GREATER SAGE-GROUSE (*Centrocercus urophasianus*) ECOLOGY IN WESTERN BOX ELDER COUNTY, UTAH
2007 Annual Report

Photo courtesy of Todd Black

submitted to

Box Elder County Adaptive Management Local Working Group
Utah Division of Wildlife Resources
USDA Natural Resources Conservation Service
US Bureau of Land Management

by

Eric Thacker, Graduate Research Assistant
Terry A. Messmer Principle Investigator
Todd A. Black Community-Based Extension Specialist
Jack H. Berryman Institute
Department of Wildland Resources
Utah State University, Logan Utah 84322-5230

January 2008

Table of Contents

Introduction

Historically, greater sage-grouse (*Centrocercus urophasianus*) were believed to be one of the most abundant and widely distributed indigenous upland game birds in the western United States (Dalke et al. 1963). Sage-grouse were once found in portions of at least 12 states and 3 Canadian provinces (Connelly et al. 2004, Schroeder et al. 2004). In Utah, sage-grouse once occupied all 29 counties. The species is currently found in 26 counties and inhabits 50% of their historical distribution (UDWR 2002, Beck et al. 2003). Western Box Elder County supports one of the largest greater sage-grouse populations in the state (UDWR 2002, Beck et al. 2003).

Due to continued downward population trends, several organizations have petitioned the U.S. Fish and Wildlife Service to list greater sage-grouse for protection under the Endangered Species Act of 1973 (Connelly et al. 2004). In 1996, the Western Association of Fish and Wildlife Agencies (WAFWA) recommended the formation of local working groups in each state that the birds occupy (Connelly et al. 2004). One of the main goals of these working groups is to research and address local area conservation issues regarding sage-grouse and their required habitat. By 2004, a total of 44 groups had been formed (Connelly et al. 2004). Sage-grouse are not currently listed for protection in the United States.

Box Elder County Adaptive Resource Management (BARM)

The Box Elder County Adaptive Resource Management Coalition (BARM) is a public and private partnership that was organized in 2002 to address stakeholder concerns about declining sage-grouse populations. The partnership employs an adaptive management approach designed to address local stakeholder concerns while working toward achieving the goal of providing multiple resource benefits (Bergerud 1988). These benefits include conservation of greater sage-grouse populations and local community economic sustainability.

The partnership is chaired by local landowners and administered by Utah State University Extension's Community-Based Conservation Program (CBCP). The working group completed 10-year adaptive resource management plan in 2007 that blends greater sage-grouse conservation and regional socio-economic sustainability with restoration of sagebrush communities. A copy of the plan can be viewed on the web site www.utahcbcp.org. The group believes that baseline information on sage-grouse ecology in Box Elder County is needed to prioritize conservation actions and measure impacts.

Research conducted by Utah State University in south-central Utah suggests that chemical and mechanical manipulations in degraded sage-grouse brood-rearing habitat can successfully restore sagebrush steppe environmental functions, resulting in increased forage production, plant diversity, and grouse use (Dahlgren et al. 2006). The research demonstrated that plant diversity and production in sagebrush habitat types can be increased if sagebrush canopy cover is reduced to 19-20% (Braun et al. 1977, Connelly

and Braun 1997, Connelly et al. 2000). This work was conducted at elevations above 2600 meters in brood-rearing areas. The size of the treatments were limited to 40.5 ha plots that exhibited 30-70% sagebrush (*Artemisia* spp.) canopy cover.

The results of preliminary research conducted by BARM in cooperation with Utah State University suggests that brood-rearing habitat may also be limiting sage-grouse populations in western Box Elder County. To address this, BARM has implemented similar sagebrush treatments on larger plots (120 ha) of private lands on the Grouse Creek Mountain range in western Box Elder County. The project area is < 2000 meters in elevation (Figure 1).

The need for conducting these types of management experiments at different elevations and scales has been highlighted in both the Utah and the Western Association of Fish and Wildlife Agencies (WAFWA) sage-grouse management guidelines. The results of this research will be used to guide the management activities of the local working group. In addition, this information will be important in assisting the U.S. Fish and Wildlife Service in making decisions regarding the impacts of conservation efforts when reviewing petitions to list sensitive species.

Project Purpose

The purpose of this project is to describe the ecology of the greater sage-grouse population in western Box Elder County and evaluate the effect of site-specific sagebrush management treatments conducted on private land to enhance livestock production and sage-grouse habitat. Completion of this project will result in the identification of conservation technologies and strategies that can assist Natural Resources Conservation Service (NRCS) field staff in the planning and implementation of habitat projects and practices on private lands. These projects also will contribute to range-wide sage-grouse conservation efforts.

This research will document the effect of larger scale chemical and mechanical treatments on rangeland forage production and greater sage-grouse habitat and habitat-use.

Study Objectives

The objectives of this study were:

1) To collect data on greater sage-grouse ecology in western Box Elder County, including information on general habitat-use, nesting and brood-rearing habitat, nesting initiation and success, survival, and seasonal movement patterns.

2) To delineate winter habitat for the sage-grouse in the Grouse Creek Valley and to evaluate the ecological stability of the wintering habitat.

3) To evaluate the effects of the 2 sagebrush treatments [spike (herbicide), and Lawson aerator (mechanical)] on pre-laying sage-grouse hens and brooding sage-grouse within treated areas as it compares to the control treatments.

Study Area

The study area is located in the Grouse Creek Mountain range in western Box Elder County, Utah (Figure 1). This area is a sub-management unit of the Box Elder County Adaptive Resource Management area. The area is bounded by the Idaho border on the north, Nevada border on the west, Grouse Creek Mountains on the east, and Route 30 on the south. There are 37 active leks within the study area, ranging from 1500-2100 m in elevation. Sage-grouse leks have been counted in this area since 1959 (Figure 2.) The area encompasses approximately 1572 km^2 of public and private lands. Grazing by domestic livestock is the primary use of these lands.

The vegetation in the study area consists mainly of shrub-steppe intermixed with grassy meadows, and woodlands. Common shrubs and trees include big sagebrush (*Artemisia tridentata*), black sagebrush (*A. nova*), rabbitbrush (*Chrysothamnus* spp.), serviceberry (*Amelanchier utahensis*), snowberry (*Symphoricarpos albus*), bitterbrush (*Purshia tridentata*), juniper (*Juniperus osteosperma*), quaking aspen (*Populus tremuloides*), and chokecherry (*Prunus virginiana*). Common grasses include wheatgrasses (*Agropyron* spp., *Elymus* spp.), Kentucky bluegrass (*Poa pratensis*), cheatgrass (*Bromus tectorum*), and great basin wildrye (*Elymus cinereus*). Common forbs include phlox (*Phlox* spp.), astragalus (*Astragalus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), lupine (*Lupinus caudatus*), western yarrow (*Achillea millefolium*), prickly pear (*Opuntia humifusa*), and wild onion (*Allium acuminatum*).

Methods

Sage-grouse Ecology

Captures and radio-telemetry

To collect habitat use and ecology data on greater sage-grouse, we captured sage-grouse near several leks in 2007 and fitted them with radio-transmitters. The birds were captured March - May 2007 on or near leks and late July-August in areas known to have grouse. Sage-grouse were located by spotlighting from the back of an ATV and captured with a long-handled net (Giesen et al. 1982). Age (adult or juvenile) was assigned based on primary feather characteristics (Dalke et al. 1963). The birds were then fitted with a Holohil radio-collar. A GPS location was also recorded within 5 m accuracy for each capture site. Fifteen sage grouse chicks were also collared within 48-hours of hatching using similar methods as the adults. The collars were suture type collars with a life of 50-70 days.

Radio-tracking allowed us to evaluate movements, number of nests initiated, brood survival, adult mortality chick mortality, and habitat use of greater sage-grouse in the study area. Radio-collared birds were located using Communications Specialists receivers and Telonics 3-element hand-held Yagi antennae, and Omni antennae.

Nests were identified and marked at a distance of 50-100 m for future reference. Nests were checked approximately every 3 days from the time they were located until they were predated, abandoned, or successfully hatched. Predated nests were evaluated for potential identification of nest predators from any eggshells, scat, tracks, or hairs. Visual locations were obtained on females with broods every 3 days between May and August of 2007. Visual locations on females without broods were obtained at least bimonthly. Birds were located at least once from fixed-wing aircraft from September to April. Adult mortalities were examined to determine depredating species (Zablan et al. 2003).

The radio-collared hens with broods were monitored every third day as described above. However, the time of the day when hens were located was adjusted to encompass roosting (midnight), feeding (sunrise), and loafing (afternoon) activity. The same vegetation measures previously described were recorded at each location.

Habitat monitoring

There were four general reasons for assessing habitats: 1) to document current conditions and trends of habitat; 2) to evaluate impacts of a land treatment; 3) to assess the success of a habitat restoration program; and 4) to evaluate the ability of habitat to support a reintroduction population (Connelly et al. 2003). We strived to determine the baseline information that will aid managers in deciding which options will best meet the desired goals and objectives.

At each nest site, GPS location (within 5 m), slope, aspect, and clutch size were recorded, along with predation information if necessary. Vegetation measurements were taken in four directions (every 90° starting with a randomly chosen direction). The visual obstruction of the vegetation to and from the nest was measured using a Robel pole (Robel et al. 1970). The Robel pole is a widespread method of measuring visual obstruction and is applicable for numerous species and habitats, and is generally recommended for assessing sage-grouse habitat (Connelly et al. 2003). We sampled shrub canopy coverage using a modified line intercept method (Canfield 1941), and the percentage of ground vegetation was measured using 20x50 cm Daubenmire frames (Daubenmire 1959). Percent cover of shrubs was measured with a 15-meter tape. The amount of live shrub canopy intersecting an imaginary vertical plane on the tape was measured. Gaps in the foliage smaller than 5 cm were counted as continuous, gaps 5 cm and larger were not counted. The amount of total shrub intersecting the line was summed and then divided by the length of the line to determine total shrub canopy coverage (Connelly et al. 2003). Use of the line intercept allowed us to compare data from many other studies because this is a very common method of measuring sagebrush canopy cover (Lyon 2000, Connelly et al. 2003). The Daubenmire frame is one of the most common methods of estimating herbaceous cover in sagebrush habitats (Connelly et al.

2003). Daubenmire frames were placed every 3 m along the 15 m tape to estimate percentages of grasses, forbs, litter, rock, and bare ground (Daubenmire 1959).

At locations of collared hens with broods, a measurement of slope, aspect, and number of visible chicks was recorded, as well as a GPS location (within 5 m). Within 24 hours, the vegetation at each brood location was also measured using the Robel pole and line-intercept method, but with a 10-meter tape. A 20x50 cm Daubenmire frame (Daubenmire 1959) was placed every 2.5 meters along the tape. These measurements were only made if the hen had or was suspected to still have a brood.

Arthropod sampling

Arthropods, particularly insects, are an essential element of early brood-rearing habitat (Patterson 1952). Sage-grouse chicks require insects in their diet for survival and normal growth, especially in the first 3 weeks after hatching (Johnson and Boyce 1990). In order to assess insect abundance in brood foraging habitat, we used pitfall traps (Morrill 1975, Connelly et al. 2003).

Hens with broods were located 3 times each week for 7 weeks after hatching, unless it was determined that chicks were no longer present. Each week one location from each hen with a brood was randomly selected to test insect abundance and diversity. After vegetation measurements were taken, a total of 8 pitfall traps were placed flush with the ground along each of the 4 transects used in the line intercept method (see above). Pitfall traps were placed at 5 and 10 m from the hen location along each transect. Insects were also sampled at the random site chosen for vegetation measurements.

Pitfall traps were filled with a 50/50 solution of water and antifreeze. All traps were opened for 48 hours, at which time all insects were collected. Insects from all traps in a single site were consolidated and refrigerated for preservation. All insects from each location were separated by class, and each class counted for individuals and measured for volume (E. Evans, Utah State University, personal communication).

Sage-grouse Habitat Treatments

Experimental Design

In 2005, we identified twenty four 120 ha plots on the Grouse Grazing Association land holdings that exhibited dense sagebrush canopy. Of these, we randomly selected 18 plots to conduct the experiment. There were 6 replications for each of the three treatments. The three treatments are a control (no treatment), Lawson aerator (mechanical treatment) and tebuthiron herbicide (chemical treatment). The plots were within 3 km of active leks and within summer brood-rearing habitat. Baseline data for herbaceous cover, plant species composition, shrub canopy cover, shrub densities and forb densities were collected in 2006. The treatment plots were seeded with a mixture provided by the Utah Division of Wildlife Resources (UDWR). Grazing was deferred for 2 growing seasons following the completion of all treatments. Four permanent 10 m transects were

established in each treatment replication. Transects were placed in representative areas within each treatment, the direction of the transect was randomly chosen by spinning a logging pin. The herbaceous cover was collected using the line intercept method. Shrub densities were taken along the same transect by laying a 10 m x 1m belt transect over the top and counting the number of shrubs present within the belt transect. The shrubs were also categorized by age class. Forb density was estimated by counting the number of forbs within the belt transect. Within each treatment and control we placed two paired sets of exclosures; one that eliminated small mammal use and one that allows small mammal use, but restricted use by large ungulates.

Sage-grouse use data were also collected to document grouse use in the treatments prior to treatment. Sage grouse pellet counts and bird dog flushes were used. Both measures were taken pre and post treatment so that grouse use can be compared for each treatment as well as the relative differences in grouse use between treatments. The pellet counts were conducted along four 100 m transects. We placed $2m^2$ hoops on the line at 0, 15, 25, 50 and 100 meters. All of the pellets and cecal droppings were counted and removed from within the hoop. The bird dog flushes were conducted by allowing 1 of 3 bird dogs to cover an entire plot and the numbers of sage-grouse flushed by age class were recorded. Sage-grouse use measures will be repeated following the treatments in 2008.

To complete the treatments, we worked with the Grouse Creek Grazing Association to prepare and submit an EQIP/WHIP proposal to NRCS. The proposal was funded and the treatments were initiated in the fall of 2005.

Monitoring

Greater sage-grouse habitat use patterns were monitored in 2006 and 2007. The sites will again be monitored in 2008. In addition, we will continue to monitor vegetation changes and determine the effect of sagebrush treatments on sagebrush-steppe systems.

In 2005, we measured the baseline shrub canopy cover and composition of the understory in each plot. We used a variation of the line intercept method (Canfield 1941) and sampled the big sagebrush areas within each plot. We mapped the big sagebrush and randomly chose five points from which to start a 100 m sampling transect. We recorded a GPS location for each starting point. Then, a 100-meter tape was stretched in a randomly chosen direction. The amount of live shrub canopy intersecting an imaginary vertical plane on the tape was measured. Gaps in the foliage smaller than 5 cm were counted as continuous, gaps 5 cm and larger were not counted. The amount of total shrub intersecting the line was summed and then divided by the length of the line to determine total shrub canopy coverage (Connelly et al. 2003). Shrub height was measured at all locations where line intercepts were taken; the tallest live part of the shrub recorded. The highest point excluded the seed head and was reported as the highest live leaves or branch. In addition, percent cover of forbs, grasses, litter, and bare ground were measured using a 20x50 cm Daubenmire frame. The frame was placed every 10 m along the 100 m transect to estimate percent understory coverage. We believe that by

increasing vegetation diversity, chick survivorship will increase as the condition of nesting and brood-rearing habitats improve.

Wintering Sage grouse – Diet Analysis

Using locations provided by radio-collard birds we identified major wintering areas. We collected sage-grouse pellets for chemical analysis by collecting 10 random pellet piles at each major wintering areas bimonthly in January and February. We subsequently extracted terpene profiles from the pellets. We than compared these profiles black sage and Wyoming big sage to determine the proportion of the black sage vs. Wyoming sage contained in the pellet.

The bird locations at major wintering areas were plotted to determine how much of the area is infested with cheat grass using GIS, remote sensing and frequency measures of cheatgrass, perennial grass, forbs and bareground.

Data Analysis

To describe pre- and post-treatment spring and summer greater sage-grouse habitat use patterns, logistic regression was used to compare vegetation parameters of use to non-use areas ($P<0.05$). Logistic regression was used to evaluate selection of nest sites for vegetation composition and to compare with random sites ($P<0.05$). Descriptive statistics were used to describe sage-grouse nesting success, mortality, and survival of broods.

Anticipated Benefits

Completion of this project will provide BARM and NRCS with information on the role of existing conservation practices and technologies relative to conserving sage-grouse and other sagebrush obligate species.

Results

Sage-grouse Ecology

Captures and radio-telemetry

Twenty-eight radio-collared greater sage-grouse hens were known to be alive at the beginning of the breeding season. An additional 15 hens were captured and fitted with radio-collars between 23 March and 10 May 2007. Fifteen chicks were collared in 3 different broods in May of 2007. In addition to the birds captured in 2007, 13 collared birds remained from the 2006 season. Thirteen females were also captured and marked in July and August of 2007. Six of the 15 chicks were later fitted with adult radio collars.

Sage-grouse were captured between the hours of 2300 - 0530 on or in the areas surrounding leks. The captures took place surrounding Badger Flat, Ray Kimber Ranch,

Dry Canyon Mountain, Meadow Creek, Twin Meadows, Kimbell Creek leks, and Cotton Thomas basin.

Nesting

Of the 28 collared females in spring 2007, 7 (28%) initiated nests. All the nests were located under big sagebrush. The vegetation data collected at each nest site is currently being analyzed. Of the 7 hens who initiated nests, 3 were successful (43%). The other nests were predated. We were not able to determine the nest predator. The average clutch size for the successful nests was 5 chicks.

Brood survival and habitat use

Two females with broods (66%) were successful in raising chicks past 50 days. The average number of chicks making it to 50 days was 4 chicks. Kimbell Creek, Twin Meadows, Simplot property, and the Cotton Thomas basin were identified as key brood-rearing areas. Vegetation data collected at brood locations is currently being analyzed.

Sage-grouse Daily Habitat Use

These data have been tabulated will be analyzed when the data from 2008 are tabulated.

Wintering Sage-grouse Diets - Pellet Analysis

These data were collected in the winter of 2006 and 2007 and was preliminary in nature. Of the 7 collections, 5 had 100% black sage terpenes. The 2 remaining samples were a mix of 95% black sagebrush and < 5% Wyoming sagebrush (Figure 3). The preliminary analysis suggested black sage may be a critical component in greater sage-grouse diets in the study area. The scope of this work has been expanded in 2008 to collect and analyze additional pellets.

2008 Plan of Work

All of the current research will be continued in 2008.

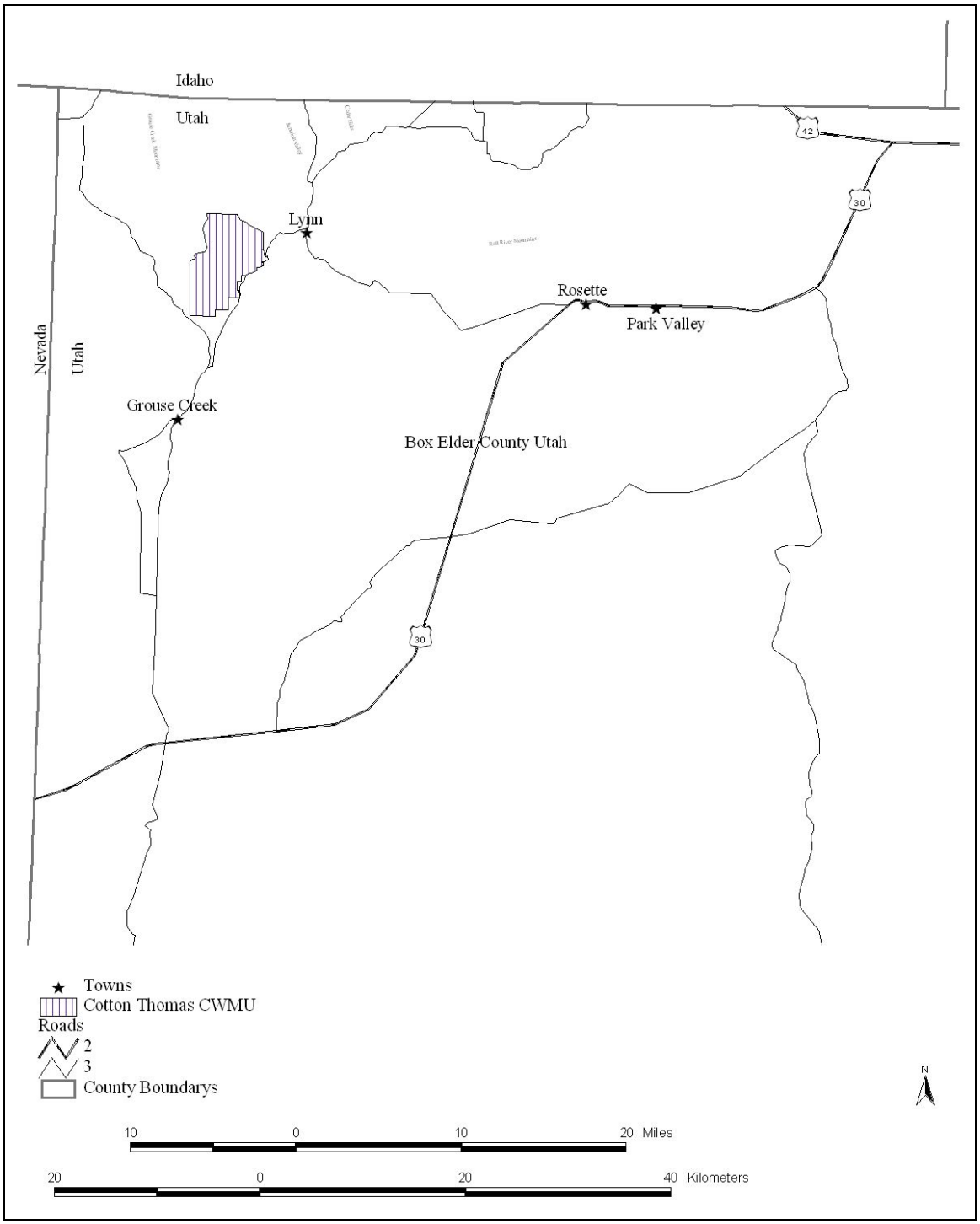

Figure 1. The Box Elder County Study Area

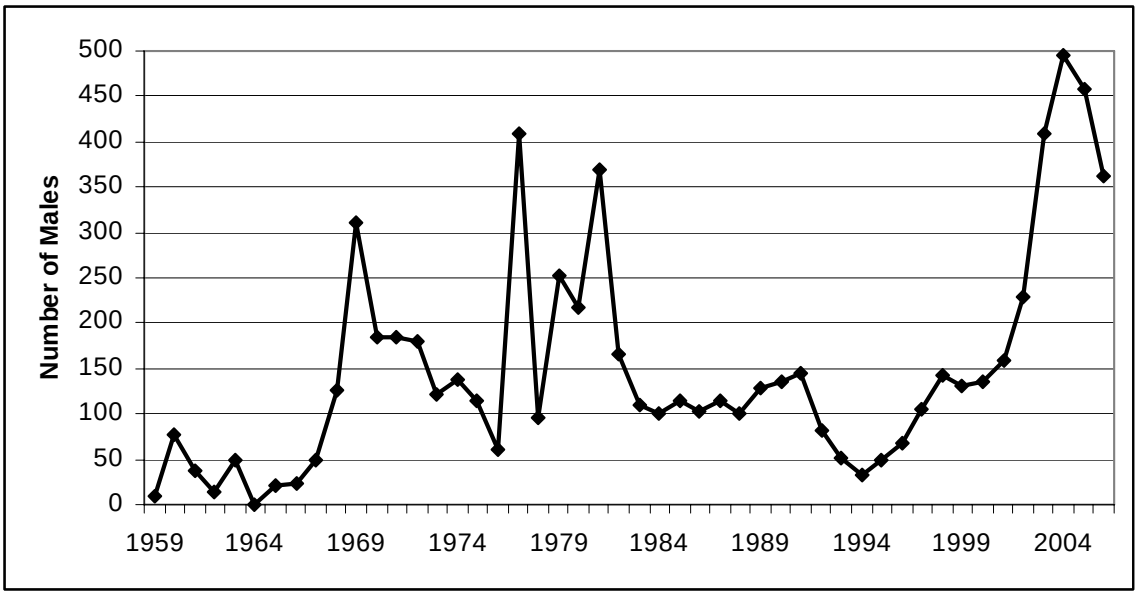

Figure 2. Historical lek count data in the study area.

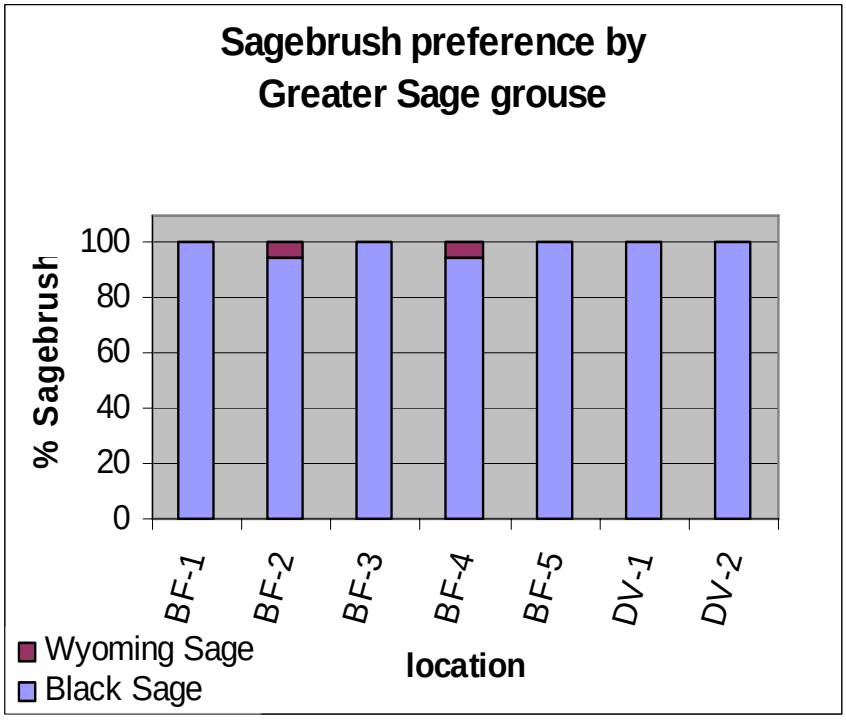

Figure 3. Preliminary results from chemical assay of wintering greater sage-grouse pellets

Literature Cited

Beck, T. D. I., and C. E. Braun. 1980. The strutting ground count: Variation, traditionalism, management needs. Proceedings of the Western Association of Fish and Wildlife Agencies 60: 558-566.

Beck, J. L., D. L. Mitchell, and B. D. Maxfield. 2003. Changes in the distribution and status of sage-grouse in Utah. Western North American Naturalist 63: 203-214.

Bergerud, A. T. 1988. Population ecology of North American grouse. Pages 578-648 *in* A. T. Bergerud and M. W. Gratson, editors. Adaptive strategies and population ecology of northern grouse. University of Minnesota, Minneapolis, Minnesota, USA.

Braun, C. E., T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of sage grouse habitats. Wildlife Society Bulletin 5: 99-106.

Canfield, R. H. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry 39: 388-394.

Connelly, J.W., and C. E. Braun. 1997. Long-term changes in sage grouse *Centrocercus urophasianus* populations in western North America. Wildlife Biology 3/4: 123-128.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000a. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28: 967-985.

Connelly, J. W., S. T Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming, USA.

Connelly, J. W., K. P. Reese, M. A. Schroeder. 2003. Monitoring of Greater Sage-grouse Habitats and Populations. Station Bulletin 80. College of Natural Resources Experiment Station, University of Idaho, Moscow, Idaho, USA.

Dalke, P. D., D. B. Pyrah, D. C. Stanton, J. E. Crawford, and E. F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. Journal of Wildlife Management 27: 811-841.

Dahlgren, D., R. Chi, and T. A. Messmer. 2006. Greater sage-grouse response of managing sagebrush in Utah. Wildlife Society Bulletin 34: 975-986.

Daubenmire, R. 1959. A canopy coverage method of vegetation analysis. Northwest Science 33: 43-64.

Emmons, S. R., and C. E. Braun. 1984. Lek attendance of male sage grouse. Journal of Wildlife Management 48: 1023-1028.

Giesen, K. M., T. J. Schoenberg, and C. E. Braun. 1982. Methods for trapping sage grouse in Colorado. Wildlife Society Bulletin 10: 224-231.

Johnson, G. D., and M. S. Boyce. 1990. Feeding trials with insects in the diet of sage grouse chicks. Journal of Wildlife Management 54: 89-91.

Lyon, A. G. 2000. The potential effects of natural gas development on sage grouse (*Centrocercus urophasianus*) near Pinedale, Wyoming. Thesis, University of Wyoming, Laramie, Wyoming, USA.

Morrill, W. L. 1975. Plastic pitfall traps. Environmental Entomology 4: 596.

Patterson, R. L. 1952. The sage grouse in Wyoming. Wyoming Game and Fish Commission Sage Books, Incorporated, Denver, Colorado, USA.

Robel, R. J., J. N. Briggs, A. D. Dayton, and L. C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23: 295.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106: 363-376.

Utah Division of Wildlife Resources (UDWR). 2002. Strategic management plan for sage-grouse. State of Utah Department of Natural Resources, Division of Wildlife Resources, Publication 02-20, Salt Lake City, Utah, USA.

Zablan, M. A., C. E. Braun, and G. C. White. 2003. Estimation of greater sage-grouse survival in North Park Colorado. Journal of Wildlife Management 67: 144-154.