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SUSTAINED EARLY INTERIOR GREATER PRAIRIE-CHICKEN (*Tympanuchus cupido pinnatus*) LEKKING BEHAVIOR AT LEK IN CENTRAL NEBRASKA

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ABSTRACT

We detected 9 adult male Greater Prairie-Chickens (*Tympanuchus cupido pinnatus*) actively lekking on 30 January of 2015 and monitored the lek once per week to determine if lekking behavior would continue uninterrupted through the typical lekking season from early March through late May. We documented lekking behavior, male and female lek attendance, habitat information, and weather data from 30 January to 20 May 2015 (21 observations). Male lekking behavior was documented during every observation throughout the study period except for the final observation on 20 May. Additionally, female Greater Prairie-Chickens were documented attending the lek as early as 11 March. We provide evidence of an early and extended lekking season in Nebraska.

INTRODUCTION

During the week of 19 January through 23 January 2015, biologists conducting land management work flushed three Greater Prairie-Chickens (*Tympanuchus cupido pinnatus*; GRPC) from the center of Mormon Island, Hall County, Nebraska (Figure 1). Following the early detection of multiple GRPCs in an appropriate lekking location, we began monitoring the area on a weekly basis for potential lekking activity. On 30 January 2015, we detected nine male GRPCs vocalizing (booming), conducting breeding displays (strutting), and sparring with each other at a known lek site. GRPCs are known to gather intermittently at lek sites during the wintering months and periodic displays have been documented during mild winter weather throughout their range (Hamerstrom 1939; Schwartz 1945; Mohler 1952; Baker 1953; Horak 1985; Horak and Applegate 1998; Thompson et al. 2011). Hamerstrom

(1939) indicated that winter displays are often incomplete with limited vocalization and sparring, though active displaying has been observed in winter in Kansas and Oklahoma (E. A. Young and D. Wolfe pers. comm.). There is a paucity of published data on display behavior beginning in the winter months (December to January) and persisting through the end of the normal breeding season (Hamerstrom 1939; Mohler 1952; Schwartz 1945; Baker 1953). Additionally, this observation was made in central Nebraska, in the center of the GRPC's current latitudinal range where lekking usually begins later than in the GRPC's southern range (Robb and Schroeder 2005; Johnsgard 2016). In a three-year study of GRPC breeding phenology in the Flint Hills of Kansas, McNew et al. (2011) found males attending leks from 2 March to 19 May and females attending leks from 20 March to 16 April, with peak attendance of both sexes in early April. Robb and Schroeder (2005) reported that GRPC lekking activity is generally documented from early March to early June throughout their geographical range. However, Thompson et al. (2011) indicated up to 100 males gather on booming grounds in Kansas starting in February, and Young (pers. comm.) observed display behaviors in January-February in the southern Flint Hills region during the 1980's and early 1990's when populations were more robust. Our objective in monitoring this lek was to determine if early lekking behavior was a temporary phenomenon, or if this lekking behavior once initiated, would continue uninterrupted through the 2015 breeding season given the atypically mild winter temperatures recorded in January (NOAA 2017).

STUDY AREA

Mormon Island (40.797163° N, -98.417318° W; Figure 1) consists of 1100 hectares of primarily relict lowland tallgrass prairie and wet meadow habitat containing scattered upland sandy ridges and riparian, cottonwood (*Populus deltoides*) dominated, woodlands bordered to both the north and south by channels of the Platte River (Currier 1982, 1989, Nagel and Kolstad 1987). Just to its west, Shoemaker Island consists of 850 hectares of upland tallgrass prairie, woodlands, and interspersed wet meadows and sloughs. The adjacent Mormon and Shoemaker islands are owned and managed by the Crane Trust, a small private non-profit conservation organization aimed at preserving habitat for Whooping Cranes (*Grus americana*) and other migratory birds along the Big Bend of the Platte River (VanDerwalker 1981). The landscape has been managed with rotational cattle grazing (rested every 3-4 yrs) and prescribed fire (burned every 4-5 yrs) to mimic historic disturbance regimes, maintain a variety of habitats in different successional stages, and promote native and endemic biodiversity (Currier 1982; Briggs et al. 2005; Fuhlendorf et al. 2009). This area constitutes the largest contiguous expanse of riverine prairie remaining along the Big Bend of the Platte River, providing habitat for an isolated breeding population of GRPCs approximately 40 km from the nearest consistent booming grounds in northwest Hall County (Lingle et al. 1994; Svedarsky et al. 2000; Sharpe et al. 2001; Johnsgard 2016).

The study lek on Mormon Island was located approximately 60 m from a cattle-drinker in short, heavily grazed, upland vegetation on a sandy ridge rising 1 m to 1.25 m in elevation above the lowland tallgrass prairie to the south and about 1.5 m

above the wet meadow north of the ridge. Vegetation on the lekking site was grazed the previous fall to less than 3 cm in height, leaving ample open ground. The lek was centered about 55 m west of a north-south oriented fence and 45 m north of an east-west positioned fence inside a 120 hectare pasture. This pasture had not been burned for three years as of 2015, but grazing had been intensive on the higher ridges in this pasture into the fall of 2014. This was especially true regarding the

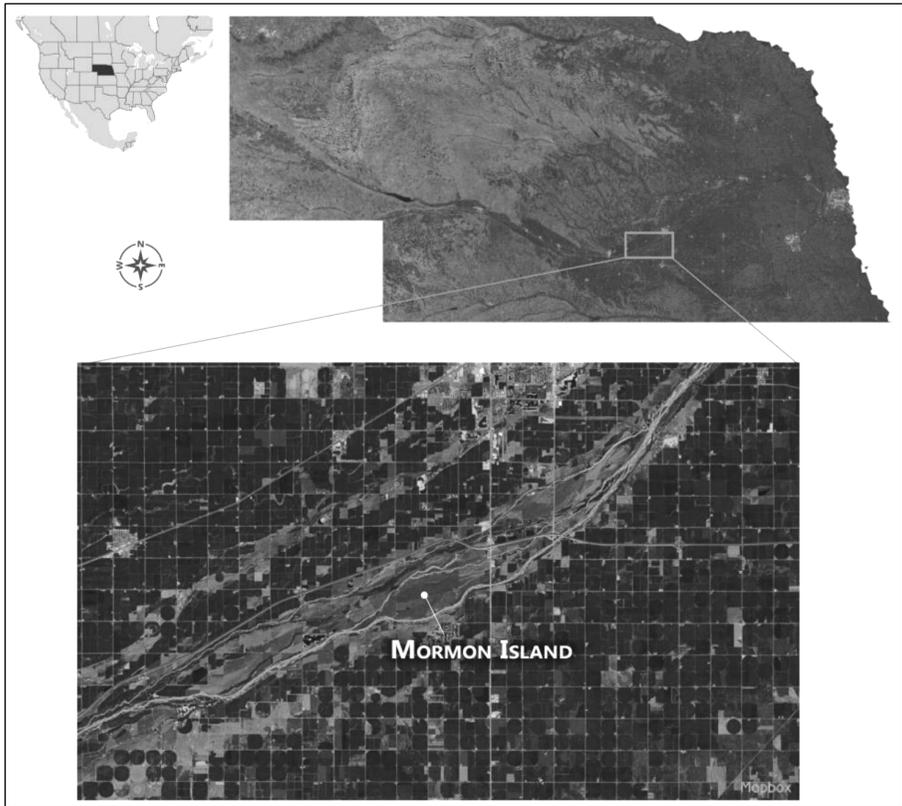


Figure 1. Map of Mormon Island, Hall County, Nebraska, including a depiction of Mormon Island’s location within Nebraska and Nebraska’s location within the United States. Aerial imagery clearly depicts the prairie habitat of Mormon Island within a largely agricultural landscape.

eventual lekking area, as the cattle-drinker was nearby, and the upland ridge was dominated by vegetation species preferred by cattle including western wheatgrass (*Pascopyrum smithii*), big bluestem (*Andropogon gerardii*), and little bluestem (*Schizachyrium scoparium*) (Stubbendieck et al. 1992). Crane Trust biology staff found GRPCs in the same location in the spring of 2014; however, in 2012, 2013, and 2016 the lek was not detected in this location, but 250 m to the northeast on a cattle-grazed sandy ridge in an adjacent pasture. On 22 April 2015, we conducted a controlled burn in the 125 hectare pasture directly south of the pasture containing

our study lek. On 30 April 2015, GRPCs were detected displaying at the actively monitored lek site as well as the newly burned area centered roughly 100 m south. The following week on 7 May, continuing through 20 May 2015, we observed the GRPCs predominantly gathering and lekking on the recently burned area. Year-round long term avian monitoring surveys conducted across Mormon and Shoemaker Islands indicate the general area described above, containing three separate lekking locations within 250 m, represents the only known lekking grounds on the Crane Trust's property (Crane Trust unpubl. data). Lingle and Hay (1982) recorded wintering GRPCs during their two year (1980-1981) avian inventory of Mormon Island, but they did not detect GRPCs breeding in the area, suggesting that lekking and breeding activity may be a relatively recent phenomenon.

METHODS

Observations began 30 January and continued until 20 May 2015. Prior to the initiation of our observational period, we erected a camouflaged pop-up blind adjacent to the fence 55 m east of the GRPC lek and observed the lek approximately once a week (mean = every 5.8 days; range = 2 to 10; SD = 3.1), for a minimum time period of one hour (mean = 1 hr 29 min; range = 1 hr to 2 hrs 5 min; SD = 28 min), starting just before sunrise utilizing an 80 mm spotting scope. Observation starting times ranged from roughly 0615 hrs to 0730 hrs gradually becoming earlier advancing into the spring following the change in sunrise timing. Observation days were determined by staff availability and weather conditions were not a major factor in determining site visit days. One to two field personnel made a total of 21 observations including 19 morning and two late afternoon observations. We employed a scan sampling method where we made passes of the lekking area and recorded the number of GRPCs present, their sex, and their general behavior at the time of our scan, including display, foraging, or loafing behavior (Altmann 1974). Lek attendance was determined by the maximum count of each sex recorded during any single scan per observation day. Display behavior based on Robb and Schroeder (2005) and Johnsgard (2016) were recorded. We also recorded narrative descriptions of the habitat conditions each week including plant regrowth as well as recent land management actions (controlled burning, etc.). We logged the temperature and wind speed at time of observation utilizing a Kestrel 3000 weather meter. Additionally, we summarized weather data from the nearest National Oceanic and Atmospheric Administration (NOAA) weather station (KHSI, 40.60056° N, -98.42583° W) located at the Hastings Municipal Airport, Hastings, Nebraska, approximately 21 km south of our research site to gauge how the winter weather in 2015 compared to historic averages (NOAA 2017).

RESULTS

We recorded a full range of male display behavior (e.g., booming, strutting, and sparring) during every observation from 30 January through 13 May 2015. During the final scheduled observation on 20 May 2015 seven male GRPCs were gathered at the lekking site loafing together but no lekking display behavior was documented.

We detected the first female GRPC on 11 March 2015, and females were documented attending the lek during five consecutive observations through 01 April 2015 (Figure 2). We did not detect females again until we documented them on four of seven observations between 22 April and 13 May 2015. During the final lek observation of this study on 20 May 2015, no female GRPCs were detected. We recorded an average of 10.8 males per survey (SD = 2.2; range = 6-14) and 0.5 females per survey (SD = 0.7; range = 0-2; Table 1, Figure 2.). We documented the first signs of new green vegetation growth at the lek site on 22 March 2015 (Figure 2).

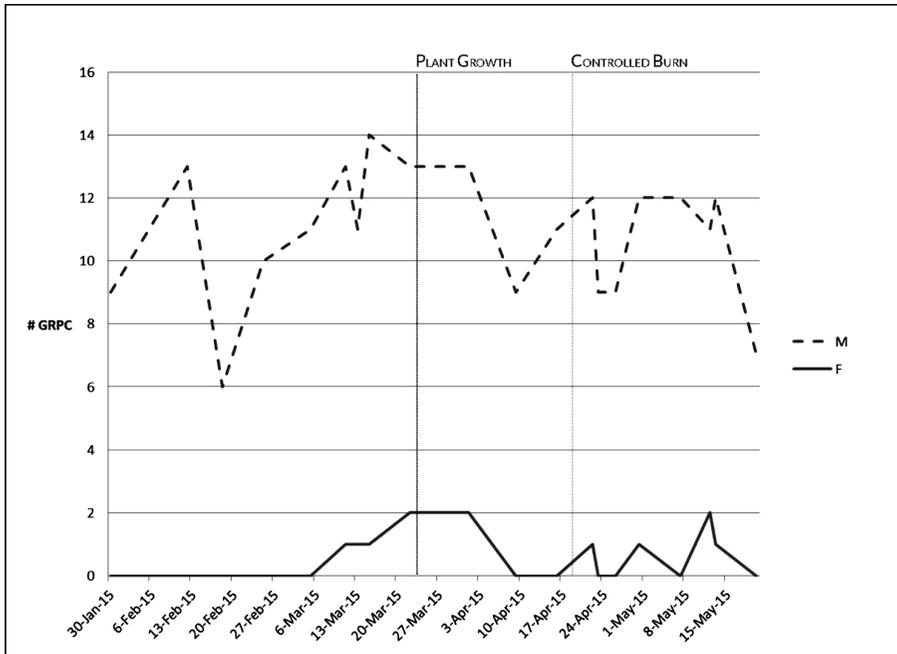


Figure 2. Male and female Greater Prairie-Chicken lek attendance, plant growth/green up, and controlled burning activity by date at Mormon Island, Hall County, Nebraska. “M” represents the number of males attending the lek, “F” represents the number of females attending the lek. “Plant Growth” indicates first signs of green plant growth. “Controlled Burn” indicates the date of the prescribed fire conducted in the pasture directly to the south of the original lekking site.

From 16 January through 30 January 2015, daily highs were approximately 10° C above average, daily average temperatures were 7.7° C above average, and daily lows were 5° C above average (Table 2), with temperatures reaching as high as 20.6° C (NOAA 2017). However, after this warm spell, temperatures returned to levels more closely resembling historic daily averages for the month of February (observed: -3.5° C; historic: -1.1° C; Table 2). Temperatures collected in the field (Kestrel 3000 weather meter) while observing active lekking behavior ranged from -15.0° C on 5 March 2015, to 15.6° C on 7 May 2015 (mean: 3.5° C; Table 1).

Table 1. Summary statistics regarding male and female Greater Prairie-Chicken lek attendance, temperature, and wind speed recorded during morning lek observations (n=19).

	Wind (kph)	Temp (°C)	Males	Females
Mean	16.2	2.6	10.8	0.5
SD	8.1	9.1	2.2	0.7
Max	32.2	15.6	14	2
Min	3.2	-15	6	0

Table 2. Average high, daily average, and average low temperatures observed from 16 to 30 January, February, March, and April 2015 near Mormon Island, Hall County, Nebraska, compared to historic averages for the same time period and location. Historic averages derived from NOAA weather station KHSI (40.60056° N, -98.42583° W), Hastings Municipal Airport, Hastings, Nebraska, for data 1949 to 2017.

Month	Avg High (°C)	Daily Avg (°C)	Avg Low (°C)
January 16 to 30			
Recorded 2015	12.2	4.4	-3.9
Historic	2.2	-3.3	-8.9
Difference	+10.0	+7.7	+5.0
February			
Recorded 2015	3.2	-3.5	-10.6
Historic	4.6	-1.1	-6.9
Difference	-1.4	-2.4	-3.7
March			
Recorded 2015	16.1	7.0	-2.3
Historic	10.7	4.6	-1.8
Difference	+5.4	+2.4	-0.5
April			
Recorded 2015	18.2	11.8	5.2
Historic	17.2	10.5	3.7
Difference	+1.0	+1.3	+1.5

DISCUSSION

The male GRPCs on Mormon Island began consistently lekking more than one month prior to the typical start of the lekking season in Nebraska and what has generally been published for the central Great Plains (Robb and Schroeder 2005; McNew et al. 2011; Johnsgard 2016; Figure 2). McNew et al. (2011) did not observe seasonal variation in lek attendance during their three-year study of three GRPC

populations in Kansas, suggesting that the timing of lek attendance is relatively stable. We recorded male GRPCs lekking across a span of 111 days beginning 30 January 2015, 34 days longer than McNew et al. (2011) documented following a 2 March start. However, Toeffler and Eng (1988) recorded radio tracked males beginning to return to the lekking grounds as early as 5 February ($n = 1$) and 10 February ($n = 2$) in their study of GRPC movements within the Sheyenne National Grasslands in southeastern North Dakota. Additionally, experienced field biologists working with GRPCs in Kansas and Oklahoma have captured GRPCs on their lekking grounds throughout the winter months. D. Wolfe (pers. comm., unpubl. data) indicated that from 1997-2000 during first capture events on lekking grounds they documented 19 individuals in February (one female, f); 43 in March (eight f), 88 in April (45 f), 19 in November (three f), and 15 in December (five f). Schroeder and Braun (1992) documented male lek attendance from late February to early June, with attendance being the most stable in March and April in their 6-year study of 80 leks across 301 square km of prairie in northeastern Colorado.

McNew et al. (2011) found that 95% of all female lek visits were recorded within 28 days between 20 March and 16 April. In 2015, per our observations, female GRPCs began consistently attending the lek on Mormon Island nine days ahead of this mark, from 11 March to 1 April (Figure 2). This time period likely coincided with mating activity prior to first clutch initiation (McNew et al. 2011; Robb and Schroeder 2005; Johnsgard 2016). However, female lek attendance in our study both predated and postdated those dates recorded by McNew et al. (2011), but are within the timeframe observed by D. Wolfe (pers. comm.) in Oklahoma. The female lek attendance dates we report herein also preceded and extended past those reported by Robel and Ballard (1974), which observed female GRPCs attending three separate leks from late March to early May on a 970 hectare prairie on the western edge of the Flint Hills in Kansas. Hamerstrom and Hamerstrom (1973) documented occasional female lek attendance beginning in late March and early April that came to a peak in the third to fourth week of April before dropping in the first week of May in their 22 year study in Wisconsin. We recorded female GRPCs attending the lek across a 64-day period, which is longer than most accounts of female lek attendance (Hamerstrom and Hamerstrom 1973; Robel and Ballard 1974; McNew et al. 2011). The late season female lek attendance we recorded from 22 April to 13 May 2015 may have been prompted by significant nest failure following a controlled burn in the pasture immediately south of the lekking grounds (Figure 2). However, a second and smaller peak of female lek attendance is often documented a few weeks after the first as females which nested unsuccessfully return to the lekking grounds to remate (Hamerstrom and Hamerstrom 1973; Robb and Schroeder 2005).

Our documentation of consistent lek attendance for both sexes, as well as male display behavior, appear to be both early and extended in references to most published dates of GRPC activity. Research has documented periodic winter lek attendance and display behavior by GRPCs, however, these were often not “complete performances” including strutting, sparring, and booming (Hamerstrom 1939; Mohler 1952; Horak and Applegate 1998). Hamerstrom (1939) documented early lekking behavior during February thaws in Wisconsin in which GRPCs were

physically acting out displays without vocalizing and first detected complete displays beginning between 2 March and 21 March during his three-year study from 1936 to 1938 in Wisconsin. However, Schwartz (1945) documented periodic GRPC booming and strutting in Missouri during February of 1941 and 1942 that was interrupted by “periods of severe cold.” Schwartz (1945) also documented “regular” use of booming grounds in 1943 starting on 5 February, which represents one of the earliest records of consistent GRPC lekking behavior documented in the central Great Plains. We noted booming, strutting, and sparring consistently during our observations beginning on 30 January 2015. We documented six male GRPCs booming even under inclement cold weather conditions with temperatures as low as -14°C and winds reaching 24.1 kph on 18 February 2015. Our observations differ from the majority of accounts of winter GRPC lekking activity, with the exception of that reported herewith by Wolfe (see above) and those recorded by Schwartz (1945) in 1943, as they indicate both consistent as well as complete lekking display behavior despite returns to cold temperatures following warm winter weather.

Male GRPC lekking behavior may be cued, in part, by sustained periods of warm late winter and early spring weather. Though hormonal processes triggered by photoperiod predominantly regulate the seasonal timing of reproductive behavior in birds, temperature and other environmental cues (forage, etc.) have been found to aid in the fine scale determination of these annual cycles (Wingfield et al. 2003; Dawson 2008). It is possible that early and consistent lekking behavior occasionally occurs throughout the GRPC’s range following extended periods of mild winter weather, and has not been sufficiently documented in the scientific literature (D. Wolfe pers. comm.). Moreover, it is likely that different geographical populations, even at the same latitude, exhibit significant temporal variation regarding the initiation of lekking behavior with some populations being more prone to consistent early display behavior than others (Sharpe et al. 2001; Conklin et al. 2013). Stable lekking grounds, which are regularly used across years as opposed to intermittently or ephemerally utilized sites, may be more likely to support periodic or sustained winter lekking behavior. Stable lekking grounds have comparatively high male lek attendance and are more likely to support some level of GRPC activity in all months of the year aside from August and July (Schroeder and Braun 1992; Horak and Applegate 1998). Our study lek was documented yearly from 2012 to 2017 within the same 250 m² area of Mormon Island. Additionally, we recorded a male lek attendance per survey in 2015 (mean = 10.8) characteristic of stable lekking grounds (Schroeder and Braun 1992). This study marks the earliest record of consistent GRPC lekking behavior within the central Great Plains documented in the scientific literature to our knowledge. Our observations also suggest that an early start to male display behavior may not simply represent a temporal advance of the lekking season but also an extension of its duration. Further research is needed to determine if winter GRPC lekking behavior is a widespread phenomenon during unseasonably warm winter weather. If our observations represent a common occurrence throughout the GRPC’s range, increased warming trends may alter the lekking phenology of GRPCs with unknown impacts (Bradley et al. 1999; Charmantier and Gienapp 2014).

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MANUSCRIPTS NEEDED

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