2020 Annual Report & 2021 Research Update

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

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August 2021

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

Cooperators

Utah Department of Natural Resources, Watershed Restoration Initiative

Utah Division of Wildlife Resources

Utah Public Lands Policy Coordination Office

US Bureau of Land Management

US Forest Service

US Geological Survey

West Desert Adaptive Resources Management Local Working Group

Utah State University Extension

Jack H. Berryman Institute

Utah Public Lands Initiative

Yamaha Outdoor Access Initiative

Utah State University Ecology Center

August 2021

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Executive Summary

In 2015, the cooperators identified on the inside cover of this report implemented a multi-year conservation effort to restore declining greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) populations in the 611,129 acres Sheeprock Sage-grouse Management Area (SGMA) located in west-central Utah. This conservation effort included completion of habitat restoration projects developed and funded by the cooperators, predation management, and the spring translocation of radio-marked sage-grouse from the Parker Mountain and West Box Elder SGMAs to the Sheeprock SGMA. From 2016-2019, the cooperators translocated 146 radio-

marked sage-grouse that were monitored by researchers from Utah State University (USU). This report is the 2020 annual field summary of our monitoring effort and a 2021 update.

In 2020, no sage-grouse were translocated to the SGMA. We counted 59 males on 7 leks-- two new leks and a reoccupied lek. This is up from the peak count of 37 males across 4 leks in 2019. We monitored 33 radio-marked sage grouse in spring and summer of 2020 and documented 15 mortalities (45% apparent mortality rate). We monitored 21 females in the nesting season and confirmed 12 nest initiations (57% apparent nest initiation), of which 6 successfully hatched (50% apparent nest success). Three of these broods fledged chicks (50% apparent brood success). In previous years (2016-2019), we estimated 13.5%, 18.2%, 35%, and 54.6% nest initiation proportions (n= 37, 44, 40, and 44); 60%, 100%, 82.4%, and 70.8% apparent nest success (n= 5, 8, 17, and 24); and 66.7%, 37.5%, 61.5%, and 29.4% apparent brood success (n= 3, 8, 8, and 17) respectively.

In 2021, no field monitoring was conducted. Lek counts were lower than 2020 with 46 actively lekking males counted on 6 leks. Currently, there is one GPS-marked resident female captured in 2020 alive and monitored remotely. Melissa Chelak is working on analyzing the 2016-2020 data for the dissertation work on this project. The dissertation will be the final project report. All of the field, seasonal, and annual reports can be found on the Utah Community-based Conservation web site under the West Desert Local Working Group tab https://utahcbcp.org/localworkinggroups/WestDesert-WDARM/westdesert.

Introduction

The estimated range-wide distribution and populations of sage-grouse have declined considerably compared to pre-settlement as well as recent estimates (Schroeder et al. 2004, Aldridge 2008, Garton et al. 2011). The prime factors contributing to the declines have been the loss and fragmentation of sagebrush habitat associated with the life history of the sage-grouse in addition to fire and invasive species (Aldridge et al. 2008, Miller et al. 2011).

Due to the range-wide population declines, the U.S. Fish and Wildlife Service (USFWS) has received multiple petitions to provide the sage-grouse protection under the Endangered Species Act (ESA). In 2010, the USFWS designated the sage-grouse as a candidate species for ESA protection (USFWS 2015). In September 2015, the USFWS reversed the 2010 decision when it announced that listing sage-grouse for ESA protection was unwarranted. The USFWS made this decision after evaluating on-going range-wide efforts by federal, state, and local partners and determined these actions had mitigated the threats to the species and provided for increased conservation certainty. In 2021, the USFWS will revisit this decision and will assess the current needs of 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 requests 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 the status review in 2021. 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).

In response to USFWS guidance, the BLM and USFS revised their management plans for monitoring and managing sage-grouse populations on public land (BLM 2015). In Appendix B of the BLM's adaptive management plan, they outlined a series of hard and soft population triggers as part of an integrated conservation strategy. The soft triggers designated population threshold levels which would require increased consultation with state partners (BLM 2015). The hard triggers were population thresholds that require immediate actions to protect the populations (BLM 2015).

Short-term Decline:

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

Long- term Decline

c) Population growth rate is decreasing for 6 consecutive years
d) Population growth rate is decreasing for 8 years in a 10-year window

Utah sage-grouse populations

Utah's sage-grouse populations contribute 6-8% of the range-wide populations, and are discontinuous due to topographical features of Utah's landscape (Dahlgren et al. 2016, PLPCO 2019). Population cycles vary from 9-12 years between peaks and troughs (Garton et al. 2011).

In 2019, Utah released their sage-grouse conservation plan that updated its goals developed in 2013. The plan supported sustaining the eleven Sage-Grouse Management Areas (SGMAs, Figure 1) 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 (Dahlgren et al. 2015, PLPCO 2019). The plan also identified two primary objectives with subsequent strategies to meet those objectives. The objectives identified include efforts to:

1) Maintain and increase sage-grouse populations statewide and within each SGMA.
    a. Monitor sage-grouse population trends annually. If necessary, implement adaptive management strategies to support viable and stable populations.
2) Maintain, protect, and increase sage-grouse seasonal habitats within SGMAs through the following actions:
    a. Identify highest-priority sage-grouse habitats and migration corridors
        i. Protect at least 5,000 acres of these habitats annually
    b. Improve and increase sage-grouse seasonal habitats by 75,000 acres annually

c. Coordinate with local, state, and federal fire-fighting jurisdictions to include sage-grouse habitats as a priority during pre-fire planning and suppression

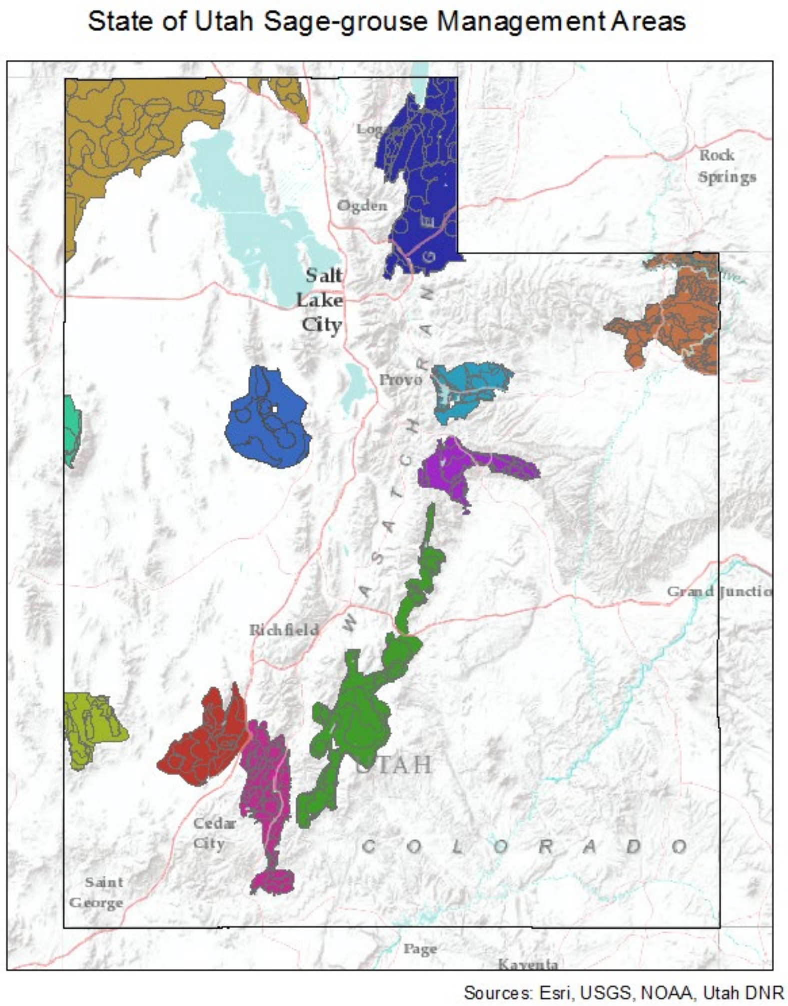


Figure 1. Utah's 11 Sage-grouse Management Areas, Salt Lake City, Utah, 2021 (PLPCO 2019).

West Desert Adaptive Resource Management Local Working Group

The West Desert Adaptive Resource Management (WDARM) local working group encompasses the Sheeprock SGMA (WDARM 2007). The WDARM (2007) identified conservation strategies to mitigate the declines in the Sheeprock sage-grouse population. These strategies included evaluating population trends, identifying research needs and knowledge gaps, determining population and habitat needs for the future, and identifying threats that have potential to affect sage-grouse in the West Desert (WDARM 2007). The strategies included:

1. Incorporate management strategies from state and federal agency partners, local governments, and established range-wide conservation and management guidelines (Connelly et al. 2004, Dahlgren et al. 2019).

2. Increase effective communication with all potential stakeholders in the West Desert and the state of Utah, through outreach, information distribution, and education
3. Address and prioritize threats to aid in prioritizing management solutions

During the normal population cycles, all 11 Utah SGMA's showed gradual declines in their populations (Garton et al. 2011). However, the Sheeprock SGMA population has continued to decline while others showed increasing population levels. Figure 2 illustrates the active male lek counts for the Sheeprocks in 2006, when 190 males were observed across the SGMA (Robinson 2007). In 2015, the number of active males counted on leks was 23 (UDWR, unpublished data).

Given these trends, the population unofficially hit the hard trigger outlined in the BLM Adaptive Management Plan (BLM 2015). During 2015, the WDARM met and discussed avenues for immediate action required to prevent extirpation of the Sheeprock population including: translocations, predator control, habitat restoration, and a long-term research project to study the population. In 2017, the BLM officially stated that the Sheeprock population reached the hard triggers outlined above. As a result, they have outlined adaptive management strategies to prevent future declines: prioritizing habitat restoration efforts, making the area the focal point for fire suppression, and seeking to minimize impacts from rights-of-way developments (BLM 2017).

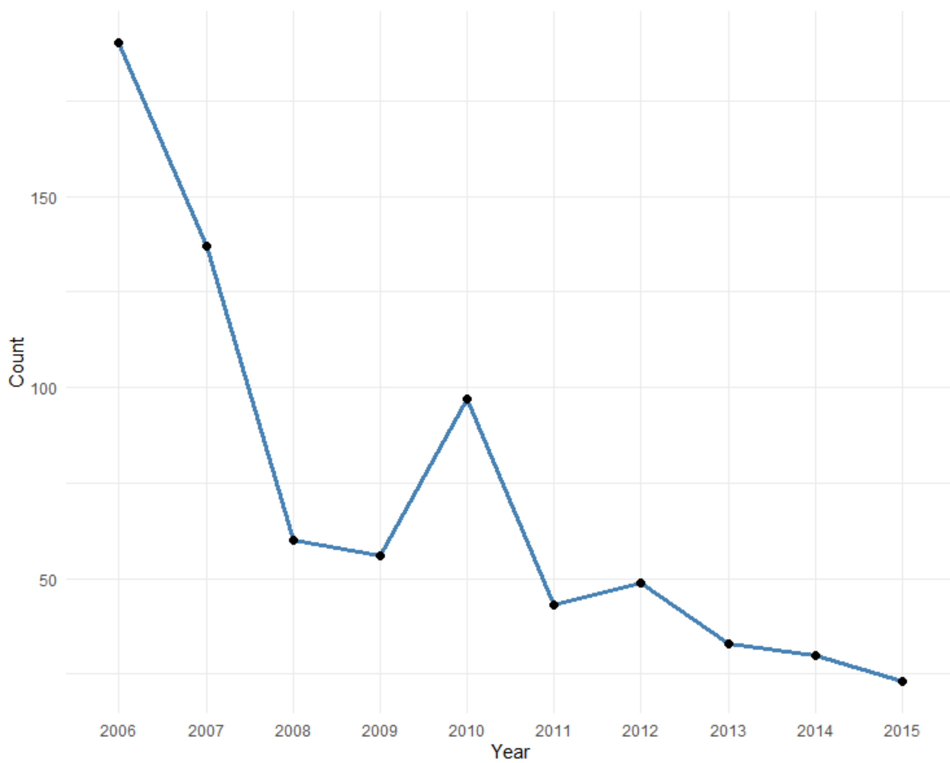


Figure 2. Average number of strutting greater sage-grouse (*Centrocercus urophasianus*) males in the Sheeprock Sage-Grouse Management Area from 2006 to 2015, Utah (Utah Division of Wildlife Resources, unpublished data), 2021.

Translocations have been used to augment, reintroduce, introduce, or genetically rescue populations of various species with the ultimate goal being to create self-sustaining populations (Griffin et al. 1989, Dickens et al. 2009). Success of translocations is contingent upon the methods and protocol of capture, among other variables. Wild and native game bird species have been reported to exhibit the highest success rate for translocations (Griffin et al. 1989). The quality of habitat will also influence the success, with higher quality habitats leading to increased success; however, in areas with lower quality habitat, ongoing habitat restoration projects aid in success (Dickens et al. 2009). In areas where predation was implicated as a factor in the population declines, predator control has increased success (Baxter 2008). Translocating sage-grouse overnight during the breeding season and releasing them on an active lek the morning of capture has also increased survival rates of translocated individuals (Reese and Connelly 1997, Baxter 2008).

Study Purpose

The purpose of this study is to evaluate if translocations could augment the population of sage-grouse located within the Sheeprock SGMA. The specific objectives of this study are to:

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

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

    a. Develop specific disturbance and habitat management recommendations for the USFS, BLM, and other partners based on marked sage-grouse vital rates and habitat-use patterns. These recommendations will 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.

3. Determine predator occupancy across the study area and if it affects sage-grouse habitat selection.

4. Quantify off-highway vehicle (OHV) recreation abundance throughout the Sheeprock SGMA and determine if it affects 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. 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 Trust Lands (SITLA; 34,131acres), and the Utah Department of Natural Resources (UDNR; 684 acres).

This area is characterized by warm, dry summers and cool winters. The 50-year average maximum summer temperature is 32.4 ˚C in July, and the minimum winter temperature is -10.4 ˚C in January (Figure 3). The average annual precipitation is 10.24 inches, with the highest amount being in the spring and fall months (Figure. 4). Average snowfall is 36.2 inches (Western Regional Climate Center 2016).

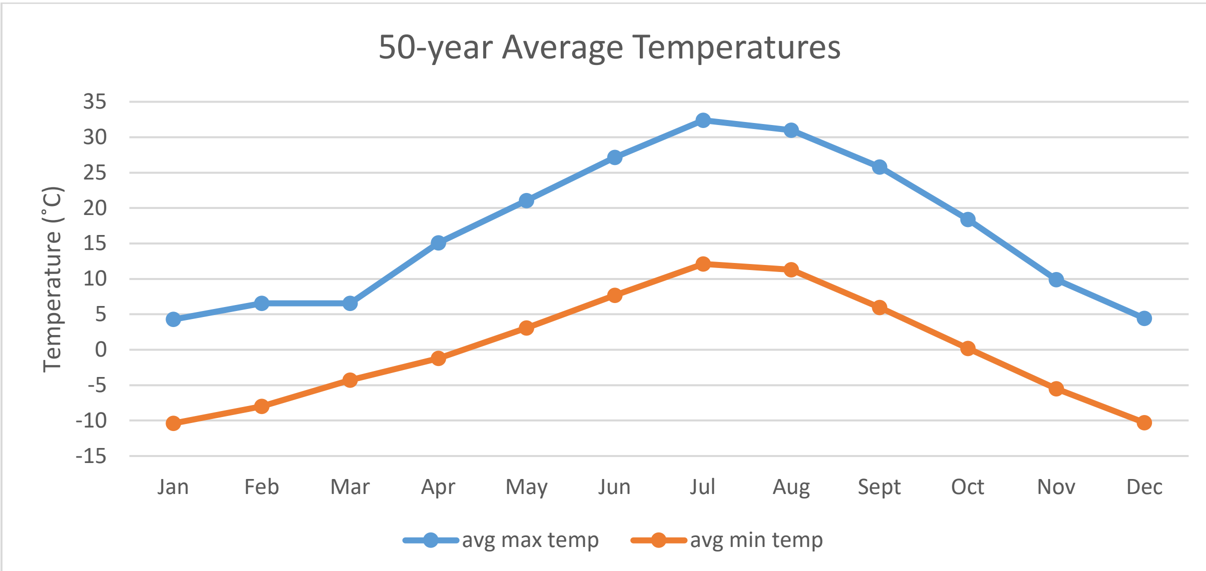


Figure 3. The 50-year average minimum and maximum temperatures per month in degrees Celsius for the Sheeprock Sage-Grouse Management Area as collected by Western Regional Climate Center in Vernon, Utah (Western Regional Climate Center 2016), 2021.

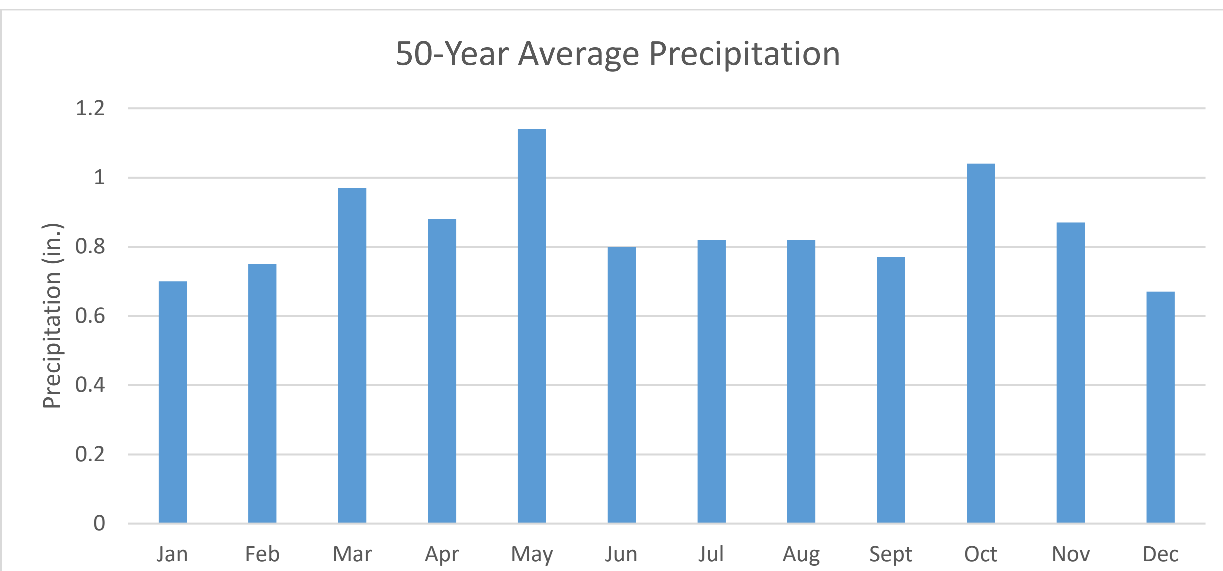


Figure 4. Average annual precipitation in inches in the Sheeprock Sage-grouse Management Area. This figure illustrates a bimodal distribution with peaks occurring during the spring and fall months (Western Regional Climate Center 2016), 2021.

Elevation ranges from 1500m in the lower valleys to 2950m at 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). 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. t. vaseyana*), and juniper (*Juniperus* spp.) stands (Robinson 2007). Higher elevations, along ridgelines, are dominated by black (*A. nova*) and low sagebrush (*A. arbuscula*; Robinson 2007). Rubber rabbitbrush (*Ericameria nauseosa*) and Douglas rabbitbrush (*Chrysothamnus viscidiflorus*) are also prevalent in lower and mid elevations (Robinson 2007).

Source Capture Areas

Parker Mountain (PM) is part of Utah's Parker Mountain-Emery SGMA (Figure 5) located in south-central Utah and contains one of the largest sage-grouse populations in the state. It is located within the Great Basin Desert and characterized by mostly black sagebrush on the ridges and slopes and big sagebrush in the drainages (Baxter et al. 2008). Elevation ranges from 2,140 m to 3,000 m (Chi 2004, Baxter et al. 2008). Average annual precipitation is 567 mm with the highest precipitation in fall, winter, and spring as is characteristic of cold deserts (Dulfon 2016).

Park Valley (PV) is located in northwestern Utah in the Box Elder SGMA (Figure 5). It contains predominately big sagebrush and black and low sagebrush similar to that of the Sheeprock SGMA (Sanford et al. 2017). It is on the edge of the Snake River plain and the Great Basin Desert. Elevation ranges from 1,350 m to 2,950 m with average annual precipitation ranging from 177 mm to 783 mm from low elevation to high elevation, respectively (Sanford et al. 2017).

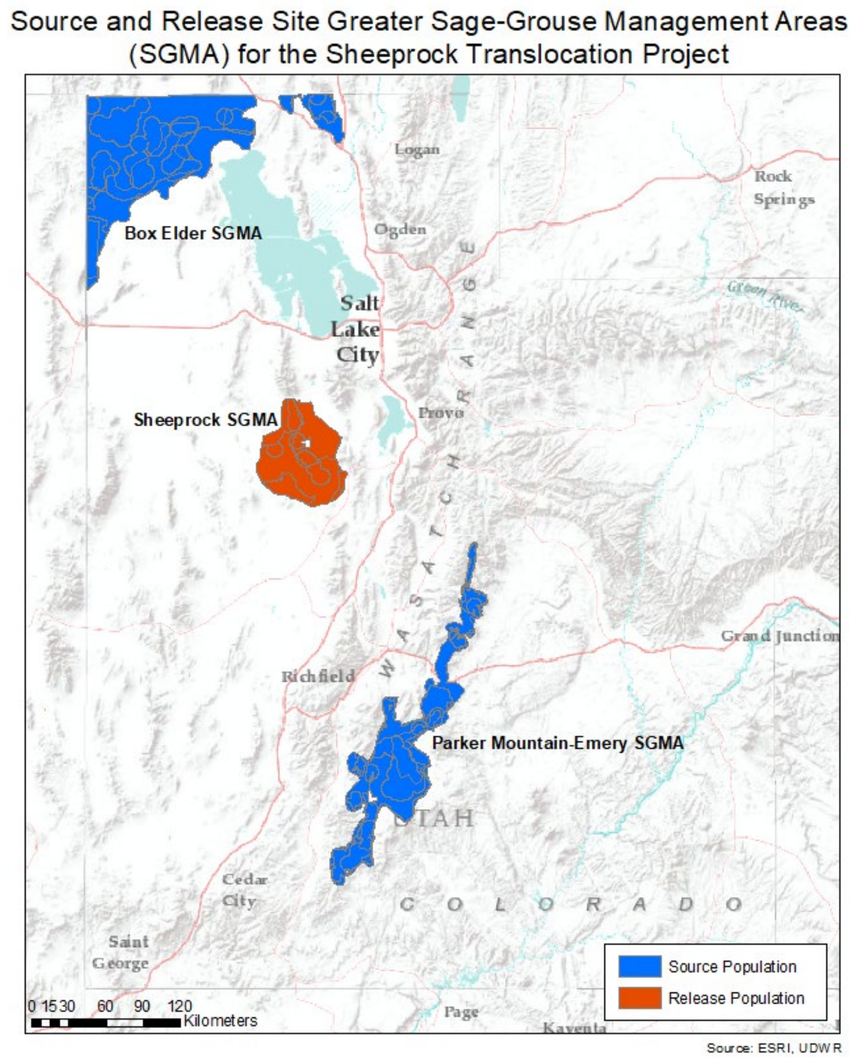


Figure 5. The release site and source populations identified for the Sheeprock Sage-Grouse Management Area (SGMA) translocations to augment the greater sage-grouse (*Centrocercus urophasianus*) population, Sheeprock Sage-Grouse Management Area, Utah, 2021.

The sage-grouse are translocated from both Park Valley, located in the Box Elder SGMA, and Parker Mountain, located in the Parker Mountain-Emery SGMA. Resident sage-grouse within the Sheeprock SGMA are also monitored.

Methods

Translocations

Translocation methods followed guidelines outlined by Connelly et al. (1997) and Baxter et al. (2008). We performed translocations from 2016-2019. During the lekking period, 30 females and 10 males were translocated annually from genetically compatible populations of sage-grouse located in Park Valley and on Parker Mountain (Reese and Connelly 1997, Oyler-McCance et al. 2005). Source populations were greater than 50km away from the Sheeprock SGMA, where the birds were released (Reese and Connelly 1997, Oyler-McCance et al. 2005). Park Valley and Parker Mountain source populations were approved by the Regional Advisory Councils, the Wildlife Board, the Resource Development Coordination Council (RDCC), the Utah State University Institutional Animal Care and Use Committee (IACUC), and the West Desert, Parker Mountain and West Box Elder SGMA local working groups.

Sage-grouse were captured at night using all-terrain vehicles, spotlights, and long handled nets near active leks (2100hr to 0200hr; Connelly et al. 2003). Sage-grouse were brought to the trucks and processed—i.e. fitted with transmitters, weighed, aged, etc.—there before leaving the capture site. Most of the females and males 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). Some females and males were fitted with camouflaged solar-powered GPS satellite transmitters mounted on the rump of the grouse. The GPS transmitters included Ultra High Frequency (UHF) capabilities to allow for relocating marked birds in the field. Processing included mounting the transmitter, ageing, sexing, weighing, leg banding, and recording the capture locations (UTM, 12N, NAD 83).

Beginning in 2017, we collaborated with two other sage-grouse translocation studies in North Dakota and the bi-state of California and Nevada on improving translocation protocols to improve post-release survival and movements of translocated individuals. Under the new protocol, birds were placed in wooden remote-release boxes that contained 5 individual compartments with ventilation and transported overnight (0200hr -0530hr) in a pickup truck to the release site, where birds were placed close to leks until sunrise to facilitate lower stress levels upon release. At sunrise (0600hr-0630hr), radio-marked sage-grouse were released the morning following capture, within 200m of an active lek site. The remote-release boxes were lined up with the opening facing the lek, and grouse were released after the immediate area was scanned for predators.

In the Sheeprock SGMA, up to 10 resident sage-grouse (8 females and 2 males) were captured annually. Some individuals, both male and female, were marked with GPS transmitters, with the remaining individuals were fitted with the VHF radio-collars. All sage-grouse were weighed and aged, with age being determined by characteristics of the P9 and P10 wing feathers. The birds were immediately released following processing. With the Sheeprock SGMA population being so low, radio-marking 10 grouse represented a realistic goal (Robinson and Messmer 2013). Data gathered from radio-marked sage-grouse provided information on the habitat use and seasonal movements of the resident population.

Feathers were collected from both resident and translocated grouse during processing for genetic analysis. Clean feathers lost incidentally during the capture were collected; if clean feathers were not present or no feathers were lost during the capture, feathers were plucked from the breast. Feather samples were placed in small paper envelopes, sealed, and labeled with the date, sex, collector's name, bird ID, and the UTM coordinates. Samples were stored in desiccant for tissue preservation.

Lek Counts

Lek counts were conducted according to the procedures outlined in the UDWR protocol. A minimum of three counts were completed at weekly intervals beginning in mid-March and ending May 7. The counts began 30 minutes before sunrise and end 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 population calculations based on their lek attendance during lek counts within the same year they were translocated. This provided an unbiased count for the years when translocated males were released during the lekking period.

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 data were uploaded at the end of each duty cycle. Five to six locations were recorded per day for the GPS transmitters at different times depending on the season. For each location for VHF-marked individuals, the date, time, observer, UTM, group size, flocking with resident birds, habitat type, nearest disturbance, and survival status were recorded. Mortality for the VHF radio-collared birds was determined by a mortality signal (faster pulse rate), which initiated after the collar has remained in the same location for 8 or more hours. Mortality for the GPS transmitters was determined using the online data, which detected a mortality mode after several fixes at the same location. After a mortality signal was detected, the observer located the transmitter and determined the cause of mortality, if possible.

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, the site checked 2 to 3 times a week from 30-50 m away to determine the fate. When the eggs hatched and the hen and brood left the nest area, the clutch size was estimated by counting the number of egg shells. If a nest failed, the observer attempted to identify the cause and the female was again monitored 2 to 3 times a week to document re-nesting attempts. Broods were located 3 times a week until the brood reached 50 days old. Females that did not have broods were located 1 to 2 times per week.

During the fall and winter, collared sage-grouse were located bi-monthly using ground telemetry. Periodic flights in a fixed-wing aircraft were also used to locate grouse that were 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 location weekly per brood (up to 50 days of age post-hatch or failure for the brood), vegetation measurements were recorded using a line intercept method to determine shrub cover, height and species (Connelly et al. 2003). Each location consisted of four, 15m transects for nest sites and four, 10m transects for brood sites. A random compass bearing was used to determine the direction of the initial transect. Daubenmire frames (20 x 50 cm) were read every 3m for nests and 2.5m for broods 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 is assessed at 4m along each transect at 100 cm high, looking both into and out from the Robel pole (Robel 1970).

Predator Surveys

Predator surveys were conducted in 2017 through 2020 concurrent with predator control efforts by U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Wildlife Services. These surveys were used to develop an index of the predator species abundance and how it may have changed in response to predator control in the Sheeprock SGMA. We will estimate predator occupancy across the SGMA by avian or mammalian predator groups. These predator survey methods were adapted from methods developed in Rich County, Utah (Dettenmaier 2018).

Avian predator surveys

We documented avian predator abundance weekly beginning in May through July from points located on scat transects. Counts included ravens (*Corvus corax*), black-billed magpies (*Pica hudsonia*), golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), northern harriers (*Circus hudsonius*), and other raptors during a 10-minute period. Counts were restricted to days with light winds (<19 kph) and little or no precipitation (Luginbuhl et al. 2001). At each survey point, avian predators are counted by visually searching the area with the aid of binoculars and listening for bird calls. The species code and counts were recorded along with the time, weather, behavior (flying or perched), and estimated distance at time of first detection. To mitigate double counting, survey points were separated by more than 5 km and previously recorded birds were tracked prior to moving to the next survey point. The survey routes were located both near and far from lek sites across the SGMA. Using a modification of the method created by Somershoe et al. (2006), we used distance annuli between <100 and >500 meters from the survey point to estimate density of the avian predator species when combined with the point count data. These distance annuli reflect the open sagebrush habitats and relative ease of detecting larger avian predator species.

Mammalian predator surveys

To conduct mammalian predator surveys, we placed 30, 1km transects on roads ranging from two-track and maintained (gravel) roads throughout the SGMA and performed scat surveys. Scat survey transects were initially cleared of all scat and surveyed every 4 to 7 days beginning in May and continuing to the end of July. Roads were driven on an ATV to maximize detection of scat presence while minimizing time spent on the transects. Similar to the avian predator surveys, transects were 5 km apart. Species identification included red fox (*Vulpes vulpes*), coyote (*Canis latrans*), American badger (*Taxidea taxis*), and other mammalian predators.

Off-Highway Vehicle Surveys

In 2018, we received funding from the Yamaha Outdoor Access Initiative to initiate a needs assessment of recreational users in the Sheeprock SGMA. We collaborated with researchers, Dr. Jordan Smith and Ben Muhlestein, to develop and implement these surveys during high, medium, and low use days during the summer of 2018 and 2019 from May to September (Smith et al. 2018). Willing participants were asked to participate in a short questionnaire and, if they agreed, a Garmin GPS device was attached to their OHV to register use of the area. The study assessed recreationalists' use based on motivations gathered from the survey as well as assessed impact on habitat fragmentation. Due to the COVID-19 pandemic, Utah State University paused research involving human subjects, therefore we forewent conducting these surveys in 2020.

Preliminary Results

2020 Resident sage-grouse captures

In 2020 we captured and radio-marked nine resident sage-grouse. The captured birds include two males and seven females. We completed trapping for the 2020 season in mid-April, when females began nesting. Between 2016-2020, we captured and radio-marked 39 resident sage-grouse. The capture lek location for the female and male resident sage-grouse caught in 2020 are listed in Table 1.

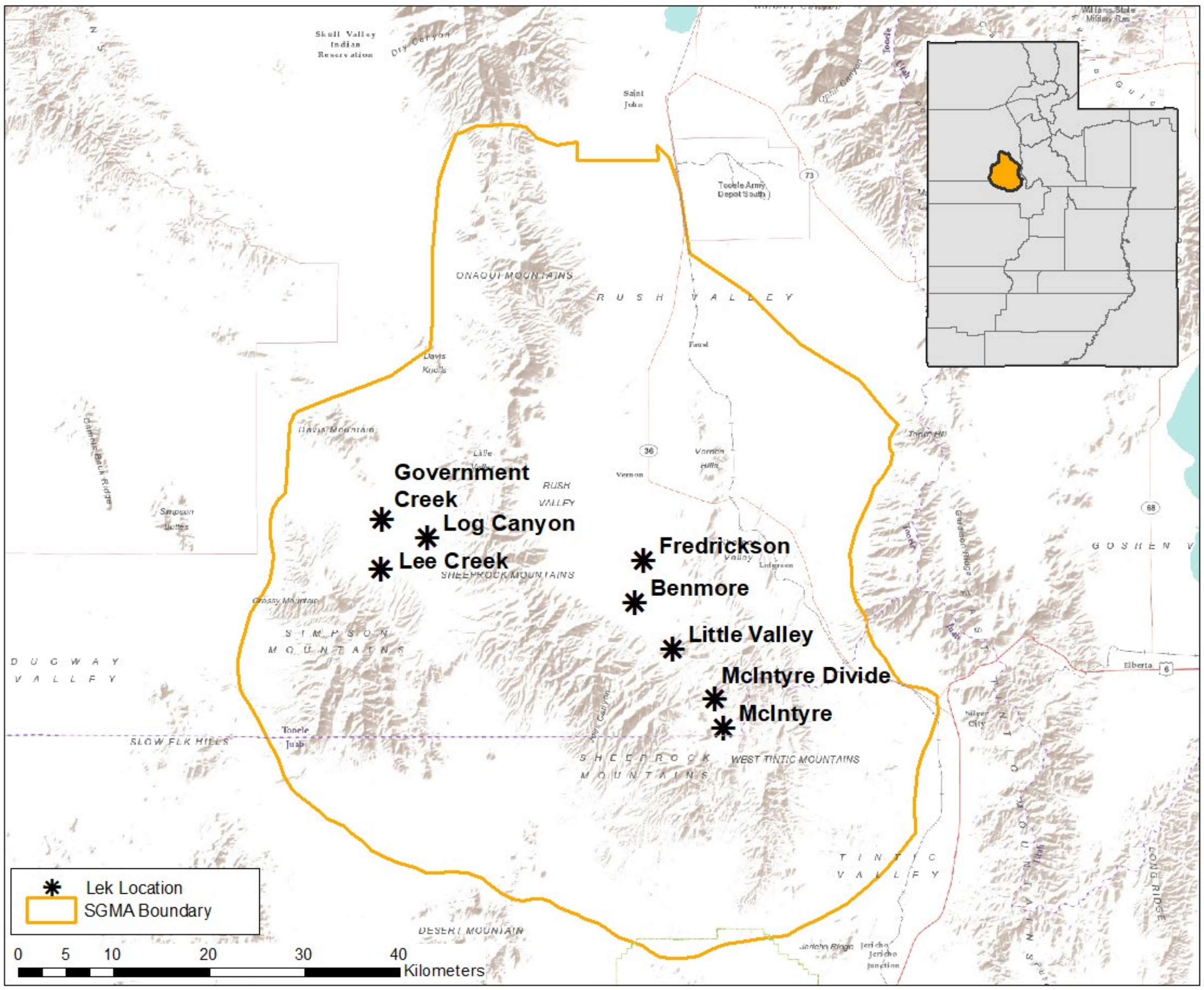
Table 1. Capture locations for male and female greater sage-grouse (*Centrocercus urophasianus*) radio-marked in 2020, Sheeprock SGMA, Utah, 2021.

Lek Name	Number of Males	Number of Females
McIntyre Meadow	0	1
Benmore	0	1
Government Creek	1	2
Fredrickson	1	0
Log Canyon	0	3
McIntyre Divide	0	0
Vernon Little Valley	0	0
Total per sex	2	7
	Total Captured	9

Lek Surveys

We discovered two new leks in 2020 in addition to Little Valley lek becoming a reoccupied lek. The new leks include Log Canyon and McIntyre Divide, seen in the Figure 6 below. In 2020, we counted 59 males on 7 leks. This is up from a peak of 37 males counted across 4 leks in 2019. However, 2019 lek counts were impacted because of limited access due to road conditions.

In Spring 2021, a new lek was discovered, named Lee Creek. There were 46 actively lekking males counted on 6 leks, down from 59 active males in 2020 on 7 leks. Figures 7 and 8 show lek and population grown rate trends, respectively.



Source: ESRI, UDWR

Figure 6. Greater sage-grouse (Centrocercus urophasianus) lek locations in the Sheeprock SGMA, Utah, 2021.

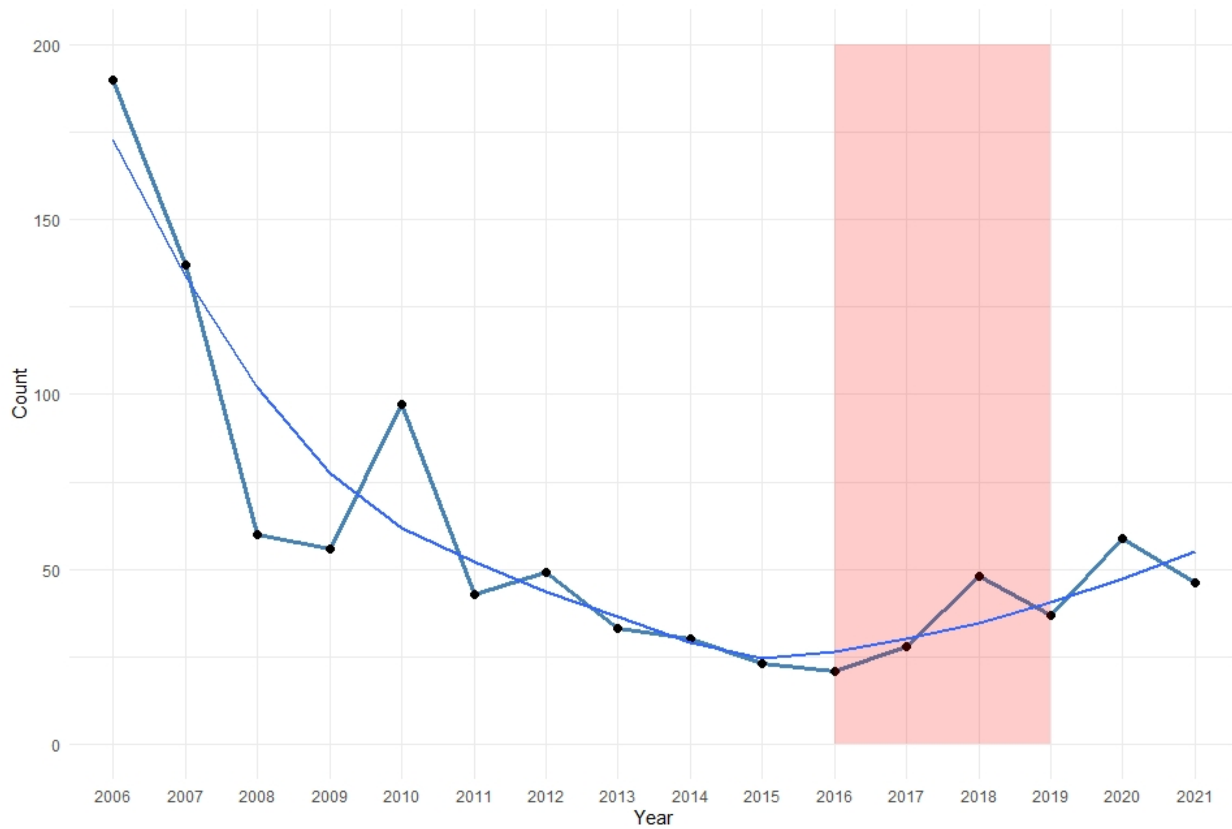


Figure 7. Lek counts from 2006-2021 of greater sage-grouse (*Centrocercus urophasianus*) located in the Sheeprock Sage-Grouse Management Area (SGMA), Utah, 2021. Counts inside the red shaded area are during the years of translocations. The 2019 counts were biased towards the late season past the peak male lek attendance due to access issues caused by increased snowfall.

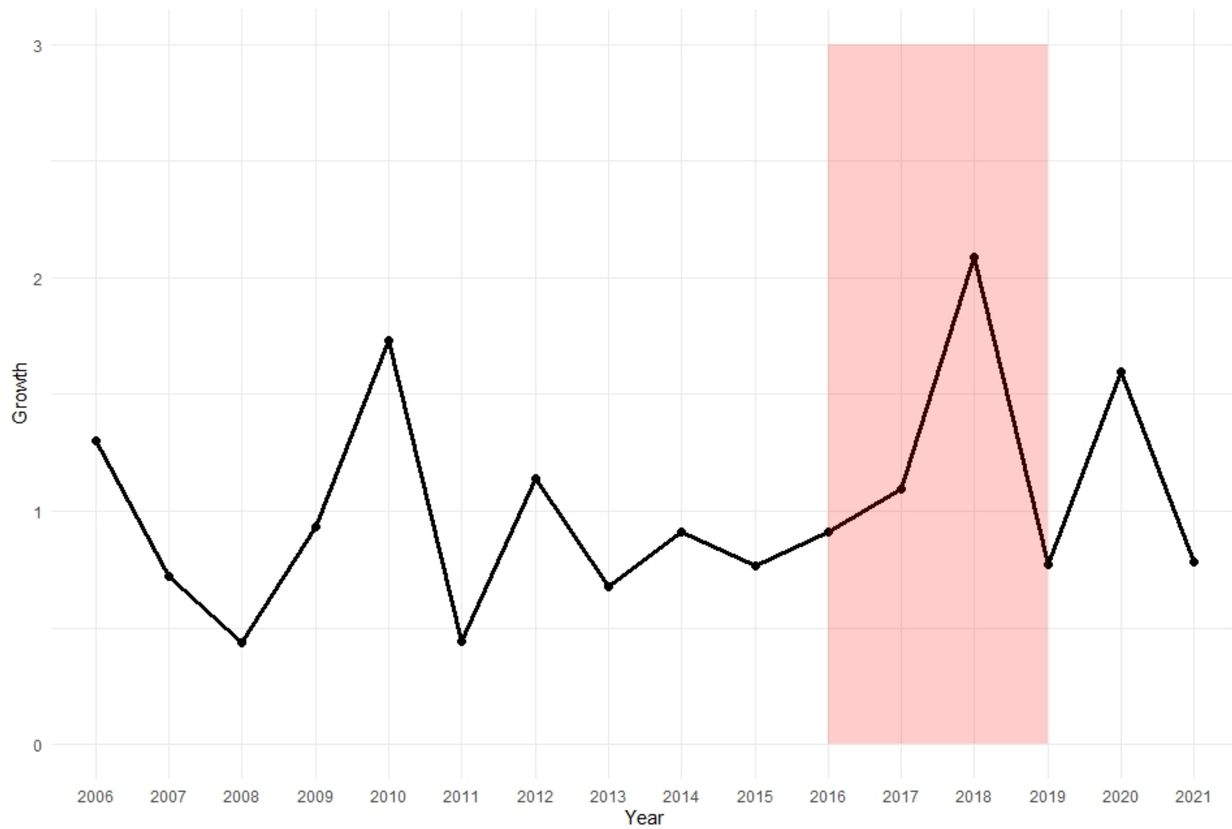


Figure 8. Population growth rates from 2006-2021 of greater sage-grouse (*Centrocercus urophasianus*) located in the Sheeprock Sage-Grouse Management Area (SGMA), Utah, 2021. A rate above one indicates an increasing population and below one indicates a decreasing population. Counts inside the red shaded area are during the years of translocations. The 2019 rates were biased towards the late season due to access issues caused by increased snowpack.

Monitoring and Movements

In 2020, trapping efforts in the Sheeprock SGMA resulted in 9 birds being radio-marked: 2 males and 7 females. As of 2020, 185 individuals (146 translocated and 39 resident) had been marked and monitored in the Sheeprock SGMA across the duration of the study. At the end of 2020, 11 sage-grouse were monitored (Table 2).

VHF-marked individuals were not monitored in 2021, but there were 3 GPS-marked individuals alive at the beginning of March 2021, with 1 currently alive in August of 2021. These individuals were all resident females captured and marked in 2020.

Table 2. Status of greater sage-grouse (*Centrocercus urophasianus*) radio-marked from 2016-2019 in the Sheeprock Sage-Grouse Management Area, Utah, 2021. Undetected individuals have either emigrated from the study area, had collars detach, malfunction, or deplete their batteries.

Year Marked	Mortality in 2019	Mortality from Previous YR	Undetected	Currently Monitoring	Total Marked
2016	1	22	23	1	47
2017	6	26	10	3	45
2018	15	17	6	10	48
2019	15	--	4	17	36
Total	37	65	43	31	176

In 2020, the movements for sage-grouse translocated in 2019 and other years previous paralleled those of resident birds. We have provided a map depicting movements of a yearling resident female radio-marked on the Benmore lek in 2020 (Figure 3). Sage-grouse radio-marked on the Benmore lek have typically moved to the mesic pastures south of Vernon in the later portion of the summer. However, this female moved to some western pastures in the valley in the spring and summer of both 2020 and 2021.

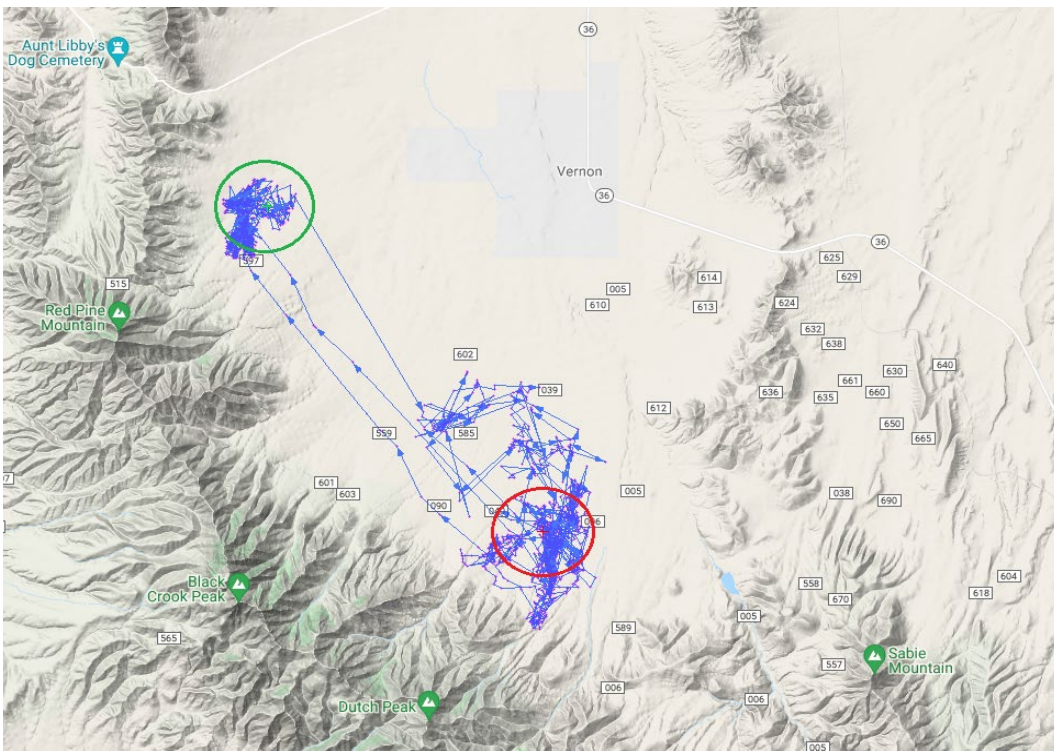


Figure 9. Flight path movements of a yearling resident female greater sage-grouse (*Centrocercus urophasianus*) radio-marked on the Benmore lek in the Sheeprock SGMA in 2020 and 2021, Utah, 2021. The red circle indicates where the female was radio-marked in the SGMA, and the green circle indicates the last location.

Below are maps showing locations for October 2020- March 2021:

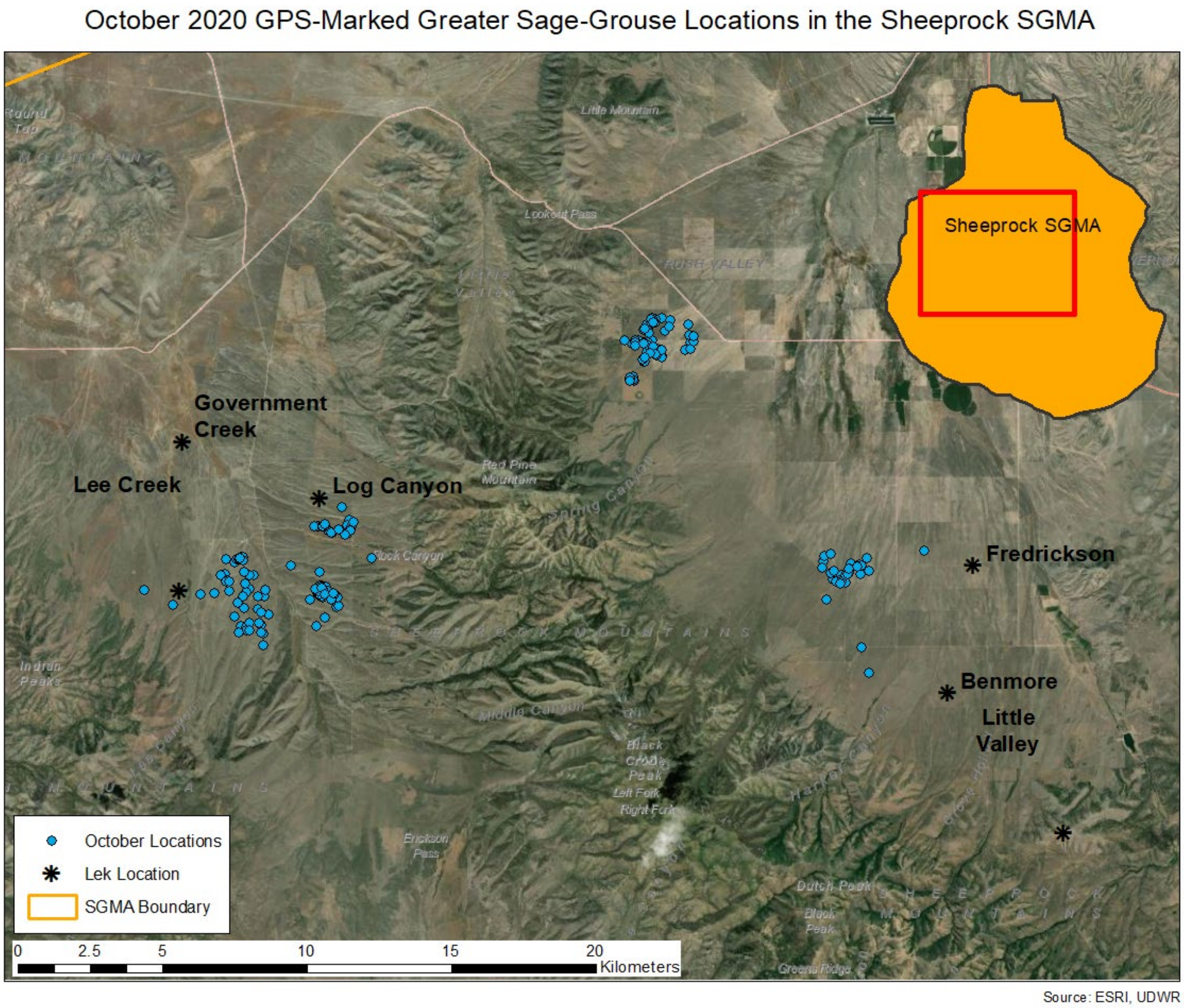
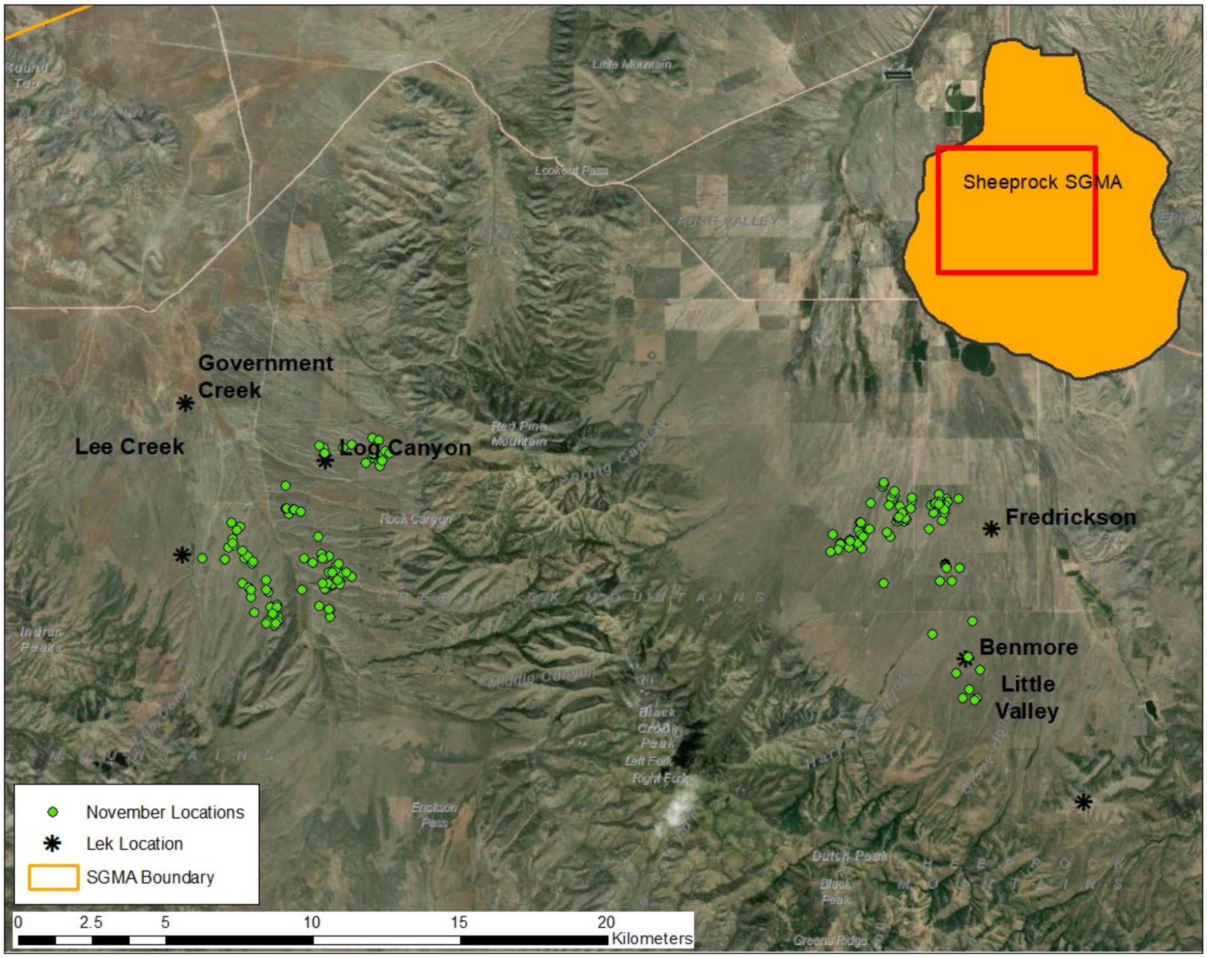


Figure 10. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in October 2020, Sheeprock Sage-Grouse Management Area, Utah, 2021.

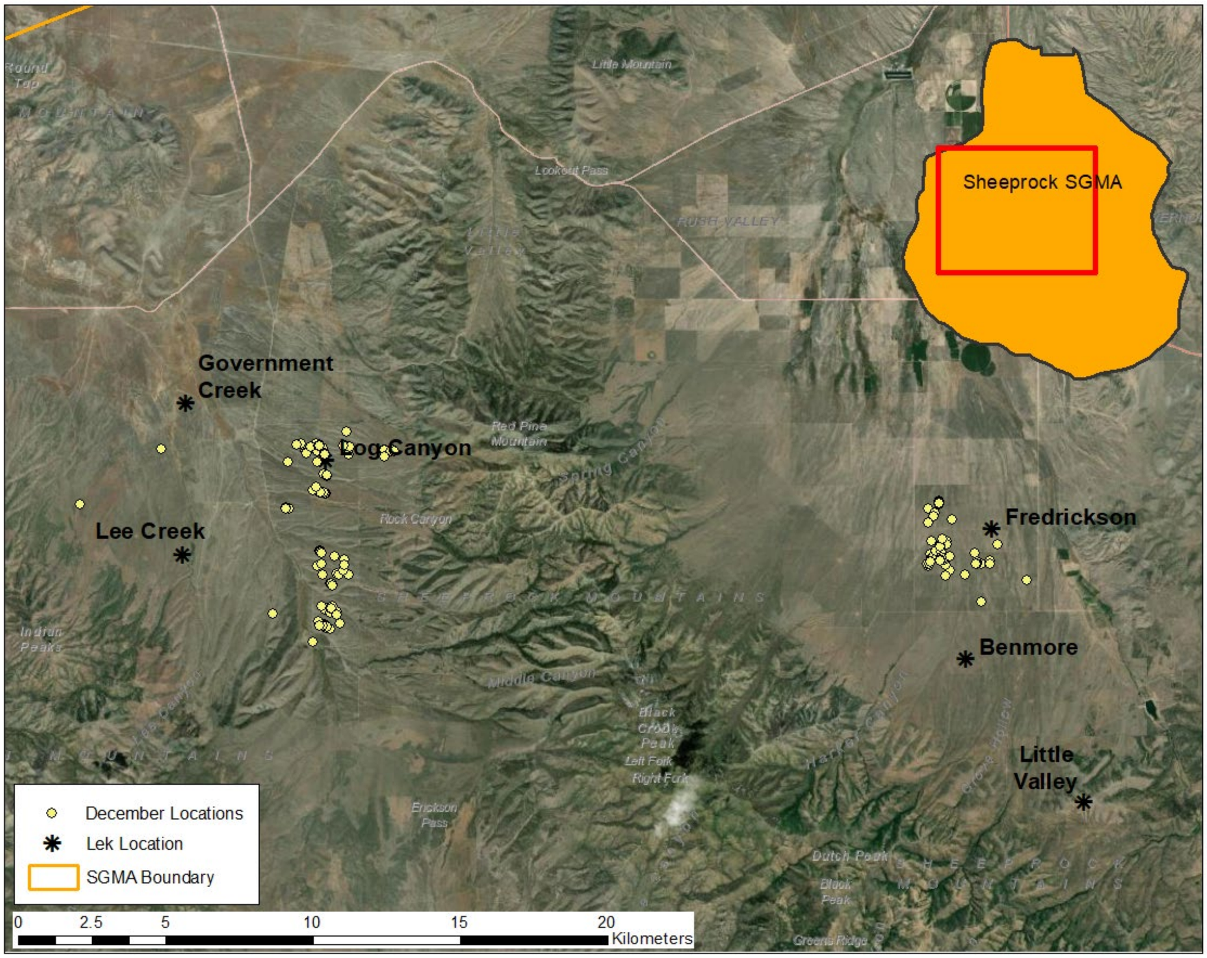
November 2020 GPS-Marked Greater Sage-Grouse Locations in the Sheeprock SGMA



Source: ESRI, UDWR

Figure 11. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in November 2020, Sheeprock Sage-Grouse Management Area, Utah, 2021.

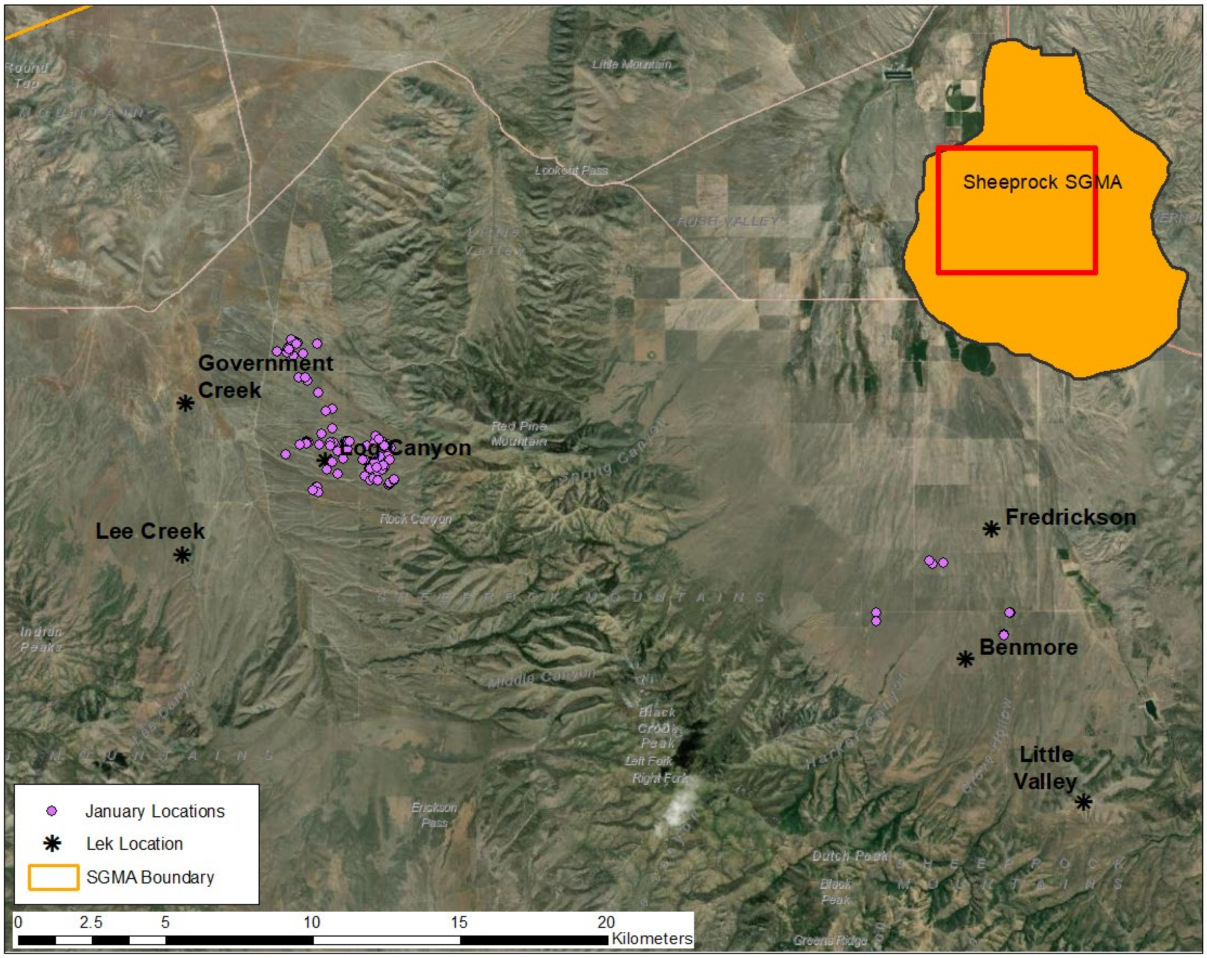
December 2020 GPS-Marked Greater Sage-Grouse Locations in the Sheeprock SGMA



Source: ESRI, UDWR

Figure 12. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in December 2020, Sheeprock Sage-Grouse Management Area, Utah, 2021.

January 2021 GPS-Marked Greater Sage-Grouse Locations in the Sheeprock SGMA



Source: ESRI, UDWR

Figure 13. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in January 2021, Sheeprock Sage-Grouse Management Area, Utah, 2021.

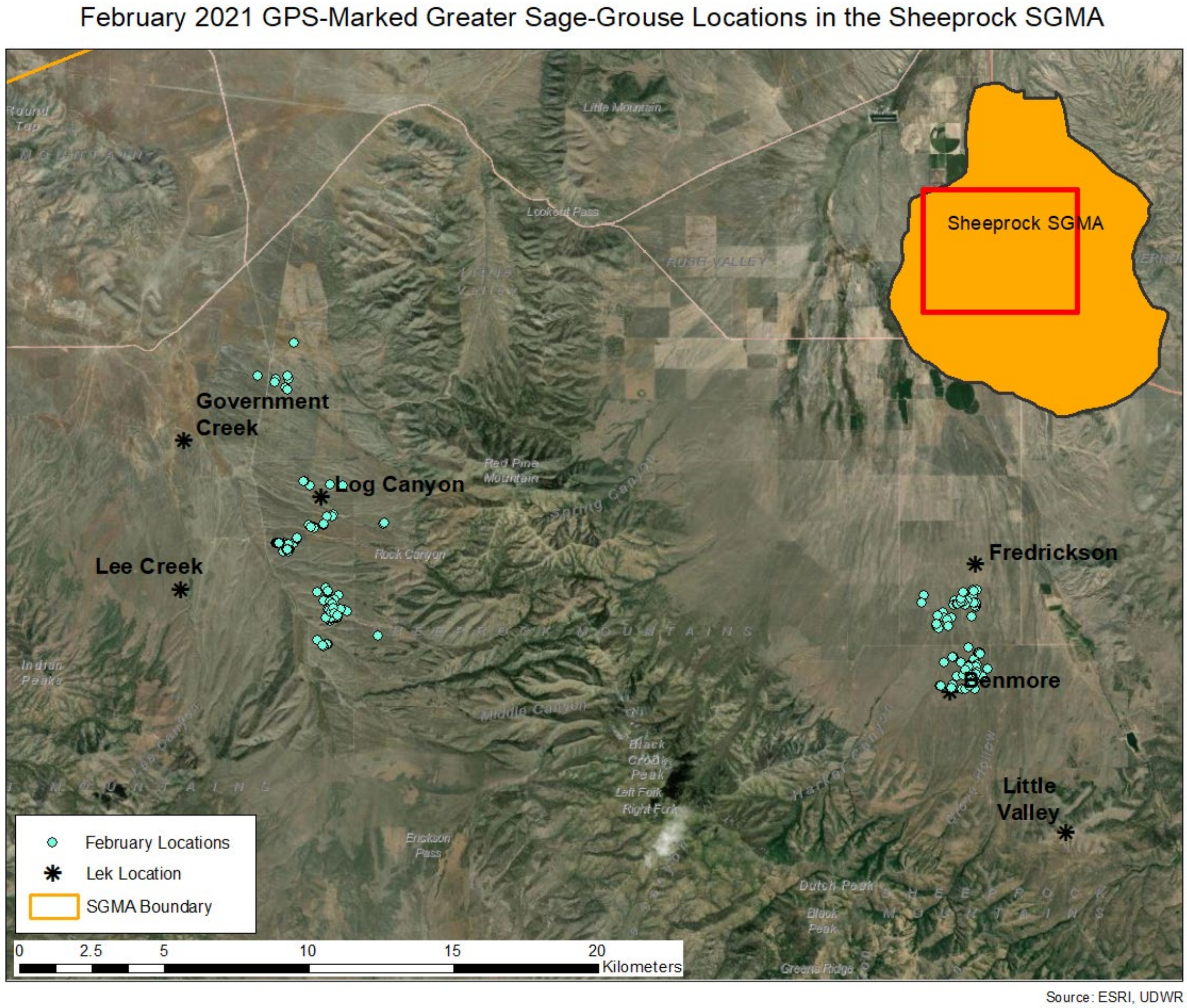


Figure 14. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in February 2021, Sheeprock Sage-Grouse Management Area, Utah, 2021.

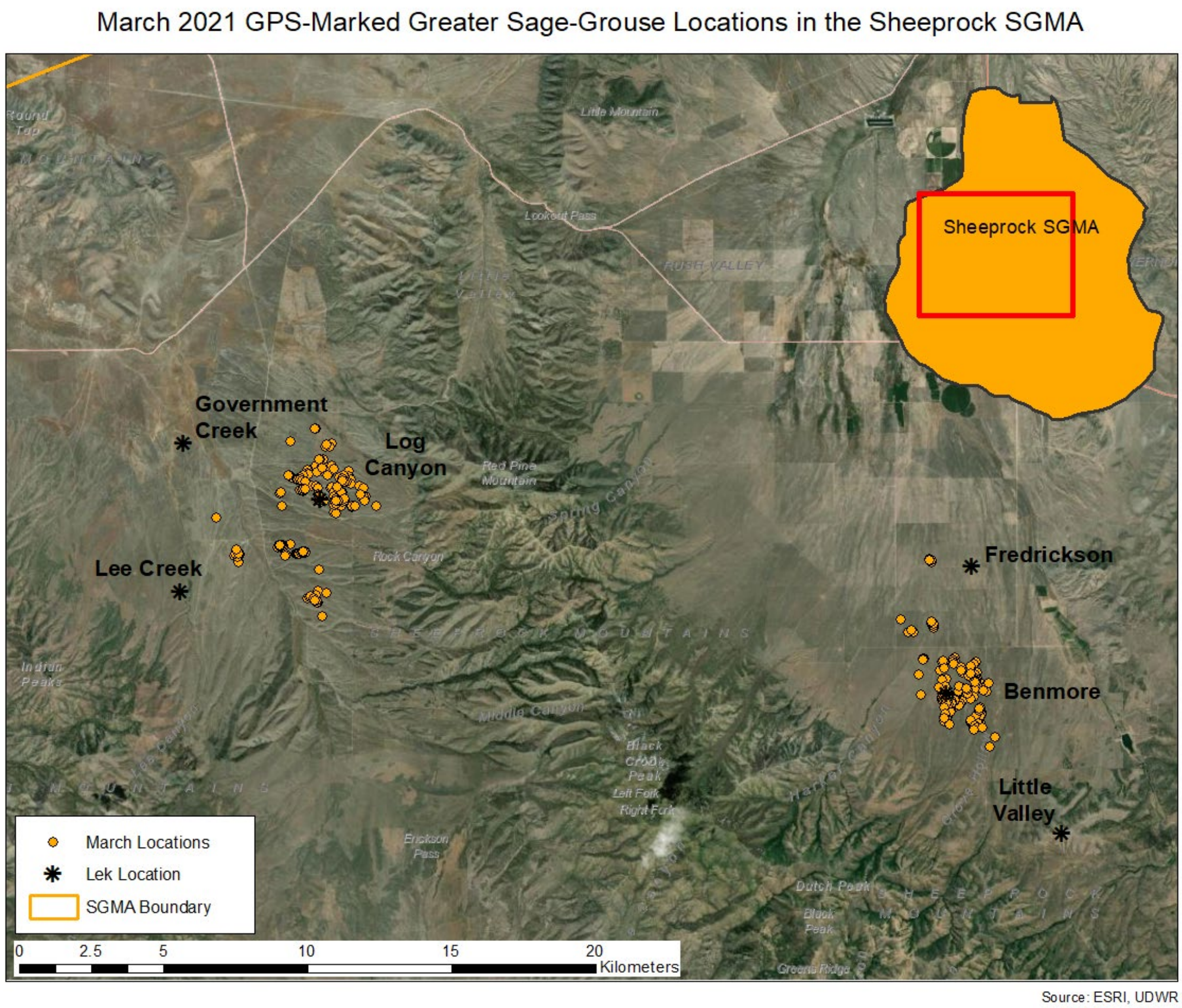


Figure 15. Locations of global positioning system (GPS)-marked greater sage-grouse (*Centrocercus urophasianus*) in March 2021, Sheeprock Sage-Grouse Management Area, Utah, 2021.

Nest Initiation, Success, and Brooding

We monitored 21 females in the 2020 nesting season. For these, we confirmed 12 nest initiations (57% apparent nest initiation) of which 6 were successful (50% apparent nest success, two females marked in 2019 and four 2020-marked females). The six successful nests hatched at least 32 chicks. Three of these broods successfully fledged 7 chicks to 50 days post-hatch (50% apparent brood success). All successful broods were located in McIntyre. We have included maps to show brooding and nesting locations for the six brooding females as well as the six failed nests.

In previous years (2016-2019), we estimated 13.5%, 18.2%, 35%, and 54.6% nest initiation proportions (n= 37, 44, 40, and 44); 60%, 100%, 82.4%, and 70.8% apparent nest success (n= 5, 8, 17, and 24); and 66.7%, 37.5%, 61.5%, and 29.4% apparent brood success (n= 3, 8, 8, and 17) respectively.

Most females initiated nests between April 11 and April 30, 2020. Nest and brooding locations are included in Figures 16-18.

Table 3. Nest initiations for translocated and resident greater sage-grouse (*Centrocercus urophasianus*), by age in 2020, Sheeprock SGMA, Utah, 2021.

Year Marked	Number of Females Nesting	Adults/Yearlings	Translocated/Resident
2016	1	1 Adult	1 Res
2017	0	0 Adult	0 Res
2018	1	1 Adult	1 Res
2019	4	4 Adults	2 Trans, 2 Res
2020	6	6 Yearlings	6 Res

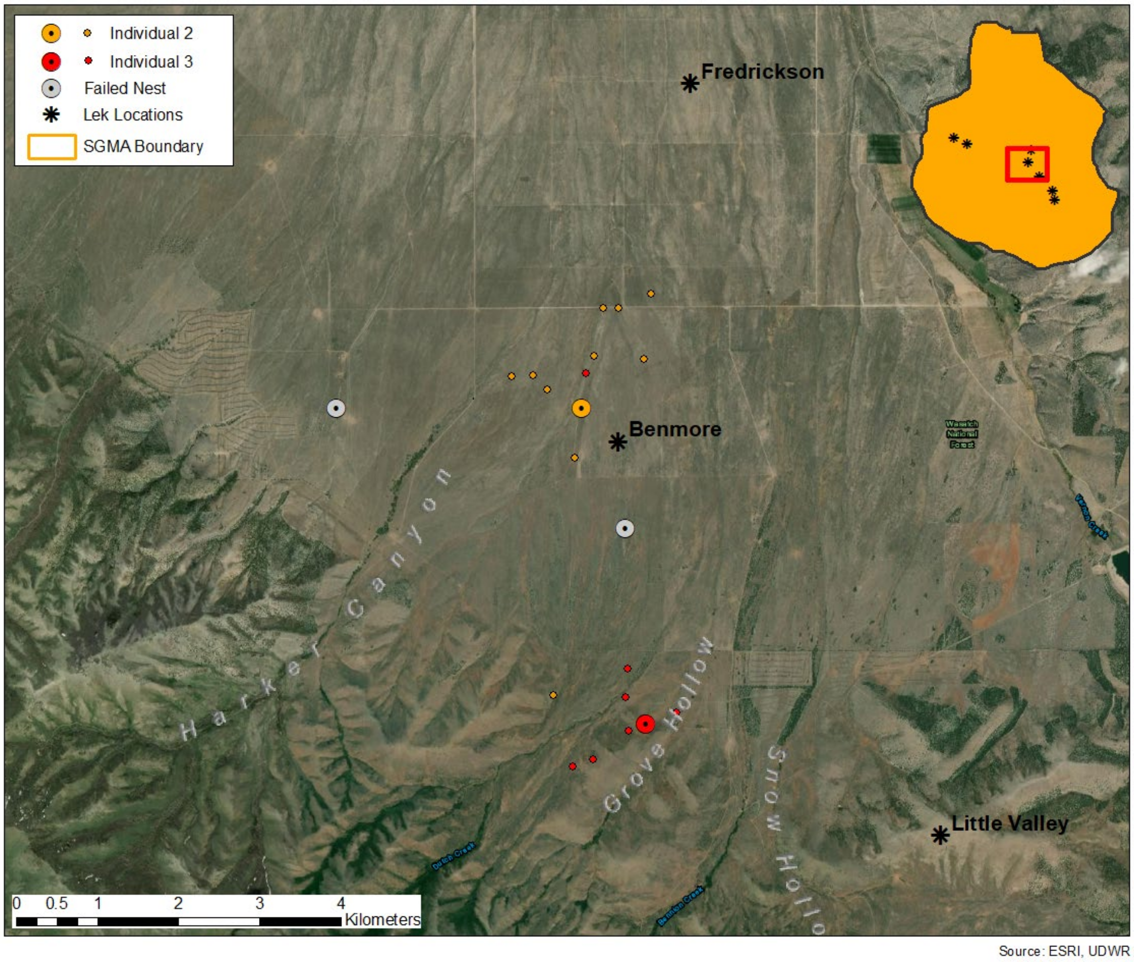


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Figure 16. Nesting and brooding locations for radio-marked greater sage-grouse (*Centrocercus urophasianus*) females located within the Benmore and Fredrickson lek areas, Sheeprock SGMA, Utah, 2021. Each nest and brood point of the same color correspond to the same female.

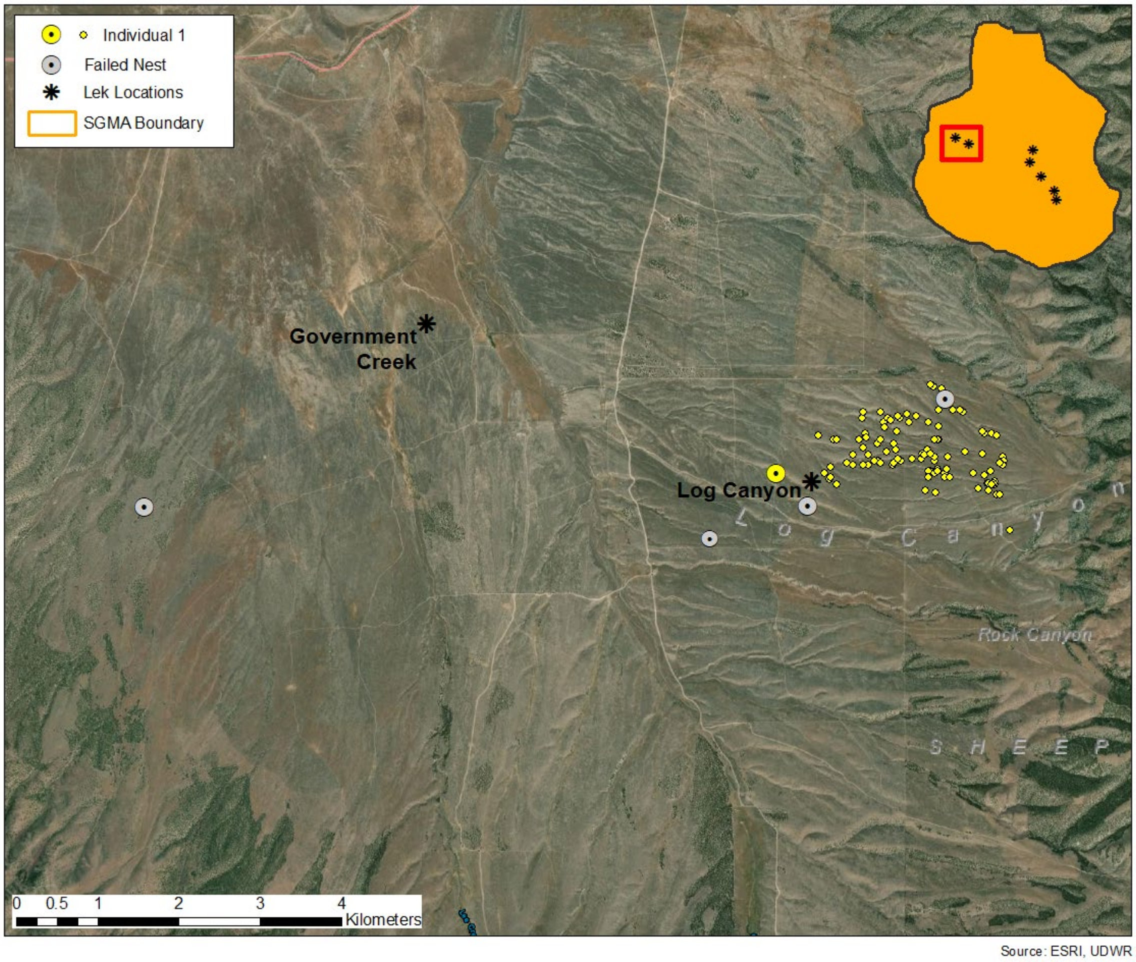


Figure 17. Nesting and brooding locations for radio-marked greater sage-grouse (*Centrocercus urophasianus*) females located within the Government Creek and Log Canyon lek areas, Sheeprock SGMA, Utah, 2021. Each nest and brood point of the same color correspond to the same female.

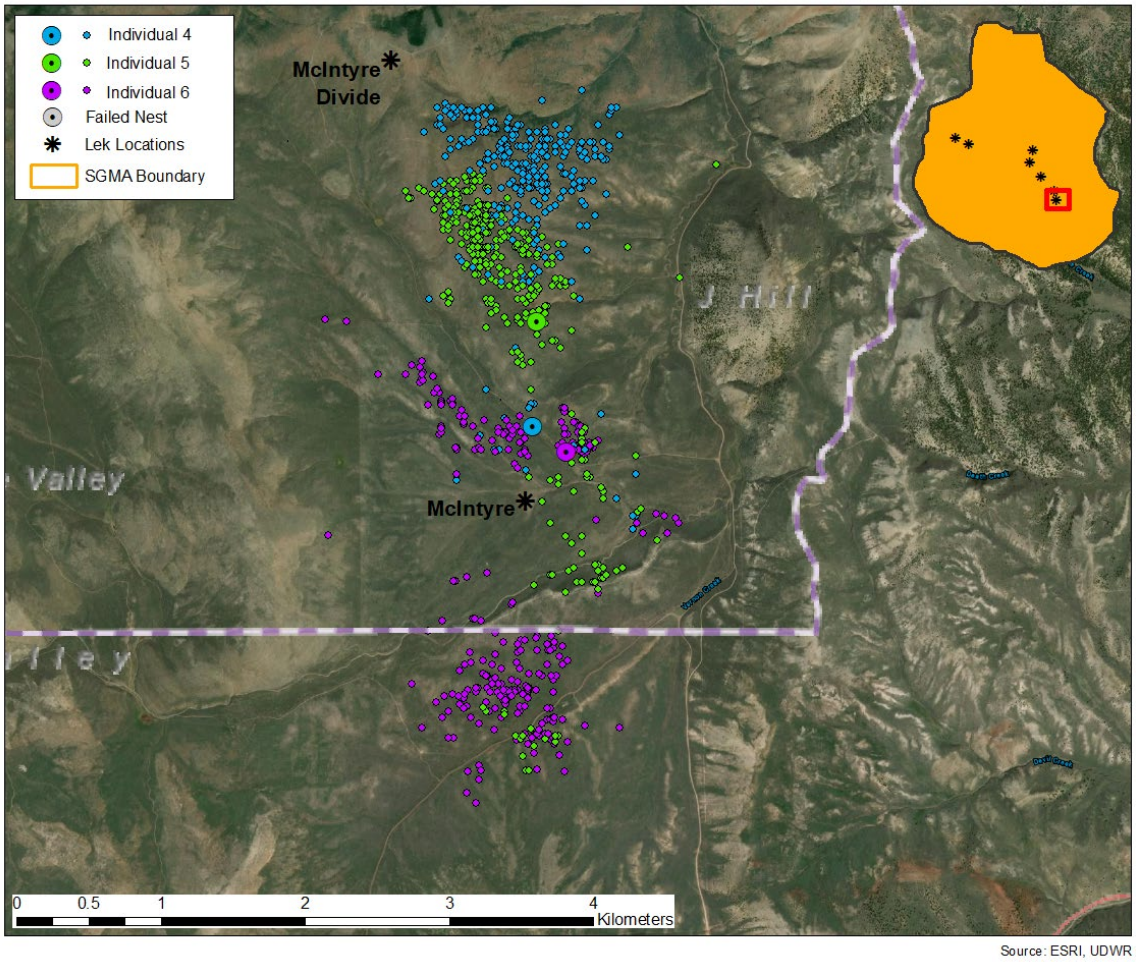
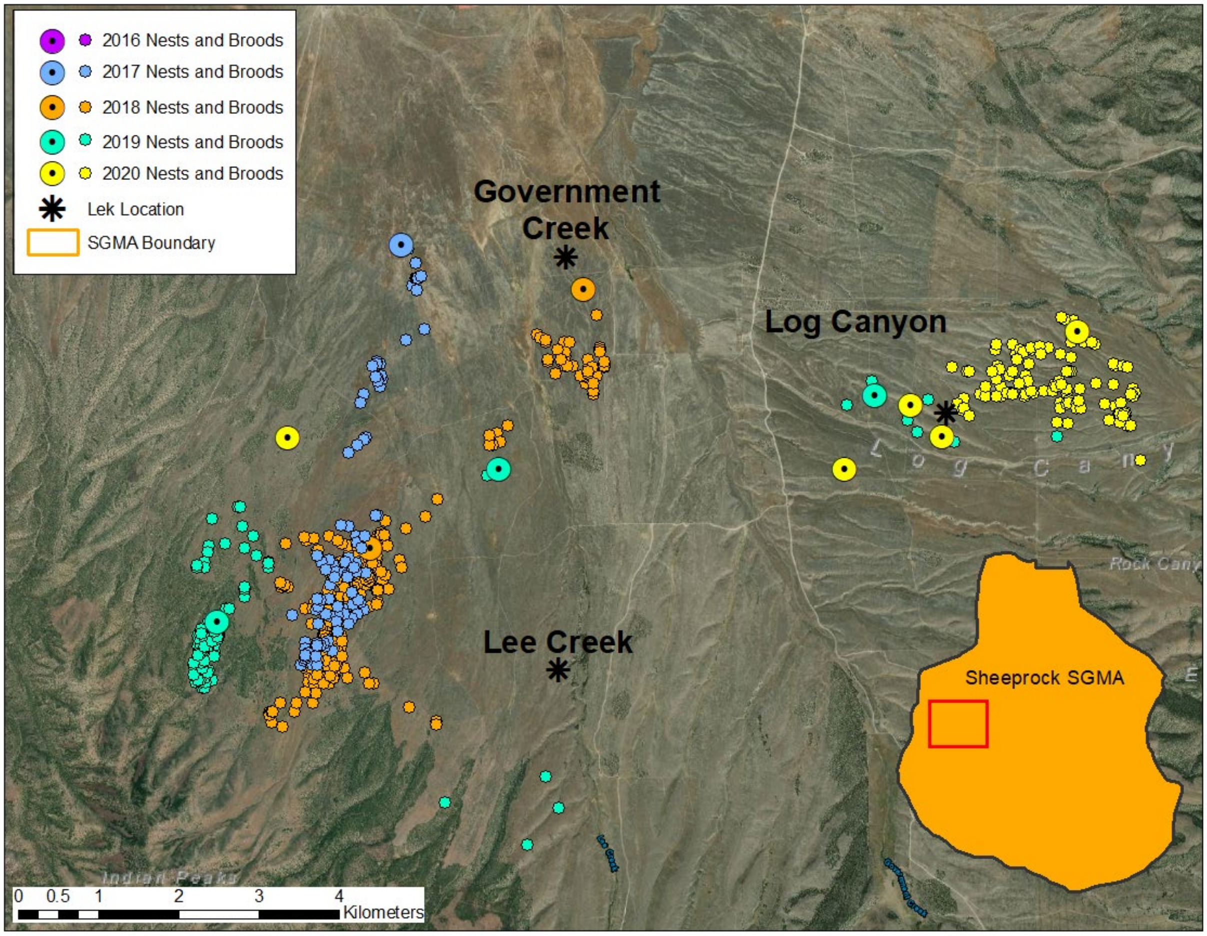


Figure 18. Nesting and brooding locations for radio-marked greater sage-grouse (*Centrocercus urophasianus*) females located within the McIntyre lek area, Sheeprock SGMA, Utah, 2021. Each nest and brood point of the same color correspond to the same female.

We have provided maps of all nest and brooding locations acquired from 2016-2020. These maps are included in figures 19-22 below.

2016-2020 Nest and Brood Locations in the Sheeprock Sage-Grouse Management Area: Government Creek



Source: ESRI, UDWR

Figure 19. <u>Nesting and brooding locations for marked females located within the Government lek area for 2016-2020, Sheeprock Sage-Grouse Management Area, Utah, 2021</u>. Each nest and brood point of the same color correspond to the same year of locations.

2016-2020 Nest and Brood Locations in the Sheeprock Sage-Grouse Management Area: Benmore

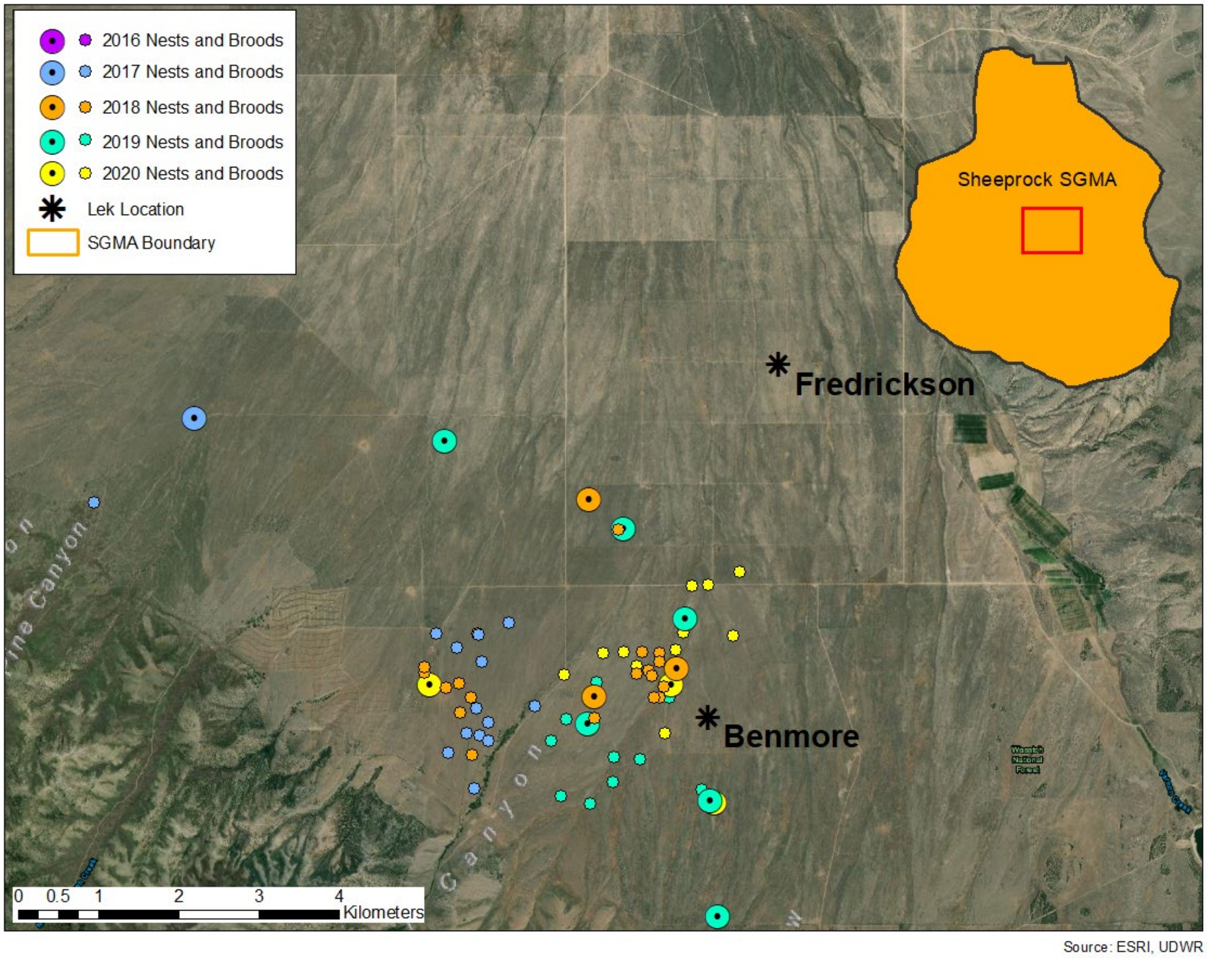


Figure 20. Nesting and brooding locations for marked females located within the Benmore, Fredrickson, and inactive Little Valley lek areas for 2016-2020, Sheeprock Sage-Grouse Management Area, Utah, 2021. Each nest and brood point of the same color correspond to the same year of locations.

2016-2020 Nest and Brood Locations in the Sheeprock Sage-Grouse Management Area: Little Valley

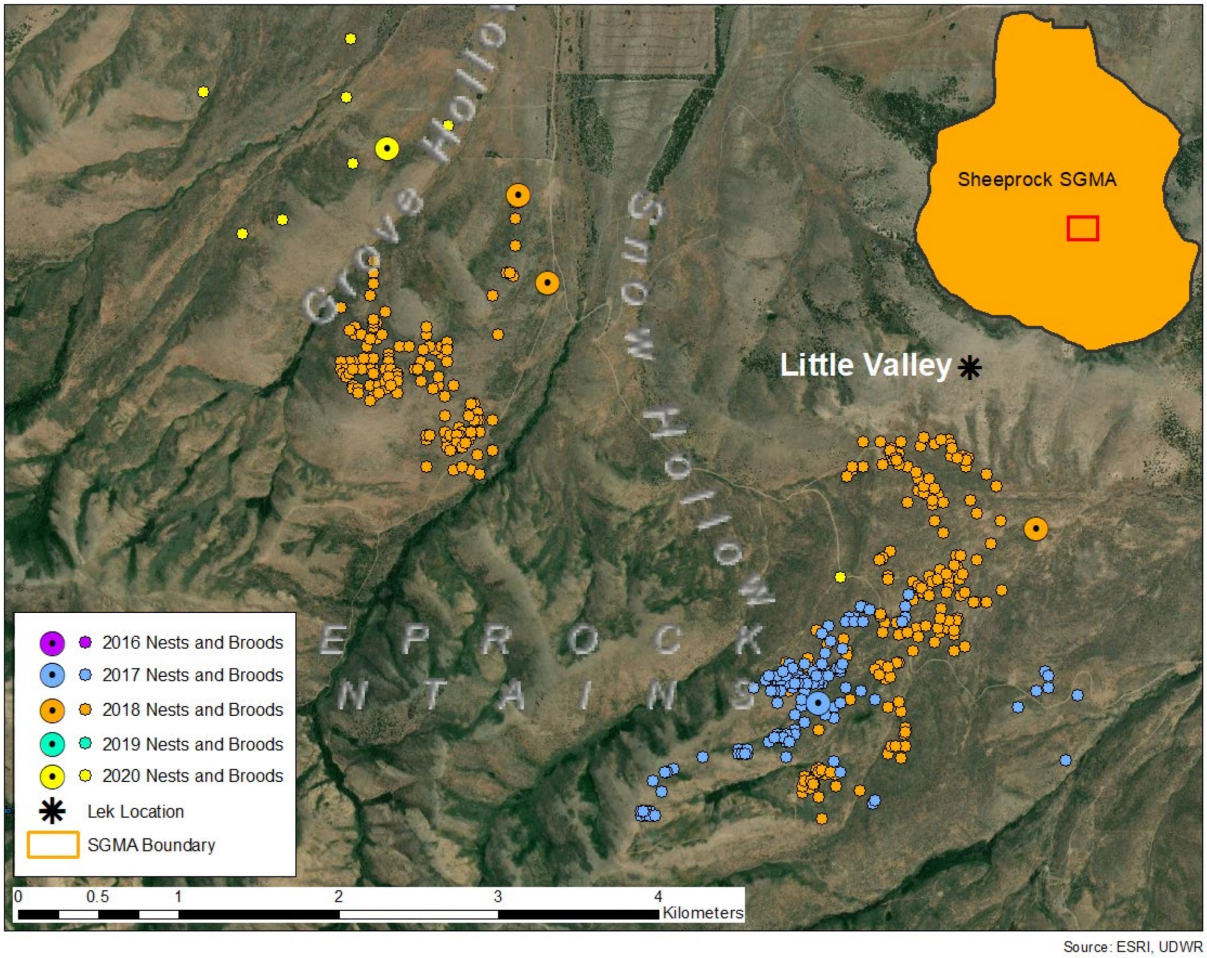


Figure 21. Nesting and brooding locations for marked females located within the Little Valley lek areas for 2016-2020, Sheeprock Sage-Grouse Management Area, Utah, 2021. Each nest and brood point of the same color correspond to the same year of locations.

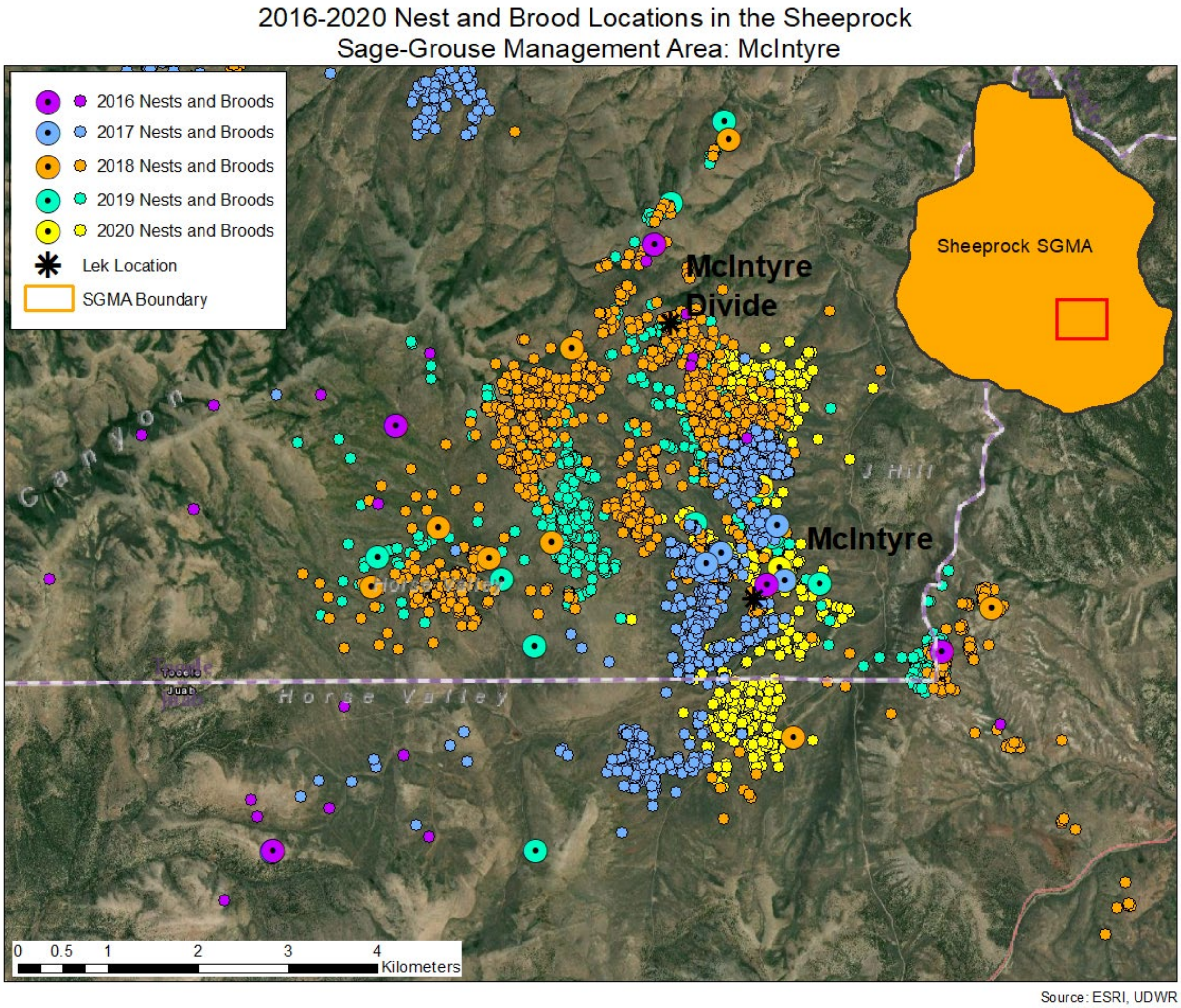


Figure 22. Nesting and brooding locations for marked females located within the McIntyre lek area for 2016-2020, Sheeprock Sage-Grouse Management Area, Utah, 2021. Each nest and brood point of the same color correspond to the same year of locations.

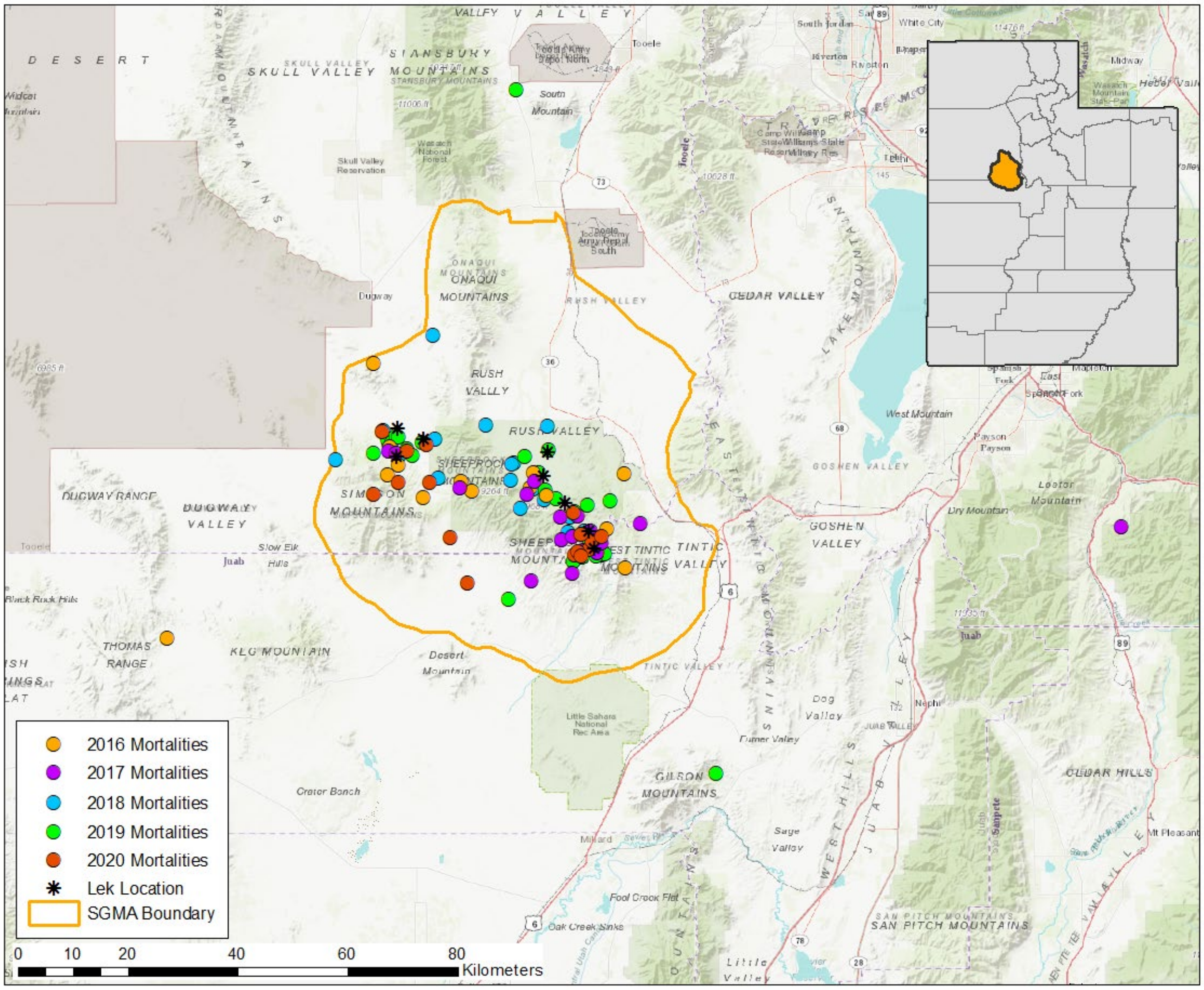
Survival

We confirmed 19 mortalities (57%) of the 33 monitored individuals in 2020 (Figure 2). During the field seasons (March-August) in 2016, 2017, 2018, and 2019, we documented 34.2%, 31.5%, 40.4%, and 45.5% (n= 35, 54, 47, and 68 respectively) apparent mortality rates respectively. We documented more mortalities in April 2020 than any other month. At twelve of the fatality sites, we could not determine the likely cause of predation due to scavenging. At 2 sites we suspected mammalian predation, and 1 site avian predation. We confirmed one mortality from a 2016-marked resident, one from a 2017 translocated female, and three mortalities from birds marked in 2018: 2 translocated females and 1 resident females. Eleven mortalities were confirmed from individuals marked in 2019: three from translocated females, 2 from resident females, and six from translocated males. In 2020-marked individuals, one resident female was confirmed as a mortality. (Table 2).

The 2016 female was our longest-living grouse during this study. In 2016, she was an adult, so at least the 2nd season, and lived until August 2020 and was 6+ years old. She nested each year and successfully raised 4/5 broods to 50-days post-hatch.

Table 4. Confirmed greater sage-grouse (*Centrocercus urophasianus*) mortalities during 2020 by sex, translocated or resident, and the year marked in the project, Sheeprock SGMA, Utah, 2021.

Year Marked	Mortalities in 2020	Male/Female	Translocated/Resident
2016	1	1 Female	1 Res
2017	1	1 Female	1 Trans
2018	3	3 Female	2 Trans, 1 Res
2019	11	5 Female, 6 Male	9 Trans, 2 Res
2020	3	3 Female	3 Res
Total Mortalities	19		



Source: ESRI, UDWR

Figure 23. <u>Locations of greater sage-grouse (*Centrocercus urophasianus*) mortalities, Sheeprock SGMA, Utah, 2021.</u>

Using a Cox Proportional Hazard model (Cox 1972), we have compared the monthly survival across years for all birds monitored from 2016 to 2020. Figure 24 illustrates the survival probabilities for 2016 through 2020.

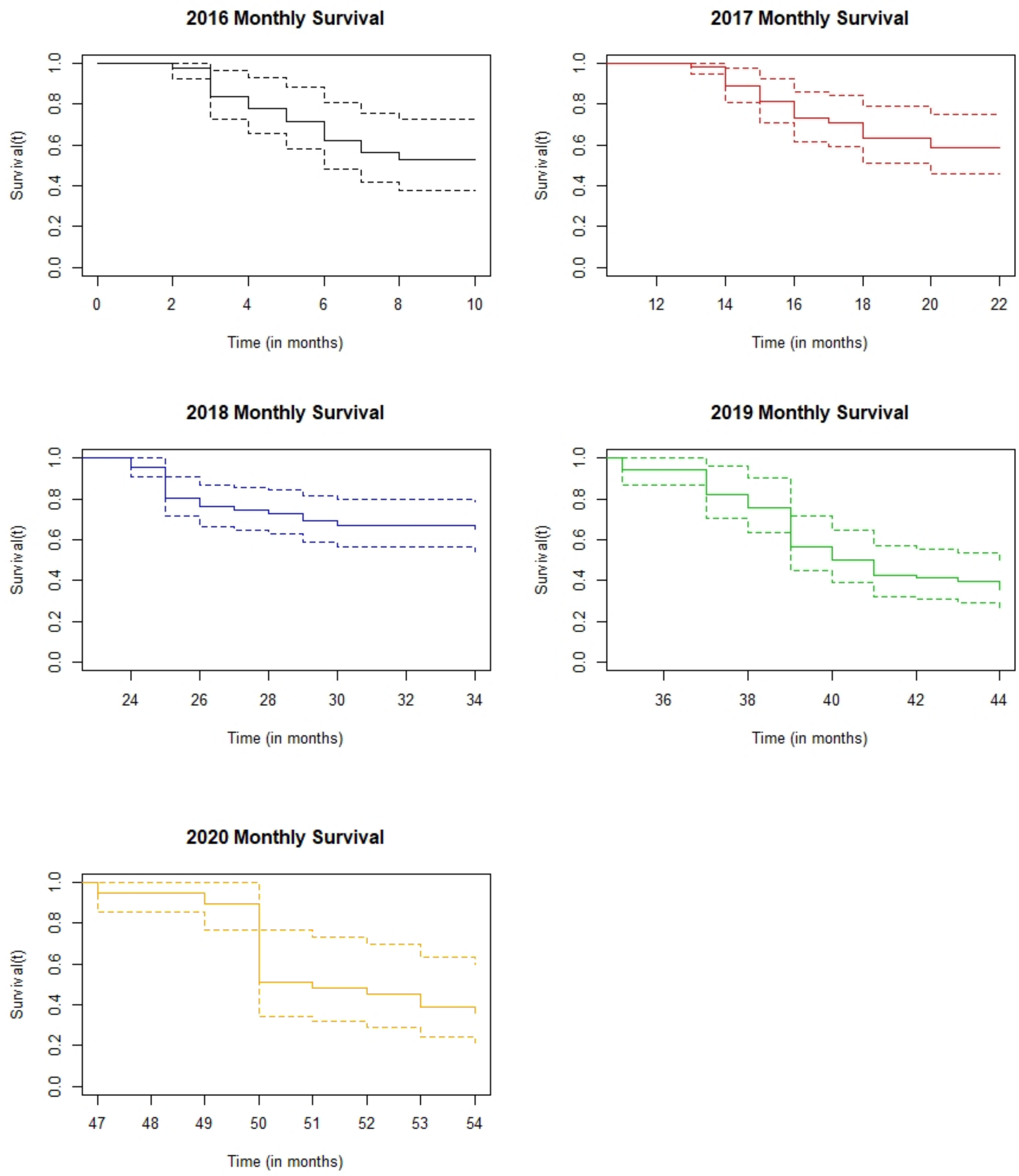


Figure 24. Cox Proportional Hazard model of monthly survival for greater sage-grouse (*Centrocercus urophasianus*) marked in 2016-2020 in the Sheeprock Sage-Grouse Management Area, Utah, 2021.

Predator Surveys

Predator occupancy across the study area is currently being worked on in analyses. This will be updated in the dissertation and presented at a local working group meeting.

2021 Work Plan

Work on dissertation analyses and writing with plans to defend during December 2021. As analyses are finished, final results will be shared with the local working group at the meetings. The local working group will be notified of the finished dissertation and journal publications as they are ready for publication in the respective journals. Plans for dissertation chapters are as follows:

- Movement chapter: analyzing movement behavior of GPS-marked translocated and resident sage-grouse from 2016-2020 and variables affecting that behavior.
- Population demographics chapter: integrated population model (IPM) assessing the Sheeprock population throughout the study (2016-2020) and projecting future population estimates
- Genetics chapter: analyzing genetic heterogeneity across the population in relation to the previous range-wide study where genetic samples were taken (Oyler-McCance et al. 2005) and if any improvement from 2016-2020 is detectable as a function of the translocations.

Acknowledgements

We thank the landowners who allow us access to their properties to capture and monitor birds. We also are extremely indebted to the dozens of volunteers who have helped with the translocation effort. We particularly thank Jason Robinson and Avery Cook, UDWR for coordinating the effort through the public review process and the logistics required to complete the translocation. We also thank the Utah Public Lands Policy Coordination Office, the BLM, the Yamaha Corporation, the West Box Elder CRM, the Parker Mountain and West Desert Adaptive Resources Management Local Working Groups, the Jack H. Berryman Institute, the Quinney Professorship for Wildlife Conflict Management, the UDWR, USU Ecology Center and the US Geological Service for funding, encouragement, and project support.

Literature Cited

Aldridge, C. L, S. E. Nielson, H. L. Beyer, M. S. Boyce, J. W. Connelly, S. T. Knick, and M. A. Shroeder. 2008. Range-wide patterns of greater sage-grouse persistence. Diversity and Distributions 14:983-994.

Baxter, R. J., J. T. Flinders, and D. L. Mitchell. 2008. Survival, movements, and reproduction of translocated greater sage-grouse in Strawberry Valley, Utah. Journal of Wildlife Management 72:179-186.

Bureau of Land Management (BLM). 2015. Utah Greater Sage-Grouse Proposed Land Use Plan Amendment B/ Final Environmental Impact Statement. Accessed December 3rd, 2016. http://www.blm.gov/ut/st/en/prog/planning/SG_RMP_rev/FEIS.html.

Bureau of Land Management (BLM). 2017. BLM Implements Measures to Restore and Maintain Habitat for the Sheeprocks Greater Sage-Grouse Population in Central Utah. Press Release. Accessed December 13, 2017. https://www.blm.gov/press-release/blm-implements-measures-restore-and-maintain-habitat-sheeprocks-greater-sage-grouse.

Chi, R. Y. 2004. Greater sage-grouse reproductive ecology and tebuthiuron manipulation of dense big sagebrush on Parker Mountain. Ph.D. Dissertation, Utah State University. Logan, UT.

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

Connelly, J. W., K. P. Reese, and M. A. Schroeder. 2003. Monitoring of greater sage-grouse habitats and populations. College of Natural Resources Experiment Station, Moscow, Idaho. Station Bulletin 80.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation Assessment for Greater Sage-grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming, USA.

Connelly, J. W., C. A. Hagen, M. A. Schroeder. 2011. Characteristics and dynamics of greater sage-grouse populations, in: S. T. Knick and J. W. Connelly (Eds.), Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats, Edition: Studies in Avian Biology (vol 38), University of California Press, Berkeley, CA. pp. 53-67.

Cox, D. R. 1972. Regression models and life tables (with discussion). Journal of the Royal Statistics Society, Series B 34:187–220.

Dahlgren, D. K., T. A. Messmer, E. T. Thacker, and M. R. Guttery. 2010. Evaluation of Brood Detection Techniques: Recommendations for Estimating Greater Sage-Grouse Productivity. Western North American Naturalist 70:233-237.

Dahlgren, D. K., T. A. Messmer, D. N. Koons. 2010. Achieving Better Estimates of Greater Sage-Grouse Chick Survival in Utah. Journal of Wildlife Management 74:1286-1294.

Dahlgren, D. K., T. A. Messmer, B. A. Crabb, R. T. Larsen, T. A. Black, S. N. Frey, E. T. Thacker, R. J. Baxter, and J. D. Robinson. 2016. Seasonal Movements of Greater Sage-Grouse

Populations in Utah: Implications for Species Conservation. Wildlife Society Bulletin 40:288-299.

Dahlgren, D. K., T. A. Messmer, B. A. Crabb, M. T. Kohl, S. N. Frey, E. T. Thacker, R. T. Larsen, and R. J. Baxter. 2019. Sage-grouse breeding and late brood-rearing habitat guidelines in Utah. Wildlife Society Bulletin 1-14; 2019; DOI: 10.1002/wsb.1029.

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

Dettenmaier, S. J. 2018. Effects of Livestock Grazing Management Practices on Greater Sage-Grouse Nest and Female Survival. Ph.D. Dissertation, Utah State University, Logan, UT.

Dulfon, N. E. 2016. Sagebrush Ecology of Parker Mountain, Utah. M.S. thesis, Utah State University, Logan, UT.

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. A. Schroeder. 2011. Greater Sage-Grouse population dynamics and probability of persistence, in: S. T. Knick and J. W. Connelly (Eds.), Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats, Edition: Studies in Avian Biology (vol 38), University of California Press, Berkeley, CA. pp.293-382.

Gibson, R. M. 1996. A re-evaluation of hotspot settlement in lekking Sage Grouse. Animal Behaviour 52:993-1005.

Gregg, M. A. 2006. Greater Sage-Grouse reproductive ecology: linkages among habitat resources, maternal nutrition, and chick survival. Ph.D. dissertation, Oregon State University, Corvallis, OR.

Herman-Brunson, K. M. 2007. Nesting and brood rearing success and habitat selection of Greater Sage-Grouse and associated survival of hens and broods at the edge of their historic distribution. M.S. thesis, South Dakota State University, Brookings, SD.

Kaczor, N. W. 2008. Nesting and brood-rearing success and resource selection of Greater Sage-Grouse in northwestern South Dakota. M.S. thesis, South Dakota State University, Brookings, SD.

Luginbuhl, J. M., J. M. Marzluff, J. E. Bradley, M. G. Raphael, and D. E. Varland. 2001. Corvid survey techniques and the relationship between corvid relative abundance and nest predation. Journal of Field Ornithology 72:556–572.

Miller, R. F., and L. L. Eddleman. 2000. Spatial and temporal change of sage grouse habitat in the sagebrush biome. Oregon State University Agricultural Experiment Station Technical Bulletin 151. Corvallis, Oregon, USA.

Miller, R. F, T. J. Svejcar, and J. A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management 53:574-585.

Norvell, R. E., F. P. Howe, J. R. Parrish, and F. R. Thompson III. 2003. A seven-year comparison of relative-abundance and distance-sampling methods. The Auk 120:1013–1028.

Oyler-McCance, S. J., S. E. Taylor, and T. W. Quinn. 2005. A multilocus population genetic survey of greater sage-grouse across their range. Molecular Ecology 14:1293-1310.

Rebholz, J. L. 2007. Influence of habitat characteristics on Greater Sage-Grouse reproductive success in the Montana Mountains, Nevada. M.S. thesis, Oregon State University, Corvallis, OR.

Reese, K. P. and J. W. Connelly. 1997. Translocations of sage grouse *Centrocercus urophasianus* in North America. Wildlife Biology 3:852-864.

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 23:295-297.

Robinson, J. D. 2007. Ecology of two geographically distinct greater sage-grouse populations inhabiting Utah’s West Desert. MS. thesis, Utah State University, Logan, Utah, USA.

Robinson, J. D. and T. A. Messmer. 2013. Vital rates and seasonal movements of two isolated greater sage-grouse populations in Utah's West Desert. Human Wildlife Interactions 7:182-194.

Schauster, E. R., E. M. Gese, and A. M. Kitchen. 2002. An evaluation of survey methods for monitoring swift fox abundance. The Wildlife Society Bulletin 30:464–477.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage Grouse (*Centrocercus urophasianus*), in A. Poole and F. Gill (editors). The birds of North America. No. 425. The Academy of Natural Sciences, Philadelphia, PA, and the American Ornithologists Union, Washington, D.C.

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. Garnder, M. A. Hilliand, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L Mitchel, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106: 363-376.

Smith, J. W., B. Muhlestein, M. Chelak, L. Belton and T. Messmer. 2018. Sheeprock Mountains Visitor Use Report. Institute of Outdoor Recreation and Tourism, Utah State University, Logan, Utah, USA.

Somershoe, S. G., D. J. Twedt, and B. Reid. 2006. Combining breeding bird survey and distance sampling to estimate density of migrant and breeding birds. The Condor 108:691–699.

U.S. Fish and Wildlife Service (USFWS). 2015. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List Greater Sage-Grouse (*Centrocercus urophasianus*) as an Endangered or Threatened Species; Proposed Rule. Web. Accessed January 24, 2016. https://www.gpo.gov/fdsys/pkg/FR-2015-10-02/pdf/2015-24292.pdf

Utah Department of Natural Resources. 2011. Utah's Watershed Restoration Initiative. Utah Department of Natural Resources, Salt Lake City, Utah, USA. Accessed December 15, 2017. https://wildlife.utah.gov/pdf/fact_sheets/watershed_restoration.pdf

Utah Public Lands Policy Coordination Office. 2019. Utah Conservation Plan for Greater Sage-grouse in Utah. Salt Lake City, Utah, USA.

West Deseret Adaptive Management Resources Working Group (WDARM). 2007. Accessed August 17, 2015. http://utahcbcp.org/files/uploads/westdesert/WDARMSAGRPlanFinal.pdf.

Western Regional Climate Center. 2016. Vernon, Utah (429133). Period of record:8/1/1953 to 6/10/2016, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ut9133. Accessed November 06, 2016.