of sites.

Mesic Sites

A total of 10 mesic sites were sampled that had been treated with 2,4-D from 1 to 15 years prior to 2006. A regression of the relationship between sagebrush cover and age of treatment revealed

that it would take about 8 years for the sagebrush canopy to recover to the minimum of 10% cover for breeding habitat following application of 2,4-D on these mesic type sites. To reach the average of 15% cover suggested for breeding habitat on mesic sites, it would take 12 years for the sagebrush to recover. Based on the sites sampled, it appears that it would take about 9 years following treatment for the canopy cover of other shrubs to recover to the suggested minimum of 5% at mesic sites. Canopy cover of forbs was quite variable, especially in the older treated areas. This may have been partially due to the fact that forbs tend to come and go over the growing season. Since we sampled over the season, our numbers may not reflect the forbs present at any one point in time. Despite this potential problem, we were able to develop a relationship between forb cover and age of treatment which indicated that it would take about 19 years to reach the minimum of 20% cover suggested for breeding habitat in mesic sites. There was no relationship between grass cover and age of treatment with an overall average of 32% cover of grass across the 10 sites. Grass cover was above the 20% minimum for mesic areas at all but one site.

Height of sagebrush, grasses, and forbs was not related to age of treatment for the mesic sites treated with 2,4-D. For sagebrush, four of the 10 sites did not meet the minimum height of 30 cm recommended for breeding habitat at mesic sites. Sagebrush height ranged from 23 to 43 cm with an overall average of 31 cm for the 10 sites. Forb height was fairly consistent and exceeded the minimum of 5 cm for breeding habitat at all sites with an overall average slightly greater than 8 cm. Average grass height ranged from 10 to 21 cm with an overall mean of 14 cm. Height of grass exceeded the suggested minimum of 10 cm for mesic areas at all sites that were sampled.

Xeric Sites

Seven sites were sampled that represented xeric areas treated with 2,4-D from 3 to 22 years prior to 2006. On these dry sites, we found no relationship between canopy cover of sagebrush and age of treatment. Although we had no beginning estimate of sagebrush kill, this response could be partially related to variable degrees of initial sagebrush control among sites. Since 2,4-D is a contact herbicide, the greatest degree of control is generally obtained when there is adequate soil moisture at time of application and the plants are actively growing. These conditions are often lacking in the Gunnison Basin which results in varying degrees of partial sagebrush control. Unlike the mesic sites, none of the xeric sites had sagebrush canopy covers greater than the recommended minimum of 15% for breeding habitat. Sagebrush cover ranged from a low of just over 2% to a high of 13.4% with an overall average of 9%. In comparison, canopy cover of sagebrush in the untreated control areas ranged from 12.2 to 26.3% with a mean of 18.3%. Recovery of sagebrush appears to be relatively slow following treatment in some of these xeric sites.

Canopy cover of other shrubs was above the 5% minimum at all xeric sites treated with 2,4-D. Following control of the sagebrush, there was a release of other shrubs, primarily various species of rabbitbrush. The oldest treated area (1984) had an average cover of other shrubs of 14.1%. This was in comparison to the untreated control sites where cover of other shrubs averaged 7.8%. Similar to the mesic sites treated with 2,4-D, there was no relationship between grass cover and age of treatment. For all xeric sites sampled, grass cover exceeded the recommended minimum of 10% for breeding habitat. Canopy cover of grasses ranged from 11.3 to 20.7% with a mean of

15.9%. For forbs, there was a relationship between cover and age of treatment with the older treated areas having slightly higher forb cover. The majority of both treated and untreated control areas met the minimum standard of 5% forb cover. Because of this, the regression relationship indicated that it would only take 4 years following treatment with 2,4-D for forb cover to meet the 5% minimum. In the older treatments, forb cover ranged from 6.2 (1986) to 7.3% (1984).

Similar to the mesic sites, heights of sagebrush, grasses, and forbs at the xeric sites were not related to age of treatment. For all but one of the sites, sagebrush heights met the minimum standard of 25 cm. The average sagebrush height across the 7 sites was 29 cm. For grasses, all sites had average heights above the 10 cm minimum for breeding habitat with an overall average of 13 cm. Only 2 of the 7 sites did not meet the minimum height standard of 5 cm for forbs, the oldest (1984 - 3.8 cm) and most recently (2003 - 3.3 cm) treated areas. Across all sites, forbs averaged 6 cm in height.

Fire

Wildfire has always occurred naturally in the sagebrush ecosystems of the Gunnison Basin. Prior to the arrival of European man, this was the main factor that set succession back in these systems. After years of fire suppression, the use of prescribed fire has gained in popularity as a tool to manipulate sagebrush ecosystems for various purposes including forage for livestock and habitat for various species of wildlife, including grouse. Of the many tools available for manipulating sagebrush habitat, fire will generally have the longest lasting effect on suppression of the sagebrush. Factors such as size and shape of treatment are also more difficult to control with fire. Since the grouse depend on sagebrush for both cover and food, fire may not be the best choice for improving grouse habitat. Also, prescribed fire is generally best suited for use in the more mesic sites which have enough fine fuels (i.e. understory vegetation) to carry the fire.

Mesic Sites

For the fire treatment, we sampled 16 sites in mesic type areas that had burned under either controlled (12 sites) or natural (4 sites) conditions. The age of the fires ranged from 4 (2002) to 22 years (1984) old at time of sampling in 2006. Sagebrush recovery tended to be very slow in all but 3 of the treated areas. These 3 sites, all treated in 1984, had sagebrush covers that ranged from 9.2 to 15.2%. Sagebrush canopy cover on the remainder of the sites sampled never exceeded 5%, regardless of year of treatment. Covers ranged from 0.2% (two separate sites burned in 1987 or 2001) to 4.6% (1987). Using all 16 sites, the relationship between cover and age of treatment indicated that it would take about 36 years for the sagebrush to recover to the 10% level recommended for breeding habitat in mesic sites. If one were to exclude the 3 sites that exhibited the greatest recovery, then the relationship indicated it would take over 100 years for sagebrush canopy cover to reach the 10% level. Looking only at 1984, we sampled 4 sites where cover of sagebrush ranged from 1.6 to 15.2% which is just another illustration of how long and how variable recovery can be. Taking into account all the data we collected, at best it would take 22 years before sagebrush would meet the 10% cover minimum, about 36 years on average, and potentially up to 100 years for some sites.

There are numerous factors that can affect the speed of sagebrush recovery at a particular site such as slope, aspect, soil type and depth, timing and amount of precipitation the first few years following the burn, and grazing intensity by both livestock and wildlife. All of these factors can affect the response of the understory vegetation. Compared to xeric sites, mesic sites generally have a thicker understory of plants which respond vigorously to removal of sagebrush by fire. If the timing and amount of precipitation is adequate and the grazing intensity can be controlled, then the grasses and forbs become so competitive that they cause the death of most sagebrush seedlings that emerge. If few sagebrush plants survive the initial flush of growth shortly after the burn, then it may take many years for plants to reestablish since the bank of sagebrush seeds in the soil will have been depleted.

For cover of other shrubs, grasses, and forbs, there was basically no relationship to age of treatment. Canopy cover of other shrubs was highly variable ranging from 2.3 to 17.4%. Only 3 of the 16 sites did not meet the 5% minimum for cover of other shrubs. Of all the treatments sampled, forb cover was highest in the burned sites with an overall average of 9.2%. Even so, only one site met the 20% minimum for forb cover in mesic areas. Grass cover was fairly high at all sites, regardless of age of treatment, with an overall average of about 28%. Only 3 of the 16 sites did not meet the minimum standard of 20% for grass cover at mesic sites. Cover of grass ranged from 16.8 to 42.8%.

Sagebrush height met the minimum standard of 30 cm for mesic areas on only 3 of the 16 sites. This would tend to support the idea that the sagebrush was stunted due to competition from the grasses and forbs. Sagebrush height ranged from 18 to 33 cm with an average across all sites of 26 cm. Only four of the sites did not meet the minimum of 5 cm for forb height. Average forb height was quite variable with a range of 4 to 14 cm across sites and an average of 7.5 cm. The grasses were quite vigorous on these mesic burned sites as indicated by the relatively high cover values as well as plant heights. All sites met the minimum standard of 10 cm for grass height with an average of about 17 cm and a range of 13.5 to 25.5 cm.

Brushmow

Brushmowing is a common method of controlling or at least setting back sagebrush. Of the different control methods available, it tends to be one of the shorter lived treatments and have one of the higher costs per acre. For these reasons, this method has not been widely used in the Gunnison Basin in the past. Despite these drawbacks, brushmowing has grown in popularity within the last 10 years as a means of improving habitat for the grouse. With the needs of the grouse in mind, a shorter lived treatment may be ideal. All that may be required is to reduce the canopy cover of sagebrush for a short period of time which will then allow the understory grasses and forbs to respond. Brushmowing also lays down a layer of litter on the soil surface which acts as mulch to improve soil water retention that aids seedling establishment of new grasses and forbs. Depending on height of mowing, not all sagebrush plants will be killed. Many younger plants will be spared while portions of older plants often escape the mower and continue to grow. One of the most important advantages of brushmowing is that it can be used to target removal of sagebrush. Areas of varying sizes can be mowed and they can be mowed in various shapes which create the edge needed by many wildlife species, including grouse. For

these latter reasons, use of brushmowing has gained in popularity in the Gunnison Basin despite the higher cost of implementation.

Xeric Sites

Brushmowing has mainly been applied as a treatment in the Gunnison Basin on the more xeric sites dominated by Wyoming sagebrush. We were able to sample 8 sites that had been treated from 3 to 9 years prior to 2006. Even though the spread in years between treatments was relatively small (6 years), we were able to develop some significant relationships.

Based on the sites sampled, it appears that it would take about 12 years for sagebrush canopy cover to return to the 15% minimum following brushmowing. None of the sites met the minimum for sagebrush cover with a range of 2.1 to 13.4% for sites treated in 2002 and 1997, respectively. The relationship was very weak, but it was determined that it would take about 6 years for other shrubs to achieve the recommended 5% cover. The relationship of cover to age of treatment was also weak for forbs, but it appears that it would take between 4 and 5 years for forbs to reach the 5% cover level. Unlike some of the other treatments, there was a significant grass response, but it was opposite of what might be expected. Grass cover was greatest in the younger treatments and declined as the treatments got older. Although this type of response is possible, it may just be an artifact of the small sample size and where the areas treated at different times were located in the Basin. The sites treated 9 years ago were in areas that were naturally lower in productivity while all but one of the more recently treated sites were in areas of higher productivity. This was confirmed by comparing grass cover in the treated sites to the adjacent untreated controls. Except for that one recently treated site, grass cover did not differ between any of the treated and untreated control sites. Although the relationship of grass cover to age of treatment was questionable, all but one of the sites had grass cover above the recommended minimum of 10%. Grass cover in the brushmowed areas ranged from a low of 7.6% to a high of 31.4% with an overall average of 18.5%.

As with the other treatments, there was no relationship between plant height and age of treatment in brushmowed areas. Only two of the eight treated sites had mean sagebrush heights above the recommended 25 cm minimum. The overall average sagebrush height in the treated sites was 23 cm compared to 36 cm in the untreated controls. Similarly, forb height was only above the recommended minimum of 5 cm in three of the eight treated sites. Forb heights ranged from 2.3 to 8.3 cm with an average of 4.8 cm. For grasses, all but one site met the 10 cm minimum height standard for breeding habitat with an overall average of about 14 cm.