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

Field Report April-June, 2018

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Background

In 2011, Utah State University (USU) initiated research on Desert Land and Livestock (DLL)and on adjacent Bureau of Land Management (BLM), U.S. Forest Service (USFS) livestock grazing allotments and private lands (known as the Three Creeks Allotments [3C]) to determine if greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) vital rates (i.e., nest and brood success and juvenile and adult survival) differed by study area, and if any of the observed differences were related to vegetation composition and structure (Dettenmaier and Messmer 2014, 2015, 2016, Smith and Messmer 2017).

The study sites are located in Rich County in northeastern Utah and constitute the southwestern portion of the Wyoming Basin Sage-grouse Management Zone II (Knick and Connelly 2011). The DLL study area consists of 80,600 ha of private lands and 6,300 ha of federal BLM lands located in the lower elevations. The DLL has been managed as a cohesive unit under rest and deferred-rotation prescribed grazing practices since 1979. The federal allotments known as the Three Creeks (3C) consists of a 56,900 ha collection of 29 individual BLM and USFS grazing allotments and private lands managed under season-long grazing practices (Payne 2011).

The research incorporated a Before-After Control-Impact study design where pre-treatment data collected on DLL and 3C were to be compared to data collected on the 3C allotment after it was consolidated under a HILF rest and deferred-rotation grazing system (Payne 2011). However, the 3C consolidation was delayed until the BLM National Environmental Policy Act (NEPA) process requirement could be met. The consolidation decision was signed on April 24, 2018, and it will be fully implemented in 2020.

Given that it may take several years for a sage-grouse population to respond to management actions, the NEPA delay provided the partners with insights regarding the underlying mechanisms – why and how – livestock grazing may affect sage-grouse populations. Sage-grouse nest survival was higher on DLL (33%) than the 3C (17%). Our habitat analyses also revealed that four sage-grouse habitat metrics (i.e., vegetation concealment, sagebrush, perennial bunchgrass, and forb height) were greater in nesting habitats on DLL than 3C. We detected differences in these vegetation parameters despite disparities in precipitation and stocking rates between study areas. The DLL study area received 7 cm (3 inches) less annual precipitation on average and had stocking rates ~50% greater (0.76 vs. 0.46 AUM · ha-1) than 3C.

Our results demonstrated the potential for grazing management practices such as those implemented by DLL in sagebrush rangeland areas to benefit sage-grouse. However, we also identified the complexities in conducting research to answer fundamental questions regarding the role of livestock grazing in managing sagebrush rangeland landscapes for multiple purposes.

2018 Project Status

Given the 3C consolidation decision in 2018, we have worked with our partners to secure funding to continue to radio-mark and monitor female sage-grouse through the 2020 consolidation. Continuation of this research will allow us to determine how grazing maybe affecting sage-grouse nesting and brood-rearing decisions based on vegetation greenness responses to grazing. This greenness can be measured using remote sensing by assessing a Normalized Difference Vegetation Index (NDVI). We will call this the "green wave" as in ocean wave not a sports event wave.

To maximize reproductive success, wildlife species in seasonal environments should time the birth or hatching of their young to periods when resources are most predictable and abundant. In Utah we compared seasonal changes in the "green wave" to telemetry data collected from 20 study sites across Utah and southern Idaho to measure variation in the timing of sage grouse nest initiation with respect to plant phenology. Eureka!! We discovered that sage grouse initiate nesting (egg laying) approximately half way between the start and peak of season. Thus, the annual hatch is timed to coincide with the peak-of-season when understory productivity is highest and late-season frosts are less frequent.

Thus, managers concerned with sage-grouse survival could use this information to improve nest success and juvenile survival by implementing projects, such as livestock grazing, which may lengthen the peak green wave periods. Predictive nesting models based on research conducted to determine how livestock grazing can be managed to increase green wave periods will help managers prioritize surveys, habitat treatments, and reduce conflict among land-uses.

Our Big Rocks (The Questions)

Here are the questions we will be trying to answer

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?

Project Staff

Terry Messmer has worked for the citizens of Utah since 1991 employed as an Extension Wildlife Specialist and Professor at USU. He is the director of the Jack H. Berryman Institute and the Utah Community-Based Conservation Program. His extension and applied research programs encompass the identification, implementation, and evaluation of conservation strategies, technologies, and partnerships to benefit agriculture, wildlife, and resource stakeholders by reducing human-wildlife conflicts.

Hailey Wayment will be starting as a graduate student this fall at USU. This summer she has been working as a technician on this project as segue into the coming two years. She grew up in Duchesne Utah, residing there until her junior year of high school when her family moved to Utah valley. After graduating high school she attended UVU for a year before transferring to BYU to obtain a bachelor's degree in Wildlife and Wildlands Conservation. Her husband is attending Veterinary School at USU which is how they came to be in Logan. She has worked for several graduate students at USU before taking this opportunity to guide her own research.

Dave Stoner is a Research Associate in the USU Department of Wildland Resources. He will be assisting us to analyze the effects of livestock grazing on NDVI and sage-grouse vital rates. He has completed applied research on mammalian and avian responses to climate, topography, and anthropogenic activities using principles from animal behavior and landscape ecology. Dave has spent the last 22 years working with and for state and federal natural resource agencies. Most of this work has involved population or habitat assessments of game or sensitive species. In 2016 he completed four years of postdoctoral work on a NASA/UDWR collaboration that used satellite imagery to map and monitor wildlife habitats in the arid West.

Methods

We are focusing on female sage-grouse because they drive population growth. We began deploying global positioning system (GPS) rump-mounted radio-transmitters on birds captured on DLL and 3C in 2015 to better describe the range of sage-grouse behavioral responses to the presence of livestock and grazing. We will continue monitoring individuals fitted with GPS transmitters and very-high frequency (VHF) necklace-style radio-collars through the 2018-2020 breeding seasons. We will recover transmitters from mortalities, refurbish, and redeploy them on new birds to maintain a minimum 35 radio-marked (10 GPS and 25 VHF) female sage-grouse each on DLL and 3C.

All sage-grouse will be captured near leks within the study area during March-April and instrumented with radio-telemetry. Sage-grouse nests will be monitored on both sites from initiation until 50 days after hatch to quantify nest ($\geq$ 1 egg hatched) and brood-rearing success (chick survival). Daily movement (m/day) and home range estimates (km^2) will be calculated and compared between sites using Spatial Analyst tools in ArcGIS Desktop (Environmental Systems Research Institute, Inc., Redlands, CA).

To evaluate overlap in habitat selection between sage-grouse and cattle (*Bos taurus*) at the scale of the allotment, we will obtain six daily locations from GPS and 2-3 weekly locations for VHF radio-marked sage-grouse. These data will be compared to livestock location data collected from 46 GPS-collars deployed on cattle in DLL (23) and 3C (23). Cattle GPS data will be used to model the distribution of livestock and identify high-use habitats. Lastly, we will use GPS and VHF location data to create spatially-explicit models of sage-grouse vital rates, seasonal movements, and habitat use patterns relative to vegetation metrics and livestock habitat-use patterns on each site.

To quantify differences in seasonal productivity between sites, we will use MODIS 500-m daily resolution NDVI (green waves). Plant phenology is rapid in systems with short growing seasons

(study site mean = 50 days), and daily measures capture variation that is lost when using 8 or 16-day composites. From these data we calculated nine metrics to characterize the 'green wave' in response to livestock grazing. These include the start-of growing season (date and NDVI value at maximum daily rate-of-change), peak of the growing season (date and value of annual maximum NDVI), end of the growing season (date and NDVI value at maximum negative daily rate-of-change), the maximum rate-of-change during the start and end of the growing season (ΔNDVI/unit-time), and time-integrated NDVI (total season productivity).

Field Work April-June 2018

Number of radio-transmitters by type deployed at the beginning of the season			
	# of transmitters deployed 2018	# of transmitters carried over from last year	**Total**
GPS	16	9	**25**
VHF	0	1	**1**
Total	**16**	**10**	**26**

Figure 1 (below) shows a quick distribution of the birds marked on DLL. Also as a note we have 3 failed, unrecovered GPS radio-transmitters, 2 from 2017 and one from April 2018 that hasn't updated since May, after being deployed in April. We have spent time looking for this most recent bird and have not yet found a signal. We have 18 GPS radio-transmitters that are transmitting location data. We have 11 VHF collars that are unaccounted for. We completed a flight in April 2018 but were unsuccessful in locating them. We still continue to search for them throughout the season.

Nesting

Nine of the 18 females we have been following initiated nests this year. Four of those nests were predated; 3 mammalian, 1 avian. Of these four nests, 3 were on DLL and 1 was a bird captured on 3C that has moved north east of Laketown, UT. None of these birds have attempted to re-nest and continue to move. There was one failed initiation attempt in early May on DLL and the female has not made any more attempt to nest. There have been no failed initiation attempts on 3C. Currently there has been one lost brood on DLL, and one lost brood on 3C. No other birds are still nesting.

Brood-rearing

So far this year we have 5 successful females with broods, 3 of these broods are on DLL, 1 on 3C, and 1 west of Laketown. Two the females have reached their 50 day mark, and both have chicks that are capable of small flights. The other three females have broods that are younger in age, hatching just two weeks ago. Four chicks from one of these females were spotted just days after hatching.

Mortality

As of June 28, 2018, we have recovered three GPS transmitters and one VHF transmitter. Although two GPS transmitters showed signs of being broken off by a predator no remains were found in the area. The third GPS transmitter recovered was from an avian depredation at end of April. Remains were found in a bush, consisting of a skeletal frame and feathers. The VHF transmitter was also broken off with no signs of the bird.

Grouse Movements

One female we radio-marked on 3C has moved to the north part of DLL. Another female we radio-marked on DLL moved 12 miles to the North West above the Monte Cristo Highway within two days. Two females we radio marked on 3C have moved north closer to Bear Lake and the remaining birds have spread out among the allotment. These observations highlight that the DLL and 3C areas are important sage-grouse winter range. This makes our job all that more difficult as we desire to capture and radio-mark females that will stay on the study area. The GPS units cost us about $4,000 each. In 2018 we will deploy 25 additional VHF units ($180 each) on both DLL and 3C to increase our overall sample size. We know some of these female will leave the study areas, but for those that stay, we will focus more time on those that nest successfully and their broods.

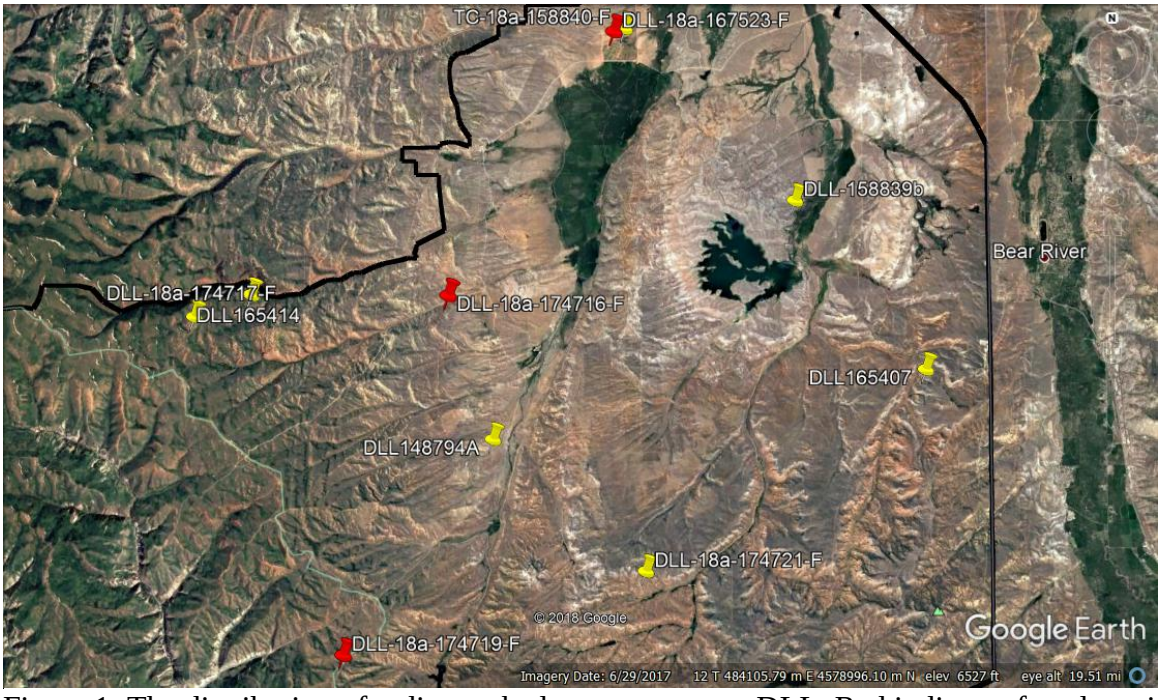

Figure 1: The distribution of radio-marked sage-grouse on DLL. Red indicates females with broods. Also note one bird tagged on 3C has moved to DLL on June 24, 2018.

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We are grateful to the Utah Public Lands Policy Coordination Office for providing project start-up funding. We also have received $52,000 from the Utah Public Lands Initiative which was sponsored by the Utah Legislature and administered by the Utah Agricultural Experiment Station. We thank DLL for providing access the support to complete the telemetry flights. We thank the BLM for housing support at the Randolph Station and for considering additional matching support. We thank the Rich County CRM and all of the private landowners who have allowed us access to their lands. Please let us know if you have any questions.

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