

THE EFFECTS OF MECHANICAL DISKING ON SHRUB STEPPE ECOSYSTEMS AND GREATER SAGE GROUSE USE IN PINE VALLEY, UTAH

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Introduction

Greater-sage grouse are large gallinaceous birds that inhabit large expanses of sagebrush rangeland in western North America (Schroeder et al. 2004). Populations of Greater-sage grouse have been declining throughout much of its historical range for the last half century (Connelly and Braun 1997). Numerous studies have been published on the status of the Greater-sage grouse and the reasons for its decline. Declines have been attributed to loss or alteration of quality sagebrush habitats (*Artemisia* spp.) to which it was dependent upon (Braun et al. 1977, Connelly and Braun 1997, Braun 1998). Sagebrush was important for nesting sage grouse as a source of food and cover (Connelly et al. 2000). Furthermore, an herbaceous understory within sagebrush habitat and a diverse invertebrate component was important for breeding and brood rearing habitat (Klebenow and Gray 1968, Connelly et al. 2000).

In Utah, breeding sage grouse populations saw a 37% decline from 1985-1994 (Connelly and Braun 1997), and the Utah Division of Wildlife Resources estimates over a 50% decline since historical times (UDWR 1997). Braun (1998) estimated that 10.6% of all sage grouse occur in Utah and the UDWR estimates that over 50% percent of the population occurs on private or state land (UDWR 2002). In Utah, much of the remaining sagebrush range was late-successional stage and lacks a significant herbaceous understory due to settlements, fire suppression, over grazing and invasion of annual grasses (Beck and Mitchell 2003). Due to its decline the Greater-sage grouse has been considered for federal listing under the Endangered Species Act.

In response, numerous management regimes to improve sage grouse habitat have been employed throughout its range. One typical strategy was using mechanical treatments to thin or kill sagebrush stands and in turn “release” a more beneficial herbaceous understory (Connelly et al. 2004). Mechanical treatments of this nature are also beneficial to cattle operations because they can create more palatable and nutritional forage. In addition to assessing vegetation qualities and their suitability for sage grouse we will assess other secondary ecological factors such as small mammal populations and invertebrate populations. Results from vertebrate and invertebrate sampling may serve as cues to help evaluate overall ecological conditions.

Study Objectives

The objectives of this study are:

- 1) Assess ecological conditions such as vegetation composition, small mammal populations, and invertebrate abundance.
- 2) To see if mechanical treatments increase Greater sage-grouse use in Pine Valley.

Study Area

The study area was in Pine Valley, approximately 27 miles northwest of Lund in Beaver County, Utah between the Indian Peak and Wah Wah Mountain ranges. The approximately 640 acre area was on SITLA managed land and was mechanically treated with a tractor-pulled disc in the fall 2007. The treated area will also be reseeded with a broadcast seeder or aerial seeder. The

specific seed mix was unknown at this time but consisted of both native and non-native grasses and forbs.

The specific location of the Pine Valley Treatment area was Section 2 of township 28 south and range 17 west. The climate in and around the study area region was semiarid cold desert. The average annual precipitation ranges from 8 to 12 inches. The mean annual air temperature was 47 to 54F, mean summer temperature was 83-87F, and the freeze-free period ranges from 115 to 145 days. The area falls within known sage-grouse brood rearing and winter habitat, it also has an active lek in close proximity on adjacent BLM land (UDWR 2002, Pers. Comm. Nile Sorensen NRCS Cedar City, Utah 2007).

Methods

Vegetation Surveys

To determine the affect of mechanical treatment on the sagebrush steppe vegetative community we conducted comparative surveys of vegetation composition. As a control area we selected a similar size of habitat no less than 6 km from the treatment area. This area was selected due to similarities in elevation, moisture, soil, and vegetative community. Within both the control and treatment areas, we randomly assigned 10 permanent points. Each point acted as the origin of a 30 meter transect resulting in 300 meters of transect line per study area. Transect points were randomized using a stratified design to create a spacing of at least 250 meters between each transect point.

Vegetation sampling efforts began in April/May 2007 and will be repeated annually. We used the line intercept method (Canfield 1941) to measure canopy cover and average shrub height along each transect. We used the Daubenmire technique (Daubenmire 1959) to measure overall herbaceous cover as well as overall vegetative composition and frequency. In addition to the aforementioned methods to sample vegetation, photos were taken at the origin of each transect at “eye level” at a zero degree bearing (facing north). Photos will be taken annually during vegetation surveys to visually document the changes in vegetation before and after treatments.

Shrub Canopy Cover and Height

To measure changes in shrub canopy cover and average shrub height we conducted vegetation sampling using the line-intercept technique. For this sampling technique we stretched a measuring tape along the length of each transect and recorded the amount of shrub that intersects the transect line. The total amounts of shrub intersecting the line was tallied and divided by the total length of each transect to yield a percentage of total canopy cover. Spaces between foliage that exceed 5cm were excluded to maintain an accurate estimate of total live shrub coverage. To measure average shrub height the tallest part of each live shrub occurring along the transect line was recorded using a meter stick and averaged for each transect.

Vegetation Composition

To measure changes in the vegetation community we conducted quadrat sampling using the Daubenmire technique. For this sampling we used a 1m Daubenmire-type frame. The frame was placed at 5m intervals along each 30 meter transect, resulting in 5 1x1m Daubenmire samples per transect and 50 1x1m samples per study plot. For each sample we identified the percentage of cover for each vegetation type (i.e. Shrub, Forb Grass) within the quadrat as well as the percentage of bare ground, rock and litter.

Sage Grouse Use Surveys

We estimated sage-grouse use using pellets count surveys (regular or cecal). Pellet counts were conducted in the late spring/early summer. To conduct pellet counts we randomly selected a starting transect to survey. For each transect we delineated a 30 x 30 meter square aligned with the cardinal directions. The southwest corner of the square was the original random point. Within the boundaries of this transect square we searched for fecal sign of sage-grouse for 15-20 minutes. When fecal sign was discovered, we recorded type, distance from the nearest habitat edge (i.e. living sagebrush or obvious vegetative cover). The distance from the nearest habitat edge might be outside the transect plot. We then removed the fecal sign from the transect plot to avoid double-counting. The process was repeated for each of the remaining transects in the treatment and control areas.

Bird-dog surveys may be implemented in late spring of each study year, beginning 2008, to estimate grouse populations in the treated and control areas. For each study area (treated and control) bird-dogs and their handlers will walk through the habitat for 1 hour each. The area will “walked” in such a way that the entire area was represented in the search. There was a ½ hour rest period between searching the treated and control areas. When a sage-grouse is flushed we will record the number of birds counted, the sex and age of birds counted, their GPS location at the point of flushing, distance from transect plot, habitat/cover type.

Invertebrate Sampling

Invertebrates, especially ants and beetles, are an important element of Greater Sage-grouse early brood-rearing habitat (Klebenow 1968, Johnson and Boyce 1990). By assessing the diversity and abundance of invertebrate populations in the study area we can evaluate the quality of the habitat. To measure changes in the invertebrate abundance between the treatment and control areas, we captured insects using pitfall and pan traps. Pitfall traps consisted of 300ml plastic containers filled with a solution of one part water and one part ethylene glycol. We buried the containers such that the rim was flush with ground level. Small pan traps (yellow plastic plates) were placed over each pitfall trap using nails and twigs. Pan traps had a small amount of water and dish soap to help capture flying insects by reducing surface tension. Traps were placed at the origin of each transect resulting in 10 traps per site. Captured insects were placed in vials with a 75% solution of ethanol for preservation and storage. Pitfall/Pan traps were left open for 24 hours during June or July to coincide with hatching time of sage-grouse chicks. The total number of captures made were recorded for each trap, each transect, and each plot. To measure insect diversity and order richness, insects were classified and sorted by order and further sorted by morphs within each respective order. Percent of total capture and diversity within each order were recorded for each survey plot.

Small Mammal Trapping

To measure small mammal population in the treatment and control areas, we used Sherman live traps to sample the area. Small mammal trapping was conducted place in summer starting in 2007 and will continue for 3 consecutive years. Traps were set along one 500 meter transect originating at a random transect point for both treatment and control sites. The transect line ran north to south for 250m and east to west for 250m resulting in a “L” shaped line. Two traps were placed along the line every 10m for a total of 100 traps. At each 10m interval one trap was placed parallel to the line and one perpendicular. The perpendicular trap’s opening faced away from the line to the west on the north-south line and to the south on the east-west line. The parallel trap’s opening faced south on the north-south line and east on the east-west line. At each interval the parallel trap was baited with peanut butter and a cracker and the perpendicular trap with a mix of rolled oats, peanuts, and raisins. Temperature data were recorded for each 24 hr period during trapping using Max-Min Thermometers or Hobo data recorders placed at each transect. A small amount of batting was placed in the traps for insulation bedding. Traps were opened in the evening and checked the following morning; traps were checked for contents and re-baited if necessary. Each day, we recorded the status of each trap (“OK” or “closed” and “bait missing”, “bait OK”, or “capture”). Traps were closed after checking them in the morning and reset each evening. This design resulted in 300 trap nights (3 nights x 100 traps) per transect. Mammals captured were identified down to species and sexed. Captured animals were marked with indelible colored ink on one of the legs each day. A different color of ink and different leg was assigned to each trapping day to distinguish recapture status. We recorded overall captures and individual species captures for each transect (treatment and control). We also recorded capture per unit effort (CPUE) for all captures and each species. CPUE was calculated by dividing the number of captures by the number of trap nights X 100. Using the markings, we recorded the percentage of recaptures made for each survey plot.

Results

Objective 1. Ecological Monitoring (Vegetation)

Vegetation Surveys

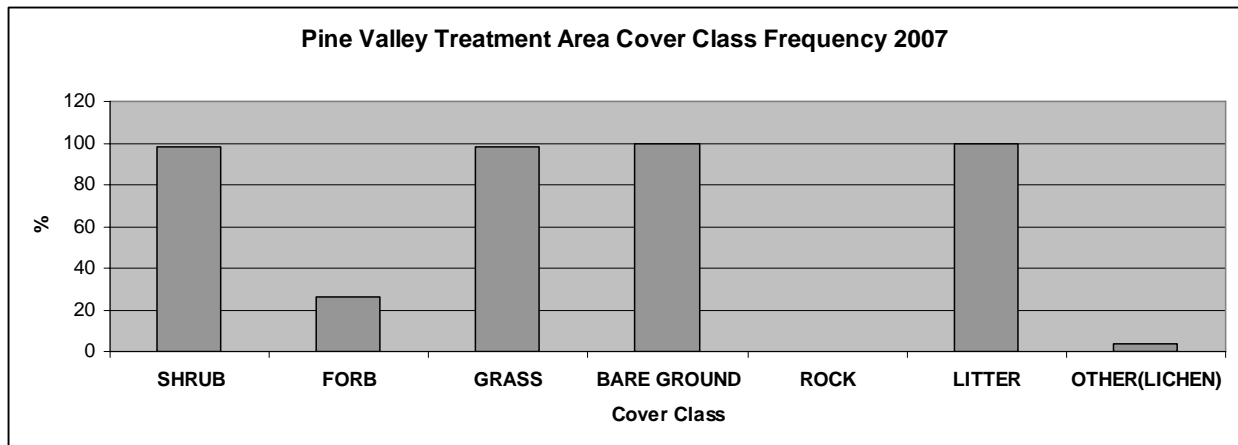
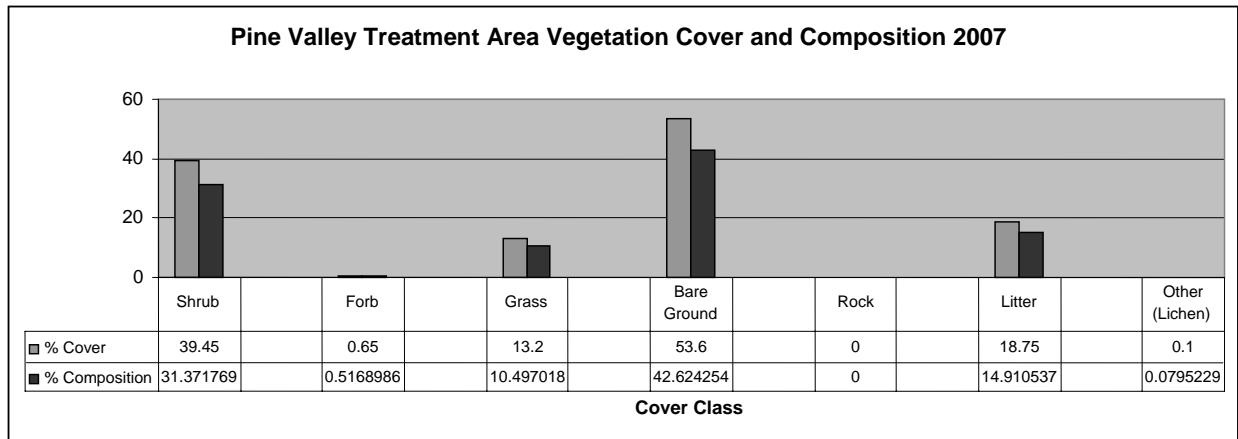
Shrub Canopy Cover and Height

Line intercept measurements were recorded in early to mid August of 2007. In the Pine Valley treatment area overall shrub canopy cover was 22.79% and was comprised of four shrub species, Wyoming sagebrush (*Artemisia tridentata wyo.*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), Green Ephedra (*Ephedra viridis*), and Black sagebrush (*Artemisia nova*) Wyoming sagebrush was the dominant shrub with a canopy cover of 18.3% and a composition of over 80%. Douglas rabbitbrush had a canopy of 3.02% and a 13.27% composition. Green Ephdra had a canopy cover of 1.27% and a composition of 5.57%. Black sagebrush was not widespread with a canopy of 0.19% and a composition of 0.85%. Average shrub height in the Pine Valley treatment area was 48.34 cm. In the Pine Valley control area overall shrub canopy cover was 18.23% and was comprised of Wyoming sagebrush, Douglas rabbitbrush, and Green Ephedra. Wyoming sagebrush was dominant with a 92.14% composition and a canopy of 16.8%. Douglas

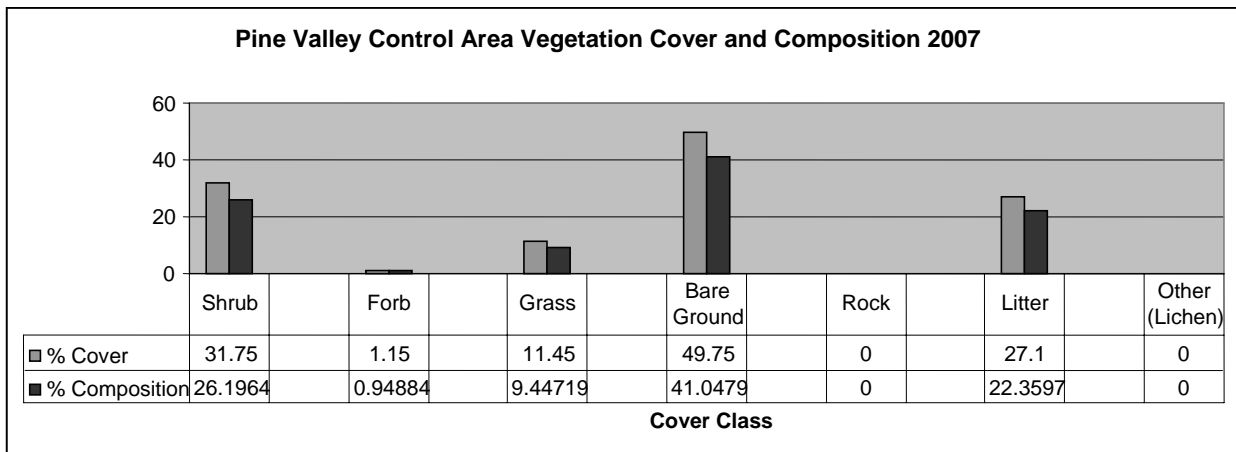
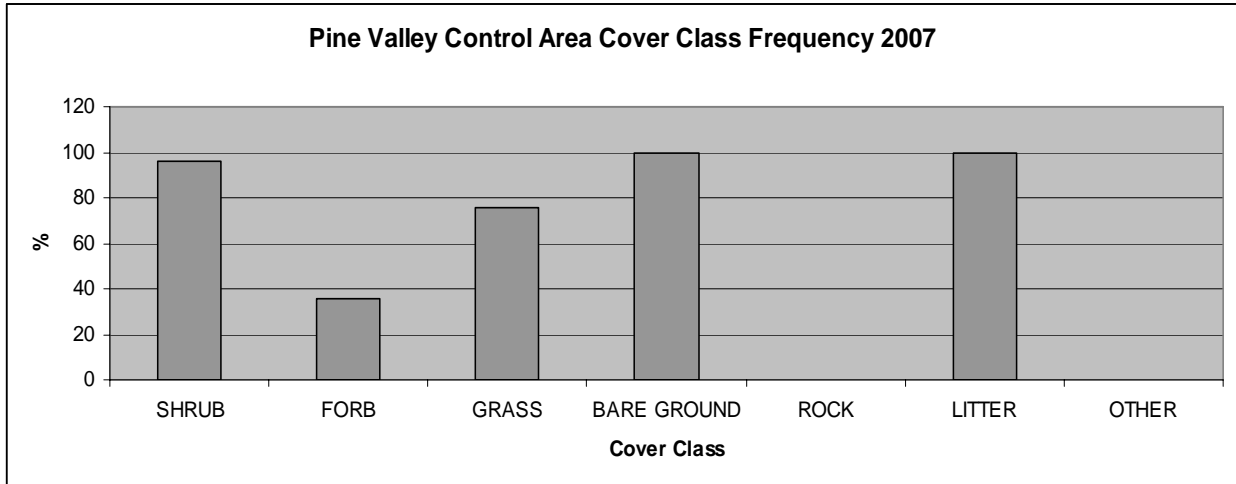
rabbitbrush had a canopy cover of 1.03% and a composition of 5.63%. Green Ephedra was present in small portions with a canopy of 0.41% and a composition of 2.23%. The average shrub height in the Pine Valley control plot was very high with an average of 59.37cm.

Vegetation Composition

Data from Daubenmire frame plots were recorded in conjunction with line intercept surveys. For Daubenmire surveys we analyzed percent canopy cover, percent composition, and cover frequency for the following categories and/or cover classes: Shrub, Forb, Grass, Bare Ground, Rock, Litter, and Other. It was of importance to note that the “rock” category was methodologically different than the traditional Daubenmire technique in that we only recorded rocks that were large boulders (>20cm) or bedrock. Small pebbles and medium stones were categorized as bare ground. Percent canopy cover was calculated by estimating the total cover for each cover class within the frames. Percent cover can total over 100% because was a measurement of foliar cover as it projects to the ground on a vertical plane. Therefore, the different levels of the canopy are separately assessed, this accounts for overlap in cover types. Percent composition was simply the percent of each cover class divided by the overall cover for all cover classes. The following was a summary of the Pine Valley treatment area vegetation cover, composition, and frequency:



Of the vegetation cover classes (e.g. Shrub, Forb, and Grass) in the Hamlin Treatment area, Shrubs exhibited the highest cover and composition. Grass cover was at 13% and had a composition of 10.49%. There was a high percentage of grass but much of the grass species had been grazed rather heavily and only the base of perennials remained. The grass species most abundant were Needle-and-Thread (*Stipa comata*), Squirreltail (*Sitanion hystrix*), and Blue Grama (*Bouteloua gracilis*). Cheatgrass (*Bromus tectorum*), Crested Wheatgrass (*Agropyron cristatum*), Indian ricegrass (*Achnatherum hymenoides*), and Junegrass (*Koeleria macrantha*) was also present throughout the treatment area but not in large quantities. Forbs were uncommon in the treatment area (26% frequency) and in very limited numbers with a 0.65% cover percentage. Common forbs in the treatment area include: Rose Heath (*Chaetopappa ericoides*), Locoweed (*Astragalus spp.*), Phlox (*Phlox and Microsteris spp.*) and, Globemallow (*Sphaeralcea spp.*) In the treatment area bare ground was present with a high cover and composition percent but this was typical for a dry shrub steppe community. A small amount of ground lichen (*xanthoparmelia spp.*) was recorded in the treatment area but none in the control area. In the Pine Valley control area vegetation results were quite similar to the treatment area with the exception of a lower grass percentage and a higher litter percentage. Cheatgrass was virtual absent from the control site, the major grasses were Blue Grama, Needle-and-Thread, Indian ricegrass, and Squirreltail. The following was a summary of the Pine Valley control area vegetation cover, composition, and frequency:



Objective 2. Habitat Use

Sage Grouse Use Surveys

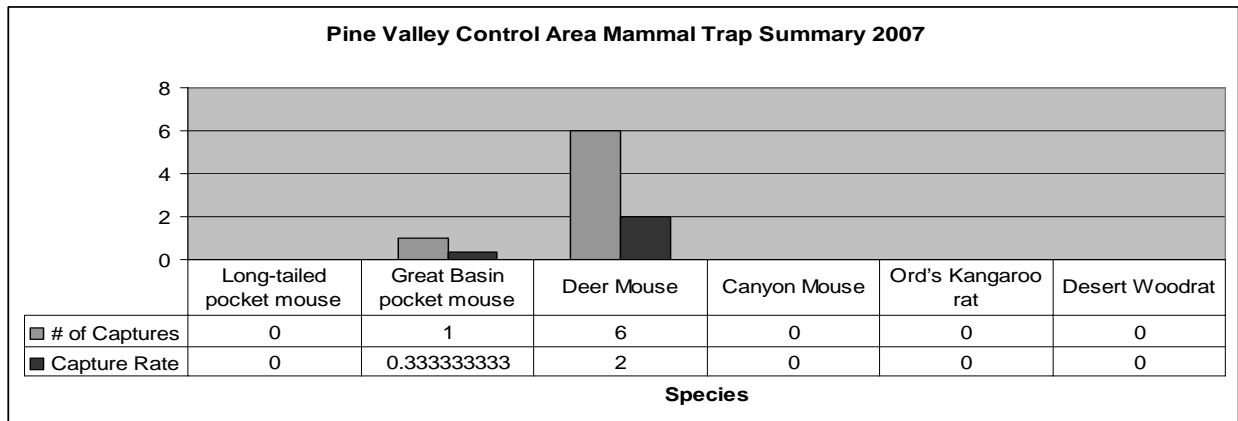
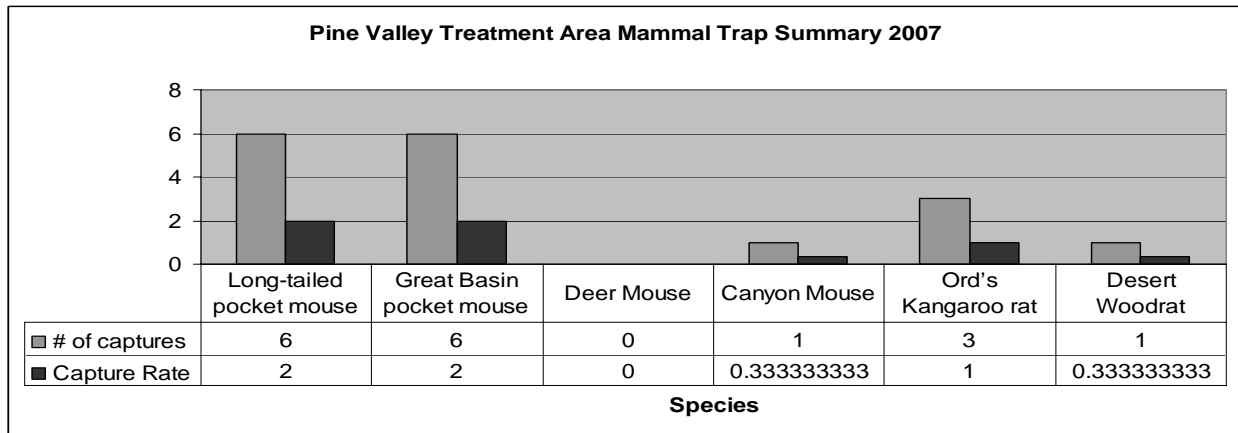
In the Pine Valley treatment and control area we found zero clusters of cecal or fecal pellets during sage-grouse pellet searches. Sage-grouse are known to use the area and pellets have been seen in the immediate area. However, no sign of pellets were found within the designated survey plots. Bird dog surveys are scheduled for the second year of the study and will take place in spring 2008 pending availability of dogs and handlers.

Objective 1. Ecological Monitoring (mammals)

Small Mammal Trapping

We completed three successive trapping nights at each of the Pine Valley transects in September 2007. The treatment area was sampled from September 6-8, 2007 and the control area was sampled from September 25-27, 2007. In future years we hope to trap mammals at the same time of year but keep the time interval between the treatment and control site within one week. Overall we made 25 captures of 6 different species between both treatment and control sites. Seven of the 25 captures were recaptures and of that seven, 3 were third time recaptures. The

total number of individual small mammals caught was therefore 15 individuals (40% recapture rate). At this time we have not analyzed mark-and-recapture data with statistical test. We plan to do so once data from subsequent years are collected. At this time we can only present descriptive data on species caught, numbers of captures made and CPUE (Catch per Unit Effort) rates. Catch per unit effort was calculated by dividing the number of captures by the number of trap nights (n=300) and multiplying by 100. At the treatment site we captured 5 different species and 18 total animals, four of which were recaptures. The most frequently captured species were Long-tailed pocket mouse (*Chaetodipus hispidus*) and Great Basin pocket mouse (*Perognathus parvus*), each having a total of six captures. The next most commonly caught species was the Ord's Kangaroo rat (*Dipodomys ordii*) with a total of 3 captures. We also caught two Canyon Mice (*Peromyscus crinitus*) and one Desert Woodrat (*Neotoma lepida*) at the treatment site. At the control site we had surprisingly different results compared to the treatment site. At the control site seven total capture were made three of which were recaptures. Only two species were represented at the control site, the Deer Mouse (*Peromyscus maniculatus*) and the Great Basin pocket mouse. A total of six deer mice were captured and only one Great Basin Pocket Mouse. We assume that a cold weather event between the time of the treatment trapping and the control trapping may have adversely affected our capture rate. Captures and capture rates from each transect are presented graphically below:



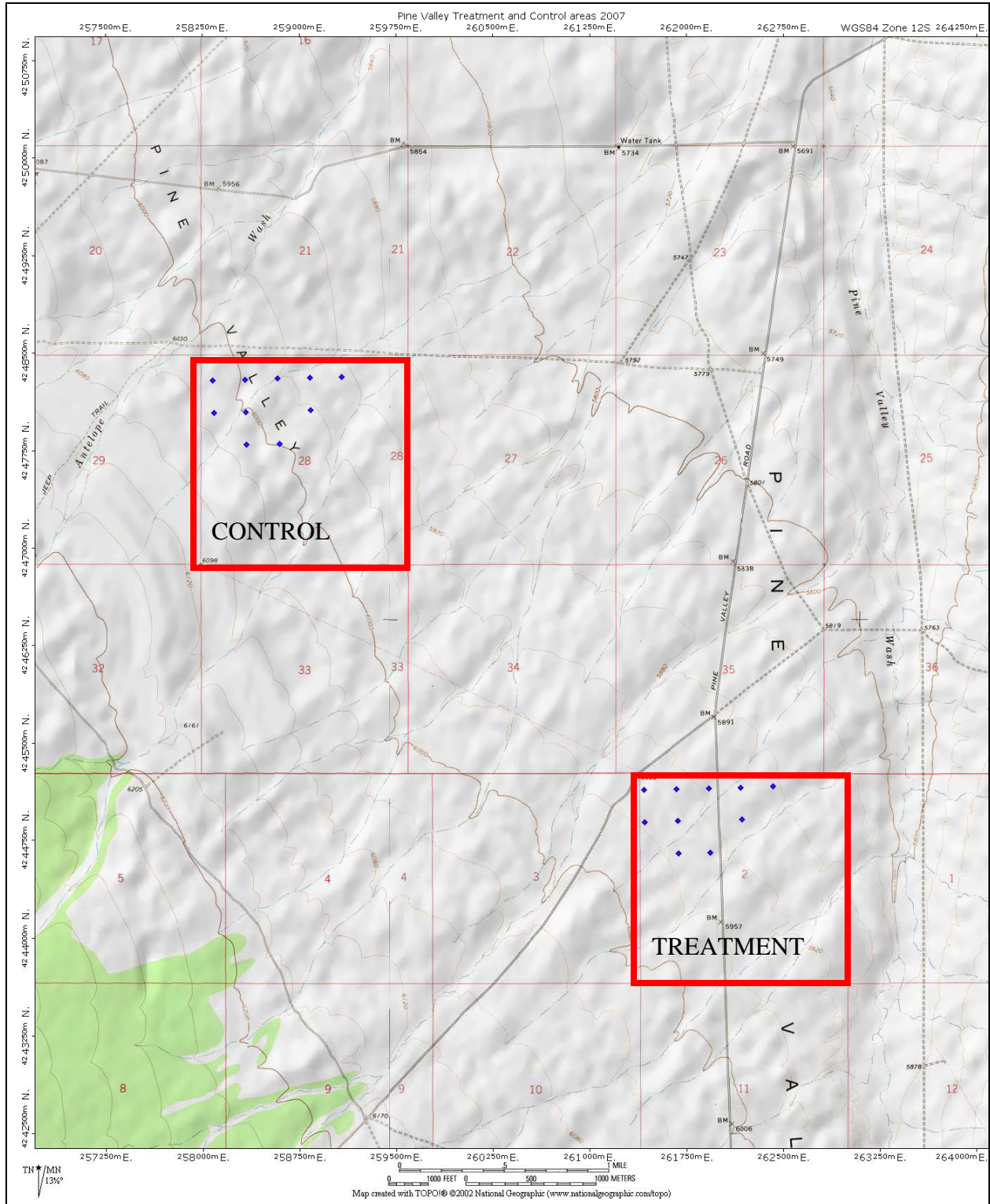
Objective 1. Ecological Monitoring (invertebrates)

Invertebrate Sampling

Invertebrate sampling was conducted in the Pine Valley study areas in early August 2007. Specimens were collected in ethanol for future sorting and identification. Analyses of the insects captured have not been completed at this time. Ants (Hymenoptera), Beetles (Coleopterans), and Flies (Dipterans) were all represented in good numbers in both study areas. Insects captured were tallied and identified to genus and sorted by order and morpho-species.

2008 Plan of Work

Next year field work will resume and we will attempt to replicate what was accomplished in 2007. The only change will be the addition of bird dog surveys to further assess sage-grouse use in Pine Valley. Vegetation and ecological surveys will become crucial once the mechanical treatments are completed to illustrate the post-treatment effects.



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