

**Project Title:**

Habitat Assessment and Conservation Strategy for Sage Grouse and Other Selected Species on Buffalo Gap National Grassland

**INTRODUCTION**

Sage grouse have been declining in distribution and numbers throughout their range. This trend has led to proposals for federal listing and designation of sage grouse as a sensitive species in Region 2 of the Forest Service. Along with the sensitive species designation, a 45,760 acre parcel of the Buffalo Gap National Grassland has been identified in the Nebraska National Forest Land and Resource Management Plan 2001 Revision (LRMP) as '3.64 Special Plant and Wildlife Habitat: Sage Grouse Area' SGA (Map 1). This area has had the only sage grouse lek found on the Buffalo Gap National Grassland. Also, Brewer's sparrows (a sagebrush obligate) are on the Region 2 sensitive species list and are known to inhabit this area. Another species that depends heavily on the sagebrush and is known to occur in this area is the sage thrasher. Sagebrush is critical for wintering pronghorn and mule deer also make extensive use of this habitat area.

Sage grouse are a relatively long-lived species with low reproductive rates. They are entirely dependent on sagebrush habitats for successful reproduction and winter survival. Sage grouse populations depend on relatively large expanses of sagebrush-dominated shrub steppe. However, the appropriate patch size needed for winter and breeding habitats used by sage grouse is uncertain. It is likely that this patch size is not a fixed amount but depends on various factors including migration patterns and productivity of the habitat (Connelly et al 2004).

Sage grouse display a variety of annual migratory patterns. Populations may have 1) distinct winter, breeding, and summer areas ; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated summer and breeding areas ; or 4) well integrated seasonal habitats (non migratory populations) (Connelly et al 2000). No studies have been done the migratory patterns of the sage grouse in the SGA.

Annual habitat requirements for sage grouse have been partitioned into 3 categories. 1) Breeding habitat which includes lek attendance, nesting, and early brood rearing. These areas are sagebrush-dominated rangelands with a healthy herbaceous understory. 2) Summer habitats are characterized by relatively moist conditions with succulent forbs in or adjacent to sagebrush cover. These habitats are used by the sage grouse after the forbs begin to dry up in the upland sagebrush community. 3) Winter habitat which is sagebrush (Connelly et al 2000) .

## **VEGETATION**

### **METHODS**

Based on Connelly et al. (2000), the habitat variables that are important to assess in sage grouse habitat are: canopy coverage of sagebrush, height of the sagebrush, canopy coverage of grasses, canopy coverage of forbs, and height of grass-forbs during the nesting period. The optimum values for the key habitat variables are summarized in Table 1.

#### **Cover-Frequency**

To obtain information on canopy coverage and frequency of occurrence, a total of 72 (20 X 30 m) vegetative sampling plots were established throughout the SGA. See Map # 2 for locations of cover-frequency plots mapped using Global Positioning System (GPS).

Care was taken to ensure that the entire range of sagebrush densities were sampled. Each plot was oriented so the 20 x 30 meter rectangle could be established within fairly homogeneous sagebrush density. All plots were marked with a steel fence post and wooden stakes driven at the 4 corners. See Figure 1 for plot layout.

A 20 X 50 cm quadrat frame was used to determine canopy coverage. Quadrates were read at 1 meter intervals along two 30 meter transects for a total of 30 quadrates per transect and 60 per site (Figure 1.). Quadrates were read using methods described in Daubenmire (1959) and USDA (1996). Seven cover classes were used 0-1%, 1-5%, 5-25%, 25-50%, 50- 75%, 75-95%, and 95-100%. In each quadrat frame total cover (total cover was defined as anything in the frame that was not bare ground or rock), bare ground, litter (standing dead vegetation or dead vegetation that was level to the ground), total herbaceous (live plants that are a combination of grasses and forbs), total live grasses, total live forbs, total live shrubs, and canopy coverage for each species was estimated. Midpoints of the cover classes were used to calculate the mean canopy coverage for each transect. These plots were read between June 12 and August 13 of 2003.

Sagebrush canopy coverage was also measured using the line intercept method (USDA 1996) along both 30 meter sides of the Daubenmire plot. The line intercept method is the preferred method for determining shrub canopy cover (Connelly et al. 2003). Only live canopy was used to determine coverage. This measurement was taken at the same time that the canopy coverage quadrates were read.

#### **Sagebrush Height**

Height of the tallest shrub was also measured in each 20 X 50 cm. quadrat frame in which a shrub occurred.

#### **Grass/forb height**

Grass/forb height was measured in each of the plots in October of both 2003 and 2004. A 50 meter line was laid out between the two 30 meter cover frequency transects in each of the 72 macroplots used in the project (Figure 1). A 20 x 50 cm quadrat frame was positioned at one meter intervals along the 50 meter transect line and the droop height was measured for the tallest plant of each of the dominant grass species that occurred

within the quadrature frame. Droop height is defined in Connelly et al (2000) as the highest naturally growing portion of the plant. The grasses species that were measured in each frame, if they occurred, were needle and thread (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), Sandberg's bluegrass (*Poa secunda*), Japanese brome (*Bromus japonicus*), cheatgrass/downy brome (*Bromus tectorum*), green needle grass (*Nassella viridula*) and crested wheatgrass (*Agropyron cristatum*). If a different grass or a forb species was the tallest plant within the quadrature frame, the species was recorded and the droop height was measured and used to calculate the maximum height for the transect. Although buffalograss (*Buchloe dactyloides*) is a dominate species, its droop height was only measured if it was the tallest plant in an individual frame.

### **Sagebrush Density Cover Map**

Aerial photography was completed on linear transects 5,900 ft apart at an altitude of 5000 ft using a Kodak 14-megapixel digital camera with a 24mm Nikon lens. The photograph were taken in the spring and summer of 2003. After the photographs were downloaded they were georeferenced using ARCMAP software.

Based on Connelly et al. (2000), it was determined that the sagebrush in the area should be divided into 4 canopy cover categories: less than 1%, between 1 and 10%, between 10 and 30%, and greater than 30% (Table 1).

A cover map of sagebrush in the SGA was created by first looking at the photos in various scales and determining at which resolution the canopy coverage of sagebrush can be best differentiated. It was determined the best scale to work in was 1:2000. The GPS locations of the cover-frequency plots were then overlaid on the 1:2000 digital aerial photos. Each plot was studied and a set of photos was created to use as keys to differentiate the densities of sagebrush. The aerial photos were examined and lines were drawn separating the different cover classes using ARCMAP software. If there was difficulty in determining the big sagebrush cover class on the aerial photo, the location was noted and the area was ground truthed.

While completing the mapping process, it became evident that additional categories were necessary. The areas in which the dominate soil type was shale are characterized by sparse vegetation and a substantial amount of bare soil. The shale areas were then separated into two separate shrub canopy coverage classifications which were between 1 and 10% and 10 and 30%. Three other categories were created during the process 1). sand sagebrush (*Artemisia filifolia*), 2) silver sagebrush (*Artemisia cana*), and 3). greasewood (*Sarcobatus vermiculatus*).

### **1992 Project**

A similar study was conducted in 1992. The 1984 Land and Resource Management Plan (LRMP) listed pronghorn (*Antilocapra americana*) as the management indicator species (MIS) for the sagebrush habitat. The direction in the LRMP was to provide habitat for MIS at a level no lower than 40% of habitat potential. The objective of the 1992 study was to determine if sagebrush habitat was meeting the direction called for in the 1984 LRMP. The study area was limited to the northwest section of the SGA (Map 3). Canopy cover for sagebrush, grasses, and forbs were sampled using the same

methodology listed above. Droop height was not collected. A sagebrush canopy cover map was developed by taking maps and 1:24000 aerial photos to the field and drawing boundaries on the maps. The categories used for delineating the canopy cover of big sagebrush were different than this study <1% , 1- 5%, 5-15%, and >15% compared to <1% , 1- 10%, 10-30%, and >30%).

## RESULTS

### Canopy Coverage

The areas created using the different categories of canopy cover of sagebrush is displayed in Map #2. The number of acres in each category and the percent of each category of the total is presented in Table 2.

The less than 1% canopy coverage of the big sagebrush category occupies the largest area within the SGA. There were approximately 30,929 acres in this category which is roughly 65% of the total area (Table 2). Nine plots were sampled that lie within the category. The average canopy cover of the big sagebrush was .7% and no other species of shrubs were found. The average canopy coverage of grasses was 64%. The species with the highest canopy coverage was buffalograss (30% ), followed by blue grama (11%), cheatgrass/downy brome (11%), Japanese brome (6%), and western wheatgrass (5%). The grass plant with the highest frequency of occurrence was western wheatgrass (76%), followed by Japanese brome (69%), buffalograss (60%), blue grama (44%) and cheatgrass/downy brome (32%) (Table 3). Other grass species found in this category are listed in Table 3. The average canopy coverage of forbs was 2%. The forb species with the highest canopy coverage was plains pricklypear (*Opuntia polyacantha*) (1%), followed by scarlet globemallow (*Sphaeralcea coccinea*), and false pennyroyal (*Hedeoma hispida*) ( both averaged less than 1%). The forb with the highest frequency of occurrence was scarlet globemallow (22%), followed by false pennyroyal (16%), and plains pricklypear (10%) (Table 3). Other forb species found in this category are listed in Table 3.

In the 1 - 10% big sagebrush canopy coverage category, there were approximately 9,980 acres, which is roughly 21% of the total area (Table 2). There were 23 plots sampled in this category. The average canopy cover of the big sagebrush was 6%, and there were no other species of shrubs found in this category (Table 4). The average canopy coverage of grasses was 48%. The species with the highest canopy coverage in this category was buffalograss (18%), followed by blue grama (11%), threadleaf sedge (*Carex filifolia*) (5%), and western wheatgrass (3%). The grass plant with the highest frequency of occurrence was western wheatgrass (59%), followed by Japanese brome (56%), blue grama (48%), buffalograss (34%), and needle and thread (30%) (Table 4). Other grass species found in this category are listed in Table 4.

The average canopy coverage of forbs was 2%. The species with the highest canopy coverage in this category was fringed sagewort (*Artemisia frigida*), followed by plains pricklypear and false pennyroyal (all less than 1%). The forb with the highest frequency of occurrence was false pennyroyal (19%), followed by scarlet globemallow (14%), and Indianwheat (*Plantago patagonica*) (7%) (Table 4). Other forb species found in this category are listed in Table 4.

In the 11-30% big sagebrush canopy coverage category, there were approximately 2,760 acres which is roughly 6% of the total area (Table 2). There were 28 plots sampled that lie within the category. The average canopy cover of the big sagebrush was 18%. Rubber rabbitbrush (*Ericameria nauseosa*) was the other shrub recorded in this category and its cover averaged less than 1% (Table 5). The average canopy coverage of grasses was 40%. The species with the highest canopy coverage in this category was cheatgrass/downy brome (8%), followed by blue grama (8%), buffalograss (7%), Japanese brome (3%) and threadleaf sedge (3%). The grass plant with the highest frequency of occurrence was Japanese brome (53%), followed by western wheatgrass (46%), blue grama (39%), Sandberg's bluegrass (30%), and needle and thread (26%) (Table 5). Other grass species found in this category are listed in Table 5.

The average canopy coverage of forbs was 1%. The species with the highest canopy coverage in this category was plains pricklypear followed by fringed sagewort and false pennyroyal (all averaged less than 1%). The forb with the highest frequency of occurrence was false pennyroyal (15%), followed by plains pricklypear (8%), scarlet globemallow (7%), and Indianwheat (6%) (Table 5). Other forb species found in this category are listed in Table 5.

In the greater than 30% big sagebrush canopy coverage category there were approximately 223 acres which is less than 1% of the total area (Table 2). There were 7 plots sampled that lie within the category. The average canopy cover of the big sagebrush was 33% and there were no other species of shrubs found in this category (Table 6). The average canopy coverage of grasses was 32%. The species with the highest canopy coverage in this category was cheatgrass/downy brome (11%), followed by Japanese brome (5%), threadleaf sedge (3%), needle and thread (3%) and blue grama (2%). The grass plant with the highest frequency of occurrence was Japanese brome (67%), followed by cheatgrass/downy brome (49%), needle and thread (43%), Sandberg's bluegrass (37%) and western wheatgrass (30%), (Table 6). Other grass species found in this category are listed in Table 6. The average canopy coverage of forbs was 2%. The species with the highest canopy coverage in this category was plains pricklypear followed by false pennyroyal, and fringed sagewort (all averaged less than 1% canopy coverage). The forb with the highest frequency of occurrence was false pennyroyal (23%), followed by fringed sagewort (9%), plains pricklypear (7%), scarlet globemallow (6%), and Indianwheat (6%) (Table 6). Other forb species found in this category are listed in Table 6.

The last categories in which plots were established were the shale banks. These areas were further separated into two groups 1-10% shrub cover and 11-30% shrub cover. In the 1-10% shrub cover category there were approximately 1,365 acres which is about 3% of the total area (Table 2). In the 11-30% shrub cover category there were approximately 222 acres which is less than 1% of the total area (Table 2). There were five plots sampled that lie within these categories (2 in the 1-10% category and 3 in the 11-30% category). Both of the areas were characterized as having high bare ground (greater than 66%) and low herbaceous cover (less than 11%). The average canopy cover of the big sagebrush was 4% and rubber rabbitbrush 5% in the 1-10% category. The average canopy cover of the big sagebrush was 13% and rubber rabbitbrush 4% in the 11-30% category (Tables 7 & 8). The average canopy coverage of grasses was 9% in both categories. The species

with the highest canopy coverage in this category was western wheatgrass in both categories. This was also the case for frequency of occurrence. Both shale categories had canopy coverage of forbs of less than 4%. Other forb species found in the shale banks are listed in Tables 7 & 8.

Three other categories were created during the process sand sagebrush, silver sagebrush, and greasewood. No plots were established in this cover type.

### **Height of Sagebrush**

A summary of the number of sagebrush plants measured and their average height for each of the density categories is presented in Table 9. The average height of sagebrush for all areas combined was 44.2 cm. In the less than 1% sagebrush cover category, 14 plants were measured, and their average height was 32 cm. In the 1 to 10% sagebrush category, 223 plants were measured, and their average height was 39 cm. In the 10 to 30% sagebrush category, 675 plants were measured, and their average height was 44 cm. In the greater than 30% sagebrush cover category, 272 plants were measured, and their average height was 51 cm. With exception of the less than 1% cover category, all of the categories appear to meet the height guidelines suggested in Connelly et al (2000) for productive sage grouse habitat, which is a minimum of 40 cm.

### **Height of the Herbaceous Vegetation**

The height of the dominant plants are presented in Table 10, and the results are displayed in Figure 2. There was very little difference in the height of each species between sagebrush cover types, but there is a considerable difference between plants measured in 2003 and 2004. The average height for western wheatgrass across all sagebrush canopy coverage types in 2003 was 24.8 cm compared to 12.4 cm in 2004, for Japanese brome it was 24.9 cm in 2003 compared to 15.3 cm in 2004, for Sandberg's bluegrass it was 28.3 cm in 2003 compared to 14.3 cm in 2004, for needle and thread it was 37.3 cm in 2003 compared to 15.7 cm in 2004, for blue grama it was 19.7 cm in 2003 compared to 14.6 cm in 2004, for crested wheatgrass it was 41.5 cm in 2003 compared to 18.8 cm in 2004, and for green needlegrass it was 53.5 cm in 2003 compared to 18.8 cm in 2004. The average maximum height measured for each plot was 33.0 cm in 2003 compared to 10.2 cm in 2004.

### **Range sites**

The sagebrush cover map (Map 2) shows an apparent belt of sagebrush that runs from the northwest corner of the SGA to the south central portion. Using ARCVIEW software and placing the sagebrush cover layer over a range site cover layer of the SGA, it appears most of the sagebrush is located in the shallow, shallow clay, grummit shallow clay and thin upland range sites (Map 4). We do not have the expertise to do an analysis of the data and relate it back to soils, but it is notable that most of the sagebrush occurs on the less productive soils.

### **Comparison of 1992 study**

The results of the 2003 study compared to the 1992 study are very similar. Even though the categories used to classify the canopy coverage of sagebrush were different, the measured value for the canopy coverage of sagebrush within each category was similar

(Figure 3). For this reason it was decided to put the 1992 values into the 2003 classification categories and use a direct comparison.

The height of the sagebrush was greater in all categories in 2003 compared to 1992 (Figure 4). The canopy coverage of grasses (Figure 5) and forbs (Figure 6) were slightly higher in 1991 compared to 2003. The percent of the area in the different canopy coverage classifications are similar (Figure 7). Although no statistics have been completed on any of these variables, it is very doubtful that there are any significant differences between the two different studies. It appears the sagebrush community within the SGA has not change significantly in 11 years.

## **DISCUSSION**

Annual habitat requirements for sage grouse have been partitioned into 3 categories breeding habitat, brood rearing habitat, and winter habitat. Table 11 summarizes the data collected and presents the optimum habitat characteristics for productive sagebrush habitat for the different sage grouse habitat categories (Connelly et al. 2000). A cursory look at the data indicates the SGA was lacking in amount of sagebrush that contains the optimum canopy coverage of sagebrush, canopy coverage of forbs, and droop height in 2004. The height of the sagebrush, canopy coverage of grasses and droop height of herbaceous vegetation in 2003 fell within the optimum values for productive sage grouse habitat.

In the 11-30% and greater than 30% categories, all of the optimum habitat values are met with the exception of percent canopy coverage of forbs and droop height of the grass-forb component in 2004. The problem is there is not enough of the area in these categories. Connelly et al (2000) states that a minimum of 80% of an area should meet these criteria in the breeding season and winter and a minimum of 40% of an area should meet these criteria during brood-rearing.

The optimum values for canopy coverage of sagebrush is 15-25% for breeding habitat, 10-25% for brood rearing habitat and 10-30% for winter habitat. Only 7% of the total area of the SGA was classified to have canopy coverage of sagebrush that is 10% or greater. If the 1-10% sagebrush cover category were added it would bring the total to 35% of the total area. This would bring the area close to providing enough habitat for brood rearing (40% of the total area) but still falls far below values required for breeding and winter habitat (80% of the total area). This points out the limiting factor for sage grouse productivity in the SGA is amount of sagebrush.

The SGA is located on the eastern edge of the dominant sagebrush communities. It is difficult to assess if the lack of sagebrush in the area is a result of management or if it is a natural occurring phenomena that occurs as sagebrush community melds into the adjoining grasslands community.

The optimum herbaceous cover for breeding habitat is greater than 25% and for brood rearing habitat is greater than 15%. The entire sage grouse management area meets these minimum with the exception of the shale areas (greasewood, sand sagebrush and silver sagebrush areas were not measured but it is reasonable to assume they will have greater than 25% herbaceous cover). The problem is there are not enough forbs in the SGA. Connelly et al. (2000) states that herbaceous cover should exceed 15% for perennial

grasses and 10% forbs in breeding or brood rearing habitat. The highest canopy coverage of forbs occurred on the shale area and was 3.27%. All the rest of the canopy coverage of forbs were less than that.

The optimum height of the herbaceous cover in breeding habitat is droop height that is greater than 18 cm (Connelly et al 2000). The droop height obtained in 2003 are considerably higher than the minimum value of 18 cm needed for productive sagebrush habitat (Connolly et al 2000) (Figure 2 & Table 10). The droop heights of herbaceous vegetation in the areas which meet the Connelly et al (2000) criteria as have sufficient sagebrush cover to be classified as productive sage grouse habitat (11-30% and >30% sagebrush canopy cover) are nearly twice as high (34.4 & 38.8 cm respectively) as the optimum value (18 cm). Considering that precipitation measured in Edgemont in 2003 was 1.38 inches below average (Figure 8), it would follow that plant production in 2003 was below average. It can be surmised that in years when the precipitation is at or above average the 18 cm value for droop height will be exceeded which should lead to adequate cover for nesting and brood rearing.

The cover values obtained in 2004 are lower than the minimum value 18 cm needed for productive sagebrush habitat (Figure 2 & Table 10). In 2004, the Edgemont rain gauge recorded 11.68 inches of precipitation, which is 4.39 inches below average (Figure 8). It is safe to assume that in years of low precipitation, the plant production will be low which is reflected in the low droop height measurements. This will affect sage grouse ability to hide their nests and raise their young.

There are some inherent problems with the data collected on this study when it is compared to the data presented in Connelly et al (2000). It is traditional to measure droop height in late May and early June, which coincides with hatching of the sage grouse Connelly et al (2003). Because of personnel limitations we chose to do this measurement in October. Comparing visual obstruction data collected using a Robel pole in the fall to data collected in the spring, there is a correlation of  $\text{Spring VOR} = (.47 \times \text{Fall VOR}) + .93$  (USFS unpublished data). The spring Robel data was collected at nest initiation which was early in the spring before green up. This could influence the data. All things considered, it appears that in years of at or above average precipitation there will be ample cover for breeding and early brood rearing activities.

Appendix A displays pictures of the plots taken in 2003 and 2004. The difference in cover between the two years is obvious. The real questions are: what are the proper stocking rates for the area, and what adjustments should be made in below average precipitation years? It will take some long term studies to determine this information.



## **WILDLIFE**

### **METHODS:**

#### **Grouse leks**

Grouse lek surveys for both sage grouse and sharp-tailed grouse were conducted in the spring during mating season when male grouse are actively displaying on the leks. The surveys started about ½ hour before sunrise and ended 2-3 hours after sunrise. The SGA was surveyed from a sports utility vehicle seeking out areas with good vantage points and looking and listening for birds. Care was taken to see all of the areas in the SGA. A parabolic microphone was used to listen for the characteristic sounds made by the males on the display grounds. Observation was aided by the use of 8X40 binoculars and a 45X60 spotting scope. When a lek was found the numbers of birds and activity level were recorded.

Also, known lek locations in the area were visited and the number of birds on each lek was recorded and activity level noted. If there were no birds in the lek area it was walked looking for sign of bird activity (scat, feathers, etc.).

Before 1991, there was one known sage grouse lek in the SGA that was visited periodically by various people, but to our knowledge no formal surveys were conducted. In 1991 & 1992 a cooperative sagebrush study between the South Dakota Game Fish and Parks and the Forest Service was completed and the area was searched methodically looking for additional leks. Starting in 1993 and continuing until 1998 the established lek sites located in the 1991 & 92 surveys were visited at least once a year. While driving between lek sites any grouse (sage or sharp-tailed) encountered were recorded but no attempt was made to do a systematic search of the area. In 1999 a thorough search of the SGA was once again conducted. From 2000-2002 the leks that were found in the 1999 surveys were visited at least once a year. In 2003 this study was initiated and complete surveys of the area were conducted in the spring of 2003, 2004, and 2005.

### **Results**

#### **Sage Grouse**

Before 1991 there was an established sage grouse lek that was checked periodically by different individuals. This lek was located in the vicinity of 48GL002 (Map 5). Between 3 and 8 birds were observed on the lek at different times. A summary is presented in Table 12.

During the 1991-2, survey there were no birds found at or near lek site 48GL002. However, 17 sage grouse were observed at a lek site approximately ¾ of a mile to the north (this site is labeled 49GL004 on Map 5). One other sage grouse was seen displaying in 1991 (this site is labeled 48GL001 on Map 5).

Sage grouse numbers at lek 49GL004 reached a high of 17 in 1991 and varied between 14 and 2 until 2003 at which time 0 birds were observed (Table 13). In 2003 a total of four sage grouse hens were observed in the study area (not at lek) and one sage grouse dropping (not fresh) was found on the current sage grouse lek (49GL004 Map 5) on April 9. No males were seen. In 2004 no sage grouse were observed anywhere in the

study area during the courtship and nesting seasons. In 2005 one male was seen displaying. (48GL005 Map 5) .

### **Sharp-tailed grouse**

No sharp-tailed grouse leks were located during the 1991-2 surveys. There was one bird that was believed to be a sage/sharp-tailed hybrid displaying on lek 49GL004 (Map 5) in 1991. In 1998, two sharp-tailed grouse leks were located in the SGA while doing the sage grouse lek surveys. In 1999, when the complete search was repeated, 7 leks were located, and a total of 43 birds were observed on these leks. In 2003, 9 leks were found, and a total of 52 sharp-tails were observed on the display grounds. In 2004, 5 leks were found, and a total of 25 sharp-tails were observed on the display grounds. In 2005, 4 leks were found, and a total of 22 sharp-tails were observed on the display grounds (Table 14) (Map 6).

## **DISCUSSION**

### **Sage grouse**

Sage grouse have been on the decline across their range for a considerable amount of time and the grouse population within the SGA seems to have followed the same trend. The highest number of sage grouse observed on any lek occurred in 1991 (49GL004 -17 sage grouse), which was the first year that a documented survey took place. In 2003 with the exception of a few incidental sightings, sage grouse had disappeared from the area.

It is impossible to determine the cause of the disappearance of sage grouse from the area. It could be management of the area or a natural occurrence. A Range Allotment Management Plan was written in May of 1991. Within this plan, there was a slight reduction in overall Animal Unit Months authorized for grazing (Approximately 650 AUM's or 4%). There were some season of use changes, turn out date changes, and livestock rotation changes. All of the changes were made with the objective of improving the overall health of the range and to bringing the area into compliance with the LRMP written in 1984. Comparing vegetation data collected in 1992 to data collected in 2003, the changes were slight, with the only difference that could have an impact on sage grouse population being the reduction in forbs. Considering that in both years the canopy coverage of forbs is below the optimum value it is doubtful that canopy cover of forbs is a major factor in the disappearance of sage grouse. One coinciding event that occurred in western South Dakota with the disappearance of sage grouse was an outbreak of the West Nile Virus, which has been known to affect sage grouse.

### **Sharp-tailed grouse**

The SGA is marginal sharp-tailed grouse habitat. The optimal habitat in South Dakota lies in the central part of the state where the average annual precipitation is around 18 inches, which is about 2 inches more than in the SGA (16 inches) (Figure 8). A sharp-tailed grouse nesting study conducted on the Fort Pierre National Grassland found the birds need a minimum of 1350 lbs / acre production to hide their nests (unpublished report). Sixty nine percent of the SGA is comprised of soils that are not capable of producing this much vegetation unless growing conditions are ideal (ample moisture

during the growing season) (USDA Soil Conservation Service & Forest Service 1980) (Table 15).

From 1984 -1989, 4 of the 5 years were below average precipitation (Figure 8) and most likely resulting in below average plant production. It would follow that sharp-tailed grouse numbers would be low and no sharp-tailed grouse were found on the SGA when thorough searches were conducted in 1991 & 1992. In the 1990's, in 7 out of 10 years, the SGA received above average precipitation. The average annual precipitation from 1990-1999 at the Edgemont rain gage was 17.76 (maximum for the period occurred in 1998 which was 24.28 inches and the minimum occurred in 1994 which was 12.19 inches) (Figure 8). We do not have production data on the area but the result of high moisture would be high vegetative production, which was beneficial to sharp-tailed grouse and resulted in significant population increases. The precipitation 2002 – 4 has been less than average, and we have started to see a decline in the sharp-tailed grouse numbers.

Sharp-tailed grouse did not just mysteriously appear in the SGA in 1998. Local people reported seeing sharp-tailed grouse regularly in their shelterbelts in the winter prior to 1998 and have seen them periodically on their pastures in the summer. It appears that sharp-tailed grouse have always lived in the area and are able to expand when favorable condition are present.

## **BIRD POINT COUNTS**

### **Methods**

Bird point counts were completed on all 72 of the established sagebrush plots in 2003 & 2004. Counts were conducted from 5:00 AM – 7:30 AM MDT from June 5 –June 19, 2003 and from June 8 – June 24, 2004. Counts were kept for birds observed at less than 50 meters and greater than 50 meters and for 3 minutes and 3 – 5 minutes periods. Those birds flying over were recorded separately. An attempt was made to only count birds observed in vegetation similar to the plot vegetation.

### **Results**

In both 2003 & 2004 the western meadowlark was the most common bird detected on all of the different sagebrush canopy coverage types (Tables 16-19). In the less than 1% sagebrush canopy coverage type, the grasshopper sparrow was the next most common species, followed by the lark bunting and horned lark (Table 16). In the 1 – 10% sagebrush canopy coverage type, the lark bunting was the next most common species, followed by the grasshopper sparrow and Brewer's sparrow (Table 17). In the 10-30% sagebrush canopy coverage type, the lark bunting was the next most common species, followed by the Brewer's sparrow and grasshopper sparrow (Table 18). In the greater than 30% sagebrush canopy coverage type, the lark bunting was the next most common species followed by the Brewer's sparrow and brown-headed cowbird. (Table 19).

### **Discussion**

The western meadowlark and the grasshopper sparrow numbers decrease as the sagebrush canopy increases, and the opposite is true for the Brewer's sparrow and the lark bunting (Figure 9).

There were more total birds observed in 2003 than 2004 (883 in 2003 compared to 601 in 2004). The notable difference was a decrease in grasshopper sparrow observations (86 in 2003 to 7 in 2004) and an increase in horned lark observations (4 in 2003 and 16 in 2004). Grasshopper sparrows prefer high cover grasslands and responded negatively to the lack of production caused by the low precipitation in 2004. The opposite is true for the horned lark.

## **MANAGEMENT RECOMMENDATIONS**

Dominant factors that influence the sagebrush ecosystem that are relevant in the SGA include fire (prescribed & wild), brush control (includes applications of herbicides and mechanical), pesticides, invasive species (the most prevalent being cheatgrass/downy brome), energy development (coal, oil, and natural gas) and livestock grazing (includes infrastructure built to accommodate grazing).

Rather than repeat management recommendations that are listed in the 2001 LRMP, all of the references to the sagebrush habitat and sage grouse that are in the plan are listed in Appendix B. The appropriate references to the 2001 LRMP are provided at the end of each section.

### **Fire**

In general, fire reduces the sagebrush, at least in the short term. Most sagebrush species are intolerant of fire and are killed, with the exception of threetip (*Artemisia tripartita*) and silver sagebrush, which are sprouters. Re-establishment of sagebrush on a site after fire requires available seed, appropriate conditions for germination and survival of a seedling. Recovery of sagebrush canopy cover to pre-burn levels may require 20 years or longer.

Fire may benefit sage grouse by enhancing nesting and brood-rearing habits and increase forb production. Considering that canopy coverage of sagebrush is most likely the limiting factor for sage grouse in the SGA, short-term benefits such as increased forb production may not balance the loss of sagebrush canopy required by sage grouse during the nesting season and winter.

Wildfire in the SGA should be suppressed as soon as possible, and prescribed burning for managing sage grouse habitat should be used cautiously and on a site-by-site basis if at all.

2001 LRMP Reference-Chapter 2-page 38 (Appendix B).

### **Brush control**

Brush control methods, both mechanical and the application of herbicide, have been used widely to eliminate sagebrush across the sagebrush ecosystem. Within the SGA, there are definite strips on the ground where there is a conspicuous absence of sagebrush and it is obvious that some type of control has been applied. After some research, it was discovered that these areas had been sprayed with chemical herbicide with the objective of eliminating sagebrush to increase grass production. The actual spraying records cannot be found, so it is not possible to document the exact dates, locations, or chemicals used. Conversations with landowners have verified the spraying, and there are photographs of a helicopter with the spraying units attached in the Forest Service files.

Connelly et al (2002) states the effects of spraying seemed more severe if the treated area was subsequently seeded to crested wheatgrass. There are several areas in the SGA that have been reseeded to crested wheatgrass.

Taking into account that canopy coverage and density of sagebrush is most likely the limiting factor for sage grouse in the SGA, no chemical herbicide should be applied to the area with the objective of eliminating sagebrush, and care should be taken by spray crews that are attempting to kill noxious weeds to avoid killing sagebrush.

Mechanical control is applied to areas in which the brush has become too thick. There are only 223 acres of sagebrush within the SGA that have a canopy coverage over 30%. The average canopy coverage of these areas is 32.7%, which is a few percentage points over the optimum value for winter sage grouse habitat (30%). No mechanical control of sagebrush will be needed in the SGA.

2001 LRMP Reference-Chapter 2-page 2-38 (Appendix B).

### **Pesticides**

Application of pesticides, often for grasshopper (Orthoptera) control, may affect sage grouse by decreasing available prey (Rowland 2004). Sage grouse chicks require insects for survival during the first few weeks of life, and the quantity of insects available is related to both survival and growth of chicks. Pesticides also poison birds through ingestion of contaminated insects or plant materials treated as bait. Spraying of herbicides not only eliminates large blocks of sagebrush, leading to increased habitat fragmentation, but also may poison insects and other invertebrates eaten by sage grouse. Application of herbicides or pesticides in sage grouse habitats, particularly during nesting or brood-rearing periods, should be avoided.

### **Invasive species**

An invasive species is defined as a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Although other invasive species occur in the SGA (e.g. Canadian thistle) cheatgrass/downy brome poses the greatest threat within the sagebrush community. Cheatgrass/downy brome readily out-competes native plant species for water and nutrients (Connelly et al, 2004). The density and structure of standing dead cheatgrass/downy brome results in increased flammability when compared to native species and leads to increased fire intensity and frequency.

Cheatgrass/downy brome is abundant on the SGA. It varied from a 1% canopy coverage and 8% frequency of occurrence in the 1-10% sagebrush canopy category to 11% canopy coverage and 49% frequency of occurrence in the greater than 30% sagebrush canopy category.

Connelly et al. (2004) cites Billings who states that it is not possible to remove or control cheatgrass/downy brome once it dominates a sagebrush community. At the present time the only way to attempt to keep cheatgrass/downy brome under control is through sound livestock management.

### **Energy development and construction.**

Resource extraction for energy development has been widespread throughout sagebrush-steppe habitats. Negative impacts on sage grouse populations could occur as a result of the construction of refineries, pumping stations, and other facilities associated with mineral development (Rowland 2004).

Currently there is one producing oil well within the SGA. There are standards in the Revised LRMP that apply to construction projects, and oil and natural exploration and production.

2001 LRMP Reference-Chapter 2-page 2-38 (Appendix B).

2001 LRMP Reference-Appendix D page D-9 & d-16 (Appendix B).

### **Livestock grazing.**

Grazing by livestock has occurred over virtually the entire range of sage grouse and its influence on sage grouse habitat is perhaps the most pervasive of any land management practice (Rowland 2004). Before European man arrived on the continent, in northern, eastern, and more mesic regions of the sagebrush biome grazing by buffalo was the primary agent disturbance. This makes this area more compatible with livestock grazing than other areas in the sagebrush biome. However, introduction of domestic livestock by European man did increase, at the least, the frequency of grazing.

Grazing and its effects on the density and canopy of sagebrush is controversial, and there is little direct experimental evidence linking grazing practices to sage grouse population levels (Connelly et al 2004). However, grass height and cover affect sage grouse nest site selection and success. Thus, indirect evidence suggests grazing by livestock or wild herbivores that significantly reduce the herbaceous understory in breeding habitat may have negative impacts on sage grouse populations (Connelly et al 2000). Improper grazing can also facilitate invasions by exotic plants species (Connelly et al 2004).

All of the units within the SGA are permitted for grazing. A map of the individual allotments and pastures is displayed on Map 7. An Allotment Management plan was prepared in 1991 (on file at the Fall River Ranger District) which brought the area into compliance with the 1984 LRMP. Specific grazing plans for each allotment are contained in the plan, and actual use records are on file at the Fall River Ranger District. Appendix C lists all of the allotments and pastures in the SGA and the number of acres and percentage of the pasture in each sagebrush canopy cover category.

The revised LRMP set the criteria for which pastures sagebrush management should be emphasized:

Pastures will be managed for sage grouse/big sagebrush only if they contain 5% or more canopy cover of big sagebrush. **Guideline**

To determine the percent sagebrush in each pasture a weighted mean was calculated using the average sagebrush canopy cover value for each category and the number of acres present in each pasture in each category. Eleven pastures were identified (Map #8) (Appendix C).

A revised LRMP was signed in 2001 and a new Allotment Management Plan will be prepared.

The first objective in the management of the area has to be to increase or maintain the amount of sagebrush on the area.

2001 LRMP Reference-Chapter 1-page 1-7 (Appendix B).

2001 LRMP Reference-Chapter 2-Objectives-Composition-page 2-35 & 2-36 (Appendix B).

2001 LRMP Reference-Chapter 2-Standards and Guidelines-Vegetation page 2-37 (Appendix B).

2001 LRMP Reference-Chapter 2-Standards and Guidelines-Sage grouse page 2-39 (Appendix B).

2001 LRMP Reference-Appendix H-page H-5 & H-6 (Appendix B).

The second is objective to increase the amount of forb cover and herbaceous cover for nesting and brood rearing.

2001 LRMP Reference-Chapter 2-Objectives-Structure-page 2-36 (Appendix B).

2001 LRMP Reference-Chapter 2-Objectives-Rest-page 2-37 (Appendix B).

2001 LRMP Reference-Appendix H-page H-5 & H-6 (Appendix B).

An additional effect that livestock have on the landscape which can effect sage grouse is the infrastructure that is built to facilitate the animals. These include fences, water developments, feeders etc.

2001 LRMP Reference-Chapter 2-Standards and Guidelines-Infrastructure page 2-38 (Appendix B).

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Tables.

Table 1. Characteristics of big sagebrush rangeland needed for productive sage grouse habitat (Connelly et al 2000).

	<b>Breeding</b>		<b>Brood-rearing</b>		<b>Winter</b>	
	Height(cm)	Canopy(%)	Height(cm)	Canopy(%)	Height(cm)	Canopy(%)
Mesic sites <sup>a</sup>						
Sagebrush	40-80	15-25	40-80	25-Oct	25-35 e	30-Oct
Grass-forb	>18 <sup>c</sup>	≥25 <sup>d</sup>	variable	>15	N/A	N/A
Arid sites <sup>a</sup>						
Sagebrush	30-80	15-25	40-80	25-Oct	25-35	30-Oct
Grass-forb	>18 <sup>c</sup>	≥15	variable	>15	N/A	N/A
Area <sup>b</sup>	>80		>40		>80	

<sup>a</sup> Mesic and arid sites should be defined on a local basis; annual precipitation, understory, and soils should be considered (The SGA is a mesic area)

<sup>b</sup> Percentage of seasonal habitat needed with indicated conditions.

<sup>c</sup> Measured as “droop height”; the highest naturally growing portion of the plant.

<sup>d</sup> Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral growth.

<sup>e</sup> Values for height and canopy coverage are for shrubs exposed above the snow.

Table 2. Summary of big sagebrush canopy coverage in the sagebrush management area.

Sagebrush Density Classification	Acres	% of the area
<1 %	30,929	64.5
1-10%	9,979	20.8
11-30%	2,764	5.8
>30%	223	0.5
Shale Breaks 11-30%	222	0.5
Shale Breaks 1-10%	1,365	2.8
Silver sagebrush	141	0.3
Sand sagebrush	14	0.0
Greasewood	2,335	4.9
Grand Total	47,971	100.0

Table 3. Canopy coverage of plants in the less than 1 % big sagebrush category (9 areas sampled)

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		85.38	100.00
Bare Ground		14.55	98.70
Litter		84.51	100.00
Total Herbaceous		65.54	99.81
Total Grass		63.72	99.81
Total Forb		2.14	42.59
Total Shrub *		0.68	
<b>Shrubs</b>			
Big sagebrush*	<i>Artemisia tridentata</i>	0.68	
<b>Grasses and Grasslike</b>			
Buffalograss	<i>Buchloe dactyloides</i>	29.71	60.37
Blue grama	<i>Bouteloua gracilis</i>	10.78	44.44
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	10.58	32.41
Japanese brome	<i>Bromus japonicus</i>	6.22	68.70
Western wheatgrass	<i>Pascopyrum smithii</i>	4.53	75.56
Sandberg's bluegrass	<i>Poa secunda</i>	1.58	27.04
Needle and thread	<i>Hesperostipa comata</i>	0.45	10.74
Sixweeks fescue	<i>Vulpia octoflora</i>	0.44	27.22
Crested wheatgrass	<i>Agropyron cristatum</i>	0.35	8.89
Needleleaf sedge	<i>Carex duriuscula</i>	0.31	8.33
Threadleaf sedge	<i>Carex filifolia</i>	0.17	0.74
Red threeawn	<i>Aristida purpurpea</i>	0.09	2.22
Green needlegrass	<i>Nassella viridula</i>	0.05	3.89
Prairie Junegrass	<i>Koeleria macrantha</i>	0.01	0.37
Sand dropseed	<i>Sporobolus crytandrus</i>	0.00	0.19
<b>Forbs</b>			
Plains pricklypear	<i>Opuntia polyacantha</i>	1.05	10.37
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	0.63	22.04
False pennyroyal	<i>Hedeoma hispida</i>	0.47	15.56
Fringed sagewort	<i>Artemisia frigida</i>	0.08	2.22
Prairie goldenpea	<i>Thermopsis rhombifolia</i>	0.05	1.30
Dandelion	<i>Taraxacum officinale</i>	0.03	3.15
Manyflower stickseed	<i>Hackelia floribunda</i>	0.02	1.67
Slimflower scurfpea	<i>Pediomelum tenuiflora</i>	0.01	0.56
Indianwheat	<i>Plantago patagonica</i>	0.01	2.04
Tall breadroot scurfpea	<i>Pediomelum cuspidata</i>	0.01	0.37
Wavyleaf thistle	<i>Cirsium undulatum</i>	0.00	0.19
Missouri pincushion	<i>Coryphantha missouriensis</i>	0.00	0.19
Rush skeletal plant	<i>Lygodesmia juncea</i>	0.00	0.56

Fragile pricklypear	<i>Opuntia fragilis</i>	0.00	0.56
Rock jasmine	<i>Androsace septentrionalis</i>	0.00	0.37
Salsify	<i>Tragopogon dubius</i>	0.00	0.37
Horseweed	<i>Conyza canadensis</i>	0.00	0.19
Scarlet gaura	<i>Gaura coccinea</i>	0.00	0.19
Stiffstem flax	<i>Linum rigidum</i>	0.00	0.19

\* Cover was measured using Line Intercept

Table 4. Canopy coverage of plants in the 1-10 % big sagebrush category (23 areas sampled).

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		78.52	100.00
Bare Ground		21.06	99.93
Litter		77.93	100.00
Total Herbaceous		50.38	99.93
Total Grass		48.25	99.64
Total Forb		2.32	52.61
Total Shrub *		5.60	
<b>Shrubs</b>			
Big sagebrush*	<i>Artemisia tridentata</i>	5.60	
<b>Grasses and Grasslike</b>			
Buffalograss	<i>Buchloe dactyloides</i>	18.40	33.99
Blue grama	<i>Bouteloua gracilis</i>	9.09	48.04
Threadleaf sedge	<i>Carex filifolia</i>	4.67	24.57
Western wheatgrass	<i>Pascopyrum smithii</i>	3.23	59.13
Japanese brome	<i>Bromus japonicus</i>	2.94	56.38
Needle and thread	<i>Hesperostipa comata</i>	2.31	29.64
Crested wheatgrass	<i>Agropyron cristatum</i>	1.07	4.93
Sandberg's bluegrass	<i>Poa secunda</i>	1.04	28.12
Green needlegrass	<i>Nassella viridula</i>	0.83	11.88
Red threeawn	<i>Aristida purpurpea</i>	0.81	8.26
Sideoats grama	<i>Bouteloua curtipendula</i>	0.60	2.90
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	0.47	8.26
Prairie Junegrass	<i>Koeleria macrantha</i>	0.23	6.30
Sixweeks fescue	<i>Vulpia octoflora</i>	0.17	11.96
Needleleaf sedge	<i>Carex duriuscula</i>	0.11	5.14
Squirreltail	<i>Elymus elymoides</i>	0.06	0.72
Inland saltgrass	<i>Distichlis spicata</i>	0.04	3.91
Alkali sacaton	<i>Sporobolus airoides</i>	0.04	0.72
Indian ricegrass	<i>Achnatherum hymenoides</i>	0.02	0.22
Sand dropseed	<i>Sporobolus cryptandrus</i>	0.02	0.43
Little barley	<i>Hordeum pusillum</i>	0.01	0.43
	<i>Schedonnardus paniculatus</i>		
Tumblegrass		0.00	0.07
Bluebunch wheatgrass	<i>Pseudoroegneria spicata</i>	0.00	0.07

<b>Forbs</b>			
Fringed sagewort	<i>Artemisia frigida</i>	0.55	5.72
Plains pricklypear	<i>Opuntia polyacantha</i>	0.49	7.03
False pennyroyal	<i>Hedeoma hispida</i>	0.37	19.20
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	0.31	14.20
Indianwheat	<i>Plantago patagonica</i>	0.15	7.25
Hood's phlox	<i>Phlox hoodii</i>	0.12	5.87
Broom snakeweed	<i>Gutierrezia sarothrae</i>	0.10	3.12
Dwarf alyssum	<i>Alyssum desertorum</i>	0.06	4.13
Heath aster	<i>Symphiotrichum ericoides</i>	0.05	2.25
Stiffstem flax	<i>Linum rigidum</i>	0.05	5.00
Tufted milkvetch	<i>Astragalus spatulatus</i>	0.03	0.14
Stemless hymenoxys	<i>Hymenoxys acaulis</i>	0.03	0.80
American vetch	<i>Vicia americana</i>	0.03	2.03
Salsify	<i>Tragopogon dubius</i>	0.02	0.87
Dotted gayfeather	<i>Liatris punctata</i>	0.01	0.29
Lacy tansyaster	<i>Machaeranthera pinnatifida</i>	0.01	0.22
Dandelion	<i>Taraxacum officinale</i>	0.01	0.43
Missouri pincushion	<i>Coryphantha missouriensis</i>	0.01	0.36
Littleleaf eriogonum	<i>Eriogonum pauciflorum</i>	0.01	0.36
Curlycup gumweed	<i>Grindelia squarrosa</i>	0.01	0.51
Creamy poison vetch	<i>Astragalus racemosus</i>	0.01	0.22
Fineleaf hymenopappus	<i>Hymenopappus filifolius</i>	0.01	0.22
Missouri milkvetch	<i>Astragalus missouriensis</i>	0.00	0.14
Bastard toadflax	<i>Commandra umbellata</i>	0.00	0.43
Rock jasmine	<i>Androsace septentrionalis</i>	0.00	0.29
Slimflower scurfpea	<i>Pediomelum tenuiflora</i>	0.00	0.29
Fleabane	<i>Erigeron pumilus</i>	0.00	0.22
Meadow death camas	<i>Zigadenus venenosus</i>	0.00	0.22
Scarlet gaura	<i>Gaura coccinea</i>	0.00	0.22
Horseweed	<i>Conyza canadensis</i>	0.00	0.14
Hoary tansyaster	<i>Machaeranthera canescens</i>	0.00	0.07
silverleaf scurfpea	<i>Pediomelum argophylla</i>	0.00	0.29
Tall breadroot scurfpea	<i>Pediomelum cuspidata</i>	0.00	0.22
Hairy goldaster	<i>Heterotheca villosa</i>	0.00	0.14
Wavyleaf thistle	<i>Cirsium undulatum</i>	0.00	0.07
Purple prairie clover	<i>Dalea purpurea</i>	0.00	0.07
Winged four o'clock	<i>Mirabilis alipes</i>	0.00	0.07
Leafy wildparsley	<i>Musineon divaricatum</i>	0.00	0.07
Fragile pricklypear	<i>Opuntia fragilis</i>	0.00	0.07

\* Cover was measured using Line Intercept

Table 5. Canopy coverage of plants in the 11-30 % big sagebrush category (28 areas sampled).

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		73.34	99.35
Bare Ground		26.54	100.00
Litter		71.46	99.23
Total Herbaceous		41.66	98.69
Total Grass		40.24	98.45
Total Forb		1.39	39.11
Total Shrub *		18.33	0.00
<b>Shrubs</b>			
Big sagebrush *	<i>Artemisia tridentata</i>	17.96	0.00
Rubber rabbitbrush *	<i>Ericameria nauseosa</i>	0.38	0.00
<b>Grasses and Grasslike</b>			
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	8.38	24.88
Blue grama	<i>Bouteloua gracilis</i>	8.05	39.17
Buffalograss	<i>Buchloe dactyloides</i>	7.13	16.13
Japanese brome	<i>Bromus japonicus</i>	3.20	52.74
Threadleaf sedge	<i>Carex filifolia</i>	3.06	19.64
Sun sedge	<i>Carex inops</i>	1.88	5.77
Western wheatgrass	<i>Pascopyrum smithii</i>	1.88	45.77
Needle and thread	<i>Hesperostipa comata</i>	1.47	26.31
Sandberg's bluegrass	<i>Poa secunda</i>	1.13	30.24
Red threeawn	<i>Aristida purpurea</i>	0.74	6.07
Crested wheatgrass	<i>Agropyron cristatum</i>	0.68	4.52
Green needlegrass	<i>Nassella viridula</i>	0.47	11.67
Sixweeks fescue	<i>Vulpia octoflora</i>	0.38	12.20
Prairie Junegrass	<i>Koeleria macrantha</i>	0.32	6.07
Needleleaf sedge	<i>Carex duriuscula</i>	0.10	3.51
Sand dropseed	<i>Sporobolus crytandrus</i>	0.09	2.44
Little bluestem	<i>Schizachyrium scoparium</i>	0.04	0.48
Squirreltail	<i>Elymus elymoides</i>	0.03	1.67
Sideoats grama	<i>Bouteloua curtipendula</i>	0.01	0.18
Indian ricegrass	<i>Achnatherum hymenoides</i>	0.01	0.12
Prairie sandreed	<i>Calamovilfa longifolia</i>	0.00	0.48
Kentucky bluegrass	<i>Poa pratensis</i>	0.00	0.12
<b>Forbs</b>			
Plains pricklypear	<i>Opuntia polyacantha</i>	0.52	7.68
Fringed sagewort	<i>Artemisia frigida</i>	0.30	5.24
False pennyroyal	<i>Hedeoma hispida</i>	0.18	14.76
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	0.13	6.79
Hood's phlox	<i>Phlox hoodii</i>	0.08	4.11
Indianwheat	<i>Plantago patagonica</i>	0.06	5.95

Slimflower scurfpea	<i>Pedimelum tenuiflora</i>	0.05	0.83
Heath aster	<i>Symphiotrichum ericoides</i>	0.04	0.77
Stiffstem flax	<i>Linum rigidum</i>	0.02	3.10
Littleleaf eriogonum	<i>Eriogonum pauciflorum</i>	0.02	0.24
Dwarf alyssum	<i>Alyssum desertorum</i>	0.02	2.56
Curlycup gumweed	<i>Grindelia squarrosa</i>	0.02	0.42
Winterfat	<i>Krashkinnikovia lanata</i>	0.01	0.12
prairie goldenpea	<i>Thermopsis rhombifolia</i>	0.01	0.65
American vetch	<i>Vicia americana</i>	0.01	0.95
Salsify	<i>Tragopogon dubius</i>	0.01	0.71
Creamy poison vetch	<i>Astragalus racemosus</i>	0.01	0.36
Dandelion	<i>Taraxacum officinale</i>	0.01	0.48
Scarlet gaura	<i>Gaura coccinea</i>	0.01	0.89
Drummond's milkvetch	<i>Astragalus drummondii</i>	0.00	0.18
Needleleaf sedge	<i>Carex duriuscula</i>	0.00	0.30
Horseweed	<i>Conyza canadensis</i>	0.00	0.48
Bastard toadflax	<i>Commandra umbellata</i>	0.00	0.18
Rush skeletal plant	<i>Lygodesmia juncea</i>	0.00	0.12
Hoary tansyaster	<i>Machaeranthera canescens</i>	0.00	0.24
Fragile pricklypear	<i>Opuntia fragilis</i>	0.00	0.36
Penstemon	<i>Penstemon spp.</i>	0.00	0.12
Small-leaf pussytoes	<i>Antennaria parvifolia</i>	0.00	0.06
Wavyleaf thistle	<i>Cirsium undulatum</i>	0.00	0.06
Stemless hymenoxys	<i>Hymenoxys acaulis</i>	0.00	0.24
Tall breadroot scurfpea	<i>Pedimelum cuspidata</i>	0.00	0.06
Foothill bladderpod	<i>Lesquerella ludoviciana</i>	0.00	0.24
Western wallflower	<i>Erysimum asperum</i>	0.00	0.12
False dandelion	<i>Agoseris glauca</i>	0.00	0.06
White sage	<i>Artemisia ludoviciana</i>	0.00	0.06
Downy paintbrush	<i>Castilleja sessiliflora</i>	0.00	0.06
Missouri pincushion	<i>Coryphantha missouriensis</i>	0.00	0.06
fleabane	<i>Erigeron pumilus</i>	0.00	0.06
Yellow sweetclover	<i>Melilotus officinale</i>	0.00	0.06
Missouri goldenrod	<i>Solidago missouriensis</i>	0.00	0.06

\* Cover was measured using Line Intercept



Table 6. Canopy coverage of plants in the greater than 30 % big sagebrush category (7 areas sampled)

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		80.82	100.00
Bare Ground		18.94	100.00
Litter		80.24	100.00
Total Herbaceous		33.75	100.00
Total Grass		32.30	100.00
Total Forb		1.60	40.00
Total Shrub *		32.74	
<b>Shrubs</b>			
Big sagebrush *	<i>Artemisia tridentata</i>	32.74	
<b>Grasses and Grasslike</b>			
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	10.84	49.29
Japanese brome	<i>Bromus japonicus</i>	4.61	66.67
Threadleaf sedge	<i>Carex filifolia</i>	3.11	14.29
Needle and thread	<i>Hesperostipa comata</i>	2.54	43.33
Blue grama	<i>Bouteloua gracilis</i>	2.13	20.24
Sandberg's bluegrass	<i>Poa secunda</i>	2.12	37.38
Buffalograss	<i>Buchloe dactyloides</i>	2.08	5.95
Western wheatgrass	<i>Pascopyrum smithii</i>	1.61	30.24
Red threeawn	<i>Aristida purpurea</i>	0.52	8.57
Green needlegrass	<i>Nassella viridula</i>	0.29	8.33
Crested wheatgrass	<i>Agropyron cristatum</i>	0.28	2.86
Sixweeks fescue	<i>Vulpia octoflora</i>	0.29	16.43
Prairie Junegrass	<i>Koeleria macrantha</i>	0.18	5.71
Squirreltail	<i>Elymus elymoides</i>	0.11	5.00
Sand dropseed	<i>Sporobolus cryptandrus</i>	0.08	2.62
<b>Forbs</b>			
Plains pricklypear	<i>Opuntia polyacantha</i>	0.42	7.38
False pennyroyal	<i>Hedeoma hispida</i>	0.40	23.33
Fringed sagewort	<i>Artemisia frigida</i>	0.38	8.57
Small-leaf pussytoes	<i>Antennaria parvifolia</i>	0.14	0.95
Indianwheat	<i>Plantago patagonica</i>	0.09	5.71
Horseweed	<i>Conyza canadensis</i>	0.07	2.62
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	0.08	6.43
Stiffstem flax	<i>Linum rigidum</i>	0.02	2.86
Dwarf alyssum	<i>Alyssum desertorum</i>	0.02	1.43
Scarlet gaura	<i>Gaura coccinea</i>	0.02	1.19
fleabane	<i>Erigeron pumilus</i>	0.01	0.71
Dandelion	<i>Taraxacum officinale</i>	0.01	0.48
Western marsh cudweed	<i>Gnaphalium palustre</i>	0.01	0.71
Slimflower scurfpea	<i>Pedimelum tenuiflora</i>	0.01	0.24

Lacy tansyaster	<i>Machaeranthera pinnatifida</i>	0.00	0.24
Yellow sweetclover	<i>Melilotus officinale</i>	0.00	0.24
Salsify	<i>Tragopogon dubius</i>	0.00	0.24
Smooth woodyaster	<i>Xylorhiza glabriuscula</i>	0.00	0.24
Meadow death camas	<i>Zigadenus venenosus</i>	0.00	0.24

\* Cover was measured using Line Intercept

Table 7. Canopy coverage of plants in the 1-10 % shale breaks category (2 areas sampled).

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		29.12	82.50
Bare Ground		70.29	100.00
Litter		14.73	74.17
Total Herbaceous		10.59	75.00
Total Grass		9.45	68.33
Total Forb		3.27	46.67
Total Shrub *		8.46	0.00
<b>Shrubs</b>			
Big sagebrush *	<i>Artemisia tridentata</i>	4.13	0.00
Rubber rabbitbrush *	<i>Ericameria nauseosa</i>	4.83	0.00
<b>Grasses and Grasslike</b>			
Western wheatgrass	<i>Pascopyrum smithii</i>	6.09	68.33
Red threeawn	<i>Aristida purpurpea</i>	0.46	2.50
Sandberg's bluegrass	<i>Poa secunda</i>	0.28	4.17
Japanese brome	<i>Bromus japonicus</i>	0.24	14.17
Green needlegrass	<i>Nassella viridula</i>	0.06	2.50
Foxtail barley	<i>Hordeum jubatum</i>	0.02	0.83
Sixweeks fescue	<i>Vulpia octoflora</i>	0.01	1.67
Indian ricegrass	<i>Achnatherum hymenoides</i>	0.00	0.83
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	0.00	0.83
<b>Forbs</b>			
Littleleaf eriogonum	<i>Eriogonum pauciflorum</i>	2.13	17.50
American vetch	<i>Vicia americana</i>	0.77	27.50
Broom snakeweed	<i>Gutierrezia sarothrae</i>	0.17	3.33
Hood's phlox	<i>Phlox hoodii</i>	0.13	2.50
Prairie goldenpea	<i>Thermopsis rhombifolia</i>	0.09	7.50
Dwarf alyssum	<i>Alyssum desertorum</i>	0.05	10.83
Indianwheat	<i>Plantago patagonica</i>	0.02	4.17
Salsify	<i>Tragopogon dubius</i>	0.00	0.83

\* Cover was measured using Line Intercept

Table 8. Canopy coverage of plants in the 11-30 % shale breaks category (3 areas sampled).

Common Name	Scientific Name	Average Cover	% Frequency
Total Coverage		33.42	91.67
Bare Ground		66.19	100.00
Litter		32.72	83.33
Total Herbaceous		9.74	82.78
Total Grass		9.23	79.44
Total Forb		0.82	30.00
Total Shrub *		16.37	0.00
<b>Shrubs</b>			
Big sagebrush *	<i>Artemisia tridentata</i>	12.70	0.00
Rubber rabbitbrush *	<i>Ericameria nauseosa</i>	3.67	0.00
<b>Grasses and Grasslike</b>			
Western wheatgrass	<i>Pascopyrum smithii</i>	7.47	81.11
Sandberg's bluegrass	<i>Poa secunda</i>	0.81	21.67
Japanese brome	<i>Bromus japonicus</i>	0.49	27.78
Green needlegrass	<i>Nassella viridula</i>	0.16	4.44
Indian ricegrass	<i>Achnatherum hymenoides</i>	0.09	1.11
Crested wheatgrass	<i>Agropyron cristatum</i>	0.02	1.67
Sixweeks fescue	<i>Vulpia octoflora</i>	0.02	1.67
Threadleaf sedge	<i>Carex filifolia</i>	0.02	1.11
Red threeawn	<i>Aristida purpurea</i>	0.01	0.56
Downy brome(cheatgrass)	<i>Bromus tectorum</i>	0.01	1.11
Prairie Junegrass	<i>Koeleria macrantha</i>	0.00	0.00
<b>Forbs</b>			
Fragile pricklypear	<i>Opuntia fragilis</i>	0.17	1.11
prairie goldenpea	<i>Thermopsis rhombifolia</i>	0.14	7.22
Hood's phlox	<i>Phlox hoodii</i>	0.11	2.22
False pennyroyal	<i>Hedeoma hispida</i>	0.10	8.33
Littleleaf eriogonum	<i>Eriogonum pauciflorum</i>	0.08	0.56
Plains pricklypear	<i>Opuntia polyacantha</i>	0.07	3.33
Dwarf alyssum	<i>Alyssum desertorum</i>	0.05	7.78
Dandelion	<i>Taraxacum officinale</i>	0.03	1.67
American vetch	<i>Vicia americana</i>	0.02	1.67
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	0.01	1.67
Salsify	<i>Tragopogon dubius</i>	0.01	1.11
Flixweed tansymustard	<i>Descuriania sophia</i>	0.00	0.56
Curlycup gumweed	<i>Grindelia squarrosa</i>	0.00	0.56
Stiffstem flax	<i>Linum rigidum</i>	0.00	0.56
Desert biscuitroot	<i>Lomatium foeniculaceum</i>	0.00	0.56

\* Cover was measured using Line Intercept

Table 9. Height of big sagebrush in the different sagebrush canopy coverage classifications.

Sagebrush Density Classification	# of shrubs Measured	Average Height (cm)
<1 %	14	31.6
1-10%	223	39.3
11-30%	675	43.7
>30%	272	51.4
Shale Breaks 11-30%	59	40.9
Shale Breaks 1-10%	10	29.1
Silver sagebrush	No plots	
Sand sagebrush	No plots	
Greasewood	No plots	
Grand Total	1253	44.2

Table 10. Droop height of the dominant grasses in the different sagebrush canopy coverage classifications.

Common Name	Scientific Name	< 1 % Sagebrush Cover Droop Ht (cm)		1 to 10 % Sagebrush Cover Droop Ht (cm)		11 to 30 % Sagebrush Cover Droop Ht (cm)		> 30 % Sagebrush Cover Droop Ht (cm)		Average Sagebrush Cover Droop Ht (cm)	
		2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Western wheatgrass	<i>Pascopyrum smithii</i>	23.0	10.0	22.7	12.7	26.0	12.5	27.7	14.4	24.8	12.4
Japanese brome	<i>Bromus japonicus</i>	22.2	17.1	21.8	18.2	25.3	12.2	30.4	13.7	24.9	15.3
Sandberg's bluegrass	<i>Poa secunda</i>	23.2	10.2	26.0	11.2	30.3	14.5	33.7	21.2	28.3	14.3
Needle and thread	<i>Hesperostipa comata</i>	32.0	15.9	36.6	15.4	36.3	16.1	44.1	15.3	37.3	15.7
Blue grama	<i>Bouteloua gracilis</i>	21.7	11.2	18.2	16.5	20.2	15.1	18.7	15.6	19.7	14.6
Crested wheatgrass	<i>Agropyron cristatum</i>	35.2	18.4	33.1	20.1	44.6	18.7	53.0	18.1	41.5	18.8
Green needlegrass	<i>Nassella viridula</i>			48.5	19.1	56.2	21.7	55.9	15.7	53.5	18.8
Maximum Height		27.5	7.2	31.0	12.4	34.4	10.6	38.8	10.6	33.0	10.2

Table 11. Summary of the actual measurements obtained for the different habitat variable compare to the optimum values.

		Sagebrush		Grass-forb		Grass-forb	Grass	Forb	
	# of plots	Height (cm)	Canopy(%)	Droop Height (cm)		Canopy (%)	Canopy (%)	Canopy (%)	% of the area
				2003	2004				
<1 % Big Sagebrush Cover	9	31.6	0.7	27.5	7.2	65.5	63.7	2.1	64.5
1- 10 % Big Sagebrush Cover	23	39.3	5.6	31.0	12.4	50.4	48.2	2.3	20.8
11- 30 % Big Sagebrush Cover	28	43.7	18.3	34.4	10.7	41.7	40.2	1.4	5.8
>30 % Big Sagebrush Cover	7	51.4	32.7	38.8	10.6	33.7	32.3	1.6	0.5
Shale 1- 10 % Shrub Cover	2	29.1	4.1			10.6	9.5	3.3	2.8
Shale 11-30 % Shrub Cover	3	40.9	12.7			9.7	9.2	0.8	0.5
Optimum									
Mesic									
Breeding		40-80	15-25	>18	>18	≥25	≥15	≥10	>80
Brood-rearing		40-80	10-25	Variable	Variable	>15	N/A	N/A	>40
Winter		25-35	10-30	N/A	N/A	N/A	N/A	N/A	>80

Table 12. Previously Reported Observations of Sage Grouse Leks in SGA.

Date	No. of Males	Observer
4/25/1980	8	Richard C. Rosche
4/14/1984	8	Richard A. Peterson
4/15/1985	4	Richard A. Peterson
5/3/1986	6	Richard A. Peterson
4/11/1987	3	Richard A. Peterson

Table 13. Sage grouse leks in the SGA.

Lek ID Number	YEAR														
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
48GL001		1													
48GL002*	0	0							0	0	0	0	0	0	0
48GL005															1
49GL001**	0	0											0	0	
49GL002**	0	0											0	0	
49GL004	17	8	4	2	6	10	10	11	14	11	4	4	0	0	0
Total # of Leks	1	2	1	1	1	1	1	1	1	1	1	1	0	0	1
Total # of Birds	17	9	4	2	6	10	10	11	14	11	4	4	0	0	1

\* Sage grouse were reported displaying in this general location 1980-1987.

\*\* These locations were given to the District by the local Game Warden (Owen Meadows)  
as possible display grounds. There are no records of birds being counted at these sights.



Table 14. Sharp-tailed grouse leks in the SGA.

Lek ID Number	YEAR														
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
48GL001									6		3		0	0	0
48GL003								10	20	13	4	0	0	0	0
48GL004													3	0	0
49GL001	0	0											4	2	2
49GL005								6					7	9	0
49GL006									9	6	0	0	0	2	0
49GL007									3				0	0	0
49GL008										9		7	9	3	0
49GL009									3	8	4	7	0	0	0
49GL010									11	16	14	9	14	9	13
49GL011									17	9	8	6	0	0	3
49GL012													1	0	0
49GL013													2	0	0
49GL014													3	0	0
60GL004												11	12	0	4
Total # of Leks	0	0	0	0	0	0	0	2	7	6	5	5	9	5	4
Total # of Birds	0	0	0	0	0	0	0	6	43	48	26	40	52	25	22

Table 15. Summary of the range sites present in the SGA and their potential production.

Range Site	% of the area	Total potential production lbs/acre *		
		Low	RV	High
<b>High production</b>				
Clayey Overflow	1	1900	2500	3100
Loamy terrace	2	1700	2500	3300
Closed Depression	0	1400	2200	4000
Silty	1	1200	1900	2400
Clayey	21	900	1800	2500
Sandy	7	1200	1800	2400
<b>Total</b>	31			
<b>Low production</b>				
Shallow Clay	11	100	1190	1510
Thin upland	36	870	1155	1900
Dense Clay	2	800	1105	1530
Thin Claypan	3	500	900	1200
Shallow	16	450	800	1100
<b>Total</b>	69			

\*<http://www.sd.nrcs.usda.gov/>

This number is the potential production of the range site if it were in climax condition

RV = Representative value

Table 16. Birds observed in the less than 1 % sagebrush category.

Bird Species	2003		2004		Total	
	Total Observed	Average # per plot	Total Observed	Average # per plot	Total Observed	Average # per plot
Western Meadowlark	68	7.6	47	5.2	115.0	6.4
Grasshopper Sparrow	18	2.0	2	0.2	20.0	1.1
Lark Bunting	7	0.8	12	1.3	19.0	1.1
Horned Lark	0	0.0	4	0.4	4.0	0.2
Brewer's Sparrow	2	0.2	0	0.0	2.0	0.1
Brown-headed Cowbird	2	0.2	0	0.0	2.0	0.1
Killdeer	0	0.0	1	0.1	1.0	0.1
Common Nighthawk	0	0.0	1	0.1	1.0	0.1

# of plots

9

Table 17. Birds observed in the 1 to 10% sagebrush cover category.

	2003		2004		Total	
	Total Observed	Average # per plot	Total Observed	Average # per plot	Total Observed	Average # per plot
Western Meadowlark	159	6.9	92	4.0	251	5.5
Lark Bunting	34	1.5	35	1.5	69	1.5
Grasshopper Sparrow	39	1.7	0	0.0	39	0.8
Brewer's Sparrow	11	0.5	16	0.7	27	0.6
Lark Sparrow	6	0.3	3	0.1	9	0.2
Vesper Sparrow	6	0.3	3	0.1	9	0.2
Horned Lark	3	0.1	6	0.3	9	0.2
Mourning Dove	2	0.1	6	0.3	8	0.2
Brown-headed Cowbird	3	0.1	4	0.2	7	0.2
Rock Wren	2	0.1	0	0.0	2	0.0
Red-winged Blackbird	0	0.0	2	0.1	2	0.0
Upland Sandpiper	0	0.0	1	0.0	1	0.0
Loggerhead Shrike	0	0.0	1	0.0	1	0.0

# of plots 23

Table 18. Birds observed in the 11-30% sagebrush cover category.

	2003		2004		Total	
	Total Observed	Average # per plot	Total Observed	Average # per plot	Total Observed	Average # per plot
Western Meadowlark	181	6.5	122	4.4	303	5.4
Lark Bunting	85	3.0	57	2.0	142	2.5
Brewer's Sparrow	58	2.1	31	1.1	89	1.6
Grasshopper Sparrow	21	0.8	4	0.1	25	0.4
Vesper Sparrow	10	0.4	5	0.2	15	0.3
Brown-headed Cowbird	7	0.3	8	0.3	15	0.3
Lark Sparrow	2	0.1	7	0.3	9	0.2
Mourning Dove	3	0.1	5	0.2	8	0.1
Horned Lark	1	0.0	3	0.1	4	0.1
Killdeer	1	0.0	1	0.0	2	0.0
Upland Sandpiper	0	0.0	1	0.0	1	0.0
Northern Harrier	0	0.0	1	0.0	1	0.0
Long-billed Curlew	0	0.0	1	0.0	1	0.0

# of plots 28

Table 19. Birds observed in the greater than 30% sagebrush cover category.

	2003		2004		Total	
	Total Observed	Average # per plot	Total Observed	Average # per plot	Total Observed	Average # per plot
Western Meadowlark	49	7.0	27	3.9	76	5.4
Lark Bunting	17	2.4	25	3.6	42	3.0
Brewer's Sparrow	22	3.1	14	2	36	2.6
Brown-headed Cowbird	1	0.1	13	1.9	14	1.0
Grasshopper Sparrow	8	1.1	1	0.1	9	0.6
Vesper Sparrow	2	0.3	2	0.3	4	0.3
Mourning Dove	2	0.3	0	0.0	2	0.1

# of plots 7

## FIGURES

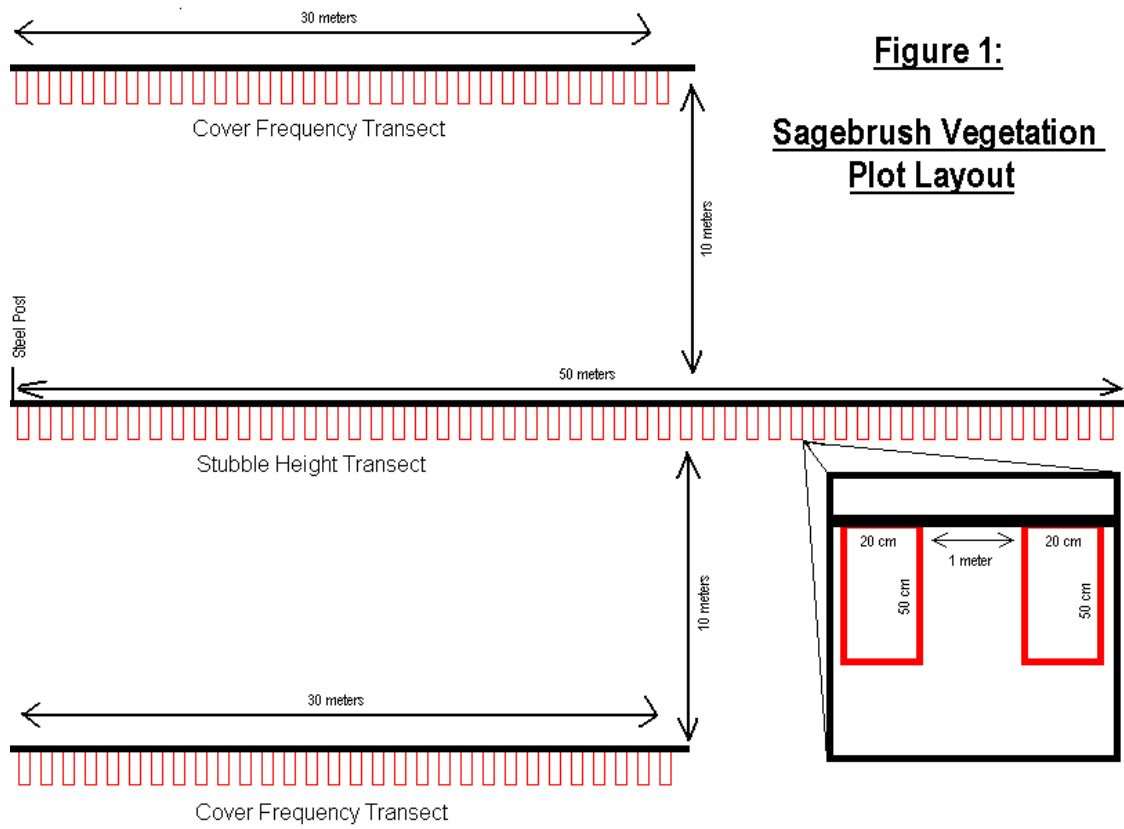


Figure 2. Maximum Average Droop Ht of Vegetation within the Sagebrush Plots

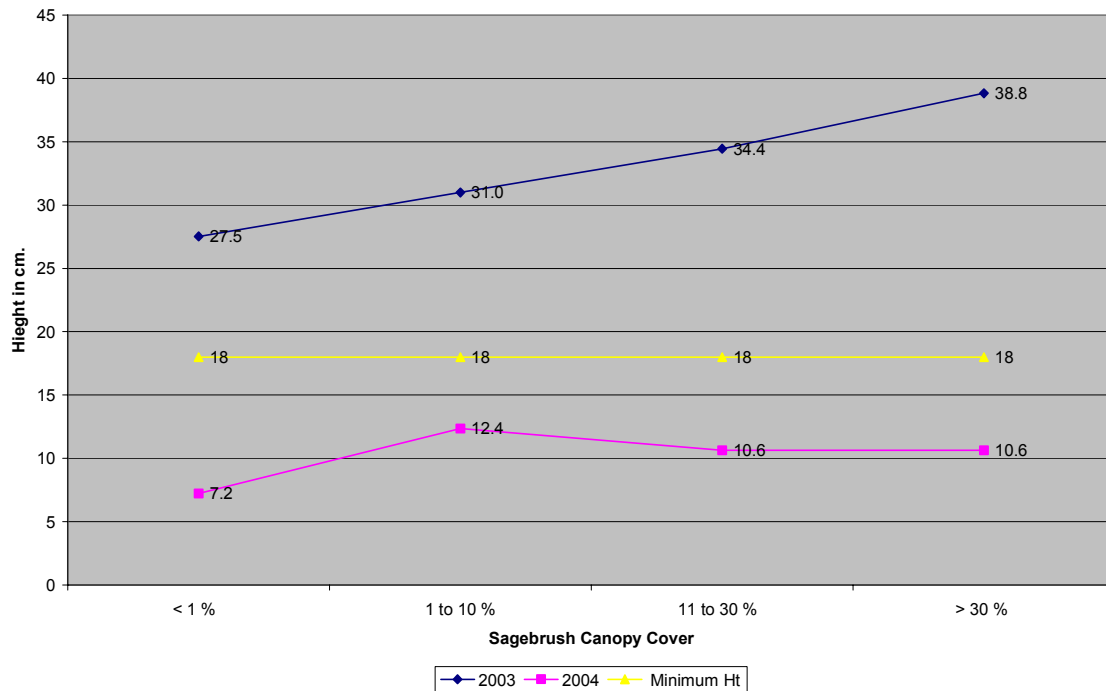
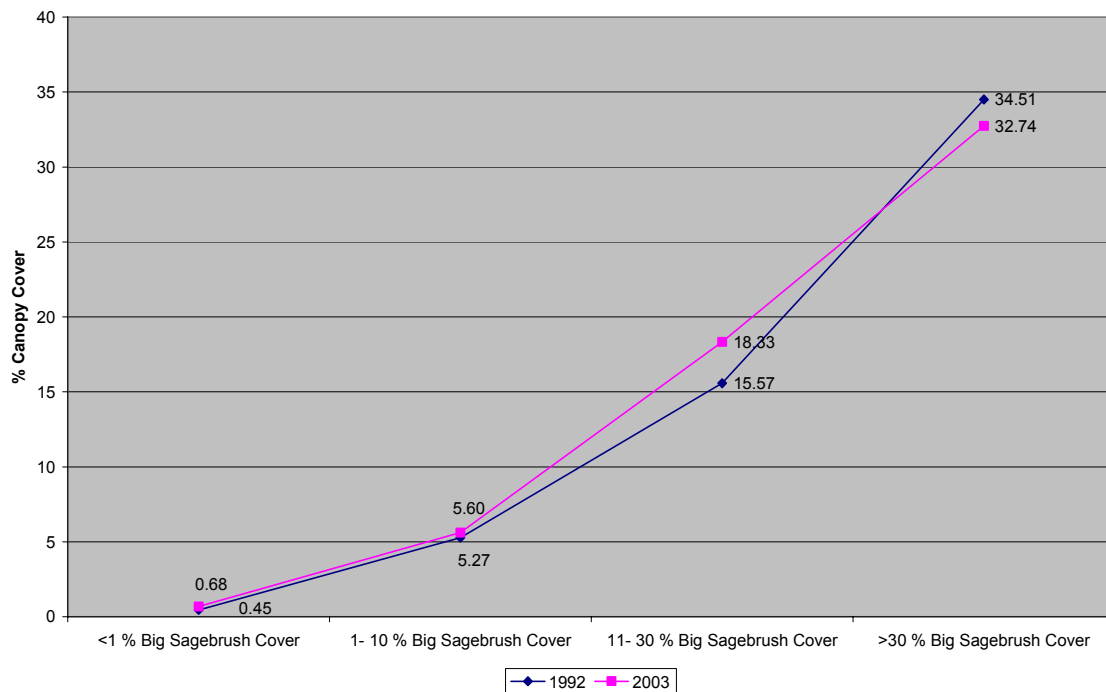
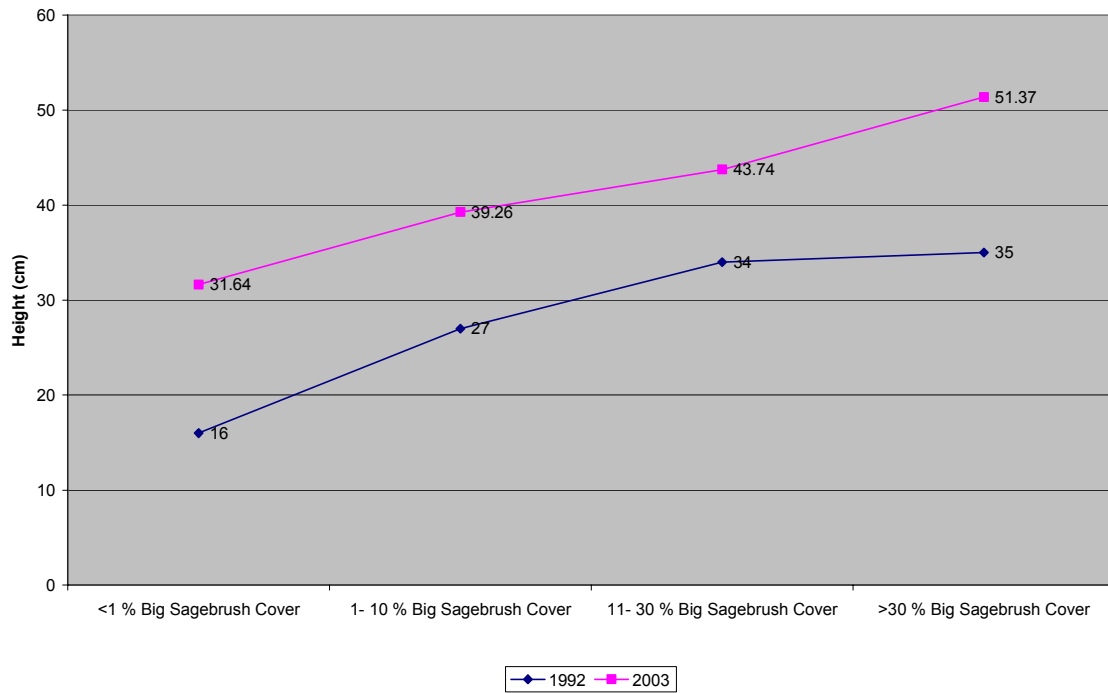


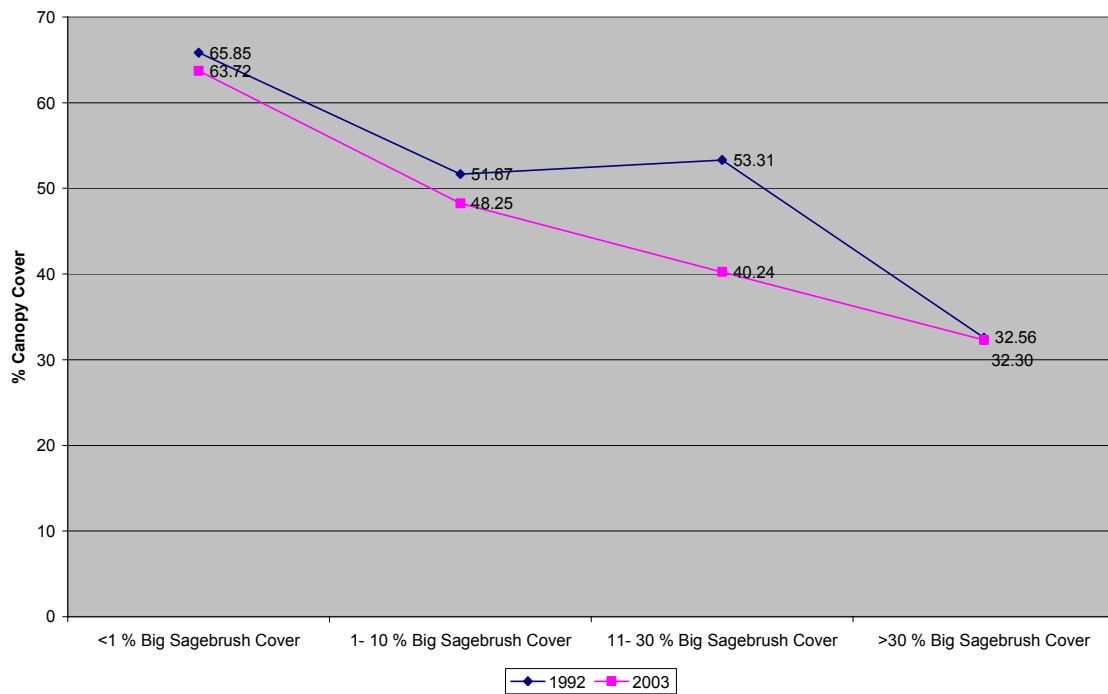
Figure 3. Comparison of Sagebrush Canopy Cover Between 1992 & 2003



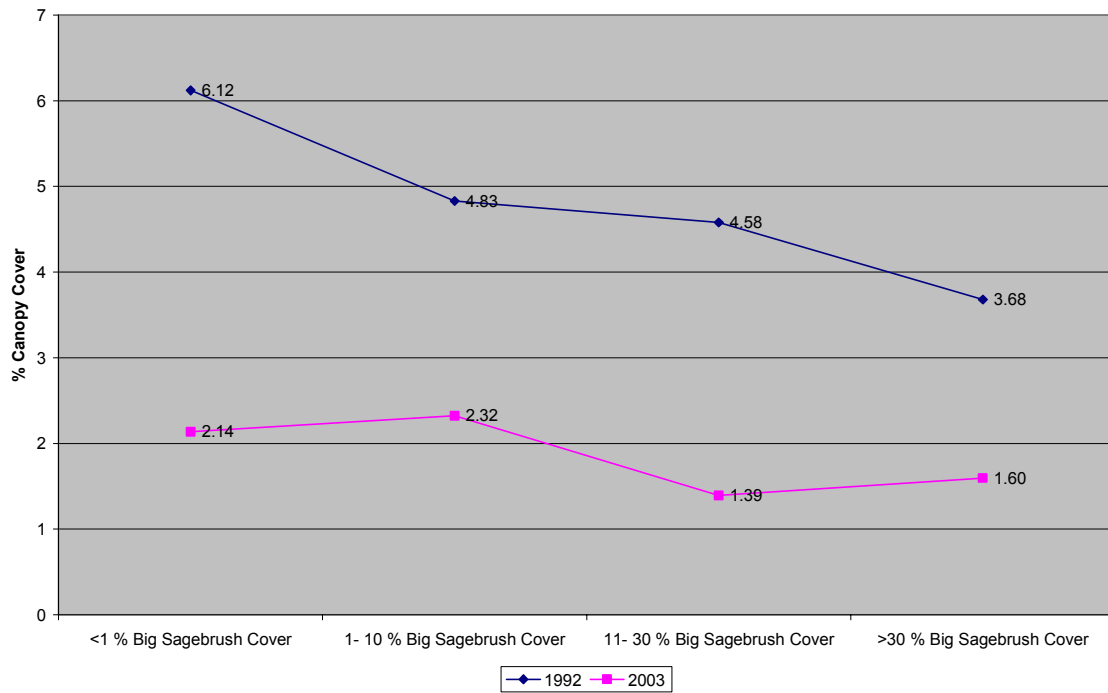
**Figure 4. Comparison of Sagebrush Height Between 1992 & 2003**



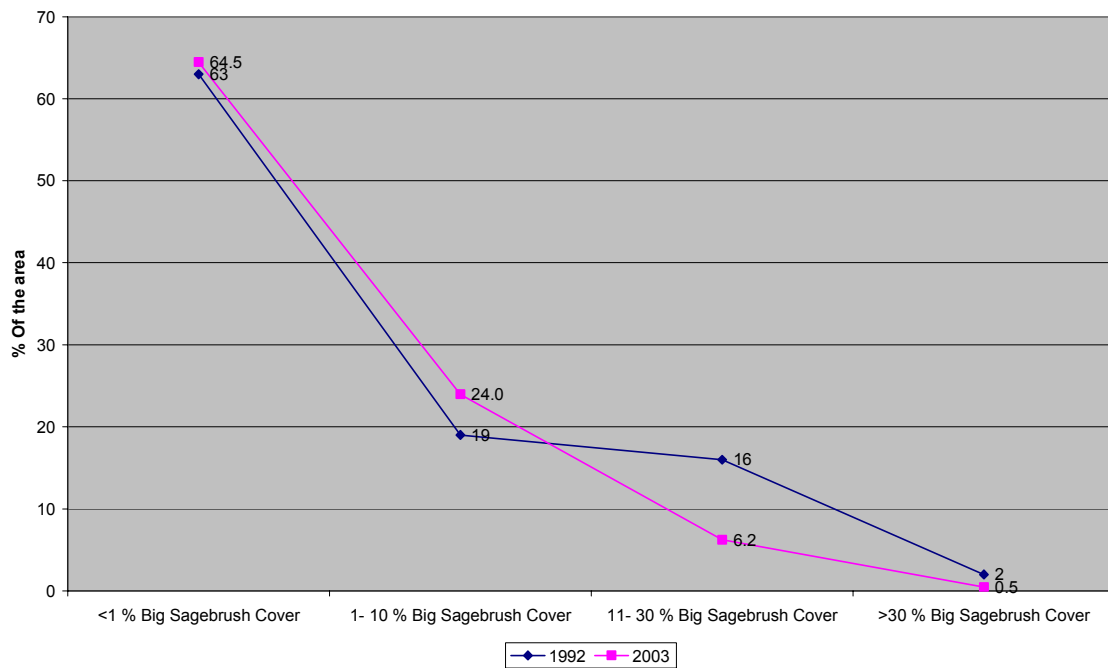
**Figure 5. Comparison of Percent Canopy Cover of Grasses Between 1992 & 2003**



**Figure 6. Comparison of Percent Canopy Cover of Forbs Between 1992 & 2003**

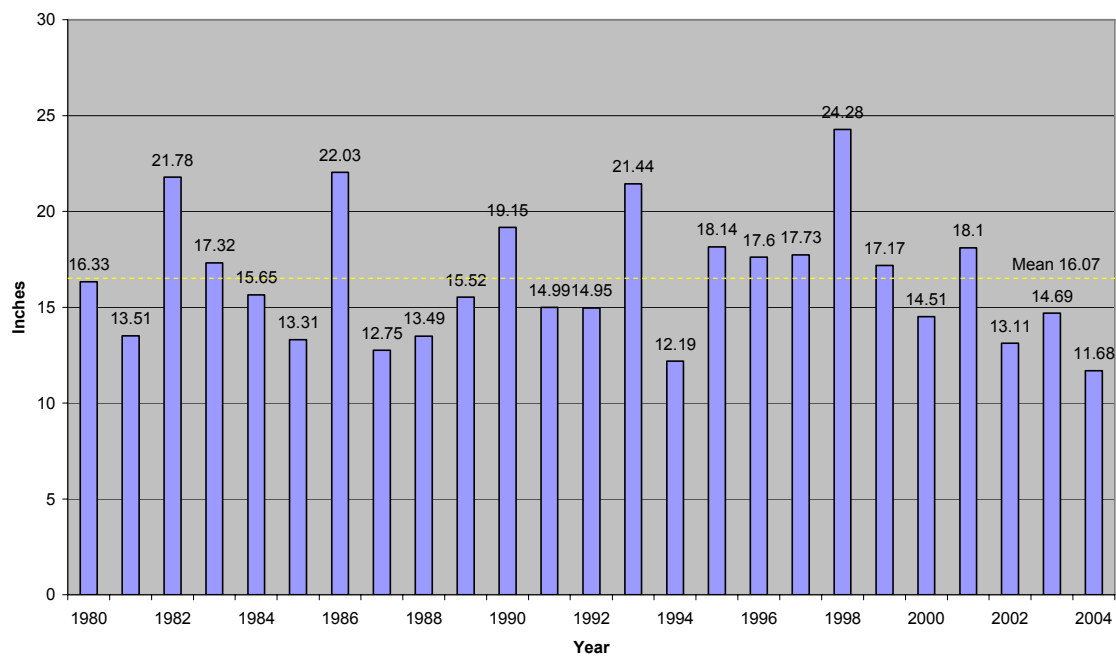


**Figure 7. Comparison of the Percent of the Area in the Different Sagebrush Canopy Cover Classifications Between 1992 & 2003**

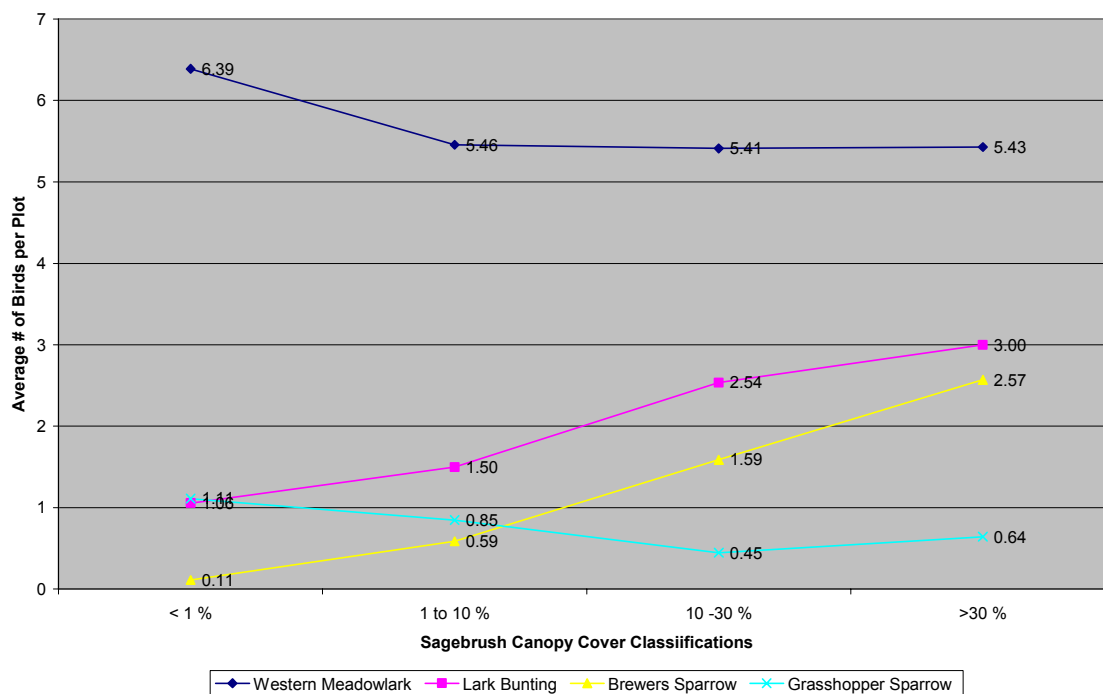


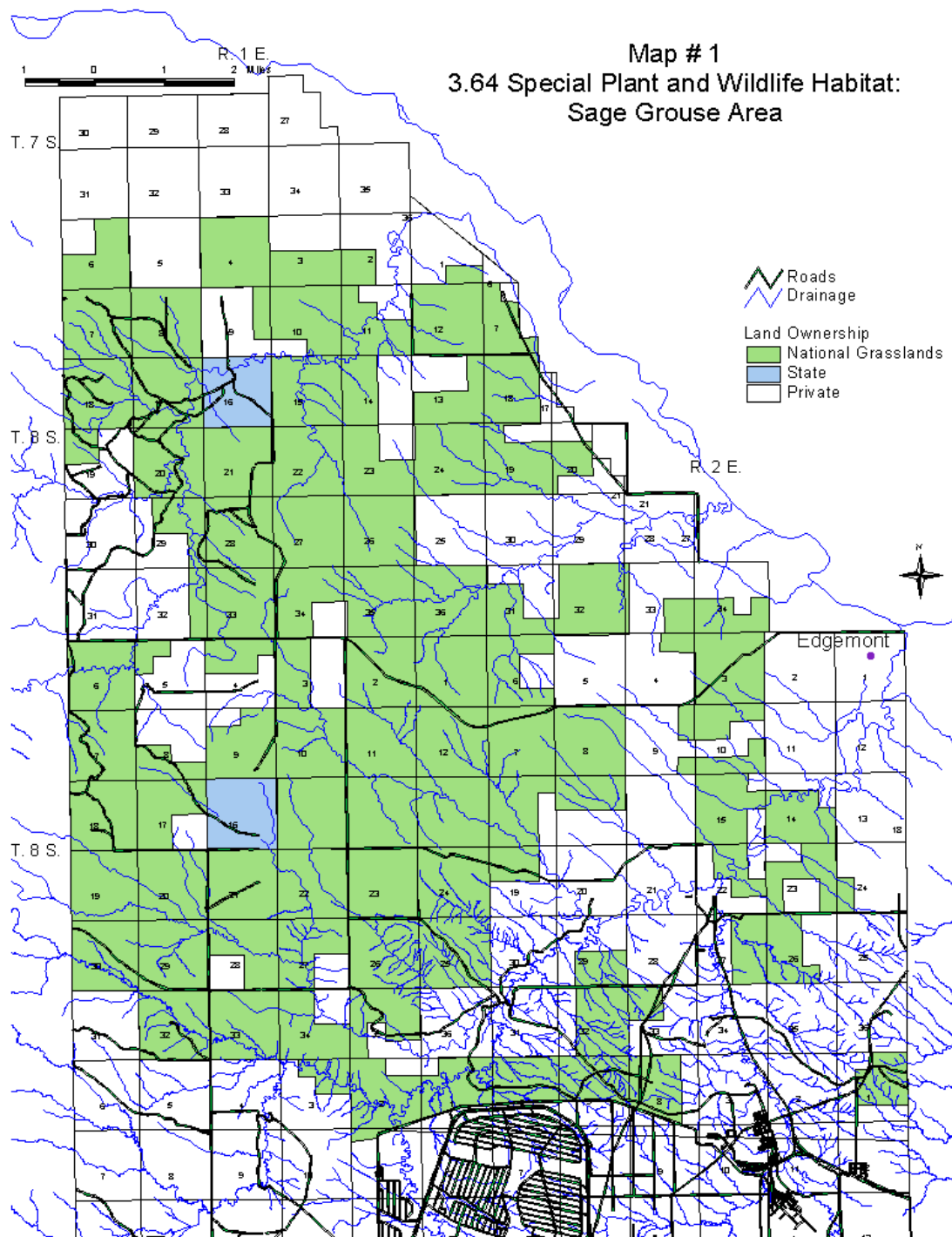


**Figure 8. Precipitation Measured at the Edgemont Rain Gauge  
(High Plains Regional Climate Center)**



**Figure 9. Sagebrush bird summary (2003 and 2004 combined)**

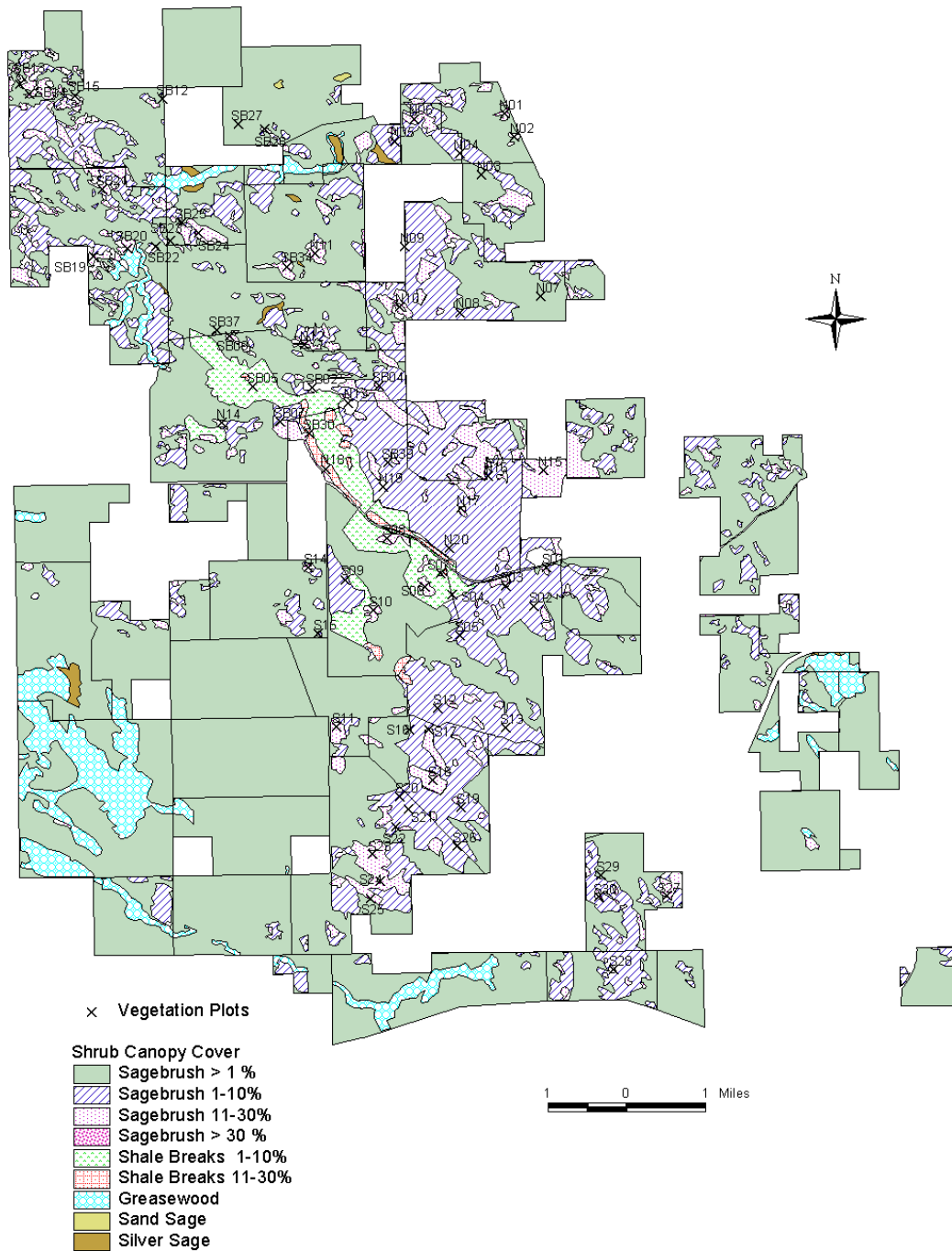




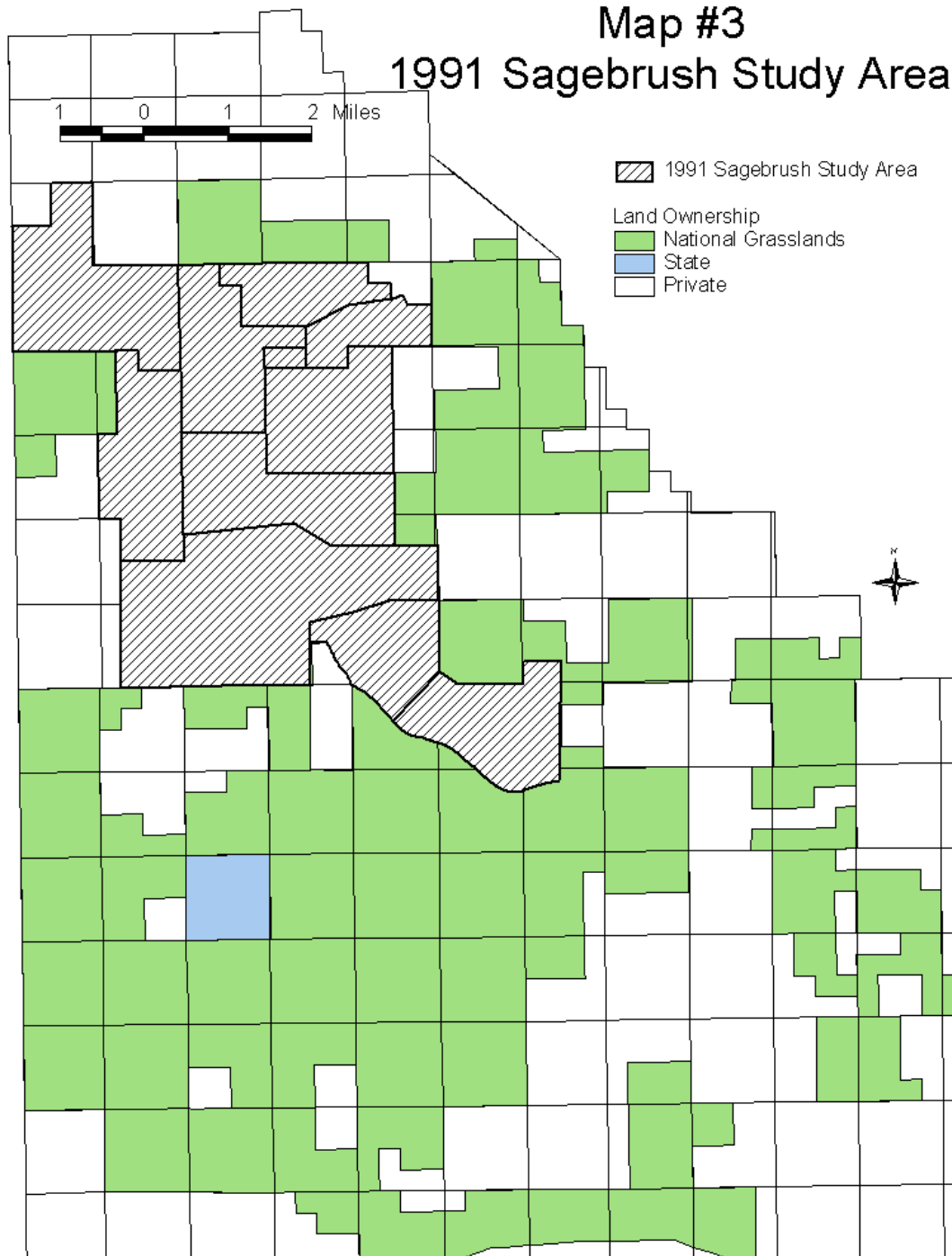
# Map # 2

## Sagebrush Management Area

### Shrub Canopy Coverage



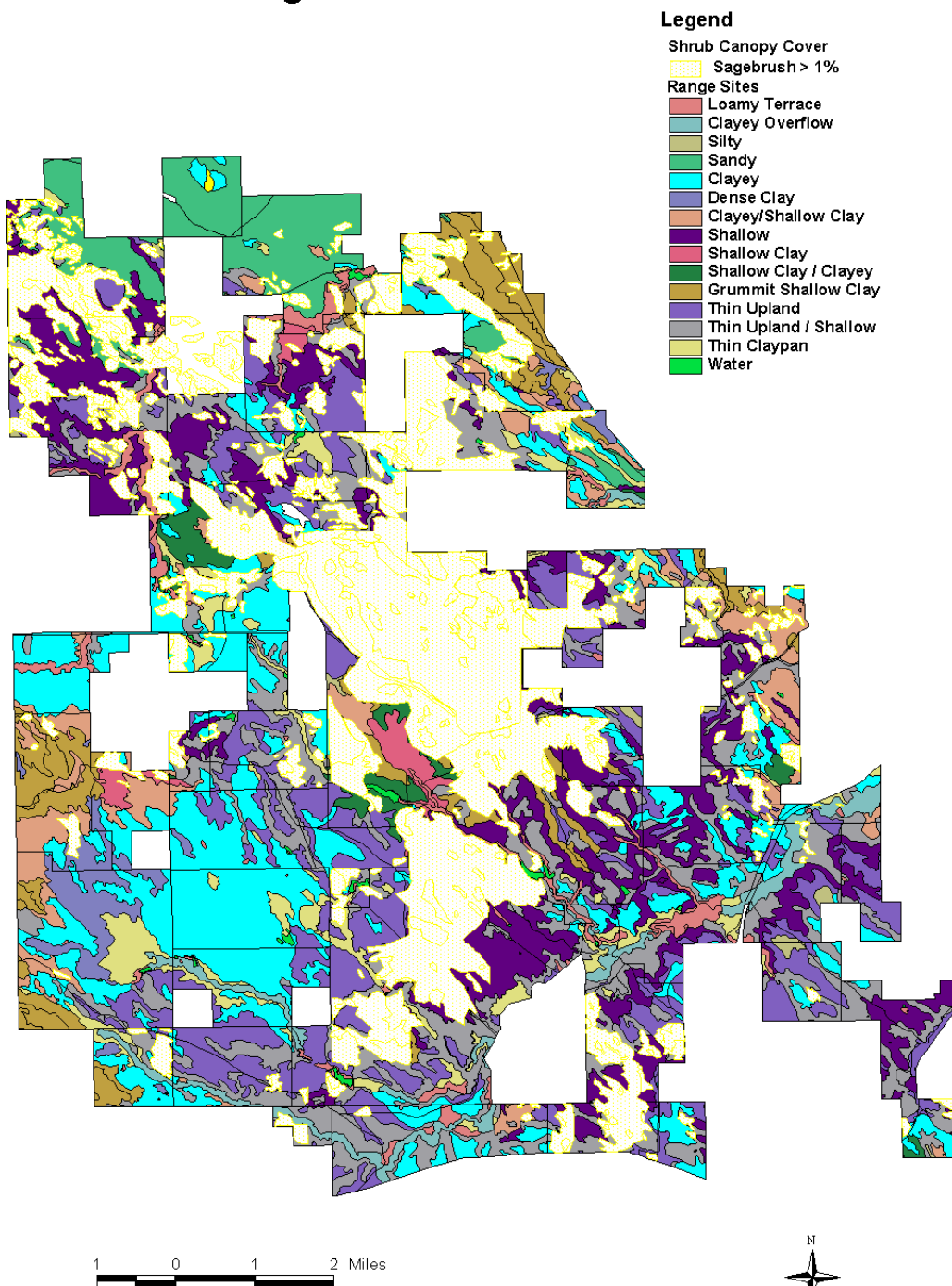
### Map #3 1991 Sagebrush Study Area



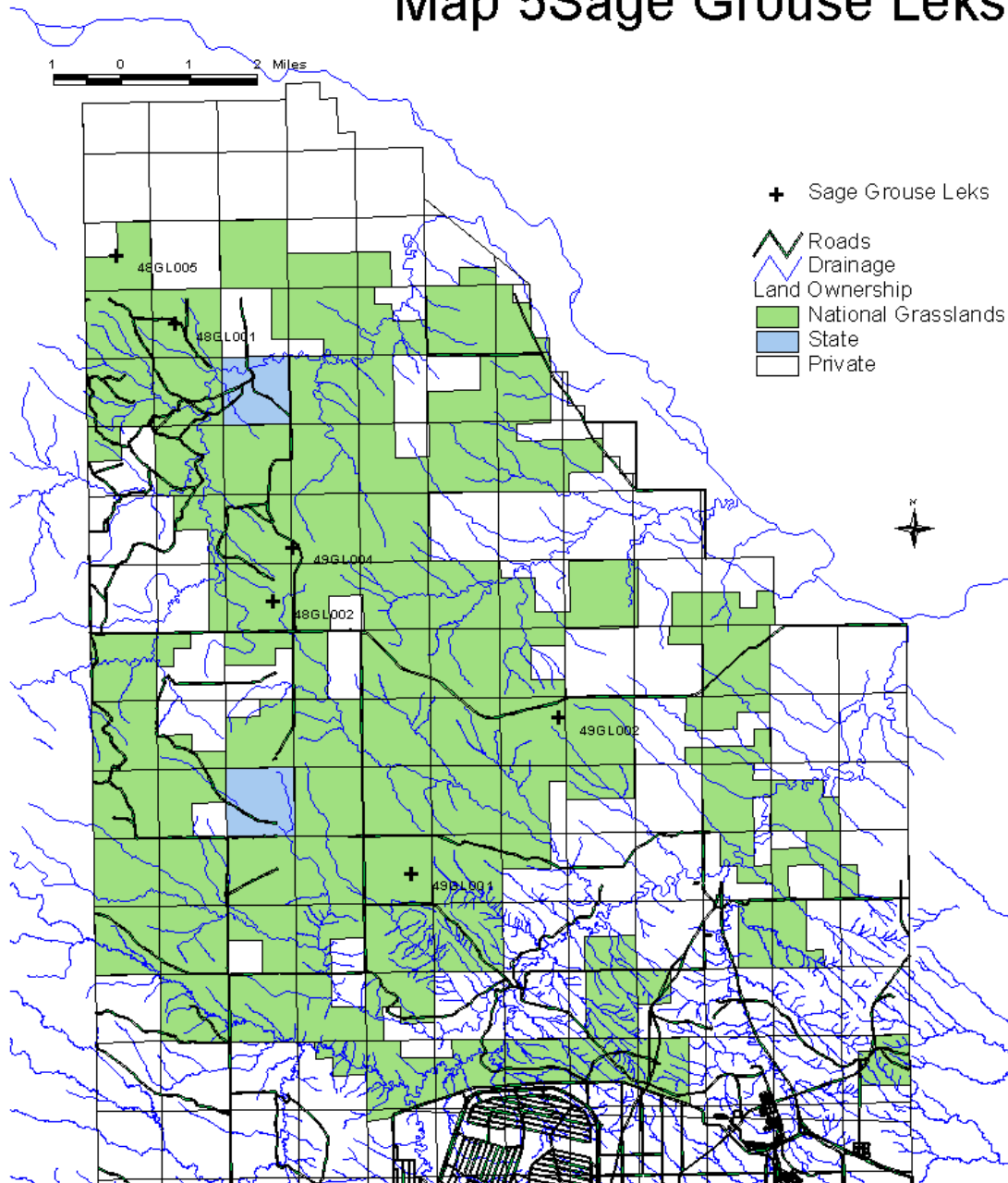
# Map # 4

## Sagebrush Management Area

### Range Sites



## Map 5 Sage Grouse Leks



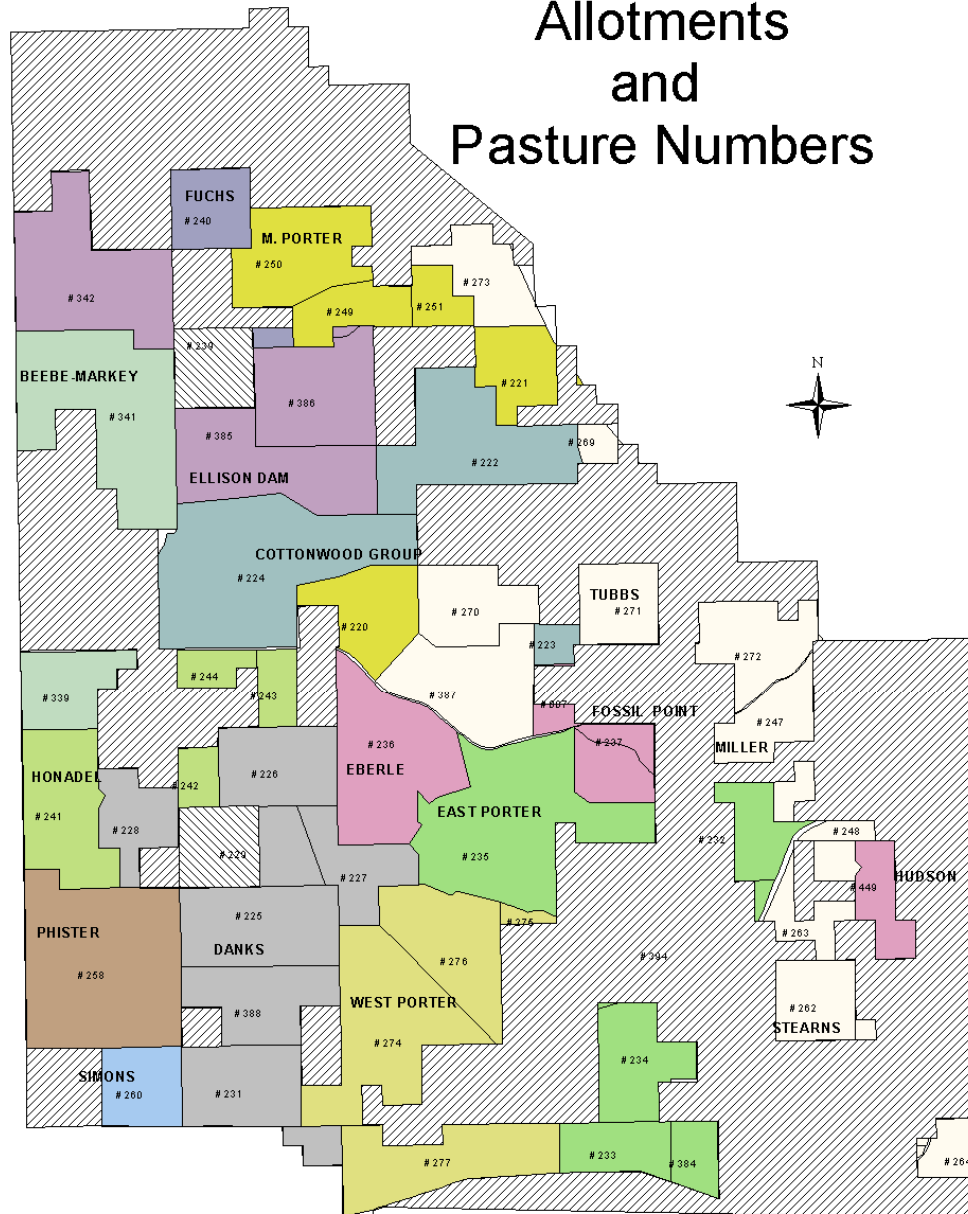
Map of the study area showing the distribution of Sharp-tailed Grouse Leks. The map includes a grid overlay, roads, drainage patterns, and land ownership. National Grasslands are shaded green, and Private land is white. A scale bar (0 to 2 miles) and a north arrow are present. Leks are marked with black dots and labeled with codes like 48GL001, 49GL003, 49GL007, etc.



# Map # 7

## Sagebrush Management Area

### Allotments and Pasture Numbers



Land Ownership

- National Grasslands
- Private
- State

1 0 1 2 Miles



