Crowned Ridge Sharp-Tailed Grouse Research Study Annual Report

Crowned Ridge I and II Wind Energy Projects

Grant, Codington, and Deuel Counties, South Dakota

Prepared for:

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WEST

EXECUTIVE SUMMARY

Crowned Ridge Wind I, an indirect, wholly owned subsidiary of NextEra Energy Resources, LLC (NEER), constructed the Crowned Ridge I Wind Energy Facility (CRI) in Grant and Codington counties, South Dakota, and began commercial operations in December 2019. Crowned Ridge Wind II, LLC, a wholly owned, indirect subsidiary of NEER, began constructing Crowned Ridge II Wind Energy Facility (CRII) immediately to the south of the CRI Project boundary in May 2020, and began commercial operations in December 2020. Shortly after CRII began commercial operation, ownership of CRII was transferred from NEER to Northern States Power Company. CRI worked collaboratively with South Dakota Game, Fish, and Parks (SDGFP) to develop a prairie grouse research study to better understand the effects of wind energy on prairie grouse populations.

While some information exists on the potential impacts of wind energy development on prairie grouse populations, no studies have directly measured potential impacts to plains sharp-tailed grouse (STGR) from wind energy infrastructure. The presence of known STGR within CRI and CRII provides a valuable opportunity to evaluate the potential effects of the CRI and CRII turbines on STGR. In accordance with Permit Condition Number 45 of the South Dakota Public Utility Commission order, CRI will undertake two years of independently conducted post-construction prairie grouse lek monitoring to evaluate the Project's effects on the local prairie grouse populations. In addition, CRI worked collaboratively with SDGFP to develop a Grouse in Lieu Mitigation Plan that incorporates an approved lek monitoring study plan and a robust telemetry study. The overall goal of this study is to quantify the effects of wind energy development on prairie grouse seasonal habitat selection and demography. During the 2020, 2021, and 2022 field seasons, lek counts and surveys were conducted within and around CRI and CRII to understand the extent of the local breeding STGR population. In addition, STGR were marked with Global Positioning System (GPS) transmitters to collect information about habitat selection and demography in relation to wind energy infrastructure.

In 2022, STGR lek surveys were conducted at 26 of 31 known leks where landowner permission was obtained. Breeding activity was documented at 20 of the 26 accessible leks. Nest survival of GPS marked females during the 2022 breeding season was 44.4%. Female survival during the breeding season was 27.4%. Reported demographic rates were generally comparable to other studies evaluating STGR demography. However, all demographic rates were lower than those estimated in 2020. A comprehensive report that summarizes data collected during all three study years and addresses the specific objectives of this study will be submitted in June 2023.

REPORT REFERENCE

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INTRODUCTION

Crowned Ridge Wind I, LLC (CRI) an indirect, wholly owned subsidiary of NextEra Energy Resources, LLC (NEER), constructed the Crowned Ridge I Wind Energy Facility in Grant and Codington counties, South Dakota. Construction began on 200 megawatts (MW) of the permitted 300 MW in August 2019 and began commercial operations in December 2019. Crowned Ridge Wind II, LLC (CRII), a wholly owned, indirect subsidiary of NEER, began constructing Crowned Ridge II Wind Energy Facility immediately to the south of the CRI Project boundary in May 2020 and began commercial operations in December 2020. Shortly after CRII began commercial operation, ownership of CRII was transferred from NEER to Northern States Power Company. CRI worked collaboratively with South Dakota Game, Fish, and Parks (SDGFP) to develop a Grouse In Lieu Mitigation Plan (Mitigation Plan; Crowned Ridge Wind LLC 2019a,b). This Mitigation Plan incorporated an approved lek monitoring study plan and a robust telemetry study to better understand the effects of wind energy on prairie grouse populations, with the overall goal of informing future siting and permitting decisions.

While some information exists on the potential impacts of wind energy development, no studies have directly measured potential impacts to plains sharp-tailed grouse (*Tympanuchus phasianellus. jamesi*; STGR) from wind energy infrastructure. The presence of known STGR within CRI and CRII (hereafter Projects) and the high probability of lek occurrence surrounding the Projects (Runia et al. 2021), provides a valuable opportunity to evaluate the potential effects of wind energy development on STGR. Understanding how STGR respond to wind energy Projects could lead to the development of focused avoidance, minimization, and mitigation measures that benefit all stakeholders, as well as the conservation of prairie grouse.

Objectives

The overall goal of this study was to quantify the effects of wind energy development on STGR seasonal habitat selection and demography over a three-year period. The study was designed to incorporate the analysis of spatial and demographic data collected from observations of lek trends and marked individuals. The study protocol included the collection of pre- and post- construction data during multiple STGR breeding cycles along a distance gradient from wind turbines and over a period that included construction and operations of the Projects. Specifically, the objectives include:

1) Predict the relative probability of habitat selection to estimate potential displacement effects and impacts to habitat connectivity associated with the Projects by using STGR use locations and habitat data.
2) Predict nest, brood, and annual adult survival relative to the Project infrastructure.
3) Investigate the possibility of estimating population growth rates relative to the Project infrastructure by incorporating the results of displacement, survival, and lek trend analyses to provide an overall understanding of the effects on population viability.

The data collected will provide detailed information on STGR habitat selection and survival near the Projects and associated infrastructure that can be used to achieve the objectives stated above. The purpose of this report is to summarize information collected during the 2020, 2021, and 2022 field seasons. In addition to the lek surveys and capture efforts, we summarized demographic rates (nesting, brood rearing, and survival) and telemetry location data collected during the three breeding seasons at the Projects in accordance with reporting requirements of the Mitigation Plan. Emphasis was placed on the 2022 field season.

METHODS

The objectives of the study necessitated capturing, marking, and monitoring approximately 60 STGR per year from leks observed in and around the Projects using Global Positioning System (GPS) technology. An important component of these objectives included monitoring historic leks and surveying for previously unknown leks within six mi (10 km) of the Projects. Prior to any surveys, landowners were contacted to gain permission to access their lands. All surveys were coordinated with SDGFP and local authorities.

Lek Counts and Surveys

Nineteen leks were identified within or around the Projects. Eight leks were documented within the Project boundaries and 11 leks were documented within six mi of the Projects. Lek locations were found during pre-construction lek surveys or from information provided by the SDGFP (previously known lek locations; Figure 1). In addition, biologists located 11 previously undocumented leks in 2020 and one undocumented lek in 2022 using ground-based and helicopter surveys.

During each field season, biologists searched for previously undocumented leks (i.e, ≥ 2 males) and visited known leks to count the number of individual STGR attending each lek. Biologists conducted ground-based lek counts during three to four occasions at all known leks. Counts were spaced approximately seven days apart and occurred between 30 minutes before sunrise and 90 minutes after sunrise. Observers scanned each lek for a minimum of 10 minutes and counted the total number of individuals attending the lek. In the event a known lek was not located, observers searched within 1.2 mi (1.9 km; when landowner access was possible) to determine if the lek moved. The 1.2 mi search area was based on inter-annual movement of lek locations documented in prairie grouse populations (Hovick et al. 2015). Lek counts were only conducted when conditions included clear to partly cloudy skies, wind speeds less than 20 mi/hour (32 km/hour), and no moderate or heavy precipitation.

Sharp-tailed Grouse Capture

STGR were captured on and near leks using walk-in drift traps during the spring lekking period; March – late April (Haukos et al. 1990). All STGR were sexed, aged, and fitted with a GPS-Ultra High Frequency (UHF) solar-powered telemetry unit with a modified rump-mounting harness (Bedrosian and Craighead 2009). The goal was to maintain a sample size of 60 individuals entering each field season. Female STGR were targeted for capture. Males were targeted after

peak female lek attendance passed. We used Ecotone Harrier GPS-UHF units (Saker GPS-GSM model L) that were approximately 0.6 ounces (17.0 grams) in mass (less than 3% body weight). SDGFP reviewed and approved all capture and handling procedures. Capture was conducted under a scientific collection permit (Permit No. 14).

Sharp-tailed Grouse Monitoring

The solar-powered GPS units fit to each individual, uploaded locations via cellular transmission (3G) to an FTP website. This enabled near real-time assessment of location data. GPS units were programmed to collect locations every 15 minutes. In addition, these units had Very High Frequency (VHF) capability so units could be retrieved in the event of mortality. Following capture, marked STGR were tracked using the uploaded GPS data. In the event locations were localized for more than a day indicating a mortality, a biologist visited the location to retrieve the GPS unit and determine cause of death, if possible. In mid-June of 2022, major cell phone carriers disabled their 3G networks (South Dakota Public Utilities Commission 2022). This resulted in GPS units no longer able to upload locations remotely. Biologists recognized the failure for data to be uploaded using 3G networks within a week of networks being disabled. Biologists swiftly began locating grouse on the ground using VHF telemetry and downloading data utilizing the UHF capabilities of the transmitters where possible.

Nests were located by visually inspecting location data that indicated homing by females to a single location (± GPS location error). STGR have an approximately 23-day incubation period (Johnsgard 1983). If a female left the nest location prior to the 23-day period, we considered the nest to have failed. However, biologists visited each nest to confirm nest fate using visual diagnostics. We defined nest success when at least one egg hatched (Rotella et al. 2004). Hatched eggs typically have a uniform break near the center with membranes that are detached from the egg shell. However, egg shells may not always provide information about nest fate because of the possibility of egg shell scavenging once the hen and chicks have left the nest bowl.

The biologist also manually tracked the bird with VHF telemetry to visually observe chicks or observe brooding behavior by the female (e.g., distraction displays or injury feigning) to confirm nest fate. When a female successfully hatched a nest, brood fate was determined during the initial telemetry visit by either visually observing the female with at least one chick, or observing the female exhibiting brooding behavior. Brood status was confirmed with telemetry visits at approximately 35 days post-hatch, and a female was considered to have successfully reared a brood when at least one chick was present with the female during the 35-day visit. If brood status could not be determined during the 35-day visit, a second visit was conducted the following day.

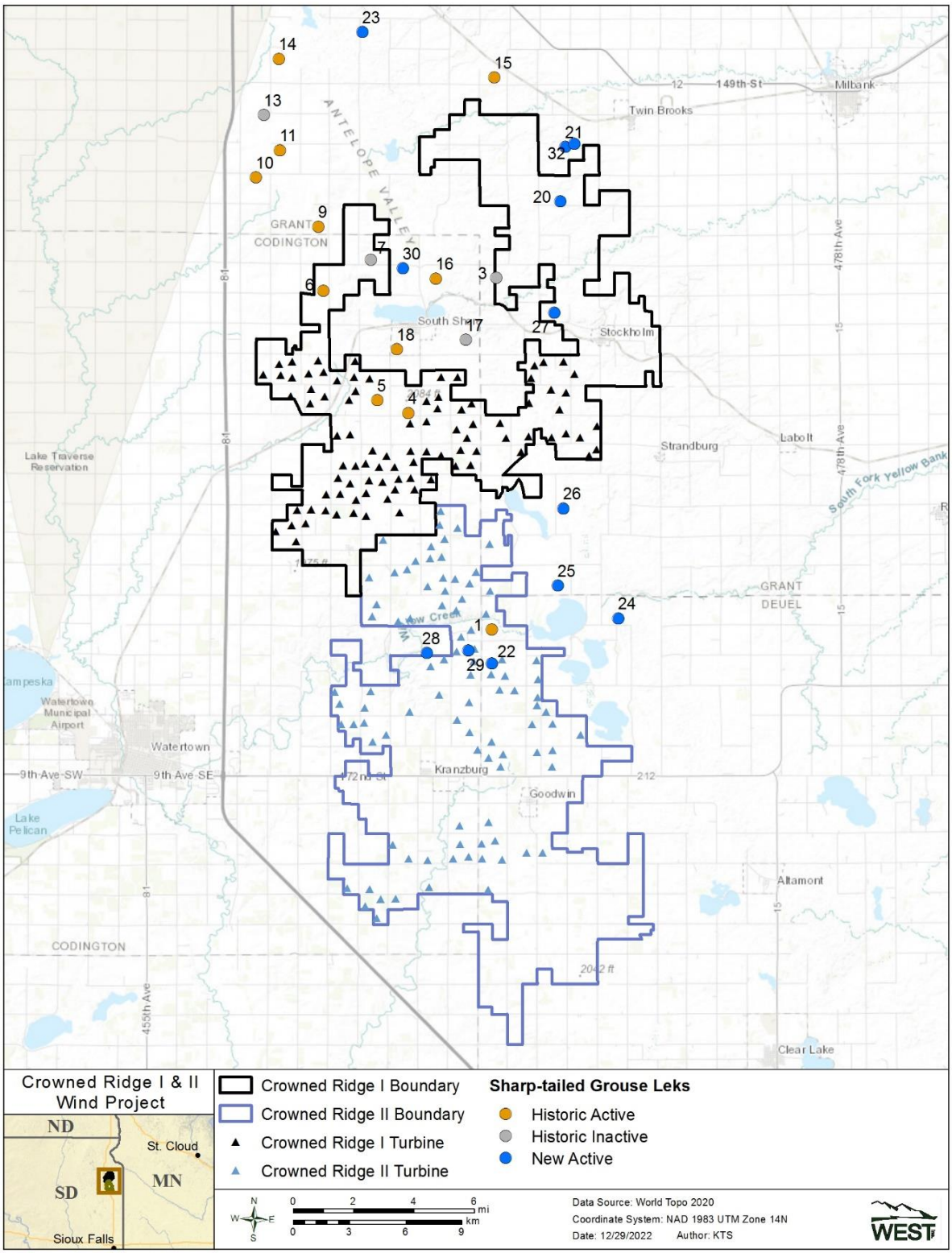

Figure 1. Known historic active, historic inactive, and new active (identified in 2020 and 2022) sharp-tailed grouse leks within Crowned Ridge I and Crowned Ridge II Wind Energy Projects surveyed during the 2022 breeding season.

Analysis

Nest, Brood, and Adult Survival

Survival estimates were calculated for each demographic rate (nest, brood, and adult survival) with the Kaplan-Meier product limit estimator (Kaplan and Meier 1958) modified for staggered entry (Pollock et al. 1989). Survival analysis periods (*t*) for nests, brood, and females and males separately during the breeding season were, t = 23 days, t = 35 days, and t = 136 (April 1 to August 15), respectively. For female survival during the breeding season, we assessed survival from April 1 to August 15 to be consistent with previous studies (e.g., Manzer and Hannon 2008, Milligan et al. 2020). We excluded individuals that had died within two days of capture (n = 2 in 2022) to remove potential bias in survival estimates. This was done because capture-related stress mortality could not be ruled out. Captures were conducted to minimize stress and individuals were released as soon as possible following capture. Survival analyses were performed with package 'survival' in Program R (Therneau 2020).

RESULTS

Lek Counts and Surveys

We obtained landowner permission to survey 26 of the 31 historic leks and leks identified in 2020 and 2022 (Table 1, Figure 1). Lek counts occurred between March 22 and April 25, 2022. Of the 26 leks where landowners granted access, 20 were active during at least one visit. The mean count of STGR at leks was eight (Figure 2; range = 1–29). On average, maximum male lek counts were similar during 2022 compared to 2021 but were greater than counts in 2020 (Figure 2).

Table 1. Summary of sharp-tailed grouse (STGR) lek attendance near Crowned Ridge I and Crowned Ridge II Wind Energy Projects surveyed during the 2020, 2021, and 2022 breeding seasons.

Lek number	Status	Max count 2020[1]	Max count 2021[1]	Max Count 2022[1]
1	Historic	2 (0–2)	6 (0-6)	2 (0-2)
2	Historic	NA[3]	NA[3]	NA[3]
3	Historic	0	0	10 (0-10)
4	Historic	2 (0–2)	7 (0-7)	3 (0-3)
5	Historic	20 (18–20)	22 (14-22)	15 (10-15)
6	Historic	2 (0–2)	0	6 (0-6)
7	Historic	0	3 (0-3)	0
8	Historic	NA[3]	NA[3]	0
9	Historic	5 (1–5)	12 (7-12)	10 (0-10)
10	Historic	0	2 (0-2)	4 (0-4)
11	Historic	12 (0–12)	27 (19-27)	7 (6-7)
12	Historic	NA[3]	NA[3]	NA[3]
13	Historic	0	0	0
14	Historic	0	8 (0-8)	0
15	Historic	NA[3]	NA[3]	26 (22-26)
16	Historic	11 (8–11)	13 (12-13)	11 (7-11)
17	Historic	0	6 (0-6)	0
18	Historic	NA[3]	4 (2-4)	6 (0-6)
19	Historic	NA[3]	NA[3]	1 (0-1)
20	Located in 2020	7 (5–7)	5 (0-5)	5 (0-5)
21	Located in 2020	23 (18–23)	31 (24-31)	17 (11-17)
22	Located in 2020	5 (3–5)	NA[3]	NA[3]
23	Located in 2020	6 (1–6)	2 (0-2)	0
24	Located in 2020	5[2]	6 (0-6)	5 (0-5)
25	Located in 2020	9[2]	NA[3]	NA[3]
26	Located in 2020	5[2]	NA[3]	29 (5-29)
27	Located in 2020	4[2]	13 (0-13)	8 (0-8)
28	Located in 2020	9[2]	NA[3]	16 (13-16)
29	Located in 2020	5 (1–5)	NA[3]	NA[3]
30	Located in 2020	16 (12–16)	8 (5-8)	9 (5-9)
32	Located in 2022	NA[4]	NA[4]	24 (18-24)

1. Range of counts in parenthesis.
2. Located via helicopter survey and were unable to obtain landowner permission for subsequent visits.
3. No landowner permission.
4. Lek discovered in 2022.

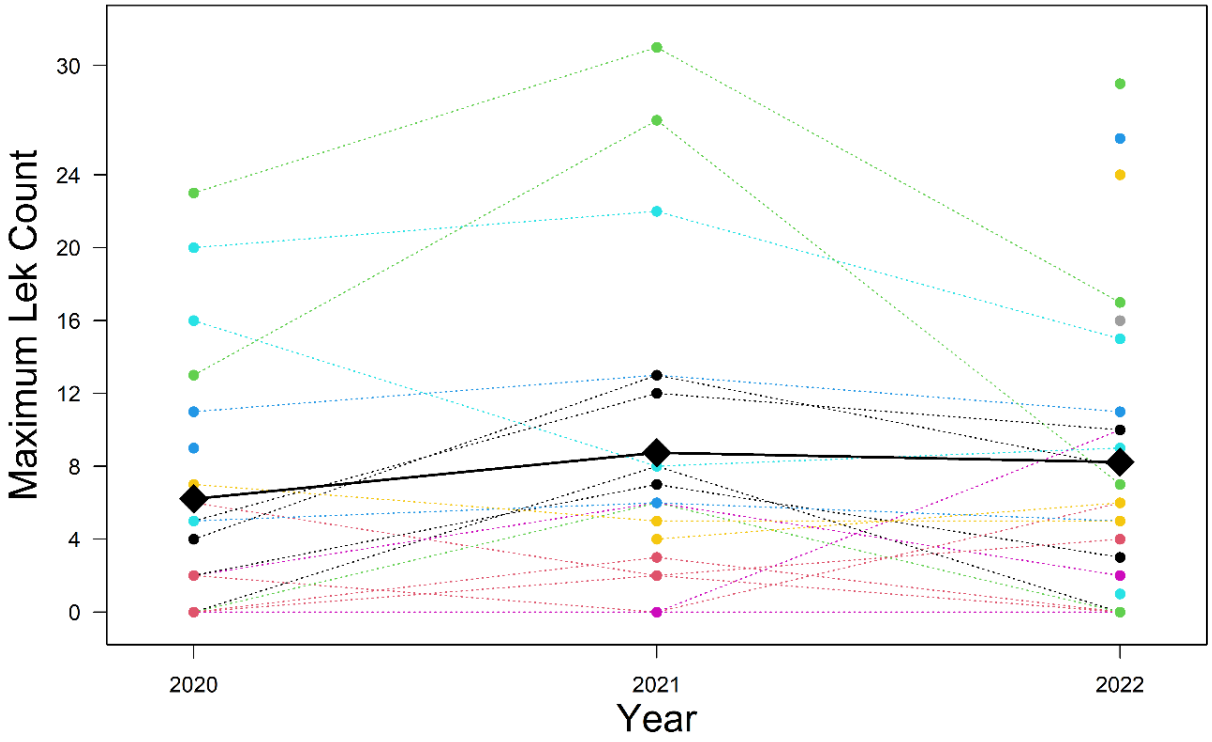

Figure 2. Trends in sharp-tailed grouse (STGR) leks monitored during 2020, 2021, and 2022 spring breeding seasons near the Crowned Ridge I and Crowned Ridge II Wind Energy Projects. Points connected by dashed lines represent individual leks. The solid black line connects the mean maximum lek count for each year.

Sharp-tailed Grouse Captures

We targeted six leks for capture between April 3 and April 27, 2022 (Table 2). We captured the majority of STGR at Lek 5 and Lek 32 located in the south central portion of CRI and northeast of CRI, respectively. Biologists trapped Lek 21 in 2022, however we did not capture any STGR there, likely because of a new lek (Lek 32) that was found 1,385 feet (422 meters) to the northeast of lek 21 in 2022. It is possible that individuals from Lek 21 were attending the larger Lek 32 where more breeding behavior was observed. Lek 20 was not trapped in 2022 as minimal lekking activity was observed during surveys. Similarly, we did not target Lek 9 for capture due to fewer individuals observed in 2022 compared to 2020. Overall, we placed 42 telemetry units on 26 females and 16 males during 2022 (Table 2).

Table 2. Summary of sharp-tailed grouse (STGR) captures at the Crowned Ridge I and Crowned Ridge II Wind Energy Projects during the 2020, 2021, and 2022 breeding seasons.

Lek number	# Females	# Males	Capture Dates
		2020	
5	15	5	3/29/2020 − 4/22/2020
9	1	2	4/22/2020 − 4/24/2020
16	3	0	3/30/2020 − 4/21/2020
20	4	0	3/30/2020 − 4/4/2020
21	21	0	3/30/2020 − 4/17/2020
30	7	3	4/13/2020 – 4/24/2020
		2021	
5	15	1	4/3/2021 – 4/18/2021
11	9	2	4/3/2021 – 4/19/2021
16	10	1	4/4/2021 – 4/17/2021
21	15	0	4/3/2021 – 4/11/2021
		2022	
5	17	2	4/4/2022 – 4/26/2022
11	1	3	4/3/2022 – 4/26/2022
16	1	1	4/9/2022 – 4/24/2022
21	0	0	4/6/2022 – 4/21/2022
30	1	2	4/17/2022 – 4/24/2022
32	6	8	4/19/2022 – 4/27/2022

Nest, Brood, and Seasonal Survival

Biologists documented nesting attempts from ten females in 2022 (Table 3). Ten first nests were documented, and no re-nesting attempts were documented. We were unable to access the property of one of the first nest attempts to determine its fate, so inference was made from the remaining nine nests. Kaplan-Meier nest survival estimates to 23 days for all nests was 44.4% (95% confidence intervals [CI] 21.4 to 92.3%; n = 4 successful nests).

Of the four successfully hatched nests, we determined brood success of one female. We were unable to determine the fate of the other three females with a hatched nest due to lack of land access or transmitter failure. Since we were unable to confirm the fates of multiple broods, we did not estimate brood survival for 2022. The brood we were able to monitor had at least one chick at 35 days post hatch.

We estimated survival of females during the 2022 breeding season (April 1 to August 15) from 29 individuals (two were excluded due to potential capture related mortality). Twenty females died during the breeding season. Kaplan-Meier female survival estimates during the breeding season was 27.4% (95% CI 13.5% to 55.4%). We estimated survival of males during the 2022 breeding season from 15 individuals. Seven males died during the breeding season. Kaplan-Meier male survival estimates during the breeding season was 43.3% (95% CI 22.4 to 83.6%). Demographic estimates obtained from 2020, 2021, and 2022 field seasons are located in Tables 3 and 4.

Table 3. Sharp-tailed grouse (STGR) demographic parameters assessed during the 2020, 2021 and 2022 field season near the Crowned Ridge I and Crowned Ridge II Wind Energy Projects.

Demographic Parameter	2020	2021	2022
Nest success	57.1% (42.9 –76.1%)	51.7% (36.4 – 73.5%)	44.4% (21.4–92.3%)
Brood success	57.9 % (39.5 – 85.0%)	46.2 (25.7 – 83.0%)	NA[1]
Female survival (April 1 to August 15)	43.3% (30.5 – 61.2%)	26.5% (16.7 – 42.5%)	27.4% (13.5–55.4%)
Male survival (April 1 to August 15)	75.0% (50.3 – 100%)	25.0% (4.6 – 100%)	43.3% (22.4–83.6%)

1. Insufficient data to estimate brood success

Table 4. Monthly Kaplan-Meier sharp-tailed grouse (STGR) survival estimates (95% confidence intervals in parenthesis) from radio-marked individuals near the Crowned Ridge I and Crowned Ridge II Wind Energy Projects, April through November 2020, 2021 and 2022.

Month	2020 Survival Estimate (%)	2021 Survival Estimate (%)	2022 Survival Estimates (%)
April	90.4% (81.7 – 100%)	64.4% (49.8 – 83.3%)	72.9% (53.9–98.7%)
May	73.1% (61.5 – 86.7 %)	68.3% (55.4 – 84.1%)	59.2% (45.2–77.5%)
June	81.8% (69.7 – 96.1%)	70.5% (55.3 – 84.1%)	49.4% (23.4–100%)
July	96.2% (89.0 – 100%)	89.5% (76.7 – 100%)	50.0% (18.8–100%)
August	95.6% (88.2 – 100%)	93.8% (82.6 – 100%)	NA[1]

1. Insufficient data to estimate monthly survival.

DISCUSSION AND CONTINUING EFFORTS

This report is intended to provide a progress update and satisfy reporting requirements outlined in the Mitigation Plan for the Projects. This report has addressed the 2020, 2021, and 2022 lek survey and capture efforts, and summarizes breeding metrics (nesting, brooding, and survival) and telemetry data collected during all three years to address objectives of the Mitigation Plan. Overall, this study will contribute to the science about potential responses of prairie grouse to wind energy development. The outcomes of this research will inform the siting of future wind energy facilities by identifying changes in selection or demography relative to wind energy infrastructure and providing recommendations on the placement and density of wind turbines to minimize impacts. Since no previous studies have investigated the response of plains STGR to wind energy development, this research will begin to fill gaps in knowledge and provide future research with baseline selection and demography parameters. A comprehensive report that addresses the specific objectives of this study (outlined above) will be submitted on June 1, 2023.

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