

**GREATER SAGE-GROUSE RESPONSES TO PINYON - JUNIPER REMOVAL:  
MITIGATING RESISTANCE IN AN ANTHROPOGENIC ALTERED LANDSCAPE**

**2016 ANNUAL REPORT**

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## Introduction

Conifer woodlands are expanding from their historical distributions across Intermountain West Rangelands (Bradley and Fleishman, 2008, Knick et al. 2014). Crawford et al. (2004) estimated a 10-fold expansion in conifer woodlands, particularly juniper (*Juniperus* spp.) and pinyon-pine (*Pinus* spp.; conifers) in the past 130 years which has impacted 18.9 million hectares of sagebrush (*Artemisia* spp.) ecosystems inhabited by the greater sage-grouse (*Centrocercus urophasianus*). Stiver et al. (2006) estimated that 60,000-90,000 ha of sagebrush habitat across the range of sage-grouse is lost annually to conifer encroachment. Sage-grouse population declines have also been partially attributed to conifer expansion (Beck et al. 2003, Schroeder et al. 2004). Mitigating conifer expansion into occupied sage-grouse habitat in core conservation areas was identified as a potentially important species conservation strategy by the U.S. Fish and Wildlife Service (USFWS) in the Conservation Objectives Team Report (USFWS 2013).

The Natural Resources Conservation Service (NRCS), through its Sage-grouse Initiative ([www.sagegrouseinitiative.com](http://www.sagegrouseinitiative.com)), has provided cost-share to landowners to mechanically remove or reduce thousands of hectares of conifers on private lands in the western U.S. Similar projects have been implemented range wide on Bureau of Land Management (BLM) and U.S. Forest Service (USFS) administered lands. In Utah alone, conifers been removed from > 200,000 hectares of sagebrush landscapes since 2006 under the Utah Department of Natural Resources (UDNR) Watershed Restoration Initiative (WRI; UDNR 2014). Large-scale mechanical conifer reduction projects are relatively low cost on a per hectare basis, and may have potential for increasing usable habitat for sage-grouse and other sagebrush obligate species (Baruch-Mordo et al. 2013, Dahlgren et al. 2016, Cook et al. *in press*). This potential increase in suitable habitat could reduce the seasonal movements for certain sage-grouse populations due to more continuous useable habitat; distances for an individual bird or population often directly reflect the availability of suitable habitat (Dahlgren et al. 2016, Cook et al. *in press*).

For sage-grouse, there are many factors that influence reproductive success and survival; however, habitat is the only factor that has remained consistently manageable (Crawford et al. 2004). Furthermore, assessing the effectiveness and benefits of management actions on sage-grouse populations has been difficult due to sage-grouse having low fecundity rates, low densities and large home ranges when compared to other gallinaceous birds (Knick et al. 2014). The effect of anthropogenic modified landscapes on species movements, gene flow, and reproductions may be quantified by resistance models. Few studies have assessed the performance of resistance models in terms of spatial and thematic resolution as well as their focus on the ecology of a particular species, or more generally on the degree of human modification of the landscape (Shirk et al. 2015). This study will focus on determining the role mechanical conifer removal on sage-grouse habitat utilization and seasonal movement patterns in a landscape that exhibits a high level of anthropogenic disturbance (Gifford et al. 2014). This research will provide land managers with additional information regarding the role of mechanical

conifer treatments in mitigating the potential effects of anthropogenic disturbances on sage-grouse populations in the Box Elder Sage-grouse Management Area (SGMA) in northeastern Utah (Utah Governor's Office 2013).

## **Study Purpose**

Several gaps in knowledge still exist on how sage-grouse select for, utilize, move and migrate through conifer treatment areas and existing conifer habitat. In this report we provide preliminary results of on-going research that is being conducted to evaluate the effects of the scale and placement of mechanical conifer removal treatments on sage-grouse habitat utilization, seasonal movement patterns, and vital rates at the landscape scale in the Box Elder SGMA. This research is being conducted by Justin Small, a M.S. level graduate student working under the guidance of Dr. Terry A. Messmer (Principal Investigator). Completion of this research will provide land managers with new information regarding the scale and placement of mechanical treatments to mitigate the potential effects of anthropogenic disturbances on sage-grouse populations in conifer-encroached areas. Land managers will be able to identify and implement conifer removal and habitat improvement areas more accurately that are critical to one of Utah's largest sage-grouse populations conservation and sustainability, as well as other sagebrush obligates found in the area.

We are seeking to develop and validate models that evaluate the effects of conifer removal treatments on mitigating resistance to sage-grouse movements and habitat-use in an anthropogenic-altered landscape that is managed by multiple jurisdictions. We are also seeking to validate the effect of mechanical conifer treatments of sage-grouse population stability and growth. Ultimately, completion of this work will provide information regarding the type and amount of potential mitigation credits that could be accrued by a landowner or agency for mechanical conifer removal treatments to offset anthropogenic disturbances in SGMAs.

## **Objectives**

- What effects have the scale and placement of mechanical conifer removal treatments completed in the Box Elder SGMA had on sage-grouse vital rates and population trends?
- What effects have scale and placement of mechanical conifer removal treatments completed in the Box Elder SGMA has had on mitigating resistance to sage-grouse movements and habitat-use in an anthropogenic-altered landscape?
- What scale of mechanical conifer removal treatments is desired to mitigate resistance to sage-grouse movements and habitat-use in an anthropogenic-altered landscape?

## Study Area

The study area encompasses the Raft River subunit found in Box Elder County Adaptive Resource Management (BARM) Local Working Group (BARM 2002). The study area was based on the Box Elder Management Area outlined in the 2002 state plan, and is embedded in the Box Elder Sage-grouse Management Area defined in the Utah Plan (Utah Governor's Office 2013). The Raft River subunit is located in the northwestern portion of Utah (Figure 1).

Geographically, the core of the study area is flanked by the Raft River Range Mountains to the north, the Grouse Creek and Pilot Mountains to the west, by the Great Salt Lake to the southeast and areas of salt flats to the south (Cook et al. 2013). The study area is primarily located in the Northern Great Salt Lake Desert HUC 8 Watershed (HUC#16020308), and also exists in parts of the Curlew Valley HUC 8 Watershed (HUC#16020309) on the eastern edge. Approximately 440,750 ha are encompassed within the study area. Land ownership within the Raft River subunit is a mixture of public and private lands consisting of: Bureau of Land Management, U.S. Forest Service, Utah School and Institutional Trust Lands Administration and private (Cook et al. 2013; Sanford and Messmer 2015).

Vegetation structure and composition are correlational with changes in elevation gradients. Low elevations are made up of salt desert shrub, through multiple sagebrush (*Artemisia* spp.) communities, transitioning into juniper and mountain mahogany (*Cercocarpus ledifolius*) woodlands, and lastly to sub-alpine and alpine coniferous forest (*Picea* spp., *Pinus* spp., and *Pseudotsuga* spp.) at higher elevations.

Climatic data from Park Valley, Utah, from 1990 to 2015 shows annual precipitation of 11.52 inches (29.26 cm) in Park Valley (elevation 5,548 ft), with 5.6 inches (14.2 cm) falling as snow between November and April. Temperatures range from a monthly average high of 87° F (31° C) in July to a monthly average low of 15° F (-9.4° C) in December and January (Western Regional Climate Center, 2014). Snow can remain at high elevations over 8000 ft. (2438 m) into late summer but does not usually persist through spring at lower elevations. Greater levels of snowfall and colder temperatures exist at higher elevations.

## Methods

### *Sage-grouse radio-marking*

Beginning in early fall 2015, five female sage-grouse were captured and fitted with geographic positioning system (GPS) radio-marked transmitters. In the spring of 2016, ten more GPS transmitters were deployed on 8 female sage-grouse and 2 male sage-grouse. The GPS transmitters were distributed evenly across the study area to ensure that a total representation of the bird population is obtained. We also deployed 20 very high frequency (VHF) necklace-style

radio-collars on an additional female sage-grouse across the study area. The combination of GPS and VHF radio-transmitters will allow us to evaluate if the type of transmitter deployed may affect vital rates. Caudill et al. (2014) reported sage-grouse fitted with back-mounted radio-transmitters had lower survival rates than birds fitted with necklace-style radio-transmitters. Every sage-grouse is weighed, sexed, aged, evaluated for general health, and receives a numbered leg band. Every capture site was recorded (UTM, 12N, NAD 1983). Birds were fitted with a backpack style GPS transmitter (Microwave Telemetry, Inc. 22g PTT-100 Solar Argos GPS Transmitter). Birds were processed and released at their capture site.

### *GPS and VHF Radio Telemetry*

The GPS and VHF radio-marked birds were relocated a minimum of twice a week during nesting and brood rearing season. Nests were visually confirmed, and then monitored 2-3 times per week from the farthest distance that observer can confirm the female's location without risk of disturbance. After hatching, females with broods were located 2-3 times per week. Broods were flushed 50 days post-hatch to determine brood success and approximate brood size. The presence of a minimum of one chick per hen is classified as brood success. In fall and winter months, GPS collared birds are being located weekly via Movebank (Movebank Animal Tracking Data 2015) to estimate survival and habitat use. Research protocols were approved by the Utah State University Institutional Animal Care and Use Committee permit #2322. A UDWR Certificate of Registration has been obtained (2BAND8743).

A UTM location was also recorded every time we relocated a VHF radio-marked female. All locations were overlaid on a remotely sensed conifer cover map to determine thresholds of use based on conifer cover. The GPS and VHF data collected from radio-marked sage-grouse will be used to illustrate and determine the magnitude of sage-grouse utilization within available habitat types (Dahlgren et al. 2006).

### *Nesting Monitoring*

For VHF radio-collared female sage-grouse, nest initiation was determined when a female was observed in the same location for two consecutive visits during or following breeding season. For GPS marked females, nesting was determined when UTM coordinates were recorded in the same location over several consecutive days during or following breeding season. Once nesting was suspected, a UHF receiver and Yagi antenna was used to pick up the UHF radio frequency(s) emitted by the GPS transmitter(s) to confirm nesting. To mitigate nest abandonment, caution was taken not to disturb nesting females. Nest locations were marked using a handheld GPS unit and a discreet physical landmark to aid researchers in returning to the point of initial observation. All nesting females were observed twice weekly. Nests were discretely monitored from 5 to 30 m until the 50 day flush. A successful hatch was determined when egg halves were found intact in or near the nest bowl, and/or the inner membrane of the egg was separated from the shell (Wallestad and Pyrah 1974). Determination of a failed nest

was when no eggs or egg halves were found at the nest site, if egg halves were not intact, or if only egg fragments remained at or near the nest site.

### *Brooding Monitoring*

Once hatched, broods were monitored twice weekly until 50 days of age, or brood was determined to fail. Each brood was flushed at 50 days and the number of chicks was recorded to determine brood success (Schroeder 1997). Broods were re-flushed if any doubt of brood success occurred during initial flushing. Due to the big sagebrush (*A. tridentate* ssp.) and tall mixed mountain brush vegetation plant communities that broods were predominantly found in, all flush counts were conducted in daylight hours to reduce the risk of missing birds that otherwise may not be visible while using a spotlight count method.

### *Vegetation Surveys*

Vegetation surveys were conducted at all nest sites, every other brood site, and one random site for every other measured brood site. These vegetation surveys provided information about cover and forage plant preferences in utilized areas. Each survey consists of four transects placed in cardinal directions from the used site; transects are 15m and 10m at nest and brood sites, respectively. The Daubenmire frame technique was used to measure and evaluate the height and species composition of grasses and forbs according to recommendations by Connelly et al. (2000). Five frames were placed on each nest survey transect at 3 m intervals, and four frames were placed at 2.5 m intervals on all other surveys. The Robel pole method was used to measure the visual obstructions that could be encountered at nest sites, brood sites and random sites (Robel et al. 1970). Vegetation data will be compared at the end of this study in order to evaluate and determine the differences in vegetation structure and composition that exist between preferred and random sites.

## **Preliminary Results**

### *Data analysis*

Due to this study involving how sage-grouse select, move through, and utilize habitat at the population level, we will use a resource selection function and resistance models for analysis (Gillies et al. 2006). Using a resource selection function, we will assess and determine whether sage-grouse are utilizing one habitat type (sagebrush, phase I, II, III juniper invaded areas, or type of juniper removal areas) over another and then investigate whether these behaviors are resulting in different survival rates and seasonal movement patterns (Sandford et al. 2016). The location data obtained from GPS/VHF radio marked female sage-grouse will also be used to conduct a landscape scale analysis and logistic regression. This analysis will evaluate a range of resistance models in terms of their ability to illustrate and predict empirical patterns of lek

occupancy and individual sage-grouse habitat used based on type, scale, age and location of mechanical conifer removal treatments (Shirk et al. 2015). Other univariate and multivariate statistics could be used throughout the duration of the study period as well. This analysis will be completed at the end of the second field season. For this annual report, we have provided only descriptive statistics.

### *Vital Rates*

For the 2016 field season, 19 of the 29 females monitored (6 GPS and 13VHF birds) initiated nests (66%). Ten females out of 19 females hatched successfully (52%). Six nests were predated across the study area. The predator type could not be determined, but my suspicion is ravens played a part in 3 and a mammalian predator in 1. In all 6 cases, none of the females were killed. Two of the six females nest that were predated re-initiated nests.

Of the 10 females with broods (5 GPS and 5 VHF females), 5 were successful at the 50 day flush (2 GPS and 3 VHF), for an overall brood success of 50%. Of the 2 VHF females that re-initiated nests, the Dry Basin female was successful at the 50 day flush. Observation and documentation of this re-nesting behavior was important due to nest re-initiations being uncommon throughout the West Box Elder SGMA.

### *Mortalities*

For the 2016 field season, 4 GPS and 4 VHF females were killed (23% of the radio-marked birds), with GPS transmitters recovered in all cases and VHF radio-collars recovered in 3 out of 4 cases. Of the observed mortalities, 3 females showed avian predation signs and 1 showed mammalian predation signs. Predation causes remain unknown for the other 4. Currently, we have 3 mortality retrieved GPS transmitters that will be redeployed in the winter of 2016-2017.

### *Survival Estimates*

We are currently completing data quality checks on location and vegetation data and importing into our database for analysis purposes. To date, summary statistics and analysis of preferred habitat are not available. However, our study population shows similar preferences as reported for other populations in the literature. The radio-marked females are selecting for taller stands of sagebrush for nesting cover and mesic areas imbedded in contiguous sagebrush habitat for late brood rearing and summer habitats.

## **Sage-grouse Movements**

Throughout July and early August, our radio-marked females were widely dispersed over the landscape, with brooding females moving into wet meadow areas and higher/cooler summer pastures. By the end of July, all brooding females were in close proximity to water sources. To provide some examples of the types of seasonal movements observed we offer the following: During July, a VHF female that was

brooding on top of the Black Hills ended up moving over to Lynn Valley just south of the Reservoir; this area was significantly wetter towards the end of the summer than her initial brooding sites. A GPS female that hatched south of the Pipeline moved her brood around 23 km in a 4-5 day period to the wet meadows and pastures south of Park Valley. The week she moved her chicks north was one of the warmest in the summer and thanks to the GPS transmitter we could visualize path she used to move her brood to their summer site. Unfortunately, she was not successful.

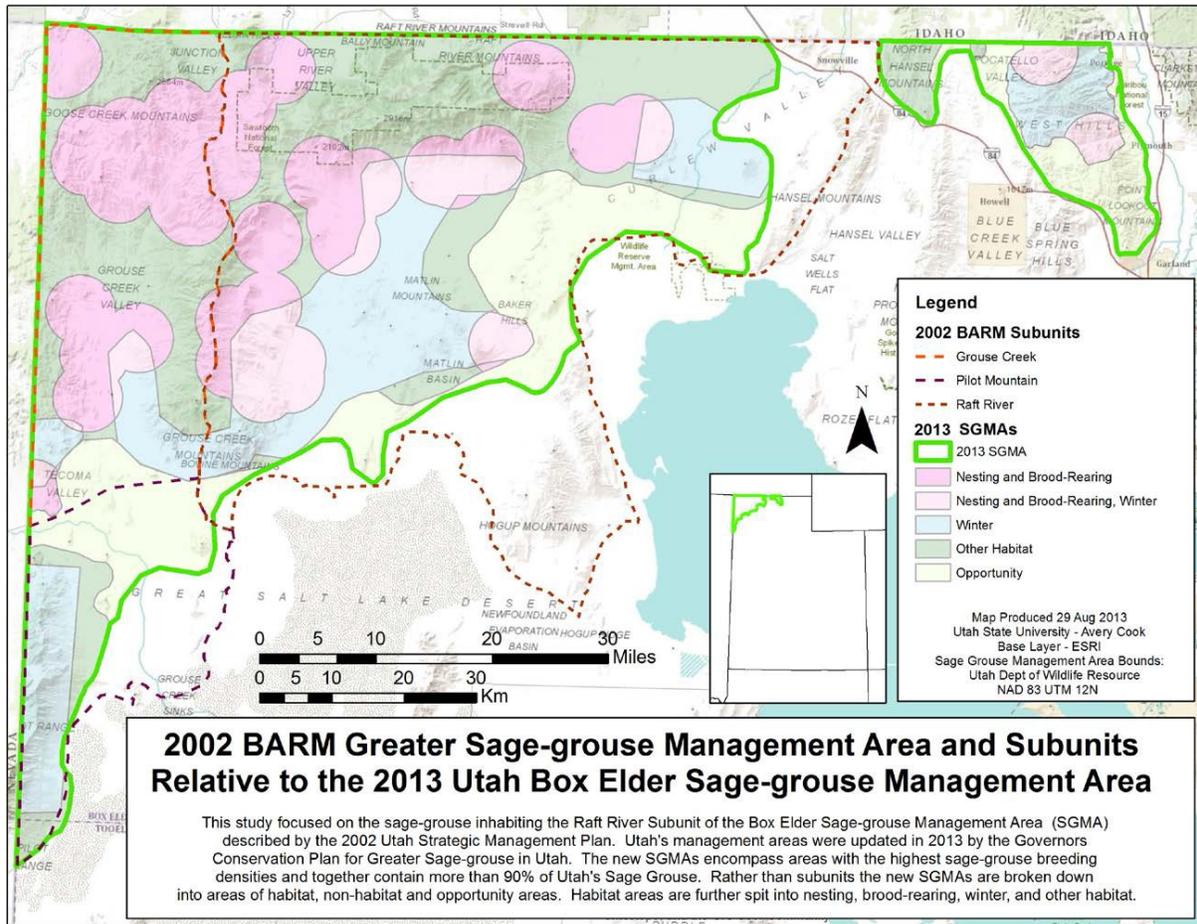
All radio-marked females were located. One of the VHF females that were missing all season was detected on June 2<sup>nd</sup> in a remote basin on top of the Grouse Creek. We determined that she was indeed brooding, but she was killed in late July.

### **Plan of Work**

To date, the 2016 breeding season has been completed. However, we are remotely monitoring GPS marked birds through Movebank interactive online mapping and location website (Movebank Animal Tracking Data 2015). This allows us to continue monitoring survival rates, seasonal movement patterns and overall population viability. For the remainder of the fall and winter of 2016, we will continue trapping to redeploy any mortality recovered GPS transmitters and to augment the current GPS and VHF radio-marked birds with 15 additional new GPS transmitters and 15-20 VHF refurbished necklace collars. Beginning in February of 2017, we will also begin trapping efforts in 2 new areas: Grouse Creek and East Kelton. The protocols previously used will be followed during all capture attempts. All data collected during the 2016-2017 field seasons will be analyzed and included in a final report and also defended in a M.S. thesis. Additional data may be included from past studies where it is applicable.

### **Acknowledgements**

This project was made possible by the support of landowners throughout the study area in addition to the cooperators identified in the title page.



**Figure 1.** Greater sage-grouse (*Centrocercus urophasianus*) Management Area and Subunits, Utah Box Elder Sage-grouse Management Area.

**Table 1.** Greater sage-grouse (*Centrocercus urophasianus*) survival rate estimate: Raft River Subunit, West Box Elder County, Utah 2016.

	<b>Sage-Grouse Radio Marked</b>	<b>Total Mortalities</b>	<b>Percent Mortality</b>
<b>Adult Male</b>	2	0	0
<b>Adult Female</b>	23	4	19
<b>Yearling Male</b>	2	0	50
<b>Yearling Female</b>	6	4	50
<b>Total</b>	33	8	39.6

**Table 2.** Overall nest and brood success estimates for greater sage-grouse (*Centrocercus urophasianus*), Raft River Subunit, West Box Elder County, Utah. 2016.

		Marked Females	Accessible Marked Females	Females Nested	Re-nest Attempts	Mean Clutch Size	Nests Hatched	Successful Broods	Mean Brood Size
2016	Adult	23	23	17 (74%)	1	4.85	9 (53%)	4 (44%)	1.25
	Yearling	6	6	2 (33%)	1	4.0	1 (50%)	1 (50%)	2
	Total	29	4	19 (66%)	2	4.43	10 (53%)	5 (50%)	1.54

**Table 3.** Nest and brood success estimates for greater sage-grouse (*Centrocercus urophasianus*) for global positioning system (GPS) transmitters and very high frequency (VHF) radio-collars, Raft River Subunit, West Box Elder County, Utah. 2016

2016						
Sex	Radio Type	# Marked	Mortalities	Nests Initiated	First Initiation	Last Initiation
Male	VHF	3				
Female	VHF	19	4	13	4/6/2016	6/2/2016
Female	GPS	14	4	6		
Sex	Radio Type	Nests Hatched	First Hatch	Last Hatch	Successful Broods	Failed Broods
Female	VHF	6	5/2/2016	6/13/2016	3	2
Female	GPS	4			2	3

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