2017 Annual Report

POPULATION DYNAMICS AND SEASONAL MOVEMENTS OF TRANSLOCATED AND RESIDENT GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*), SHEEPROCK SAGE-GROUSE MANAGEMENT AREA

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Cooperators

Utah Division of Wildlife Resources

Bureau of Land Management

US Forest Service

US Geological Survey

West Desert Area Regional Management Group

Utah State University Extension

Jack H. Berryman Institute

Yamaha Motor Corporation

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Cover photo: McIntyre lek area during brooding season showing the abundance of forbs and grasses, Sheeprock Sage-grouse Management Area, 2017. (Photo courtesy of M. Chelak).

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Executive Summary

In April 2017 project partners translocated an additional 40 (30 females and 10 males) greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) to the Sheeprock Sage-grouse Management Area (SGMA) from the Box Elder and Parker Mountain SGMAs in northern and south-central Utah, respectively. In concert with two other sage-grouse translocation projects, we artificially inseminated (AI) translocated females this year to evaluate if AI could increase nest initiations and reduce bird dispersal from the study site. Ten translocated females were AI with semen collected from resident males, 10 were given an avian semen buffer treatment, and 10 received no treatment. In addition, we captured and radio-marked an additional five resident sage-grouse (3 males and 2 females) in the Sheeprock population. The number of males counted on leks in 2017 increased from 31 in 2016 to 33. Eight radio-marked females hatched 41 chicks and fledged three broods with seven chicks. In 2017, we recovered 20 sage-grouse mortalities. Presently we are monitoring 26 radio-marked translocated (21 females, 5 males) and 8 resident (6 females, 2 males) sage-grouse. Monthly survival for marked sage-grouse in 2016 and 2017 was found to be 38% (n=82). In a resource selection function (RSF) performed for the marked sage-grouse selection of completed Watershed Restoration Initiative (WRI) habitat projects, we found probability of selection to be 68%. We are currently planning for another 40-bird translocation in 2018 following the same protocols as well as capturing and radio-marking 10 resident sage-grouse. In 2018, we will continue to monitor sage-grouse habitat-use and vital rates. We will also record vegetation attributes at sites used by sage-grouse for nesting and brooding and monitor changes in predator abundance. Thanks to a grant received from the Yamaha Motor Corporation, we will interview campers and off-road-vehicle users in the Sheeprock SGMA to determine their recreation use patterns and needs. This information will be coupled with data obtained on sage-grouse movements, and vehicle traffic counters deployed in the area, to better inform the development of a travel management plan for the Sheeprock SGMA.

Introduction

Background

Currently, the estimated distribution of greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) has declined to 56% of the species' pre-settlement range (Schroeder et al 2004). One of the prime factors contributing to the range-wide decline has been the habitat loss and fragmentation of sagebrush habitat associated with the life history of the sage-grouse (Aldridge et al 2008). Despite the reduction to the current distribution, populations have demonstrated more stable trends overall; however, some smaller populations have continued to decline (Connelly et al. 2004).

Due to the range-wide population declines, the U.S. Fish and Wildlife Service (USFWS) identified the sage-grouse as a candidate for protection by the federal Endangered Species Act (ESA, USFWS 2010). The principal threats to the species identified by the USFWS were habitat fragmentation, habitat loss, wildfire, conifer encroachment, agricultural conversion, and invasive species (USFWS 2015). In September 2015, the USFWS determined that ESA protection for the species was unwarranted. The USFWS credited on-going range wide efforts by federal, state, and local partners for mitigation of the threats to the species.

The Bureau of Land Management (BLM), the U.S. Forest Service (USFS), and the western states with sage-grouse populations and habitats, had initiated land-use planning amendments and other actions designed to mitigate the identified threats, protect important sagebrush habitats, and develop adequate regulatory mechanisms to eliminate the need for a listing under the ESA. The USFWS will continue to request annual updates from federal, state, and local partners regarding conservation plan implementation and population status. This information will be used by the USFWS to complete a 5-year status review of the population in 2020 to determine if the species may warrant further consideration for ESA protection.

The USFWS has emphasized the need to focus conservation efforts on protecting and enhancing the priority habitats as the essential mechanism for species conservation (USFWS 2013). The BLM subsequently developed an adaptive management plan for monitoring the sage-grouse populations and their habitat range-wide and developed short-term and long-term decline triggers specifically for Utah sage-grouse populations (BLM 2015). In Appendix B, they outlined a series of hard and soft triggers that are a part of the strategy. The soft triggers represent thresholds in the population and habitat that need to be addressed before they become severe (BLM 2015). The hard triggers are a threshold that require immediate action necessary to prevent large deviations from their objectives, which are illustrated in the following criteria (BLM 2015):

Short-term Decline:

a) 4 consecutive years of 20% or greater annual decline in average males per lek each year
b) average males per lek, based on lek trends, drops 75% below the 10-year rolling average males per lek in any single year

Long- term Decline

c) Lambda (population growth rate) less than 1 in 6 consecutive years
d) Lambda less than 1 in 8 years of a 10-year window

Utah's Sage-grouse Conservation Strategy

Utah's sage-grouse populations constitute 6% of the range-wide populations (Western Association of Fish and Wildlife Agencies 2015). The sage-grouse habitats in Utah are discontinuous because of natural topography (Dahlgren et al. 2016). Population levels also tend cycle at 9-12 year intervals between peaks and troughs (Garton et al. 2011).

In, 2013, the State of Utah published the Utah Greater Sage-grouse Conservation Strategy (Utah Governor's Office 2013). The strategy identified 11 Sage-Grouse Management Areas (SGMAs) within the state of Utah, which represent the highest sage-grouse breeding density areas and support more than 90% of the combined Utah population of sage-grouse (Figure 1, Dahlgren et al. 2016). The strategy identified five objectives:

1) Population: Sustaining an average male lek count of 4100 males (based on a ten-year rolling average on a minimum of 200 monitored leks) in the SGMAs and increase the population of males to an average of 5000 (based on the same ten-year rolling average on a minimum of 200 monitored leks) within the SGMA's.
2) Habitat: Protect 10,000 acres of sage-grouse habitat on private and School and Institutional Trust Lands Administration (SITLA) lands annually through conservation covenants, leases, easements or other legal tools, with emphasis on best-of-the-best populations
3) Habitat: enhance an average of 25,000 acres of sage-grouse habitat in SGMA's annually
4) Habitat: increase the total amount of sage-grouse habitat acreage within the SGMA's by an average of 50,000 acres per year, through management actions targeting opportunity areas—areas which offer the best potential for creating new habitat for greater sage-grouse
5) Distribution: maintain viable populations within each SGMA.

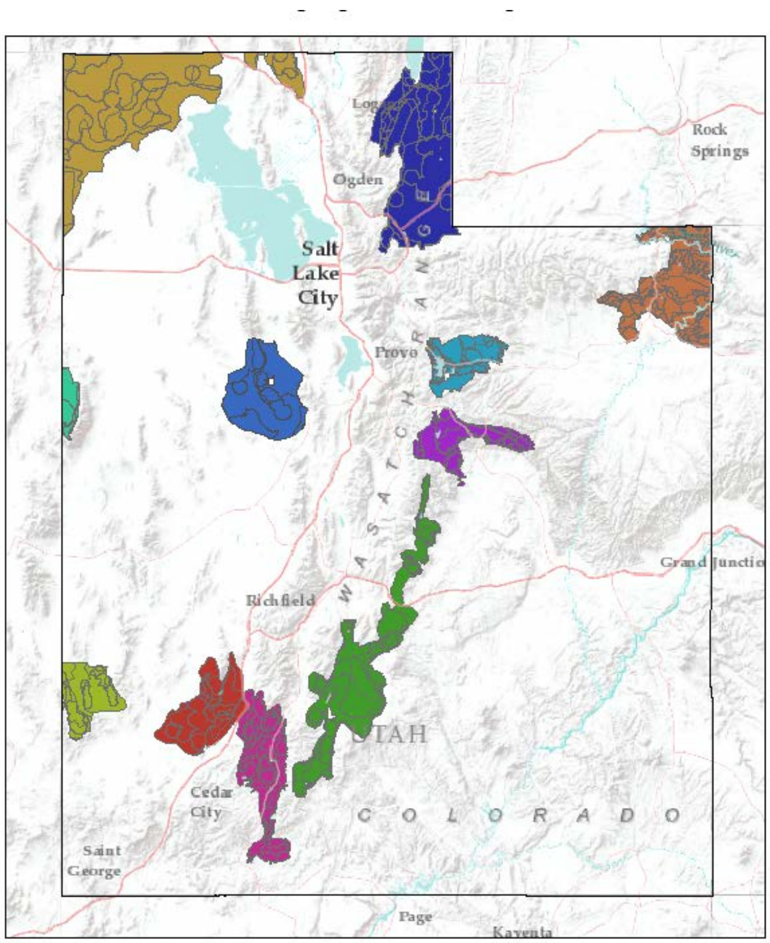


Figure 1. Utah's 11 Greater Sage-grouse (*Centrocercus urophasianus*; sage-grouse) Management Areas as delineated by the Utah Sage-grouse Conservation Strategy (State of Utah 2013)

The West Desert Adaptive Resource Management (WDARM) local working group covers the Sheeprock SGMA. Since 2007, the number of males counted in leks has consistently declined. Robinson and Messmer (2013) identified continued habitat loss and fragmentation and a change in the predator community as factors contributing to the declines. In response, to the population's declines, WDARM developed an integrated conservation strategy that called for increased effort to restore sage-grouse habitats, predation management, and sage-grouse translocations.

The Sheeprock SGMA

Since 2007, lek counts in the Sheeprock SGMA has continued to decline. In 2006, 190 males were counted on six leks (Robinson 2007). In 2015, only 23 were counted on three leks (Utah Division of Wildlife Resources, unpublished data). Given these trends, the Sheeprock SGMA population status triggered the hard trigger outlined in the BLM Adaptive Management Plan (BLM 2015). In 2015, WDARM met and discussed avenues for immediate action required to prevent extirpation of the Sheeprock population: translocations, predator control, habitat restoration, and a long-term research project to study the population.

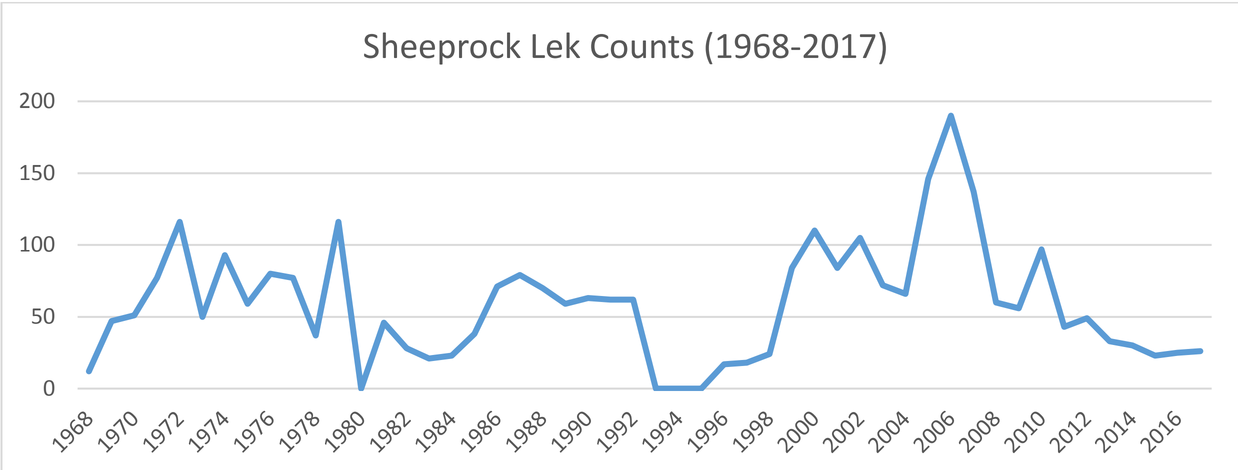


Figure 2. Average number of greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) males counted on leks, Sheeprocks Sage-grouse Management Area, 1968-2017 (Utah Division of Wildlife Resources, unpublished data).

Translocations have been used to establish, reestablish, or prevent extirpation of species populations with the ultimate goal being to create a self-sustaining population (Griffin et al. 1989, Dickens et al. 2009). Success of translocations is contingent upon the methods and protocol of capture. The species that have the highest success of translocations are wild, native game species of birds into areas that contain individuals of the species (Griffin et al. 1989). The quality of habitat will also influence the success, with higher habitats leading to higher success; however, in areas with lower quality habitat, on-going habitat restoration projects aid in success (Dickens et al. 2009).

In areas with higher predation, predator control has been shown to increase success as well (Baxter et al. 2008). Translocating birds overnight during the breeding season and releasing on the lek the morning of capture has lead to the highest probability of survival (Reese and Connelly 1997, Baxter et al. 2008).

In 2017, the BLM released a press release officially stating that the Sheeprock population hard triggers had been tripped. The BLM outlined adaptive management strategies to prevent future declines: prioritizing habitat restoration efforts in the area, making the area the focal point for fire suppression, and seeking to minimize impacts from rights-of-way developments (BLM 2017).

Study purpose

The purpose of this study is to evaluate the responses of the Sheeprock SGMA sage-grouse population to an integrated management plan which will include multiple-year translocations. Specific objectives include:

1. Estimate vital rates for radio-marked birds and if they differ for translocated and resident sage-grouse.

2. Evaluate habitat-use (breeding, winter), responses to habitat management actions, seasonal movements and travel corridors for marked birds and if they differ for translocated and resident sage-grouse.

3. Determine if the translocations increase population growth rate (Lambda) to greater than 1 in years 2 and 3. (Note: because all translocated males will be radio-marked we will be able to censor them from lek count population estimates).

4. To develop specific disturbance and habitat management recommendations for Sheeprocks SGMA based on modeled sage-grouse vital rates and habitat-use patterns. These recommendations may include the prioritization and placement of habitat restoration projects to increase mesic habitats, usable space, development and placement of migration corridors, and actions to mitigate the potential effects of dispersed recreation on sage-grouse seasonal habitats.

5. Determine if predation rates differ for resident and translocated sage-grouse and provide recommendations for predator removal strategies based on predator abundance surveys.

6. Determine if employing the use of artificial insemination to translocated female sage-grouse offers best management practice for improving the outcome of future translocations through improving vital rates and decreasing homing (the action of returning to the individual's source population).

7. Quantify off-highway vehicle (OHV) recreation abundance throughout the Sheeprock SGMA and determine its relationship to sage-grouse habitat selection or reproductive success.

Study Area

The Sheeprock SGMA is located near Vernon, Utah, in central Utah's West Desert. It is an area comprised of 611,129 acres located in both Tooele and Juab counties. Of the total area, approximately 535,233 acres has been estimated to provide adequate sage-grouse habitat. The BLM and the USFS manage 325,280 and 92,328 acres of the SGMA, respectively. The remaining acres are divided as follows: private ownership (82,740 acres), Utah School and Institutional Trustlands (34,131acres), and the Utah Department of Natural Resources (684 acres).

The 50-year average maximum summer temperature is 32.4 ˚C in July, and the minimum winter temperature is -10.4 ˚C in January. This area is characterized by warm, dry summers and cool winters. The average annual precipitation is 10.24 inches, with the highest amount being in the Spring and Fall months. Average snowfall is 36.2 inches (Wester Regional Climate Center 2016).

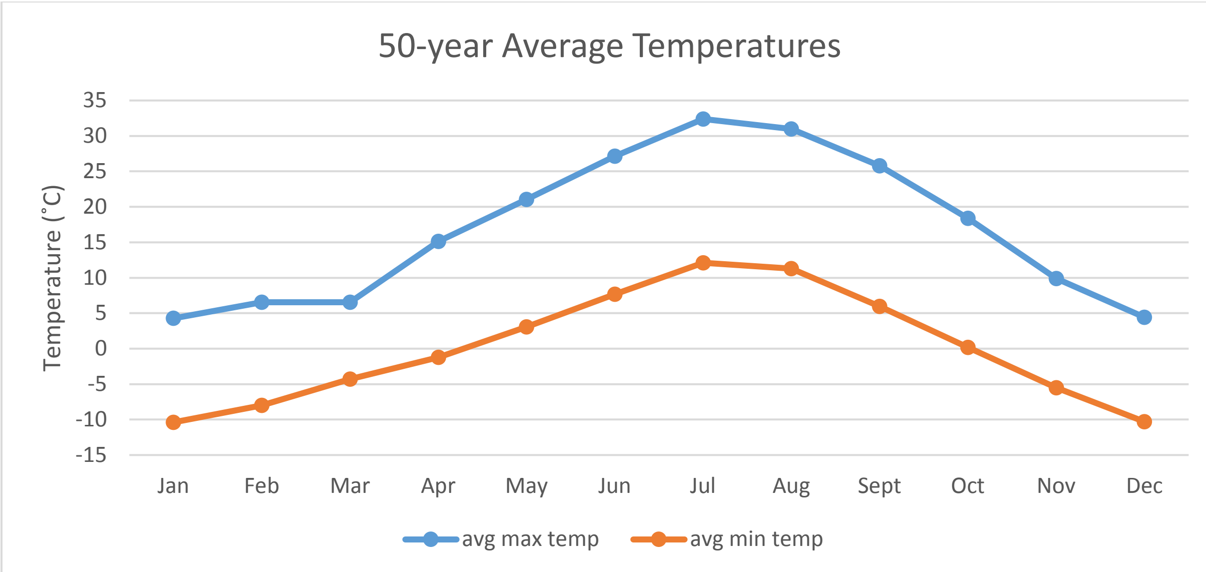


Figure 3. Average minimum and maximum temperature data as collected by Western Regional Climate Center in Vernon, Utah (Western Regional Climate Center 2016).

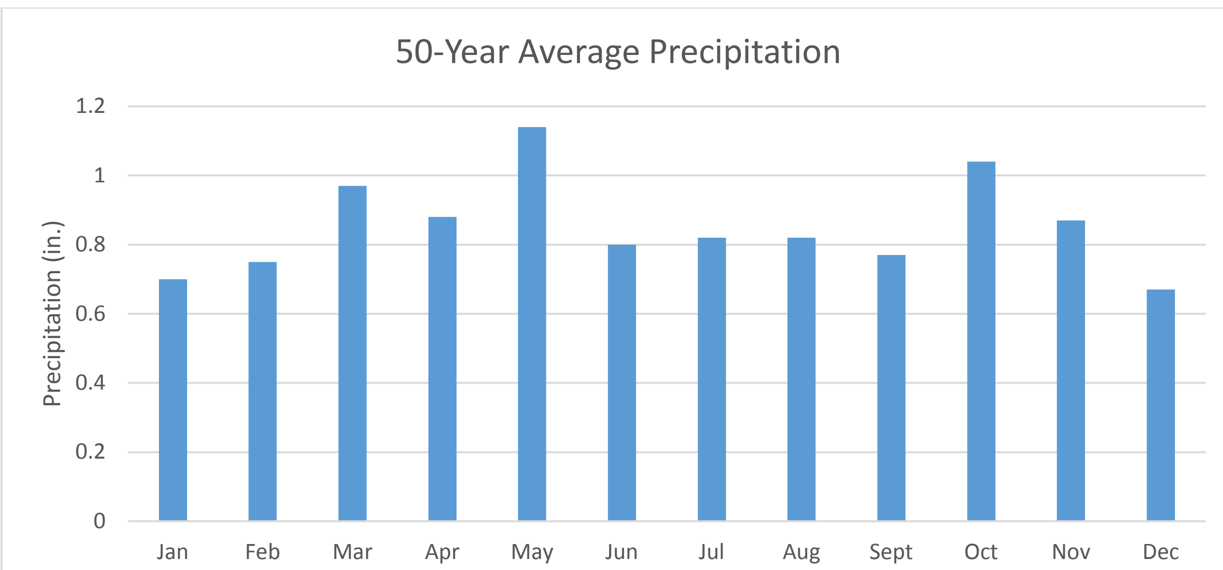


Figure 4. Average annual precipitation in inches, illustrating a bimodal distribution with peaks occurring during the Spring and Fall months, Vernon, Utah (Western Regional Climate Center 2016).

Elevation ranges from 1500m in the lower valleys to 2950m with the tallest peaks. The lower elevation vegetation is comprised of Wyoming big sagebrush (*A. tridentata* spp *wyomingensis*), crested wheatgrass (*Agropyron cristatum*), and bulbous bluegrass (*Poa bulbosa;* Robinson 2007, Robinson and Messmer 2013). Invasive vegetation located in the lower elevation includes cheatgrass (*Bromus tectorum*) and knapweed (*Centaurea* spp.; Robinson 2007). As elevation increases, shrubs such as the following become more prevalent: serviceberry (*Amelanchier alnifolia*), common snowberry (*Symphoricarpos albus*), antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*A. tridentate vaseyana*) and juniper (*Juniperus* spp) stands (Robinson 2007, Robinson and Messmer 2013)). Higher elevations, along ridgelines, are dominated by black (*A. nova*) and low sagebrush (*A. arbuscula)*. Rubber rabbitbrush (*Ericameria nauseosa*) and Douglas rabbitbrush (*Chrysothamnus viscidiflorus*) are also prevalent in lower and mid elevations. Other grasses and forbs include: oniongrass (*Melica bulbosa*), sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), bottlebrush squirreltail (*Elymus elymoides*), great basin wildrye (*Leymus cinereus*), indian ricegrass (*Achnatherum hymenoides*), foxtail barley (*Hordeum jubatum*), little barley (*Hordeum pusillum*), western wheatgrass (*Pascopyrum smithii*), arrowleaf basalmroot (*Balsamorhiza sagittata*), blue-eyed mary (*Collinsia parviflora*), tailcup lupine (*Lupinus caudatus*), tapertip hawksbeard (*Crepis acuminate*), and clover (*Trifolium* spp).

According to the 2013 Utah Conservation Plan, one of the greatest threats posed to sage-grouse are wildfires on the landscape and the introduction invasive plants that fill those gaps. Wildfires occur periodically throughout the SGMA. Since 1986, 13 fires have occurred periodically, the last one occurring in late summer of 2016. In some areas of these wildfires, cheatgrass and rabbitbrush have replaced existing sagebrush stands (WDARM 2007).

The WDARM cited altered fire regimes as being incompatible with sagebrush habitat in their 2007 plan. First, cheatgrass invasion has increased the frequency of fires and potentially changes the sagebrush community into grasslands (Connelly et al. 2000, Miller and Eddleman 2000, WDARM 2007). Second, fire suppression has encouraged the expansion of pinyon-juniper stands into the sagebrush community, altering the ecosystem (WDARM 2007, Miller et al. 2000).

Predation has also been identified as a major threat in the Sheeprocks SGMA, primarily due to increased populations of corvids and red fox, which did not co-evolve with sage-grouse (WDARM 2007, Robinson and Messmer 2013). Predators of the sage-grouse at different life stages and/or nests include weasel (*Mustela* spp.), badger (*Taxidea taxus*), coyote (*Canis latrans*), common raven, *(Corvus corax*), American crow (*Corvus brachyrhynchos*), red fox (*Vulpes vulpes*), golden eagle (*Aquila chrysaetos*), ferruginous hawks (*Buteo regalis*), red-tailed hawks (*Buteo jamaicensis*), and Northern harrier (*Circus cyaneus;* WDARM 2007).

Principal land uses include ranching, OHV recreation, and hunting. For the private landowners, ranching constitutes their primary income and therefore is an important industry for the area. Sheep and cattle grazing are the two major livestock species that are grazed on the study area. The BLM and the USFS have grazing allotments that they allow the ranchers to graze on for certain times of the year, and some landowners graze cattle on their own land for grazing periods throughout the year as well. OHV recreation has been identified from the WDARM group to have a potentially large impact on the survival of sage-grouse, due to its high activity along several key areas used by the grouse. The impacts of the OHV recreation are likely two main factors: disturbance of individuals and alteration of habitat (WDARM 2007).

Methods

Translocations

Our sage-grouse translocations followed guidelines outlined by Connelly et al. (1997) and Baxter et al. (2008). During the breeding season, for three consecutive years beginning in 2016, 30 females and 10 males will be translocated from genetically compatible populations of sage-grouse located in Box Elder SGMA and Parker-Emery SGMA (Reese and Connelly 1997, Oyler-McCance et al. 2005). These populations are greater than 50km away from the Sheeprock SGMA, where the birds will be released (Reese and Connelly 1997, Oyler-McCance et al. 2005). These populations have been approved by the Regional Advisory Councils, the Wildlife Board, the Resource Development Coordination Council (RDCC), and the West Desert, Parker Mountain SGMA, and West Box Elder SGMA local working groups.

Sage-grouse were captured using all-terrain vehicles, spotlights, and long handled nets at night near active leks (2100hr to 200hr; Connelly et al. 2003). Captured sage-grouse were fitted with radio-transmitters at the capture location. Nineteen females were fitted with an 18-gram necklace style very high frequency (VHF) radio transmitter (Advanced Telemetry systems, Insanti, MN and American Wildlife Enterprises, Monticello, FL). Eleven females were fitted with camouflaged and solar-powered global positioning system (GPS) satellite transmitters. Seven of the translocated males were fitted with the VHF radio collars, and three with the GPS satellite transmitters. Several GPS transmitters contain Ultra High Frequency (UHF) capabilities to allow for relocating marked birds in the field and contain a ground-track window for several hours per day to transmit the UHF signal. Other GPS transmitters contained VHF radio transmitters epoxied to the side. Processing included mounting the transmitter, ageing, sexing, weighing, marking with a 14-16 leg band for females and males, respectively. The capture location was also recorded (UTM, 12N, NAD 83).

In 2017, we coordinated our work with two other greater sage-grouse translocation studies out of North Dakota and California. We built wooden remote release boxes with five individual compartments with ventilation and transported overnight in a pickup truck to the study site (0200hr to 0700hr). The radio-marked sage-grouse were released the morning following capture, within 200m, adjacent to the lek site. The release boxes were lined up with the opening facing the lek, and the sage-grouse were released after the immediate area was scanned for predators.

In 2017, the Sheeprock SGMA, we captured and radio-marked 10 resident sage-grouse (8 females and 2 males). Four GPS transmitters were deployed on two males and two females of the resident population. The remaining male was fitted with a VHF radio-collar. All sage-grouse were weighed, with age being determined by the plumage characteristics indicated by the P9 and P10 wing feathers. They were immediately released following processing after capture. With the population being so low in the Sheeprock SGMA, capturing 10 grouse represented a realistic goal (Robinson and Messmer 2013). Data gathered from the resident population will provide information requested by the WDARM on the habitat use, seasonal movements, and habitat corridors of the resident population.

Feathers were collected from both resident and translocated grouse during processing for genetic analysis. Clean feathers lost naturally during the capture were collected; however, if clean feathers were not available, feather samples were plucked from the breast area located under the white ruff for males and the breast area for females. After taking 2-5 feathers for a sample, they were placed in small paper envelopes, sealed, then labeled with the date, sex, collector's name, bird ID, and the UTM coordinates. The feathers were stored in desiccant to preserve any tissue of DNA analysis.

Artificial insemination (AI)

The AI methods we used were developed by Steven Mathews (ISU), Pete Coates (USGS), and David Delehanty (ISU) for a sharptail grouse (*Tympanuchus phasianellus*) translocation study in Idaho. We coordinated with two other translocation studies in North Dakota and California to incorporate AI techniques in our 2017 and 2018 translocations. We are interested in determining if AI can increase nest initiations and thus reduce the dispersal in translocated females. The AI experiment study design included three treatments:

1. Artificial Insemination (AI): females receive a sample that includes a recorded amount of male semen sample and an avian semen extender buffer at a ratio that depends on the quality and quantity of sperm cells extracted from the male.
2. Avian Semen Extender Buffer (SHAM): females receive a sample of a recorded amount of only the semen extender.
3. Control: females of this treatment do not receive any treatment and are the control group

Females were randomly assigned to one of the three groups so as not to bias any of the results. The semen used to AI the females was obtained from male sage-grouse captured in the lekking areas. Teams captured males and brought to a central location where researchers extracted samples. This process is called desemenation. Upon extraction from the male, the sample was observed underneath a microscope and three characteristics were assessed: 1) Number of sperm, 2) Speed that sperm were moving in the sample, and 3) Appearance of sperm, i.e., whether they were fully developed or underdeveloped. After the sample was assessed based on these 3 criteria, it was then rated. Depending on that rating, it was then buffered with avian semen extender to aid in keeping the sperm alive before female insemination.

After the sample had been assessed and buffered, captured females were first fitted with GPS or VHF transmitters, leg bands, had feather samples taken, and, lastly, the buffered solution was inserted into the vaginal opening in cloaca using a rubber-tipped syringe to avoid damage to the female. The sample male, band number, sample quality, and female treatment type were recorded in an artificial insemination database as well as the capture database for the female.

Lek counts

Lek counts were conducted according to UDWR protocols. A minimum of three counts were conducted at weekly intervals beginning in mid-March and ending May 7. The counts began 30 minutes before sunrise and ended 1 hour and 30 minutes after sunrise, counting 3 to 5 times during that time period and recording the maximum number of males that visited the lek. To record whether translocated males visit the lek, the observer used radio telemetry equipment to listen for the translocated males' frequencies. Radio-marked translocated males were excluded from lambda calculations based on lek counts. The presence of resident males fitted with GPS transmitters, whose windows do not include times around the lek count, were accounted for later by analyzing location data points.

Radio-telemetry

To monitor sage-grouse vital rates and habitat-use, locations were recorded for all radio-marked grouse using UTM's in NAD83. For the VHF transmitters, birds were located with VHF receivers and VHF antennas. The data for the GPS-marked birds has a duty cycle of 5 days, so location data were uploaded at the end of each duty cycle. Five locations were obtained each day for the GPS transmitters. For each location, the date, time, observer, UTM, group size, flocking with resident birds, nearest lek, habitat type, visible wells, nearest disturbance and mortality were recorded. Mortalities for the VHF radio-collared birds were determined by a mortality signal (faster pulse), which turns on after 8 hours when the collar has been in the same place. Mortality for the GPS transmitters were determined using the data, which detected a mortality mode after several fixes at the same location. After a mortality signal was heard, we attempted to locate the transmitter and determine the cause of death.

During the nesting season, all radio-marked females were located 2 to 3 times per week to determine the date of nest initiation. Once a nest was confirmed by visually seeing a female on a nest without flushing her, we continued to located it 2 to 3 times a week from 30 to 50 meters away to determine the fate of the nest. Once the eggs hatched after 26-28 days of incubation, the clutch size was estimated by counting the number of egg shells after the female left the nest. For nest that failed, the observer attempted to identify the cause and that female was monitored 2 to 3 times a week to document re-nesting attempts. Broods were visually radio-tracked 3 times a week until the brood reached 50 days old. Females that did not have broods were tracked 1 to 2 times per week.

During the fall and winter, the sage-grouse were located bi-monthly using ground telemetry. Periodic flights in a fixed wing aircraft were used to locate the grouse that are undetectable from the ground. Locations of the GPS birds were downloaded after each 5-day duty cycle to determine movement corridors and fall and winter ranges. All research activities were completed in accordance with Utah State University IACUC approved protocol.

Vegetation surveys

For each nest and one brood location per week (up to 50 days of age for the brood), vegetation attributes were measured using a line intercept method to determine shrub cover, height and species (Connelly et al. 2003). Each sample site consisted of four, 15 meter transects for nest sites and four, 10 meter transects for brood sites. A random compass bearing was taken to determine the direction of the initial transect. Daubenmire frames, 20 x 50 cm every 3 meters for nests and 2.5 meters for broods were used along each transect to determine the percent cover of forbs and grasses at each site (Daubenmire 1959). A Robel pole was used at each vegetation plot to assess visual obstruction, which will be assessed at 4 meters along each transect at 100 cm high, looking both into and out from the Robel pole (Robel 1970).

Predator surveys

Predator surveys were initiated in 2017 and will be conducted through 2019 in accordance with the period of predator control efforts for USDA Wildlife Services: March through July for corvid and raptor surveys and May through July for mammalian survey.

These surveys will be used develop an index of the predator species currently located within the Sheeprock SGMA. This will enable us to estimate occupancy across the SGMA landscape of presences or absence of a species. These predator survey methods were developed from methods conducted in Rich County, Utah, for another sage-grouse population study.

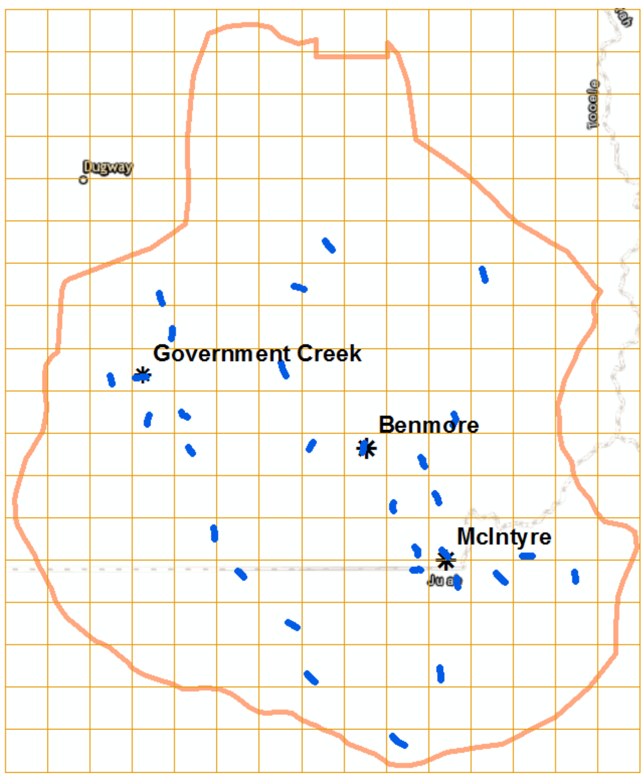


Figure 5. Distribution and locations of the 30, 1-kilometer transects. Each transect is located inside a 5-by-5-kilometer quadrat, Sheeprock Sage-Grouse Management Area, 2017.

Mammalian predator surveys

Scat counts were set up along the 30 1-kilometer transects to assess the abundance and relative distribution of mammalian predators across the study site. Similar to the avian predator surveys, they were at least 5 kilometers apart. Scat surveys are inexpensive and noninvasive while still providing information on abundance (Shauster et al. 2002, Kamler et al. 2013), patterns and occupancy (Long et al. 2011), and diet (Kitchen et al. 1999, Losinger et al. 2016). They can be employed over large spatial extents and long-term monitoring (Gese 2001). Thirty, 1-kilometer transects will be plotted on two-track and maintained (gravel) roads across the SGMA. Species identification included red fox, coyote, American badger, and other mammalian predators. To prevent this decrease in detection, scat survey transects were initially cleared of all scat and surveyed every 4 to 7 days. Roads were driven using an ATV to maximize detection of scat presence while minimizing time spent on the transect.

Avian surveys

We monitored avian predator abundance weekly beginning in March through July, from initial scat transect points. Counts were restricted to days with light winds (<19 kph) and little or no precipitation (Luginbuhl et al. 2001). At each survey point, performed at the beginning of each scat transect to economize technician work across the 30 transects, birds were counted by visually searching the area with the aid of binoculars and listening for bird calls. Counts included ravens, black-billed magpies, and raptors during a 10-minute period. The species code and count were recorded along with the time, weather, behavior (flying or perched), and distance at time of first detection. To mitigate double counting survey points are separated by more than 5 kilometers and previously recorded birds were tracked prior to moving to the next survey point.

The survey routes were placed both near and away from lek sites across the SGMA. Using a modified method of Somershoe et al. (2006) distance annuli to reflect the open sagebrush habitats and ease of detecting larger avian predator species, we used annuli of <100m, 100-200m, 200-300m, 400-500m, and >500m from the survey point to estimate avian predator species densities.

Preliminary Results

Translocated and resident sage-grouse captures

The 2017 translocations were completed April 6-7 (Parker Mountain– 6 males: 6 VHF, 25 females: 11 GPS and 14 VHF) and April 14-15 (Park Valley- 4 males: 3 GPS and 1 VHF, and 5 females: 1 GPS and 4 VHF). Forty sage-grouse (30 females and 10 males) were translocated into the Sheeprock SGMA using the specially-constructed wooden release boxes. The AI experiment was set up to give the 30 females one of three treatments: AI (artificial insemination from males of the location from which they were translocated), SHAM (receiving a control of the avian semen extender buffer), or control (no treatment). Ten females received the AI treatment, 10 the SHAM, and 10 the control.

Trapping sage-grouse females in the resident population continued to be difficult. In 2017, we radio-marked three males and two females. Both females were fitted with a GPS PTT transmitter, and, for the males, two were fitted with GPS, and one was marked with a VHF radio collar.

Lek surveys

Lek surveys were by technicians and the UDWR biologists. They counted a total 33 males on 3 leks this year. It is also important to note that the leks were documented to have moved slightly from their previous locations. Lek sites are chosen by males based on the proximity to nesting habitat as well as areas through which females travel from wintering habitat to breeding habitat (Gibson 1996).

The population growth rate (λ), shows the rate at which a population is growing from one time interval to the next. When the population growth rate is above one, it means that the population is increasing. In 2017, population growth rate was 1.1, which means it grew by ten percent from the previous year in 2016. Figure 6 shows the growth rate from 2006-2017 in the Sheeprocks:

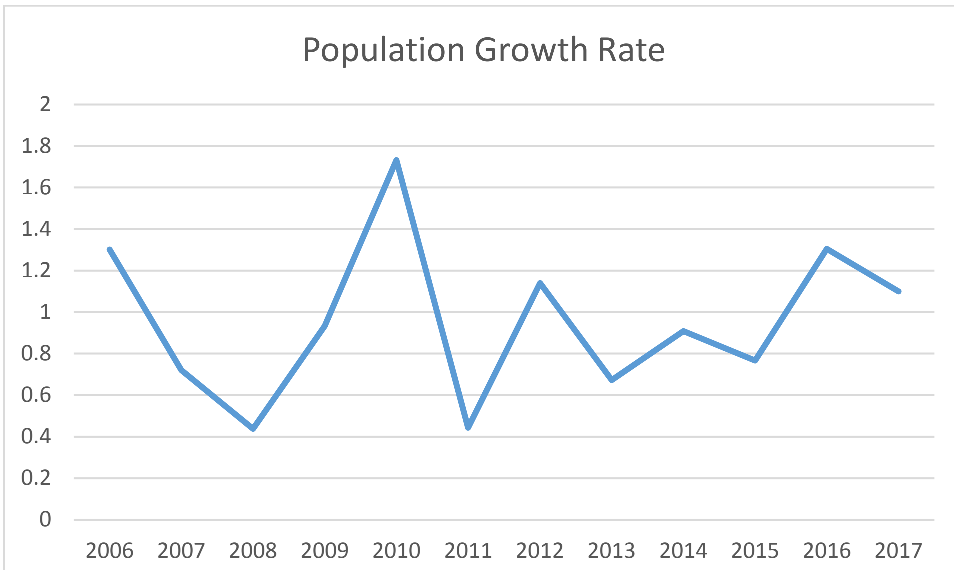


Figure 6. Population growth rate (λ) showing an increase in population growth for 2016 and 2017, Sheeprock Greater Sage-Grouse (*Centrocercus urophasianus*) Management Area, 2006-2017 (Utah Division of Wildlife Resources, unpublished data).

Radio-telemetry monitoring

In 2017, translocation efforts combined with trapping efforts in the Sheeprock SGMA resulted in 45 sage-grouse being captured and radio-marked: 40 translocated and 5 resident birds (10 translocated males, 30 translocated females, 3 resident males, 2 resident females). This increases the number of translocated and resident birds radio-marked in 2016-17 to 92.

Of the 92 birds marked, we have not been able to find 22 (23.9%) radio-marked sage-grouse: 14 and 8 from 2016 and 2017, respectively. This could be for various reasons to include malfunctioning transmitters to dispersal. We have confirmed 36 (39.1%) confirmed mortalities:

16 and 20 in 2016 and 2017, respectively. To date, we have 34 surviving birds, either sporadically or consistently detected: 11 from 2016 and 23 from 2017.

Figure 7 shows general location points for all radio-marked sage-grouse in the Sheeprock SGMA. Figure 8 shows the dispersal pattern of a 2017 translocated female that travelled from the release site in McIntyre to the mountains above Birdseye, Utah. We hope to mitigate these type of wandering movements using AI.

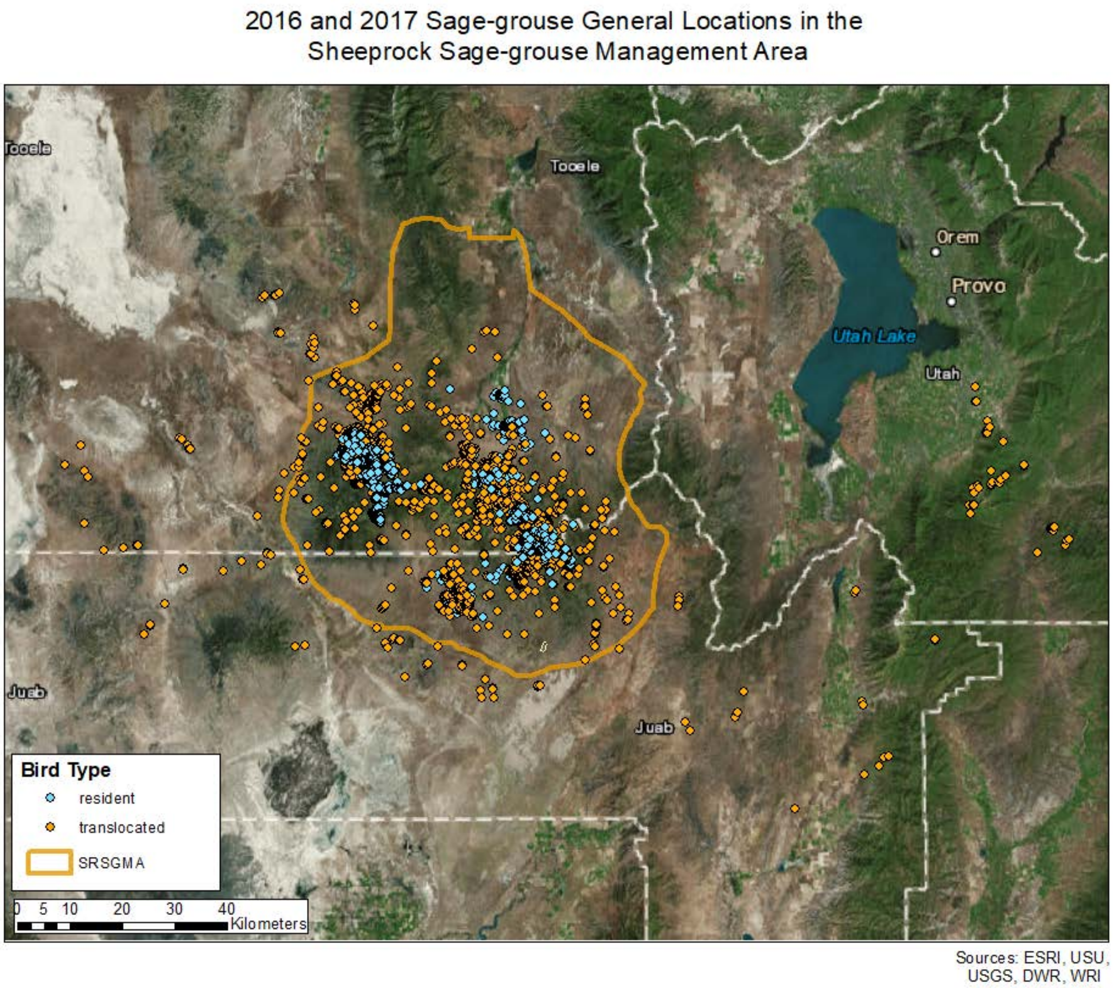


Figure 7. Resident and translocated greater sage-grouse (*Centrocercus urophasianus*) locations from 2016 and 2017 distributed across the landscape in central Utah, Sheeprock Sage-Grouse Management Area, 2017.

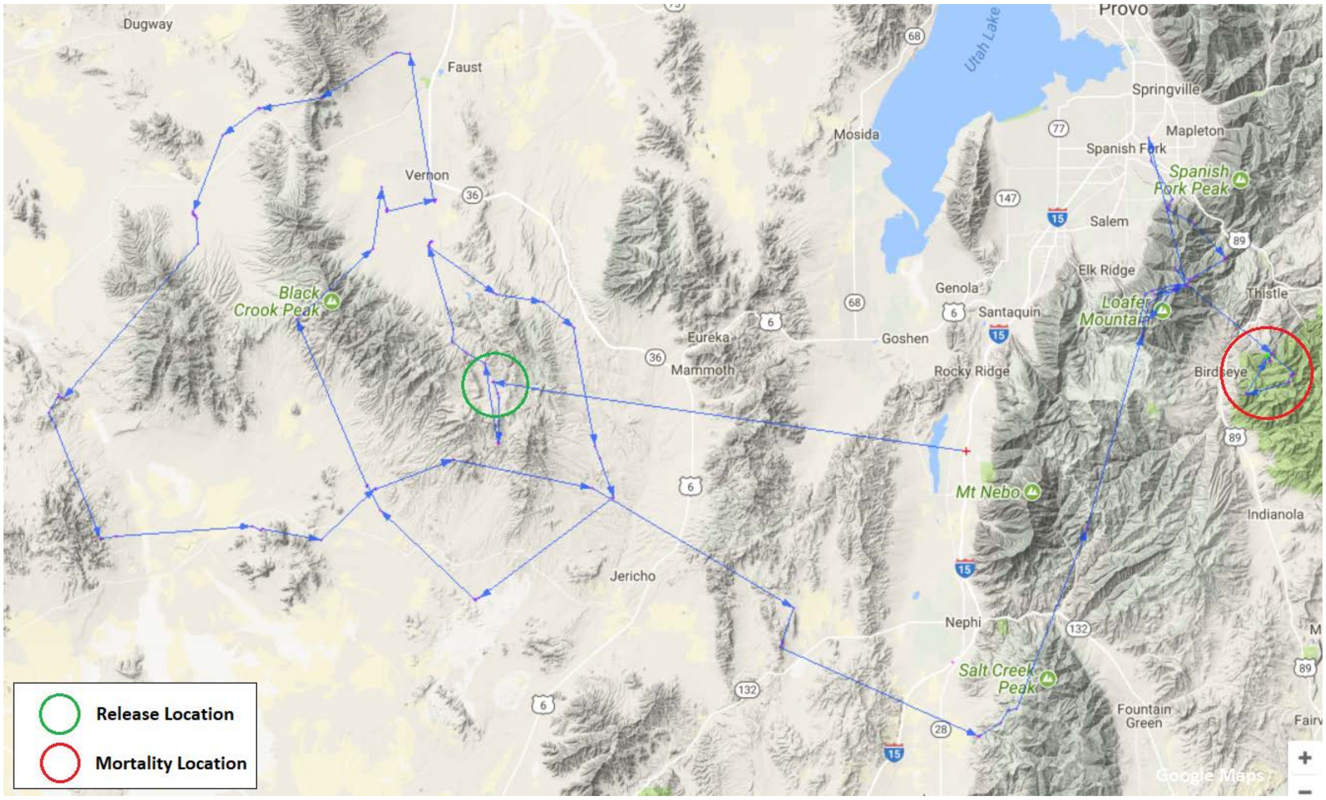


Figure 8. Dispersal of a translocated female greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) released onto the McIntyre lek in 2017, Sheeprock Sage-Grouse Management Area, 2017.

Of the 44 marked, live females detected during nesting season, we recorded nest initiations for an apparent nest initiation rate of 18.2%. The eight nest initiations were from the following females: one from a 2016 resident female, three from 2016 translocated females, one a 2017 resident female, and three 2017 translocated females. Forty-one chicks hatched from these nests (Table 1).

Table 1. Nest initiation and hatch dates for translocated and resident female greater sage-grouse (*Centrocercus urophasianus*) by source population and AI treatment, Sheeprock Sage-grouse Management Area, 2017.

Nest Number	Bird-ID	Year Caught, Res/Trans	Source Population	AI treatment	Estimated Initiation	Nest Hatch Date	Number of Chicks
1	SR-16-8032	2016 Trans	Box Elder	---	4/16/2017	5/15/2017	7
2	SR-16-2350	2016 Res	Sheeprocks	---	4/17/2017	5/16/2017	9
3	SR-16-2750	2016 Trans	Parker Mt.	---	4/26/2017	5/23/2017	4
4	SR-16-2500	2016 Trans	Parker Mt.	---	4/27/2017	5/24/2017	--

5	SR-17-2300	2017 Res	Sheeprocks	---	4/30/2017	5/26/2017	8
6	SR-17-8621	2017 Trans	Box Elder	Control	5/8/2017	6/7/2017	3
7	SR-17-8742	2017 Trans	Box Elder	SHAM	5/10/2017	6/9/2017	5
8	SR-17-0550	2017 Trans	Parker Mt.	SHAM	5/26/2017	6/25/2017	5

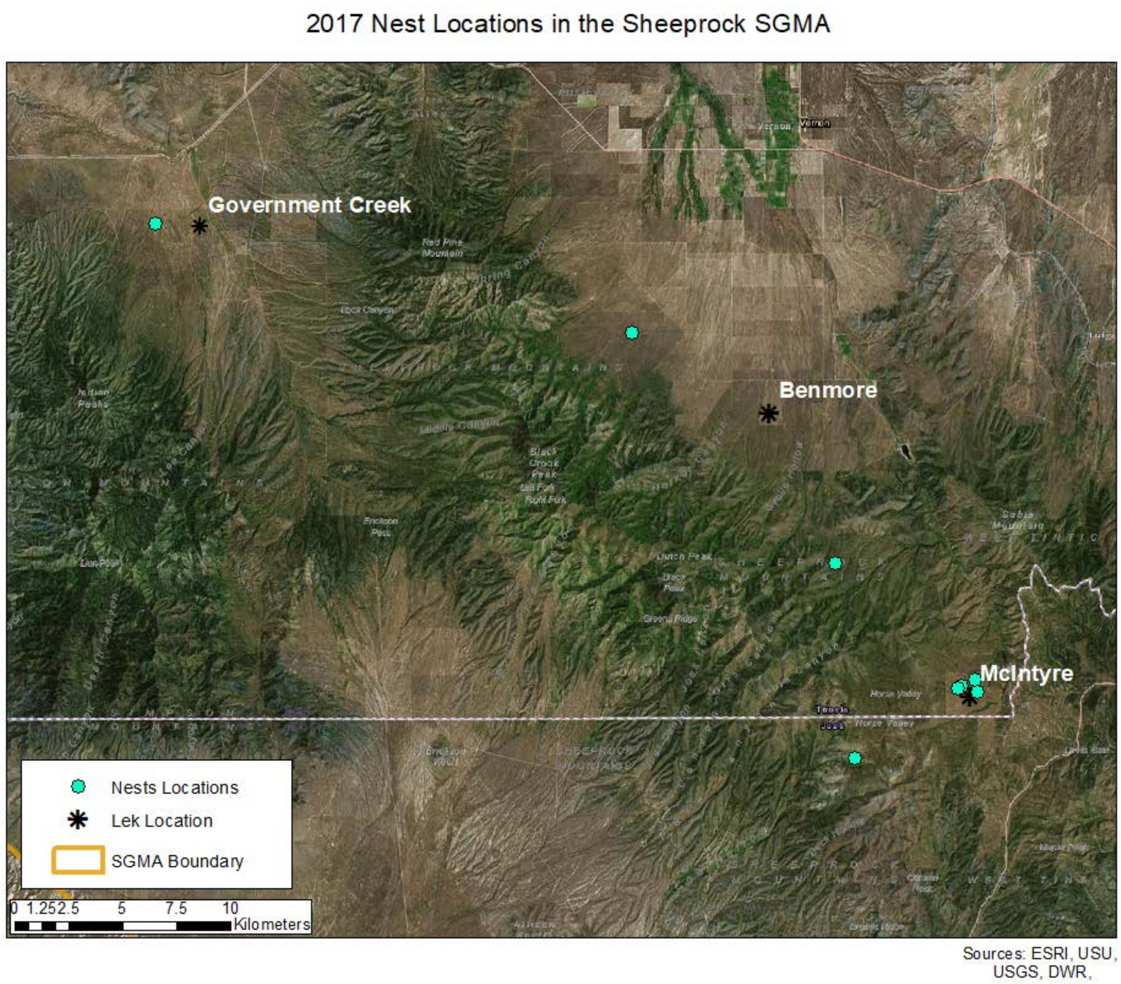


Figure 9. Greater sage-grouse (*Centrocercus urophasianus*) nest locations, Sheeprock Sage-grouse Management Area, 2017.

Brood success

Of the eight broods that began after successful nest hatches; three fledged seven chicks. We performed a Cox Proportional Hazard (CoxPH) model on the brood survival throughout the 50-day (7-week) period that we actively monitored broods. By the end of the 50-day brooding period, apparent brood survival was estimated to be 40%. Various studies found chick survival, from either apparent or estimated from marked chicks, to be: 39% at 28 days posthatching

(Gregg 2006); 44% at 18 days posthatch in Nevada (Reholz 2007); 34% to 42% in North Dakota and 32%-50% in South Dakota, respectively at 21 days posthatch (Herman-Brunson 2007, Kaczor 2008); and 50% at 42 days in Utah (Dahlgren et al. 2010).

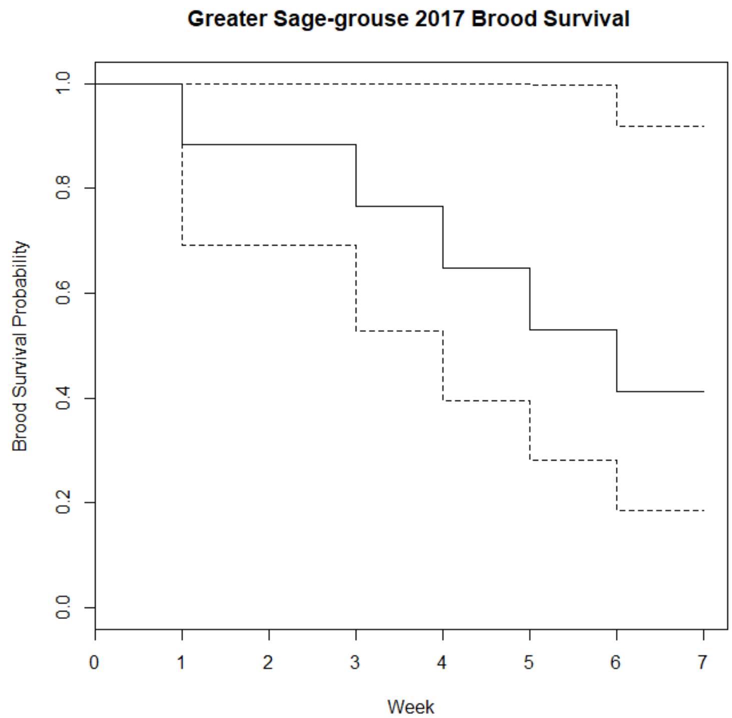
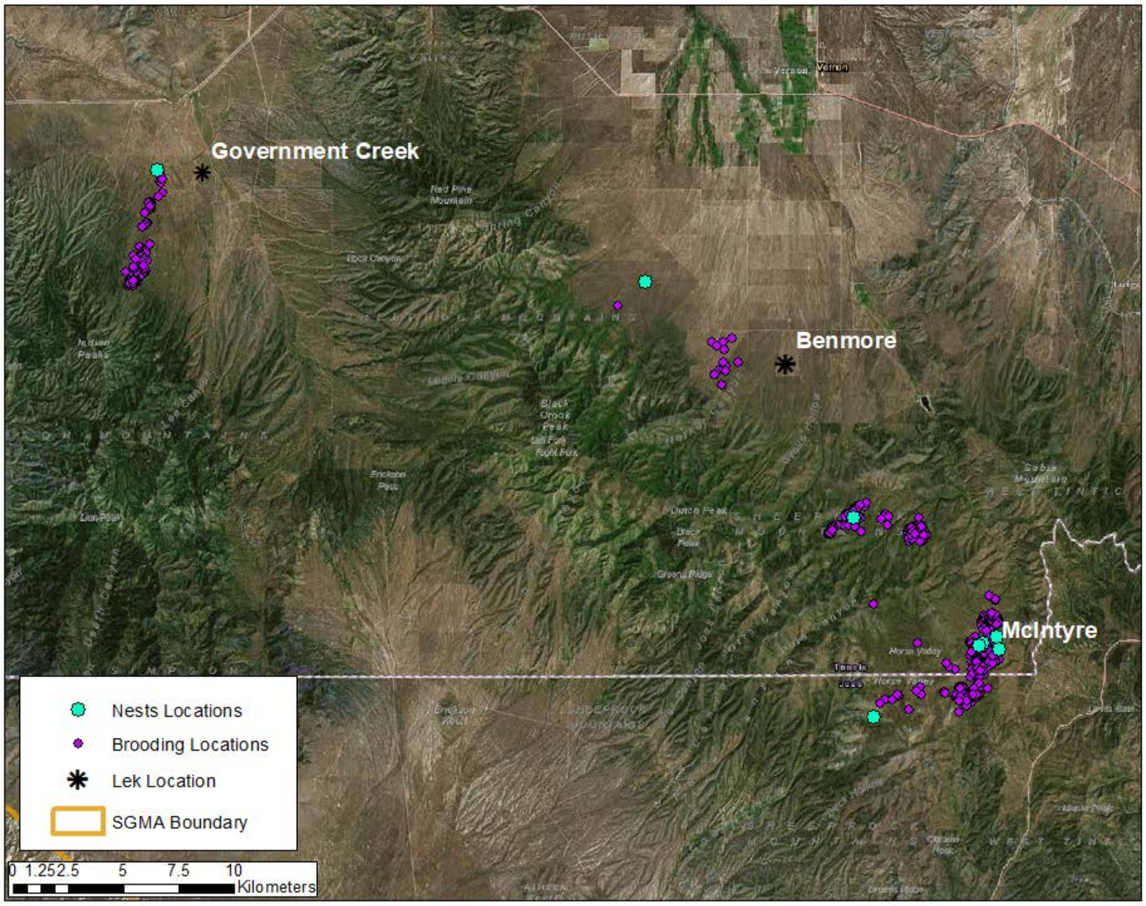


Figure 10. Weekly greater sage-grouse (*Centrocercus urophasianus*) brood survival, Sheeprocks Sage-grouse Management Area, 2017.

2017 Brooding Locations with Nest Locations



Sources: ESRI, USU, USGS, DWR,

Figure 11. Greater sage-grouse (*Centrocercus urophasianus*) brood and nest locations, Sheeprock Sage-grouse Management Area, 2017.

Sage-grouse habitat selection

Utah’s Watershed Restoration Initiative (WRI) was launched in 2005 is a partnership-driven effort designed to restore, conserve, and manage ecosystems in areas that have been delineated as priority areas across the state. The WRI has completed 1,719 projects on over 1.4 million acres of land in Utah since its conception, with plans to finish and implement more than 310,000 acres in the near future, as described on their website.

The Sheeprock SGMA has benefited greatly from these WRI projects located within the boundaries. As of the fall of 2017, several WRI projects were completed in the SGMA (Figure 12).

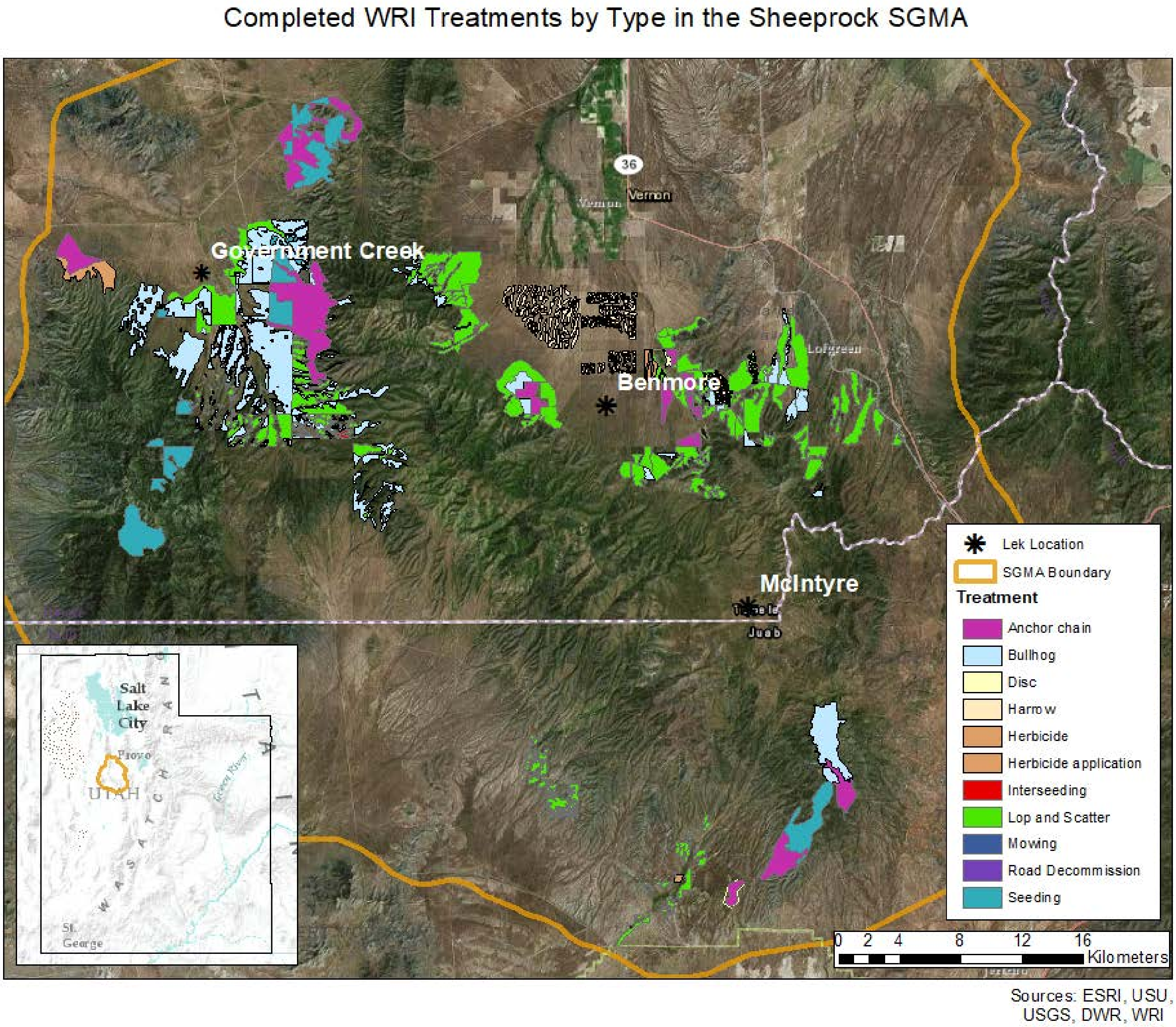


Figure 12. Watershed Restoration Initiative (WRI) Projects by type completed in the Sheeprock Sage -grouse Management Area, 2017.

To assess the sage-grouse selection of WRI habitat restoration projects, we completed a logistic regression model comparing the proximity of the general location points to the completed WRI projects in 2017 compared to random points. This gave us a statistic for the relative probability of use of 68%.

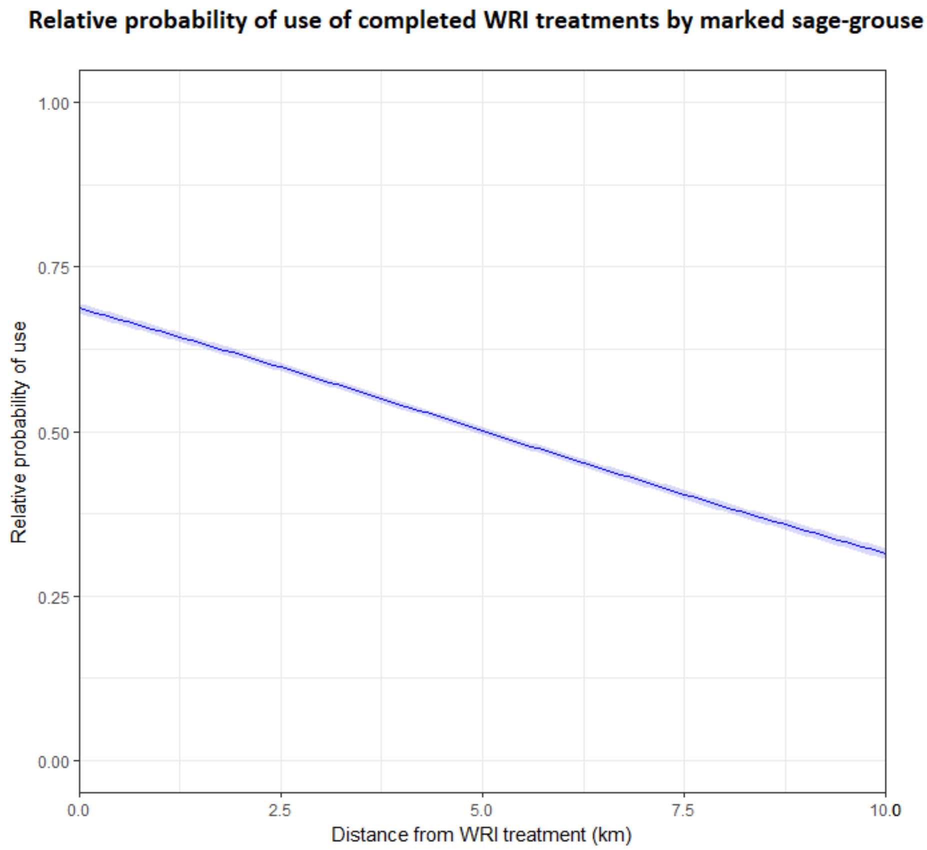


Figure 13. Relative probability of greater sage-grouse (*Centrocercus urophasianus*) location occurring in a Watershed Restoration Project compared to random points, Sheeprock Sage-grouse Management Area, 2017.

Survival

In 2017 we documented 20 mortalities: 4 translocated 2016 females, 12 translocated 2017 females, 3 translocated 2017 males, and 1 resident 2016 male. To date, we have documented 36 mortalities since 2016. A Cox Proportional Hazard (CoxPH) model was completed to assess the monthly survival, difference in survival by sex, and survival probability by age classes for all birds in 2016 and 2017. Survival probabilities did not differ by sex and age for marked sage-grouse. Resident radio-marked birds had higher survival rates (Figure 17).

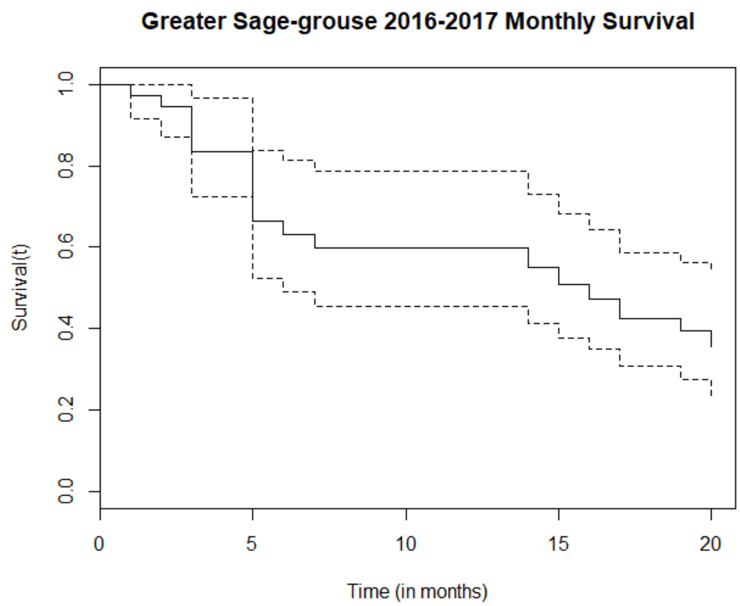


Figure 14. Survival probabilities by month of for radio-marked greater sage-grouse (*Centrocercus urophasianus*), Sheeprock Sage-grouse Management Area, 2016-2017. Month 0 indicates March 2016, and Month 20 indicates November 2017.

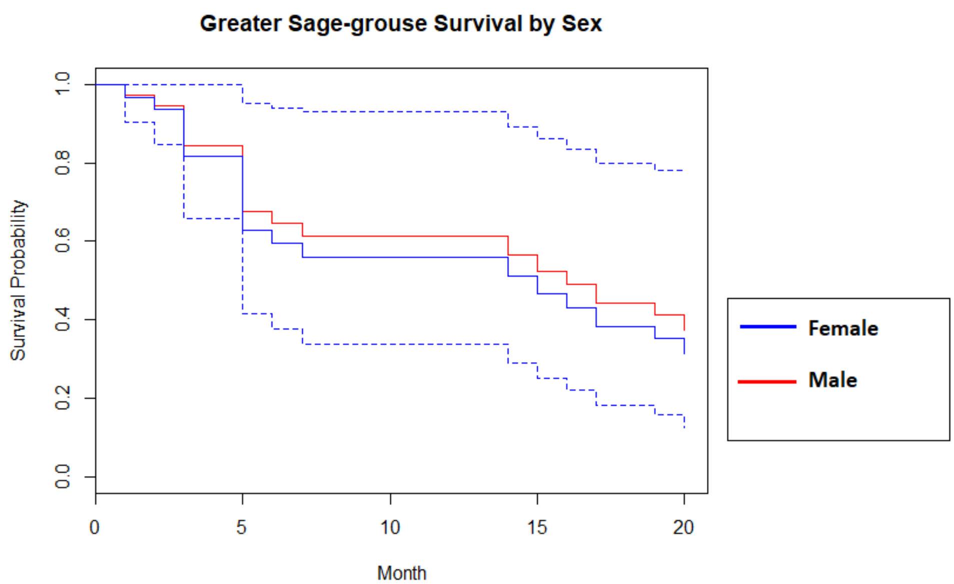


Figure 15. Survival probabilities by sex of radio-marked greater sage-grouse (*Centrocercus urophasianus*) in 2016 to 2017 showing no significant difference between male and female survival, Sheeprock Sage-grouse Management Area, 2017. Month 0 indicates March 2016, and Month 20 indicates November 2017.

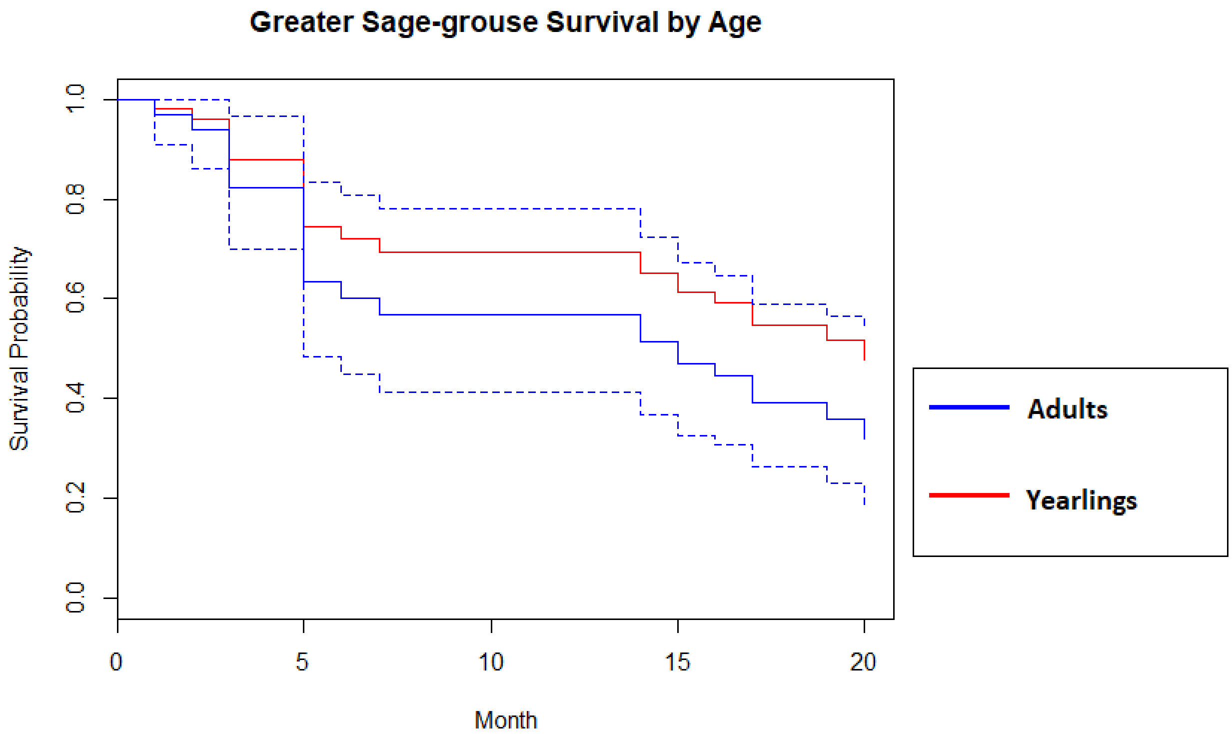


Figure 16. Survival probabilities by age class of radio-marked greater sage-grouse (*Centrocercus urophasianus*) in 2016 to 2017 showing no significant difference with yearling survival within the confidence intervals of adult survival, Sheeprock Sage-grouse Management Area, 2017. Month 0 indicates March 2016, and Month 20 indicates November 2017.

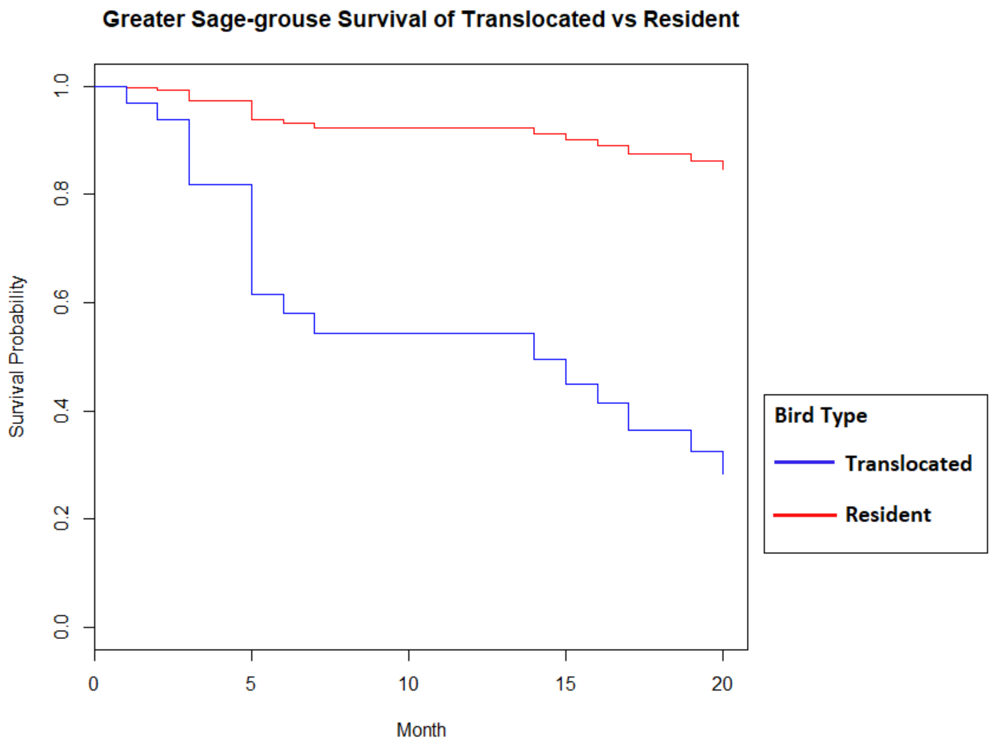


Figure 17: Survival probabilities of translocated and resident greater sage-grouse (*Centrocercus urophasianus*), Sheeprock Sage-grouse Management Area, 2016-2017. Month 0 indicates March 2016, and Month 20 indicates November 2017.

Predator surveys

We have included some preliminary numbers on how many individuals we observed per species on our avian point counts and mammalian scat surveys (Table 2). In addition to our predator surveys, we also, in collaboration with Wildlife Services, have the estimated predator take numbers from 2017 as well (Table 3).

Table 2. Predator counts by species during May through July in the Sheeprock Sage-grouse Management Area, 2017.

2017 Predator Survey Species Counts	
Species	**Counts**
Coyote	64
Red Fox	5
American Badger	8
Common Raven	168
Golden Eagle	27
Northern Harrier	7
Red-tailed Hawk	16
Turkey Vulture	17

Table 3. Estimated take numbers by species as well as the method used for take as collected by Wildlife Services, Sheeprock Sage-grouse Management Area, 2017, unpublished data.

2017 Wildlife Services Sheeprock SGMA Predator Take Numbers				
Target Species	**# Predator Present**	**# Estimated Species Taken**	**Method**	**# Of Bait Placed**
Badger		2	trap	
Black-billed Magpie	15	15	Meat Bait	30
Common Raven	9	9	Meat Bait	30
Common Raven	44	30	Firearm	
Common Raven	214	80	Eggs	400
Coyote		7	Firearm	
Coyote		3	trap	
Red Fox		1	Firearm	

Preliminary Observations

The higher mortality rates seen in the translocated birds are to be expected; this stresses the importance of the continued habitat projects currently under way in the Sheeprock SGMA. Sage-grouse have already been using WRI treatments that have been completed. To aid in assessment of juniper removal projects, we will be performing analyses to predict where the highest priority of juniper removal would be relative to where greater sage-grouse travel and their mortality locations. Habitat fragmentation has could be a limiting factor for the survival and movement of the birds.

2018 Work Plan

Jan-March: Field preparations to include finalizing research funding plan, a flight in January/February to see birds' winter range location, hiring technicians, purchasing radio-transmitters and field equipment, and participation in local working group and related meetings.

March-April: Sage-grouse capturing, radio-marking, translocations with artificial insemination of half of females and participation in local working group and related meetings. We will be hiring 4 technicians this field season. More effort will be put into trapping in Government Creek and Benmore to acquire better data of resident birds' movements. Predator surveys will also be conducted during the field season to estimate predator abundance.

April-August: Monitoring radio-marked sage-grouse vital rates and habitat-use, predator surveys, and participation in local working group and related meetings. In order to better estimate chick survival during the brooding season, we will employ the use of pointing-dogs to detect females with their chicks for their 50-day brooding surveys. Dahlgren et al. (2010) found that spotlight and pointing-dog surveys detected 96% of chicks that were marked in the study, and found no significant difference between the use of pointing-dogs and spotlight surveys.

August- December: Bi-weekly monitoring of population, data analysis and reporting, and participation in local working group and related meetings.

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