Greater Sage-grouse Responses to Livestock Grazing in Semi-Arid Sagebrush Rangelands

2019 Annual Report

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Introduction

The distribution and abundance of the greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) have declined in the last 60 years (Connelly et al. 2004). Range contractions and population declines have been attributed to anthropogenically-driven loss and fragmentation of their sagebrush (*Artemisia* spp.) habitats (Knick et al. 2003, Connelly et al. 2004, Schroeder et al. 2004, Garton et al. 2011). Grazing by domestic livestock remains the predominant anthropogenic land-use across the sagebrush ecosystem in North America, occurring on 87% of remaining sage-grouse habitat (Crawford et al. 2004, Knick and Connelly 2011, Dettenmaier et al. 2017). However, little research has been conducted to evaluate sage-grouse response to this particular land-use.

To open up mature, dense stands of sagebrush to promote forb and grass production in high elevation rangelands, Deseret Land and Livestock (DLL) combined sagebrush treatments with a high-intensity, low-frequency (HILF) rest and deferred-rotation grazing system (Dahlgren et al. 2015b). Preliminary data suggest that the increase in forbs and grasses following range treatments provided greater forage for livestock, but may have also improved sage-grouse brooding habitat (Danvir et al. 2005). In southcentral Utah, Dahlgren (2009) reported that forb cover could be increased by late season grazing resulting in increased use by sage-grouse. Thus, what remains to be determined, is whether the intensity and duration of grazing has facilitative or competitive relationships with sage-grouse (Monroe et al. 2017), especially during the critical brood-rearing life phase.

A comparison study site to the north of DLL, known as the Three Creek allotment (3C), has been following a traditional season-long grazing system where livestock continuously graze the landscape with no pasture rotations. Research has found that sage-grouse nest success is better on DLL than 3C. In addition to this, we want to know if brood-rearing habitat use patterns and vital rates differ under prescribed rotational and season-long grazing practices. The seasonal flush of nutrient rich vegetation that tracks the temperature-moisture optimum through time has become known as the "green wave" (van der Graaf et al. 2006, van Wijk et al. 2011). Dahlgren et al. (2016b) reported that sage-grouse broods tracked the elevational wave of succulent vegetation to minimize variation in forage quality through the brood-rearing season. We want to test the hypothesis that the green wave could be facilitated, enhanced, or prolonged by managing livestock grazing. This hypothesis will be validated if radio-marked sage-grouse that select pastures where livestock have removed standing residual vegetation creating a "green wave" on DLL, are more successful than those that nest on 3C.

Both sage-grouse and cattle consume grasses and forbs during spring (Dahlgren et al. 2015a), but the question remains as to how grazing affects sage-grouse vital rates and habitat selection. Our working hypothesis is that the effects are contingent on the prevailing grazing regime. Evaluation of this hypothesis depends on the ability to monitor phenological phases of herbaceous vegetation across large extents. Here, we propose to measure plant phenology at the scale of the pasture using the Normalized Difference Vegetation Index (NDVI; Tucker 1979). NDVI is a satellite-derived index of photosynthetic biomass, typically scaled from 0-1. It has been used to map plant phenology across climatic regimes (Stoner et al. 2016), track avian migration (van der Graaf et al. 2006), and to index forage quality for ungulates (Ryan et al. 2012, Garroutte et al. 2016). We will use these data to study differences in green-up rates on each study area relative to

grazing management and annual climatic conditions. Changes in the study area NDVI will be correlated with livestock stocking rates, frequency of use, rest periods, temperature, precipitation, sage-grouse nest initiation rates, nest hatch dates, brood movements, and brood success rates. We will then evaluate the relationship between observed differences in NDVI on each study area and sage-grouse vital rates and daily/seasonal movements.

Study Purpose

The purpose of this study is to evaluate the response of sage-grouse to livestock grazing. We will model sagebrush treatment areas on DLL to determine resource selection patterns of sage-grouse broods. While research previously reported in peer-reviewed literature has reported the potential for negative impacts of sagebrush reduction treatments, to increase livestock forage, on sage-grouse habitat (Beck and Mitchell 2000), few studies have linked livestock grazing at the landscape level to vital rates for ground-nesting tetraonids such as the sage-grouse (Dettenmaier et al. 2017). If we can parameterize sage-grouse vital rates under different grazing and treatment scenarios, this may have implications for grazing policy west-wide. Completion of this project will provide definitive information regarding sage-grouse vital rates and habitat selection with respect to the presence of cattle and the effects of livestock grazing on vegetation composition and structure. This research will also provide managers with areas most suitable for sagebrush treatments that will have positive impacts on both cattle grazing and sage-grouse.

Research Questions

1) Do sage-grouse brood-rearing habitat-use patterns and vital rates differ under prescribed rotational (DLL) and season-long grazing practices (3C)?
2) Can any of the observed differences be explained by avoidance behavior or differences in vegetation composition and structure, and the green wave that are the result of livestock grazing?
3) Can the green wave be facilitated, enhanced, or prolonged by managing livestock grazing?

Study Area

The study area is located in Rich County, Utah, in the western United States. Rich County is located in northeastern Utah and constitutes the southwestern portion of the Wyoming Basin Sage-grouse Management Zone II. The research will be conducted on 2 study sites within Rich County. The first study site is Deseret Land and Livestock (DLL), a 200,000 acre privately owned ranch comprised of roughly 160,000 acres of private lands and 40,000 acres federal BLM grazing allotments located in the lower elevations. The DLL study area is managed as a cohesive unit and land managers there have used rotational prescribed grazing practices since 1979. The DLL constitutes a landscape allotment. The second study area known as the Three Creek Allotment (3C) is a 146,000 acre collection of 29 individual BLM and USFS grazing allotments and private lands that are generally managed under season-long grazing practices.

Methods

Trapping and radio-marking of sage-grouse began April 17 and ran through April 27th. The trapping season was truncated by unseasonably cold weather and prolonged snow cover. We captured and radio-marked 14 female sage-grouse on 3C (5 GPS, 9 VHF) and 27 female sage-grouse on DLL (4 GPS, 23 VHF). We trapped and radio-marked 41 sage-grouse in 2019. Trapping ended abruptly on the 27th as the leks were empty of almost all birds, where attendance had been high just days before. We believe with the late snow pack that breeding was delayed and we were fortunate to catch peak lek attendance before dispersal and nesting started. With all combined birds from 2018-2019 we radio-marked 52 (34 on DLL, 18 on 3C) females between the two study areas.

All trapping was done at night in minimal light conditions using spot lights, dip nets and traveling around leks by use of all-terrain vehicles. The spot light is used to first detect female sage-grouse and then capture them following procedures described by Connely et al. (2003). All captured females were fitted with either a 22g very-high frequency (VHF) necklace collar or a 22g PTT rump-mounted global positioning systems (GPS) transmitter.

Before each bird was released, location of capture (using a handheld GPS unit), age (adult/ juvenile), and weight was recorded, as well as any additional comments regarding behavior or health of the bird. Birds were released as quickly as possible after processing in the same area of capture, in attempts to reduce capture myopathy.

Radio-Telemetry

Marked sage-grouse were located through the use of their attached VHF radio collar 1-3 times per week until confirmed nesting. After confirmation, monitoring was reduced to twice per week until the week of the projected hatch day (28 days after nesting) when nests were monitored every other day to determine exact hatch date. If the nest was abandoned or predated at any time the marked female was immediately located to determine fate and then monitoring was reduced to once a week due to Cooks (2015) study documenting the low probability of re-nesting. After successful hatching the UTMs (Universal Transverse Mercator) of the exact nest was recorded using a handheld GPS.

Each PTT unit is also equipped with a VHF radio transmitter for immediate on the ground location. PTT marked grouse were manually located twice per week until confirmed nesting and then once per week until projected hatch day. Three to six locations are recorded every 24 hours and uploaded to Argos (http://www.argos-system.org/) every three days from each individual PTT unit. If the nest is abandoned or predated, the female was located to determine fate and additional monitoring concluded. If either VHF or PTT-marked females fail to nest at the beginning of the nesting season, monitoring was immediately be reduced to once per week.

Vegetation Surveys

Vegetation cover and structure was recorded at every nest site whether failed or successful as well as at one brood location per week until the brood reaches 50 days of age. Additionally, a random nest and brood vegetation site was paired with each actual site measured. The

Daubenmire quadrat method was used to measure forb species and abundance, and point line intercept was used to measure shrub species, height, and length. Four 15 meter transects were conducted in each of the cardinal directions at each site.

Preliminary Results

Radio-marked sage-grouse began nesting May 1st with the last nest-initiated May 25th (Figure 1). All nests were hatch or predated by June 16th. One marked sage-grouse traveled from a lek on DLL where she was collared ~40 miles north through the 3C study site and began nesting (Figure 2). Her nest was predated nine days later. She continued to move around that area for the rest of the season. For every predated nest great effort is made to determine which predator was responsible, though it is often difficult and inconclusive.

There were eight females that left either study area and each nested. These nest areas are shown in Figure 1, excluding 1 female that has nested in Idaho for the past two years. Four were successful nesting of which two were successful in brooding.

From the marked birds followed at the time (excluding birds that were missing) nest initiation and hatching rates were higher on 3C then DLL, but brood success rates were higher on DLL then 3C (Table 1). Mortality rates were also higher on DLL then 3C (Table 2).

2020 Plan of Work

Currently collared sage-grouse will be monitored periodically through the winter months by use of planes equipped with telemetry capabilities, any additional on the ground monitoring is difficult in the winter months due to snow. Beginning early spring 2020 we will again proceed to trap and collar female sage-grouse. Our objective numbers are 15 GPS and 25 VHF collars on each site. Vital rates will be monitored by following collared females through the breeding, nesting and brood rearing seasons. This data will be combined with previous years data and used to determine vital rates between the two sites as well as evaluate the relationship between brood survival and cattle grazing practices.

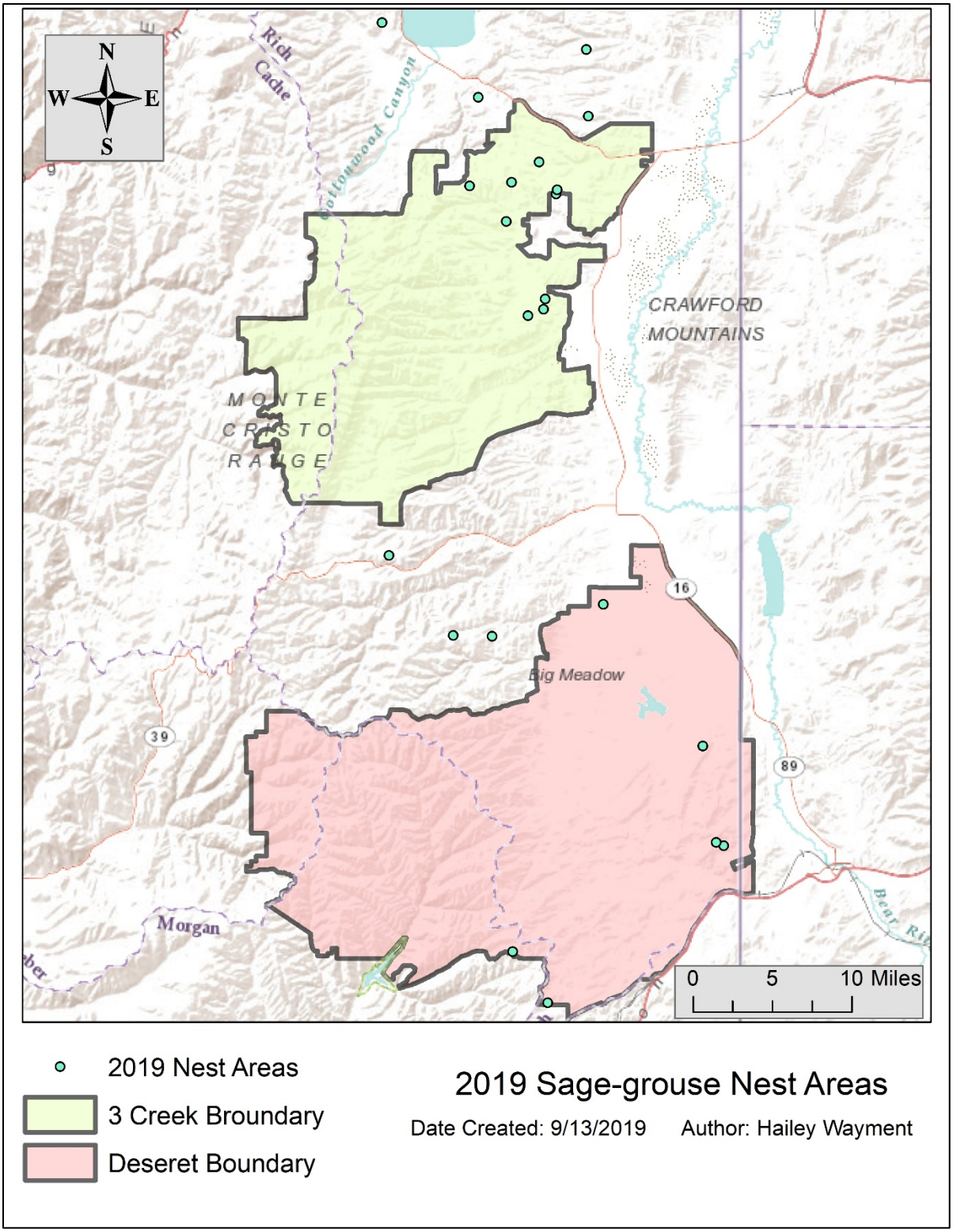

Figure 1. Radio-marked female greater sage-grouse (*Centrocercus urophasianus*) began nesting May 1st with the last nest initiated May 25th. Nest sites are shown in green. We located 6 nests of sage-grouse that nested on Deseret Lands and Livestock (DLL), 9 on Three Creeks (3C), and 7 nested outside either boundary

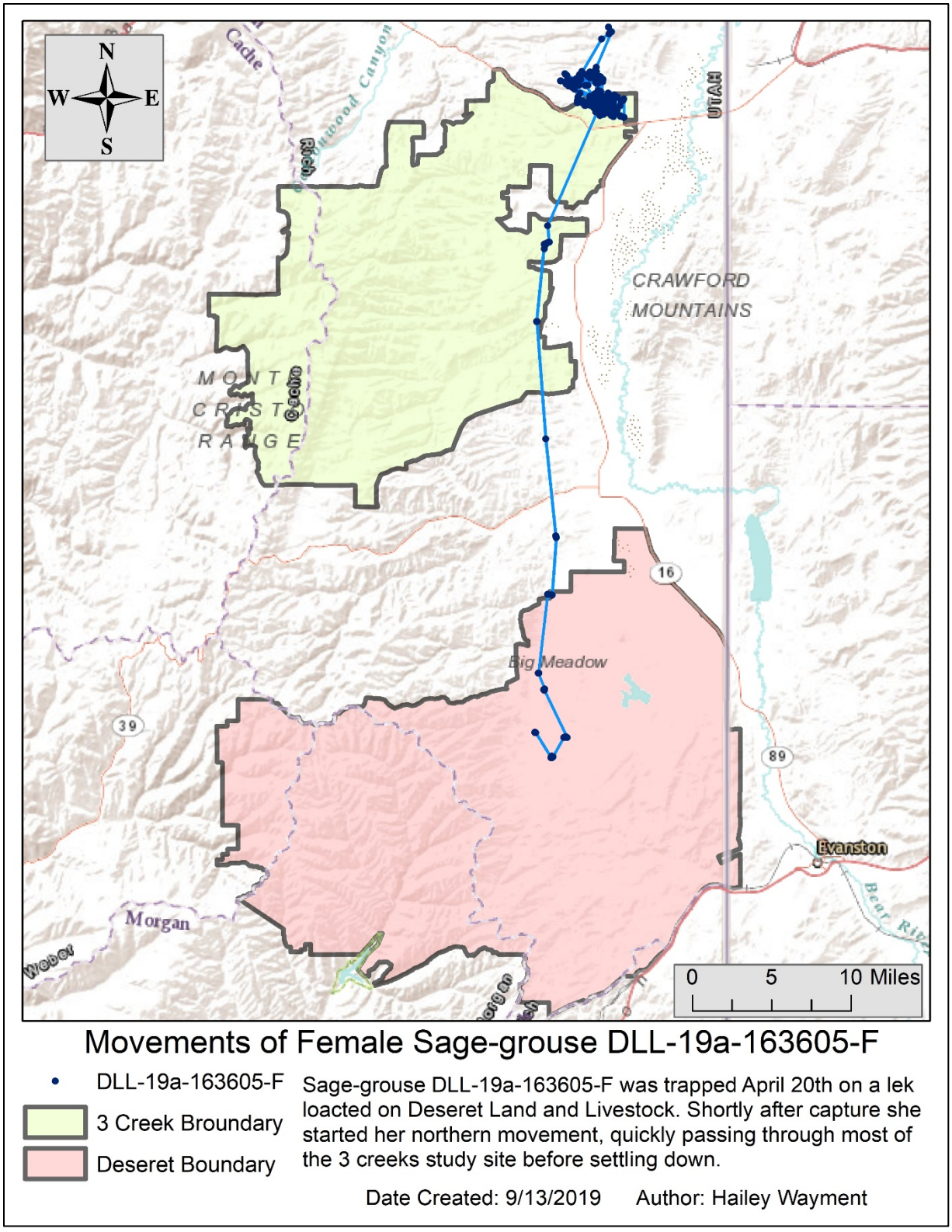

Figure 2. Movements of a female greater sage-grouse (*Centrocercus urophasianus*) on Deseret Land and Livestock (DLL) from April 20, 2019 to August 20, 2019. DLL-19a-163605-F traveled from a lek on DLL where she was collared ~40 miles north through the Three Creeks (3C) study area

Table 1. Estimated nesting and brooding rates for greater sage-grouse (*Centrocercus urophasianus*) radio-marked and monitored on Deseret Land and Livestock (DLL) and the Three Creeks Grazing Allotment (3C) in Rich County, Utah, 2019

	Nests Initiated	Nesting Rate	Nests Hatched	Hatching Rate	Successful Broods	Brood Success Rate
DLL	6	50.0%	2	33.3%	1	50.0%
3C	9	81.8%	7	77.8%	3	42.9%
Off Site	8	100.0%	4	50.0%	2	50.0%
Total	23	74.2%	13	56.5%	6	46.2%

Table 2. Mortality rates for greater sage-grouse (*Centrocercus urophasianus*) radio-marked and monitored on Deseret Land and Livestock (DLL) and the Three Creeks Grazing Allotment in Rich County, Utah, 2019

	# Followed	Mortalities	Mortality Rate
3C	12	2	16.7%
DLL	26	12	46.2%
Off Site	7	3	42.9%
Total	45	17	37.8%

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