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Home Range and Movements of Greater Sage-grouse in Its Southern-most Distribution

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Abstract: In Utah Greater sage-grouse (sage-grouse) habitat has been reduced to 50% of what is considered historical availability, due to habitat degradation and loss. We conducted a small study to determine the home range size, space use, and movement patterns of the southern-most sage-grouse population to facilitate future management actions to benefit sage-grouse. From 2005-2009 we collected VHF telemetry data on sage-grouse in Alton, Utah. Using Arc GIS we calculated home range size and movement patterns for 19 sage-grouse. Home-range size was similar to other non-migratory populations, suggesting sage-grouse in this region are capable of inhabiting sparse habitat conditions in southern Utah. Additional research is needed to determine if the current home range size and space use is adequate for maintaining this population.

Key Words: *Centrocercus urophasianus*, Greater sage-grouse, habitat use, southern distribution, Utah.

Greater Sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) have been a species of concern in the west for more than a decade, and at this time, are a candidate species for listing under the Endangered Species Act. Throughout their range across the Western U.S. and Canada, their distribution has been reduced (Connelly et al., 2004). In Utah, sage-grouse are found in 26 counties and are thought to occupy 50% of the habitat they once did (Utah Division of Wildlife Resources, 2009). In a synthesis paper by Schroeder et al. (2004), this decline is primarily attributed to habitat degradation and loss, from a wide variety of causes. In Utah, habitat change has been particularly evident in the southern portion of the sage-grouse distribution, where piñon pines (*Pinus edulus* and *P. monophylla*) and junipers (*Juniperus osteosperma* and *J. scopulorum*) have increased in areas that were once considered sage-brush steppe, and wildfires and human disturbance has increased cheatgrass (*Bromus tectorum*) (Utah Division of Wildlife Resources, 2009). Many studies have shown direct positive relationships between habitat characteristics and sage-grouse recruitment (see Crawford, 2004; Knick and Connelly, 2011). While broad scale management prescriptions can be useful, when conserving a sensitive species it is important that resource managers use their limited resources to produce the best possible result; therefore understanding the habitat requirements at the local scale is invaluable (Crawford et al., 2004). Furthermore, populations

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may exhibit unique spatial patterns within suitable habitat, which should be taken into account to ensure the success of habitat management actions at the site level.

Populations of sage-grouse living on the edge of their distributions are often isolated from larger central populations and live in marginal habitat (Bush et al. 2011). For example, sage-grouse in Garfield and Kane Counties, Utah, persist in locations that were predicted by Aldredge et al. (2008) to not support grouse based on known habitat characteristics. Aldredge et al. (2008) reported that fringe populations [such as those located in Kane and Garfield Counties, Utah], "blink out" more than interior populations, but these populations might also have differences in their home range or space use that allow for persistence. For example sage-grouse in hotter, drier portions of their range might have larger home ranges or larger movement patterns than other populations in order to find habitat that meets their demands. Very little is known about the sage-grouse in southern Utah.

Anecdotal documentation from lifetime residents of the Alton area, the location of the southern-most sage-grouse lek, suggest sage-grouse have fluctuated over time and always persisted over the last hundred years, but sage-grouse populations never reached extremely high numbers as seen in other areas (Frey et al., 2008).

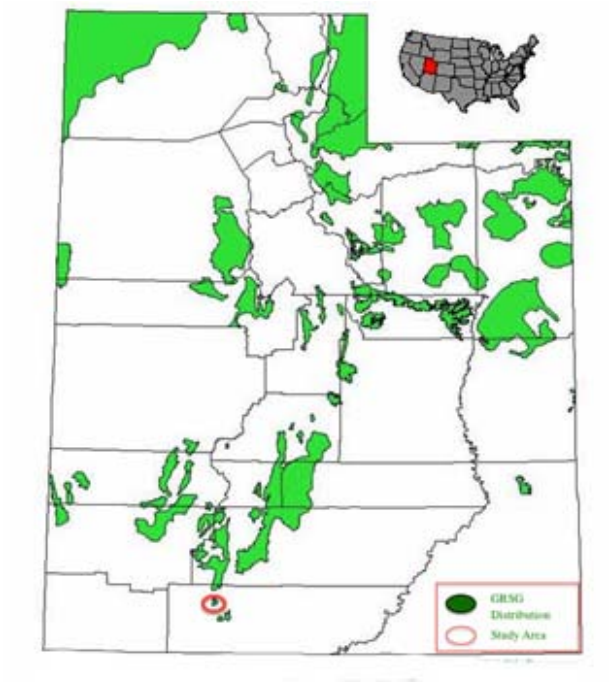

Figure 1. The location of the study area.

To increase our knowledge of the space use of sage-grouse populations in southern Utah, we studied the southern-most population of sage-grouse, in Alton and Sink Valley, Kane County, Utah, to determine their home range size and movement patterns at a local scale, as suggested by Herman-Brunson et al. (2009), with the goal of obtaining baseline information that can be used in future studies.

Study Area

Our study focused on a population of sage-grouse associated with the only lek in Sink Valley, Kane County, Utah; the southernmost lek of sage-grouse distribution (Figure 1). The Sink Valley study area was 8.6 km long and on average 2 km wide, situated on a SE-NW trajectory, surrounded by small hills ranging in elevation from 2072.6 m – 2194.6 m. Situated at the north end of Sink Valley is the small town of Alton (37°26′24″N 112°28′55″W). Alton is a small rural town of approximately 55-130 permanent residents (U.S. Census Bureau, 2000; U.S. Census Bureau, 2010). The town itself is 1.0 km²; however, agricultural practices occupied fields adjacent to the town and south into Sink Valley. During this study, winter temperatures (November – March) ranged from -5.7° – 5.4° C. Summer temperatures (May – August) ranged from 9.4°-25.0° C (Utah Climate

Center (a), 2012). Alton receives more precipitation than many southern Utah towns. Normal precipitation is 41.9 cm, and ranged from 30.5 – 43.1 cm during our study (http://climate.usurf.usu.edu/reports/waterYear.php.

The study area is characterized by four plant associations: piñon/juniper woodlands, sagebrush-steppe, pasture grasslands, and irrigated croplands. In the woodlands, species include juniper, piñon pine, big sagebrush (*Artemisia tridentata var. tridentata* and *var. vaseyana*), black sagebrush (*Artemisia nova*), and antelope bitterbrush (*Purshia tridentata*), with predominant grasses of bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and needlegrass (*Stipa spp*.). In the sagebrush steppe, predominant species include big sagebrush, black sagebrush, and antelope bitterbrush, with predominant grasses of bluebunch wheatgrass, Idaho fescue, and squirreltail (*Sitanion hystrix*). Pasture grasslands include Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), intermediate wheatgrass (*Thinopryum intermedium*) and several *Carex* species, as well as a variety of forbs such as lomatium (*Lomatium spp*.) and western yarrow (*Achillea millefolium*). Irrigated crops are predominantly alfalfa (*Medicago sativa*) and cereal crops.

Methods

We began sage-grouse trapping in March of 2005 using an ATV to access roosting locations, a spotlight to locate sage-grouse, and handheld nets to capture sage-grouse; this was repeated each fall and spring to maintain a population of at least 12 birds during the rearing and dispersal seasons (Utah State University IACUC # 1322). The attending male population at the Sink Valley lek was 6-12 individuals during the time of this study; thus we may have been sampling a much as one third of the population at any one time (D. Schaible, Utah Division of Wildlife Resources, pers. comm., 2008). Captured sage-grouse were sexed, assessed for injuries, fitted with a necklace radio-transmitter (Holohil Sytems Ltd., Ontario, Canada), and released on site.

During the summer, sage-grouse were visually located at least twice a week with the use of a 3-element Yagi antenna and a handheld radio receiver (Communications Specialists Inc., California, USA). From September to April, sage-grouse were visually located at least once a week. Efforts were made to get only as close as needed for a visual sighting without flushing the birds. At each sighting the GPS coordinate was recorded (GARMIN Etrex Legend H) along with the habitat characteristics at the location, flock size, and activity.

To analyze sage-grouse locations, home range size, and movements, we imported GPS locations into ArcGIS (ESRI, Redlands, CA, USA). We categorized the data into four biological seasons: summer (May 16 – July 15), late summer/fall (July 15 – October 31), winter (November 1 – February 28) and breeding (March 1 – May 15). Seasons were categorized post-facto, based on current literature (Connelly et al., 2003), bird activity, and weather we observed during the course of the data collection. For example, we chose November 1 to delineate winter because the first heavy snowfall of the season was around this date during our study, and birds should be using winter habitat at this point. Using the Hawth's Tools application in ArcGIS (Beyer, 2004); we created a 90% density and 50% core activity kernal estimate for sage-grouse each season and each year ($km^2 \pm$ SE). We determined differences in home range sizes using a Kruskall-Wallace test in Systat 11 (Systat Software, Inc., Richmond, CA, 2004). We assessed movements descriptively, using ArcGIS tools to determine distances moved in between seasons.

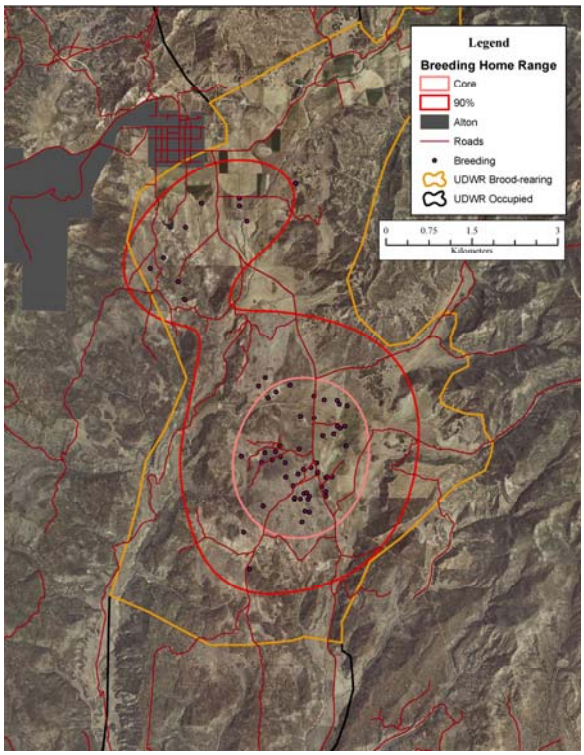

Figure 2

Results

We radio-tracked sage-grouse from March 2005 – March 2009. We obtained 1021 locations, and calculated home ranges for 19 sage-grouse. We used the asymptote method to determine the minimum number of locations needed to accurately calculate home range size for each season. Thus, these 19 sage-grouse represented a subset of the total study population for which we were able to obtain an adequate number of locations to determine home range size. For each bird, we calculated an overall home range size as well as an estimate for each season. We collared only two females, therefore we did not assess difference in sex, and pooled all sage-grouse data, regardless of sex, for home range size analysis.

The average annual home range size (90%) was 20.34 ± 1.53 km^2. The average annual home range size for their core activity (50%) was 5.63 ± 0.38 km^2. The average home range size of sage-grouse differed among seasons, with fall and winter home ranges smaller than breeding and early summer seasons (KW 18.3, df = 3, P = 0.00). However, for core activity estimates, fall and winter core home ranges were larger than breeding and early summer (KW 18.6, df=2, P = 0.00; Table 1).

This difference may have been caused by the staggering of individual sage-grouse's return to the lek site from their summer habitat, such that some birds were still in their summer habitat when we classified the location as "fall."

Table 1: The average core home range size (50% Kernal estimate) of Greater sage-grouse by season (km^2± SE) in the Alton, Utah study area, March 2005 – March 2009.

Season	N	Mean km^2
Breeding	3	4.52 ± 1.84
Summer	3	6.48 ± 2.37
Late Summer/Fall	3	5.73 ± 0.96
Winter	3	5.18 ± 0.03

Our study population moved from the lek site in Sink Valley to Alton, 5 km north of the lek site during all seasons (Figures 2 - 4). Our sample population did not travel > than 10km out of the Alton/Sink Valley area; therefore, we considered this population non-migratory.

Discussion

Animals that live at the edge of their species' distribution often live in sub-optimal conditions; after all it is these conditions that create the terminus of the distribution. To adjust to food, shelter, or weather conditions that exist in these fringe areas, species may increase their home range size to find suitable quality and quantity of food, migrate further to find shelter, or exist in unusual habitat to survive the elements, to name a few adaptations. The Alton Greater sage-grouse

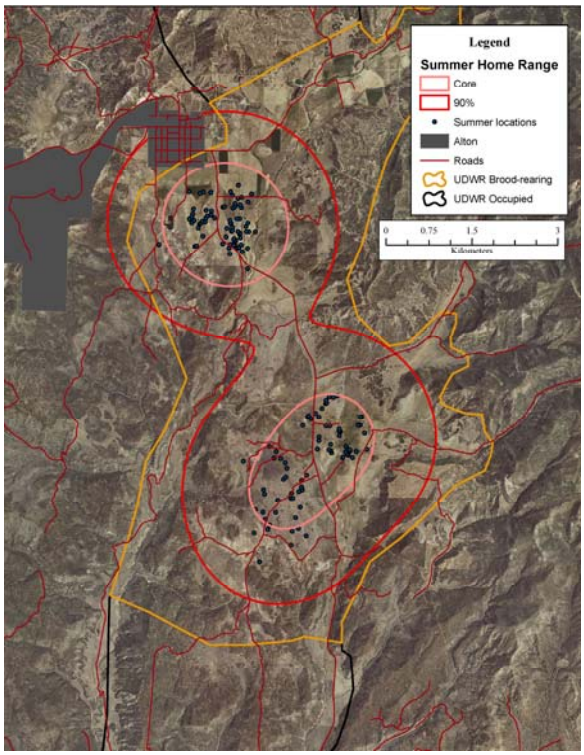

Figure 3

population represents the southern-most distribution of its species. Habitat in this area is generally characterized as sagebrush desert, with a lower density of grasses and forbs than is found in sagebrush-steppe habitat (Frey et al., 2013), the habitat type where the highest densities of grouse are found. Thus, we expected that these sage-grouse may have larger than average home range sizes or large migratory patterns to adjust to southern vegetation and climate conditions.

Annual home ranges in our study area in the lower end of the range of sizes reported for sage-grouse (Connelly et al., 2000). Additionally, the birds were not migrating outside of the valley to find more appropriate habitat at different times of the year. This suggests that the food, shelter, and social needs of the birds are capable of being fulfilled in the Alton area in a manner similar to other areas within the species' range.

Because the town of Alton is only 5 km away from the lek, and represents the northern extent of 90% of the movements, we consider the Alton population to be non-migratory. The birds that

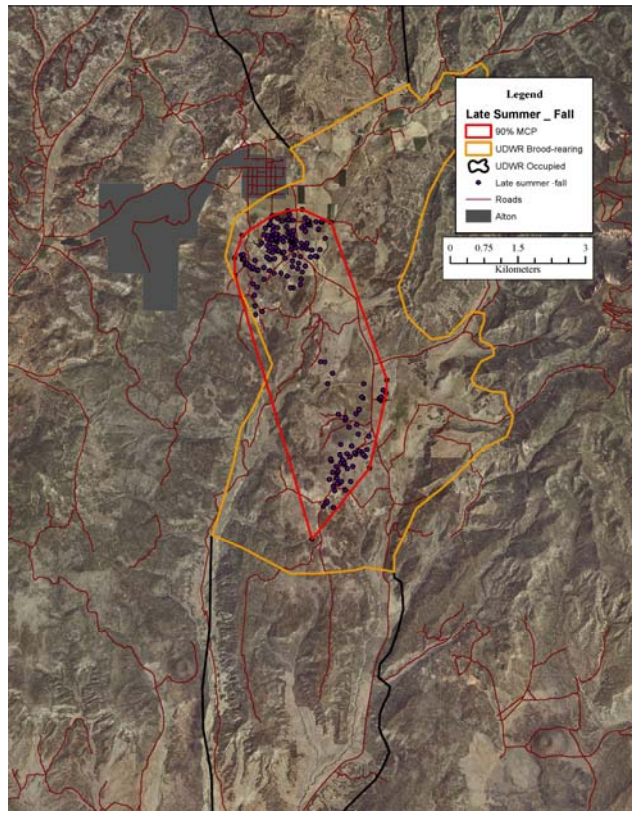

Figure 4

travel to Alton are not necessarily females attracted to the alfalfa fields for brood-rearing habitat; we observed both sexes, adults, and juveniles in and around the alfalfa fields all summer. By August, most juveniles were found in the wet meadows south of Alton. The use of the agricultural fields may be a result of the desiccation of forbs in sagebrush uplands and an increase in forb growth at more mesic sites later during the summer, similar to results found by Wallestad (1971).

Management Implications

This study suggests that populations of sage-grouse in the extreme southern end of their distribution are capable of using habitat that may be considered sub-optimal in other regions. However, sage-grouse may still respond to treatments to provide more foraging opportunities (Frey et al., 2013). Future studies might question if this current space use pattern is a successful adaptation to the local climate or if

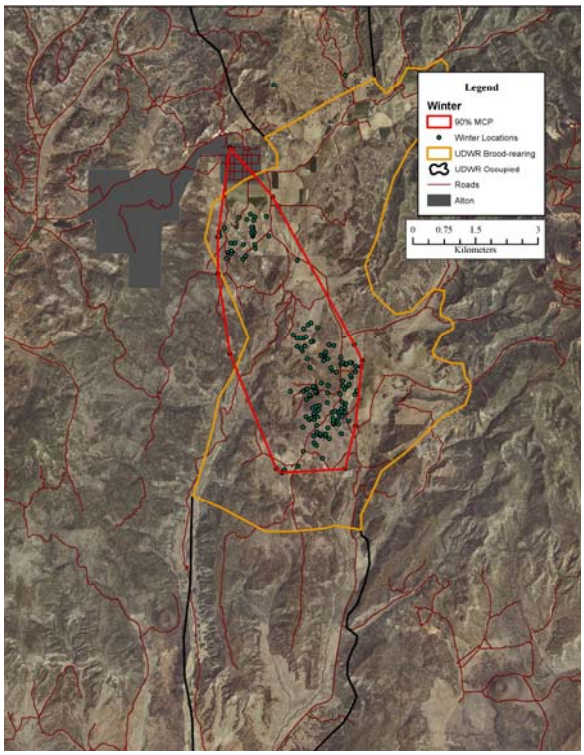

Figure 5

habitat management to increase seasonal habitat components such as grasses and forbs would result in improved sage-grouse survival and recruitment.

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