

# Avian Use Survey Report for the Proposed Crowned Ridge II Wind Facility, Codington, Deuel, and Grant Counties, South Dakota

June 2019

PREPARED FOR

**Crowned Ridge Wind II, LLC**

PREPARED BY

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**AVIAN USE SURVEY REPORT FOR THE  
PROPOSED CROWNED RIDGE II WIND FACILITY,  
CODINGTON, DEUEL, AND GRANT COUNTIES,  
SOUTH DAKOTA**

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# 1 INTRODUCTION

Crowned Ridge Wind II, LLC, a wholly-owned, indirect subsidiary of NextEra Energy Resources, LLC, plans to develop an approximately 300-megawatt wind facility known as the Crowned Ridge II Wind Energy Facility (the project) in Codington, Deuel, and Grant Counties, South Dakota (see project boundary, Figure 1). The proposed project also includes an on-site generation tie line. This line is located within the project boundary. Crowned Ridge Wind II, LLC, has entered into a purchase and sale agreement under which it will permit and construct the project (including the on-site generation tie line) and, thereafter, transfer the project, along with its Facility Permits, to Northern States Power at the commercial operations date. For the purposes of this assessment, the study area consisted of an approximately 50,175-acre area (see study area, Figure 1).

Crowned Ridge Wind II, LLC, contracted SWCA Environmental Consultants (SWCA) to conduct large and small bird use surveys in the study area. The objectives of the surveys were to characterize the activity, spatial distribution, and relative abundance of avian species there. This report summarizes the methods and results of large and small bird use surveys conducted from April 1, 2017, through November 30, 2017, in the study area.

## 2 METHODS

### 2.1 Large Bird Use Surveys

SWCA developed the large bird use survey protocols in accordance with recommendations set forth in the U.S. Fish and Wildlife Service's (USFWS's) *Land-Based Wind Energy Guidelines* (USFWS 2012) and *Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Version 2* (ECPG) (USFWS 2013). The purpose of these studies is to characterize the activity, spatial distribution, and relative abundance of diurnal raptors and other large bird species using the study area. Survey data is useful to identify potential high use areas in the study area that may be avoided during project design to avoid and minimize the potential risk to large birds.

Large birds generally are defined as those the size of waterfowl or larger and include raptors, vultures, waterfowl, herons, pelicans, and corvids. Federally listed species, state-listed species, and large flocks of small birds also were considered target groups during large bird use surveys.

SWCA used a spatially balanced sampling design to establish 29 circular point count locations, each with a survey area of 800 meters (m) (2,625 feet) in radius, throughout the study area (Figure 1). This sampling method captures the variability in habitat and vegetation conditions, topography, and potential turbine numbers and densities within the study area. These locations allowed for nearly 30% survey coverage of the study area, which is recommended in the ECPG (USFWS 2013). Point count locations were micro-sited in the field to minimize obstructed views of the surrounding terrain and corresponding airspace.

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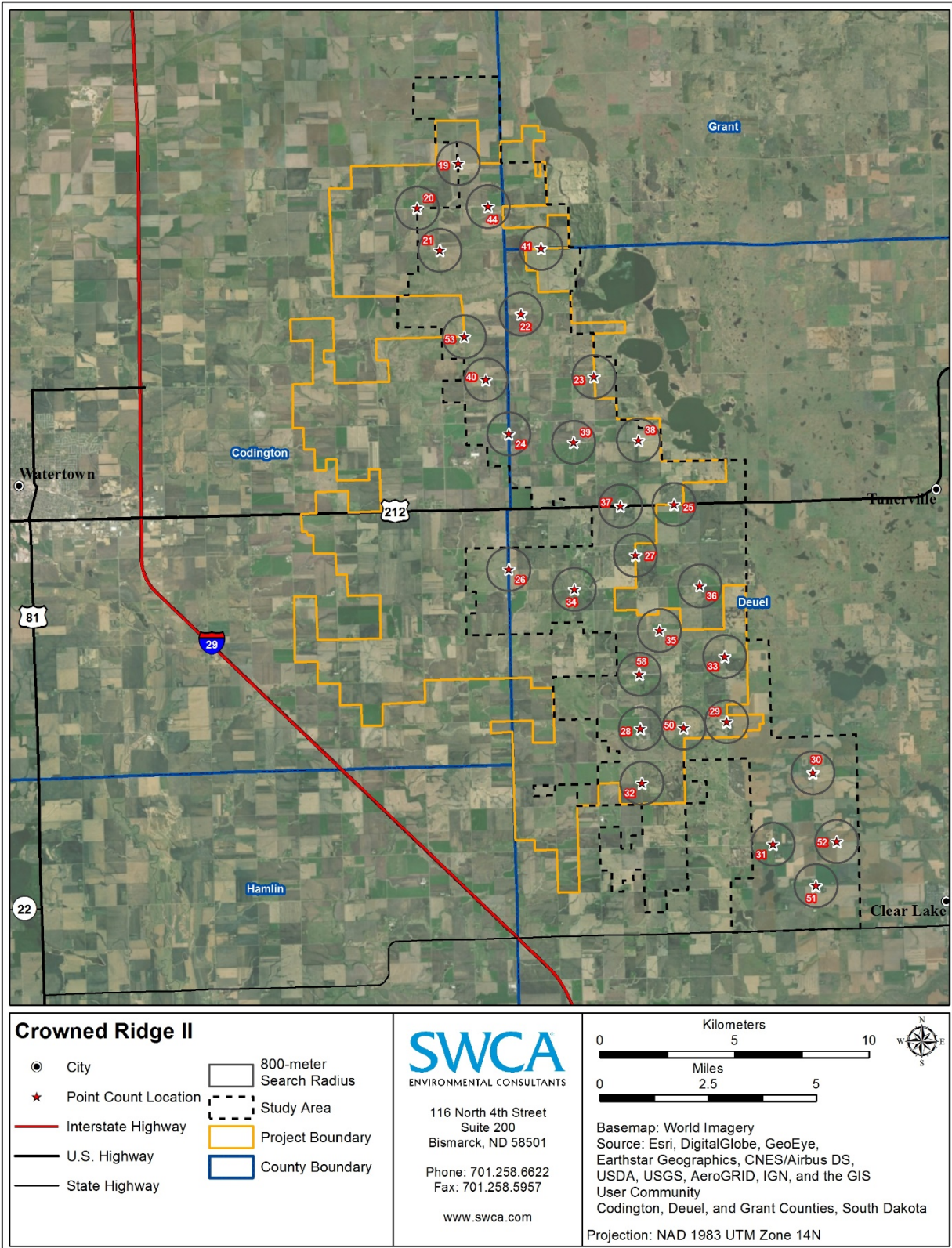


Figure 1. Project location and study area showing point count survey plots.



SWCA completed surveys of each of the 29 point count locations once a month for 8 months (232 surveys total for the study area). The surveys lasted for 1 hour per survey date at each of the 29 point count locations, in accordance with ECPG guidance in the (USFWS 2013:Technical Appendix C). The schedule was designed and implemented to provide survey coverage across all hours for each of the point count locations in accordance with ECPG guidance. The schedule also was designed such that multiple large bird use surveys conducted on any given day were separated spatially to increase the likelihood of independent observations.

SWCA collected the following data for each large bird observation within the 800-m-radius survey areas: species, age, sex, number of individuals, distance to bird(s), azimuth to bird(s), estimated flight height within three bins (0–30 m [0–98 feet], 30–200 m [98–656 feet], and 200+ m [656+ feet]), flight direction, beginning and ending time of presence within the point count location, flight time (recorded as number of seconds), behavioral activity, and interactions with other birds. SWCA also collected flight pathway information per recommendations in Strickland et al. (2011) and the ECPG (USFWS 2013). Flight pathway data were collected for raptor species. Flight pathways within the point count location 800m survey area were digitally recorded using ArcGIS Collector software. This software allowed biologists to record the flight path as a spatial data layer, which overlaid aerial imagery displaying relevant landforms in each survey area. The data was uploaded and analyzed using geographic information system (GIS) software.

## 2.2 Small Bird Use Surveys

SWCA developed the small bird use survey protocols in accordance with recommendations set forth in the USFWS's *Land-Based Wind Energy Guidelines* (USFWS 2012). The purpose of small bird use surveys is to characterize the activity, spatial distribution, and relative abundance of passerine and other small bird species using the study area. To understand small bird use in the study area across all daylight hours, SWCA conducted small bird point count surveys in conjunction with the large bird use surveys.

Small birds generally are defined as those smaller in size than a crow and include passerine species. Federally listed species, state-listed species, and large flocks of small birds also were considered target groups during small bird use surveys. The small bird use surveys were conducted at the same point count locations as the large bird use surveys (see Figure 1). The biologists recorded all birds detected within a 100-m-radius (328-foot-radius) of each location for 10 minutes before beginning the large bird use surveys.

SWCA collected the following data for each observation made during the small bird use surveys: species, number of observations by species, age and sex, behavior, method of detection (visual or auditory), estimated distance from the observer to each bird, time each bird or group of birds was detected within the point count location survey area, temperature, wind speed and direction, cloud cover, and precipitation. In addition, the biologists recorded large bird species observed outside the 100-m-radius survey areas as incidental observations during the small bird surveys.

## 3 DATA ANALYSIS

Data collected during the large bird use surveys allow for robust analysis of large bird use in the study area. Analysis of these data provides the following metrics: species composition, diversity, and abundance; relative abundance and frequency of observations per guild and species; eagle and raptor use (number of observations/60-minute-survey/800-m-radius survey plot) and minutes (eagle flight minutes within 800-m-radius survey plot up to 200 m [656 feet] in height); large bird use (large bird observations/survey period/800-m-radius survey plot); comparisons of use below, in, and above the rotor-swept area; vegetation type near observations; and notable behavior or flight patterns. In addition, analysis has the potential to identify potential high-use areas in the study area that may be avoided during project design to avoid or minimize the potential risk to birds.

The small bird point count survey data were analyzed to measure different indices of abundance for the study area. Analysis of small bird use survey data provides the following metrics: species composition, diversity, and abundance; frequency of observations per guild and species; small bird use (number of observations/8-minute survey/100-m-radius survey plot); comparisons of use below, in, and above the rotor-swept area; and notable behavior patterns observed during the survey. Small bird use also was compared between seasons to understand the relative use by individuals and species between seasons.

## 4 RESULTS

### 4.1 Large Bird Use

SWCA performed 232 surveys across the 29 point count locations in the study area from April 1, 2017, through November 30, 2017. In total, large bird use surveys were conducted for 13,920 survey minutes (232 survey hours). The survey efforts were evenly distributed across the 29 point count locations. All point count locations were surveyed for 60 minutes monthly for 8 months.

No large birds were observed during 67 (28.8%) of the 232 surveys. During the remaining 165 surveys, SWCA recorded 471 large bird observations (Table 1). The number of observations per point count locations ranged from seven to 28 (mean = 16.2, standard deviation = 5.9). Relative abundance (i.e., the percentage of total large bird observations made at an individual point count location) ranged from 1.0% to 6.0% (see Table 1).

**Table 1. Number and Relative Abundance of Large Bird Observations by Point Count Location**

Point Count Location	Number of Observations	Relative Abundance*
CR19	17	4.0
CR20	26	5.0
CR21	19	4.0
CR22	17	4.0
CR23	28	6.0
CR24	16	3.0
CR25	7	1.0
CR26	8	2.0
CR27	13	3.0
CR28	8	2.0
CR29	16	3.0
CR30	23	4.0
CR31	12	4.0
CR32	13	3.0
CR33	16	3.0
CR34	14	3.0
CR35	17	4.0
CR36	22	5.0
CR37	18	4.0

Point Count Location	Number of Observations	Relative Abundance*
CR38	18	4.0
CR39	11	2.0
CR40	17	4.0
CR41	18	4.0
CR44	21	4.0
CR50	12	3.0
CR51	22	5.0
CR52	18	4.0
CR53	10	2.0
CR58	14	3.0
Total	471	100.0

\* Relative abundance is expressed as the percentage of total large bird observations (n=471) recorded at an individual point count location.

### 4.1.1 Species

The 471 large bird observations consisted of 33 species and individuals that could not be identified to species but were placed within three generic categories (unknown duck, unknown dowitcher, and unknown swan) (Table 2). Ten raptor species were recorded: American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), Cooper's hawk (*Accipiter cooperii*), merlin (*F. columbarius*), northern goshawk (*Accipiter gentilis*), northern harrier (*Circus cyaneus*), rough-legged hawk (*Buteo lagopus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipiter striatus*), and Swainson's hawk (*Buteo swainsoni*).

The 23 non-raptor species recorded were American crow (*Corvus brachyrhynchos*), American white pelican (*Pelecanus erythrorhynchos*), American wigeon (*Anas americana*), blue-winged teal (*Spatula discors*), Canada goose (*Branta canadensis*), double-crested cormorant (*Phalacrocorax auritus*), Franklin's gull (*Leucophaeus pipixcan*), gadwall (*Mareca strepera*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), greater prairie-chicken (*Tympanuchus cupido*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), ring-billed gull (*Larus delawarensis*), ring-necked pheasant (*Phasianus colchicus*), sandhill crane (*Grus canadensis*), snowy egret (*Egretta thula*), snow goose (*Chen caerulescens*), turkey vulture (*Cathartes aura*), Wilson's snipe (*Gallinago delicata*), and wild turkey (*Meleagris gallopavo*).

Red-tailed hawk (*Buteo jamaicensis*) accounted for 106 of the 471 observations (22.5% of total observations) followed distantly by northern harrier (*Circus cyaneus*) with 60 observations (12.7% of total observations). Collectively, those two groups accounted for 166 (35.2%) of all observations.

SWCA's biologists recorded red-tailed hawk during 52 of the 232 surveys (22.4% of total surveys) and northern harrier during 45 surveys (19.3% of total surveys) (see Table 2). SWCA determined the frequency of species occurrence during the 232 large bird surveys, with 19 of the 33 large bird species (57.6%) observed during more than 1% of the 232 surveys and 16 of the 33 large bird species (48.5%) observed during less than 1% of the 232 surveys. SWCA's biologists recorded the bald eagle within the study area, which is one large bird species recognized by the USFWS as a bird of conservation concern (BCC).

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**Table 2. Total Large Bird Species Composition, Abundance, and Occurrence**

<b>Large Bird Species</b>	<b>Abundance*</b>	<b>Relative Abundance†</b>	<b>Number of Surveys During Which Species Was Recorded</b>	<b>Frequency of Occurrence‡</b>
American crow	28	5.9	25	5.3
American kestrel	1	0.2	1	0.2
American widgeon	1	0.2	1	0.2
American white pelican	14	3.0	12	2.5
Bald eagle	6	1.3	2	0.4
Blue-winged teal	1	0.2	1	0.2
Canada goose	50	10.6	26	5.5
Cooper's hawk	5	1.1	4	0.8
Double-crested cormorant	7	1.5	6	1.3
Franklin's gull	25	0.4	19	0.4
Gadwall	2	5.3	2	4.0
Great blue heron	6	0.4	6	0.4
Great egret	3	1.3	3	1.3
Greater prairie-chicken	2	0.6	2	0.6
Greater yellowlegs	3	0.2	2	0.2
Lesser yellowlegs	1	0.2	1	0.2
Mallard	38	0.6	31	0.4
Merlin	1	0.2	1	0.2
Northern goshawk	1	8.1	1	6.6
Norther harrier	60	0.2	45	0.2
Northern shoveler	2	0.2	2	0.2
Ring-billed gull	20	12.7	18	9.6
Rough-legged hawk	8	0.4	7	0.4
Ring-necked pheasant	15	4.2	14	3.8
Red-tailed hawk	106	1.7	36	1.5
Sandhill crane	3	2.1	3	2.1
Snowy egret	1	1.1	1	0.8
Snow goose	11	0.4	10	0.2
Sharp-shinned hawk	5	22.5	5	11.0
Swainson's hawk	10	0.6	9	0.6
Turkey vulture	17	0.2	14	0.2
Unknown dowitcher	2	2.3	2	2.1
Unknown duck	4	1.1	2	1.1
Unknown swan	1	0.2	1	0.2
Wilson's snipe	1	2.1	1	1.9
Wild turkey	3	3.6	3	1.3

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Large Bird Species	Abundance*	Relative Abundance†	Number of Surveys During Which Species Was Recorded	Frequency of Occurrence‡
Total	471	100	165§	71.1¶

\* Abundance = total number of observations per species.

† Relative abundance = the percentage of large bird observations (n=471) recorded at an individual point count location.

‡ Frequency = percentage of all surveys (n=232) during which the species or group was recorded.

§ The total number of surveys with at least one large bird observation (regardless of number of species) is 165.

¶ The percentage of surveys with at least one large bird or flock observation (165 of 232 = 71.1 %).

## 4.1.2 Seasonality

Monthly totals for large bird species observed during the study period are provided in Table 3. Large bird observations varied considerably between months, ranging from 14 to 144 observations per month. The three lowest monthly totals occurred in May, July, and September (see Table 3).

Northern harrier was the only species recorded each month. Seasonal occurrence of migratory species is evident for several species. Seasonal occurrence of migratory species is evident for several species. For example, biologists recorded Canada goose during August, September, October, and November. Conversely, biologists recorded rough-legged hawk only during its expected migratory and overwintering season in October and November.

**Table 3. Number of Large Bird Species Observations by Month**

Large Bird Species	2017							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
American crow	5	4	4	0	3	0	6	6
American kestrel	0	0	0	0	0	0	0	1
American widgeon	1	0	0	0	0	0	0	0
American white pelican	1	0	8	3	2	0	0	0
Bald eagle	0	0	0	0	0	0	0	6
Blue-winged teal	0	0	1	0	0	0	0	0
Canada goose	3	2	0	0	5	3	3	34
Cooper's hawk	0	0	2	0	1	0	2	0
Double-crested cormorant	1	0	2	1	1	0	2	0
Franklin's gull	0	0	0	0	3	11	11	0
Gadwall	0	1	1	0	0	0	0	0
Great blue heron	0	0	0	0	4	0	2	0
Great egret	0	0	1	1	1	0	0	0
Greater prairie-chicken	0	0	1	0	1	0	0	0
Greater yellowlegs	0	0	0	0	0	0	3	0
Lesser yellowlegs	0	0	0	0	0	0	1	0
Mallard	11	5	12	0	3	0	2	5
Merlin	0	0	0	0	0	0	1	0

Large Bird Species	2017							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Northern goshawk	1	0	0	0	0	0	0	0
Norther harrier	9	6	4	1	6	4	26	4
Northern shoveler	1	1	0	0	0	0	0	0
Ring-billed gull	10	0	3	1	2	1	3	0
Rough-legged hawk	0	0	0	0	0	0	1	7
Ring-necked pheasant	0	0	5	3	1	1	0	5
Red-tailed hawk	5	9	9	2	4	6	71	0
Sandhill crane	1	0	0	0	0	0	0	2
Snowy egret	1	0	0	0	0	0	0	0
Snow goose	1	0	0	0	0	0	1	9
Sharp-shinned hawk	0	0	0	0	0	0	2	3
Swainson's hawk	4	0	1	1	4	0	0	0
Turkey vulture	1	1	4	1	5	2	3	0
Unknown dowitcher	0	0	0	0	1	0	1	0
Unknown duck	0	0	0	0	0	0	1	4
Unknown swan	0	0	0	0	0	0	0	1
Wilson's snipe	0	0	0	0	0	0	2	0
Wild turkey	2	1	1	0	3	0	0	2
<b>Total</b>	<b>58</b>	<b>30</b>	<b>59</b>	<b>14</b>	<b>50</b>	<b>28</b>	<b>144</b>	<b>88</b>

### 4.1.3 Flight Height

The estimated flight height upon initial detection of an observation was recorded to characterize raptor use within the zone between 0 to 200 m aboveground, which the USFWS recognizes as a zone with potential for collisions between raptors and wind turbine infrastructure. Two-hundred seventy-five flight observations out of the total 471 flight observations (58.4% of total) were of large birds flying within this zone (Table 4). However, 209 of the observations (44.4% of total observations) were of large birds flying below 30 m aboveground and therefore may be considered outside the rotor-swept zone for wind turbine models typically used at commercial wind energy facilities (31–200 m). A total of 196 observations (41.6% of total observations) were of large birds flying above 200 m aboveground. A total of 66 observations (14.0% of total observations) were of large birds flying within the rotor-swept zone.

**Table 4. Number of Large Bird Observations Per Flight Height Bin**

Large Bird Species	Flight Height Bin (meters)		
	0–30	31–200	>200
American white pelican	2	4	8
Bald eagle	1	4	0
Blue-winged teal	1	0	0
Canada goose	9	5	36
Cooper's hawk	3	1	1

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Large Bird Species	Flight Height Bin (meters)		
	0–30	31–200	>200
Double-crested cormorant	2	3	2
Franklin's gull	2	9	14
Gadwall	2	0	0
Great blue heron	3	0	3
Great egret	2	1	0
Greater prairie-chicken	2	0	0
Greater yellowlegs	0	0	3
Lesser yellowlegs	0	0	1
Mallard	26	1	11
Merlin	0	0	1
Northern goshawk	0	0	1
Norther harrier	46	2	12
Northern shoveler	2	0	0
Ring-billed gull	12	1	7
Rough-legged hawk	4	1	3
Ring-necked pheasant	15	0	0
Red-tailed hawk	30	21	55
Sandhill crane	0	1	2
Snowy egret	1	0	0
Snow goose	2	5	4
Sharp-shinned hawk	0	1	1
Swainson's hawk	5	1	4
Turkey vulture	5	2	10
Unknown dowitcher	0	0	2
Unknown duck	2	0	2
Unknown swan	0	0	1
Wilson's snipe	0	0	2
Wild turkey	9	0	0
<b>Total</b>	<b>209</b>	<b>66</b>	<b>196</b>

#### 4.1.4 Behavior

Large bird observations per type of behavior are provided in Table 5. Most of the observations (267 of 471; 56.7%) were of large birds exhibiting the behavior of powered flight. Biologists recorded large bird observations demonstrating the behavior of circle soaring (63; 13.4%), gliding (24; 5.1%), soaring (6; 1.3%), and hovering (30; 6.4%). Eighty-one observations (22.8%) were recorded using a non-flight behavior category (e.g., calling, foraging, perched).

**Table 5. Number and Frequency of Large Bird Observations Per Type of Behavior**

Behavior	Number of Observations	Frequency (percent)
Circle soaring	63	13.4
Gliding	24	5.1
Powered flight	267	56.7
Hovering	30	6.4
Soaring	6	1.3
Calling	20	4.0
Foraging	33	7.0
Perched	28	6.0
Total	471	100.0

#### 4.1.5 Time of Day

SWCA's biologists conducted the surveys between 6:00 a.m. and 5:00 p.m., with hourly average number of large bird observations ranging from 1.5 to 3.3 per survey. The biologists recorded very few observations in the early morning (6:00 a.m.) and early evening (4:00 p.m.) hours relative to other hours. The 7:00 a.m., 11:00 a.m., and 5:00 p.m. hours were associated with an uptick in observations per survey, which averaged 2.4, 2.5, and 3.3, respectively. Table 6 provides the total number of observations for each survey hour, number of surveys per hour, and average number of observations per survey in each hour during the study period.

**Table 6. Number of Large Bird Observations and Surveys by Hour Per Month**

Month	6:00 a.m.	7:00 a.m.	8:00 a.m.	9:00 a.m.	10:00 a.m.	11:00 a.m.	12:00 p.m.	1:00 p.m.	2:00 p.m.	3:00 p.m.	4:00 p.m.	5:00 p.m.
April	2	6	9	9	3	6	4	7	7	5	0	0
May	6	0	6	4	2	1	2	4	3	2	0	0
June	0	3	6	6	7	2	8	3	4	8	3	9
July	0	2	1	2	0	1	1	2	0	5	0	0
August	4	5	4	0	4	1	14	0	8	6	4	0
September	2	3	1	7	0	1	1	1	5	0	6	1
October	7	2	12	20	10	33	22	15	15	6	2	0
November	0	24	14	1	18	4	7	4	9	4	3	0
Number of observations per hour	21	45	53	49	44	49	59	36	51	36	18	10
Number of surveys per hour	14	19	26	25	27	20	28	18	25	20	11	3
Average number of observations per survey	1.5	2.4	2.0	2.0	1.6	2.5	2.1	2.0	2.0	1.8	1.6	3.3



### 4.1.6 Eagle Observations

During the 8-month study period, the biologists recorded six observations of bald eagles across 29 survey plots. One bald eagle was observed at point count location CR29, and the other five bald eagle observations took place at point count location CR33. All six bald eagle observations were made of individuals in flight within the potential zone for collisions between raptors and infrastructure (0–200 m). However, one of these observations (16.6% of the observations) occurred below 30 m aboveground and therefore may be considered outside the rotor-swept zone for wind turbine models typically used at commercial wind energy facilities. All six observations took place for a total of 38 flight minutes. The 38 recorded eagle flight minutes during the 13,920 minutes of survey across the 8-month study period equates to 0.00273 flight minute per survey minute. No golden eagles (*Aquila chrysaetos*) or other unidentified eagles were detected during the 8-month study period.

## 4.2 Small Bird Use

SWCA performed 232 surveys across the 29 point count locations in the study area from April 1, 2017, through November 30, 2017. The survey efforts were evenly distributed across the 29 point count locations. All locations were surveyed for 10 minutes per survey for eight survey sessions. The small bird use surveys took place before the large bird use surveys at each point count location.

No small birds were observed during 34 of the surveys (14.7% of total surveys). During the remaining 198 surveys, SWCA biologists recorded 637 observations (Table 7). The number of observations per point count location ranged from nine to 35 (mean = 22.0, standard deviation = 6.8). Relative abundance (i.e., the percentage of total small bird observations made at an individual point count location) ranged from 1.4% to 5.5% (see Table 7).

**Table 7. Number and Relative Abundance of Small Bird Observations Per Point Count Location**

Point Count Location	Number of Observations	Relative Abundance <sup>a</sup>
CR19	11	1.7
CR20	26	4.1
CR21	22	3.5
CR22	15	2.4
CR23	24	3.8
CR24	16	2.5
CR25	17	2.7
CR26	27	4.2
CR27	31	4.9
CR28	17	2.7
CR29	15	2.4
CR30	25	3.9
CR31	22	3.5
CR32	27	4.2
CR33	22	3.5
CR34	26	4.1

Point Count Location	Number of Observations	Relative Abundance <sup>†</sup>
CR35	30	4.7
CR36	24	3.8
CR37	9	1.4
CR38	22	3.5
CR39	17	2.7
CR40	31	4.9
CR41	21	3.3
CR44	16	2.5
CR50	30	4.7
CR51	35	5.5
CR52	10	1.6
CR53	30	4.7
CR58	19	3.0
Total	637	100.0

<sup>†</sup> Relative abundance = the percentage of total small bird observations (n=637) recorded at an individual point count location.

### 4.2.1 Species

The 637 total small bird observations consisted of 54 species and individuals that could not be identified to species but were placed in four generic categories (unknown sparrow, unknown longspur, unknown blackbird, and unknown yellowlegs) (Table 8). Western meadowlark (*Sturnella neglecta*) accounted for 100 of the 637 observations (15.7% of total observations), followed by red-winged blackbird (*Agelaius phoeniceus*) with 83 observations (13.0% of total observations), and American robin (*Turdus migratorius*) with 36 observations (5.7% of total observations). Collectively, these three species accounted for 219 (34.4%) of all observations.

SWCA biologists recorded western meadowlark during 70 of the 232 surveys (30.2% of total surveys), followed by red-winged blackbird during 71 surveys (30.6% of total surveys), and American robin during 36 surveys (15.5% of total surveys). SWCA detected the frequency of species occurrence during the 232 small bird surveys, with 18 of the 54 small bird species (33.3%) observed during more than 1% of the 232 surveys and 36 of 54 of the small bird species (66.6%) observed during less than 1% of the 232 surveys (see Table 8).

SWCA's biologists recorded three small bird species recognized by the USFWS as BCC within the study area: the chestnut-collard longspur (*Calcarius ornatus*), grasshopper sparrow (*Ammodramus saviannarum*), and upland sandpiper (*Bartramia longicauda*) (USFWS 2008). No observations of the federally threatened red knot occurred during the 8-month survey period.

**Table 8. Total Small Bird Species Composition, Abundance, and Occurrence**

Small Bird Species	Abundance*	Relative Abundance <sup>†</sup>	Number of Surveys During Which Species Was Recorded	Frequency of Occurrence <sup>‡</sup>
American goldfinch	21	3.3	17	2.7

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<b>Small Bird Species</b>	<b>Abundance*</b>	<b>Relative Abundance†</b>	<b>Number of Surveys During Which Species Was Recorded</b>	<b>Frequency of Occurrence‡</b>
American pipit	5	0.8	5	0.8
American robin	36	5.6	33	5.2
Baltimore oriole	1	0.2	1	0.2
Barn swallow	22	3.4	20	3.1
Black-billed magpie	1	0.2	1	0.2
Brown-headed cowbird	18	2.8	15	2.3
Blue jay	2	0.3	2	0.3
Bobolink	10	1.6	10	1.6
Brewer's blackbird	12	1.9	12	1.9
Clay-colored sparrow	4	0.6	4	0.6
Cedar waxwing	2	0.3	2	0.3
Chestnut-collard Longspur	1	0.2	1	0.2
Chipping sparrow	6	0.9	6	0.9
Cliff swallow	4	0.6	4	0.6
Common grackle	29	4.5	25	3.9
Common redpoll	1	0.2	1	0.2
Common yellowthroat	3	0.5	3	0.5
Dickcissel	6	0.9	6	0.9
Downy woodpecker	2	0.3	2	0.3
Eastern kingbird	13	2.0	13	2.0
European starling	13	2.0	13	2.0
Field sparrow	3	0.5	3	0.5
Fox sparrow	1	0.2	1	0.2
Franklin's gull	2	0.3	2	0.3
Grasshopper sparrow	13	2.0	13	2.0
House finch	1	0.2	1	0.2
Horned lark	36	5.6	33	5.2
House sparrow	18	2.8	16	2.5
House wren	1	0.2	1	0.2
Killdeer	26	4.1	25	3.9
Lapland longspur	4	0.6	3	0.5
Mourning dove	18	2.8	17	2.7
Northern rough-winged swallow	2	0.3	2	0.3
Pine siskin	2	0.3	2	0.3
Rock pigeon	2	0.3	2	0.3
Red-winged blackbird	83	13.0	71	11.1
Savannah sparrow	19	3.0	10	1.6
Sedge wren	1	0.2	1	0.2

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<b>Small Bird Species</b>	<b>Abundance*</b>	<b>Relative Abundance†</b>	<b>Number of Surveys During Which Species Was Recorded</b>	<b>Frequency of Occurrence‡</b>
Snow bunting	2	0.3	2	0.3
Song sparrow	23	3.6	22	3.4
Spotted sandpiper	1	0.2	1	0.2
Spotted towhee	1	0.2	1	0.2
Swamp sparrow	2	0.3	2	0.3
Tree sparrow	18	2.8	15	2.3
Unknown blackbird	3	0.5	2	0.3
Unknown longspur	1	0.2	1	0.2
Unknown sparrow	7	1.1	6	0.9
Unknown yellowlegs	1	0.2	1	0.2
Upland sandpiper	7	1.1	7	1.1
Vesper sparrow	15	2.3	15	2.3
Western kingbird	4	0.6	4	0.6
Western meadowlark	100	15.6	70	11.0
Yellow warbler	3	0.5	3	0.5
Yellow-headed blackbird	3	0.5	3	0.5
Yellow-rumped warbler	1	0.2	1	0.2
Yellow-throated vireo	1	0.2	1	0.2
<b>Total</b>	<b>637</b>	<b>100</b>	<b>198<sup>§</sup></b>	<b>85.3<sup>¶</sup></b>

\* Abundance refers to the total number of observations per species or group.

† Relative abundance is expressed as the percentage of small bird observations (n=637) recorded at an individual point count location.

‡ Frequency is expressed as the percentage of all surveys (n=232) during which the species or group was recorded.

§ The total number of surveys with at least one small bird observation (regardless of number of species) is 198 and is not the sum of individual species.

¶ The percentage of surveys with at least one small bird observation (198 of 232 = 85.3%).

## 4.2.2 Seasonality

Table 9 provides monthly totals for the small bird species observed across all point locations during the study period. The total number of small bird observations per month varied considerably between months, ranging from 34 to 132. The three lowest monthly totals occurred during the late-fall and winter period in September, October, and November (see Table 9). Red-winged blackbird was the only species recorded during all 8 months.

**Table 9. Number of Small Bird Observations by Month**

<b>Small Bird Species</b>	<b>2017</b>							
	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sept</b>	<b>Oct</b>	<b>Nov</b>
American goldfinch	0	0	2	3	12	2	2	0
American pipit	0	0	0	0	0	0	5	0
American robin	7	4	2	4	6	10	3	0

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Small Bird Species	2017							
	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Baltimore oriole	0	0	1	0	0	0	0	0
Barn swallow	0	6	8	0	8	0	0	0
Black-billed magpie	0	1	0	0	0	0	0	0
Brown-headed cowbird	0	0	15	1	0	1	1	0
Blue jay	0	0	0	0	0	0	1	1
Bobolink	0	0	5	5	0	0	0	0
Brewer's blackbird	0	0	0	6	2	2	1	1
Clay-colored sparrow	0	0	2	0	1	1	0	0
Cedar waxwing	0	0	0	2	0	0	0	0
Chestnut-collard Longspur	0	0	1	0	0	0	0	0
Chipping sparrow	0	1	1	0	4	0	0	0
Cliff swallow	0	0	0	0	4	0	0	0
Common grackle	0	6	14	1	7	0	1	0
Common redpoll	0	0	0	0	0	0	0	1
Common yellowthroat	0	0	3	0	0	0	0	0
Dickcissel	0	0	6	0	0	0	0	0
Downy woodpecker	0	0	0	0	0	0	1	1
Eastern kingbird	0	3	3	0	6	1	0	0
European starling	0	6	2	0	2	0	3	0
Field sparrow	3	0	0	0	0	0	0	0
Fox sparrow	0	1	0	0	0	0	0	0
Franklin's gull	0	0	0	0	0	0	2	0
Grasshopper sparrow	1	2	5	4	0	1	0	0
House finch	0	0	0	0	0	0	1	0
Horned lark	1	11	3	0	1	1	4	15
House sparrow	7	9	0	0	2	0	0	0
House wren	0	0	0	1	0	0	0	0
Killdeer	6	10	3	4	0	3	0	0
Lapland longspur	0	0	0	0	0	0	0	4
Mourning dove	2	6	0	0	7	3	0	0
Northern rough-winged swallow	0	0	1	0	1	0	0	0
Pine siskin	0	0	0	0	0	0	0	2
Red-winged blackbird	0	0	0	0	1	0	1	0
Rock pigeon	24	24	15	9	1	2	5	4
Savannah sparrow	0	0	5	1	3	1	9	0
Sedge wren	0	0	1	0	0	0	0	0
Snow bunting	0	0	0	0	0	0	0	2
Song sparrow	0	2	2	9	8	1	1	0

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Small Bird Species	2017							
	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Spotted sandpiper	0	0	0	0	1	0	0	0
Spotted towhee	0	0	0	1	0	0	0	0
Swamp sparrow	0	0	0	0	0	0	1	1
Tree sparrow	0	0	0	0	0	0	0	18
Unknown blackbird	0	0	0	0	0	0	3	0
Unknown longspur	0	0	0	0	0	0	1	0
Unknown sparrow	0	0	0	0	0	0	6	0
Unknown yellowlegs	0	0	0	0	0	0	1	0
Upland sandpiper	0	7	0	0	0	0	0	0
Vesper sparrow	0	0	2	12	1	0	0	0
Western kingbird	0	0	1	1	0	2	0	0
Western meadowlark	27	33	7	10	6	1	16	0
Yellow warbler	0	0	1	2	0	0	0	0
Yellow-headed blackbird	0	0	2	1	0	0	0	0
Yellow-rumped warbler	0	0	0	0	0	1	0	0
Yellow-throated vireo	0	0	0	0	0	1	0	0
Total species observed/ month	78	132	113	77	84	34	69	50

### 4.2.3 Flight Height

The estimated flight height upon initial detection of an observation was recorded to characterize small bird use within the zone between 0 to 200 m aboveground, which the USFWS recognizes as a zone with potential for collisions between avian species and wind turbine infrastructure. Thirty-three flight observations of the total 637 flight observations (5.2% of total observations) were of small birds flying in the 31 to 200 m aboveground zone (Table 10). Most of the flight observations (604, 94.8% of total observations) were of small birds flying below 30 m and therefore may be considered outside the rotor swept zone for wind turbine models typically used at commercial wind energy facilities (31–200 m). No observations of small birds flying above 200 m were made.

**Table 10. Number of Small Bird Observations Per Flight Height Bin**

Small Bird Species	Flight Height Bin (meters)		
	0–30	31–200	>200
American goldfinch	20	1	0
American pipit	5	0	0
American robin	35	1	0
Baltimore oriole	1	0	0
Barn swallow	20	2	0
Black-billed magpie	1	0	0
Brown-headed cowbird	18	0	0

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Small Bird Species	Flight Height Bin (meters)		
	0–30	31–200	>200
Blue jay	2	0	0
Bobolink	10	0	0
Brewer's blackbird	10	2	0
Clay-colored sparrow	4	0	0
Cedar waxwing	2	0	0
Chestnut-collard longspur	1	0	0
Chipping sparrow	5	1	0
Cliff swallow	3	1	0
Common grackle	27	2	0
Common redpoll	1	0	0
Common yellowthroat	3	0	0
Dickcissel	6	0	0
Downy woodpecker	2	0	0
Eastern kingbird	13	0	0
European starling	12	1	0
Field sparrow	3	0	0
Fox sparrow	1	0	0
Franklin's gull	0	2	0
Grasshopper sparrow	13	0	0
House finch	1	0	0
Horned lark	33	3	0
House sparrow	18	0	0
House wren	1	0	0
Killdeer	26	0	0
Lapland longspur	4	0	0
Mourning dove	17	1	0
Northern rough-winged swallow	2	0	0
Pine siskin	2	0	0
Red-winged blackbird	2	0	0
Rock pigeon	75	8	0
Savannah sparrow	9	1	0
Sedge wren	9	0	0
Snow bunting	1	0	0
Song sparrow	2	0	0
Spotted sandpiper	22	1	0
Spotted towhee	1	0	0
Swamp sparrow	1	0	0
Tree sparrow	2	0	0

Small Bird Species	Flight Height Bin (meters)		
	0–30	31–200	>200
Unknown blackbird	18	0	0
Unknown longspur	3	0	0
Unknown sparrow	0	1	0
Unknown yellowlegs	7	0	0
Upland sandpiper	0	1	0
Vesper sparrow	7	0	0
Western kingbird	15	0	0
Western meadowlark	4	0	0
Yellow warbler	97	3	0
Yellow-headed blackbird	3	0	0
Yellow-rumped warbler	3	0	0
Yellow-throated vireo	0	1	0
Total	604	33	0

#### 4.2.4 Behavior and Initial Detection

During the small bird use surveys, the biologists recorded the method by which each bird was initially detected (visual or aural detection) and the bird's behavior upon initial detection. Most of the observations (223 of 637, or 35.0%) were of individuals in powered flight (Table 11). Calling was the next most frequently observed behavior, totaling 179 (28.1%) of the observations. The remaining flight categories (circle soaring, gliding, hovering, and soaring) accounted for 14 observations. Of the 637 observations, 259 (40.6 %) were made by aural detection (e.g., singing).

**Table 11. Number and Frequency of Small Bird Observations Per Type of Behavior**

Behavior	Number of Observations	Frequency (percent)
Calling	179	28.1
Copulating	0	0
Circle Soaring	6	0.9
Displaying	8	1.3
Foraging	63	9.9
Gliding	1	0.2
Hovering	0	0.0
Perched	77	12.1
Powered flight	223	35.0
Singing	80	12.6
Total	637	100.0



## 4.2.5 Time of Day

The highest average number of small bird observations by hour for the 232 small bird surveys was during the 6:00 a.m. hour, which averaged 4.6 small bird observations per hour. The number of observations across hours was slightly skewed towards the morning hours of 6:00 a.m., 7:00 a.m., 8:00 a.m., 9:00 a.m., and 10:00 a.m., which averaged 4.6, 3.4, 3.8, 3.1, and 3.6 observations per survey hour, respectively, during the 8-month study. The average number of observations was evenly distributed across the remaining hours with a slight uptick in the 3:00 p.m. hour, which averaged 3.1 observations per survey hour. Table 12 presents the total number of observations for each hour, the number of surveys per hour, and the average number of observations per survey in each hour during the study period.

**Table 12. Number of Small Bird Observations and Surveys by Hour Per Month**

Month	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	12 p.m.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.
April	2	8	15	13	11	3	8	6	4	8	0	0
May	16	7	20	17	16	13	6	6	17	14	0	0
June	0	15	15	4	18	19	5	2	6	17	8	4
July	6	7	7	3	5	5	6	13	8	12	5	0
August	30	8	10	6	2	1	14	0	7	2	4	0
September	6	5	2	8	6	0	1	2	0	3	1	0
October	0	10	8	10	14	10	5	4	1	3	2	2
November	0	11	7	1	8	9	7	7	0	0	0	0
Number of observations/ hour	60	71	84	62	80	60	52	40	43	59	20	6
Number of surveys/ hour	13	21	22	20	22	20	18	16	18	19	8	3
Average number of observations/ survey	4.6	3.4	3.8	3.1	3.6	3.0	2.9	2.5	2.4	3.1	2.5	2.0

## 4.2.6 Vegetation Type

Table 13 presents the dominant National Landcover Dataset (U.S. Geological Survey 2014) habitat type and the number of species and observations for each of the 29 100-m-radius point count locations. Biologists recorded all 54 species and three other categories of small birds at point count locations dominated by tallgrass prairie and agriculture. However, biologists made approximately 80.8% more observations (515) in point count locations dominated by agriculture than observations (122) in tallgrass prairie dominated survey point locations. Species richness based on habitat type ranged from 6 to 21 species per point count location regardless of habitat type.

**Table 13. Habitat Type, Number of Species, and Number of Observations Per Point Count Location**

Survey Plot	Habitat Type	Number of Species	Number of Observations
CR19	Agriculture	8	11
CR20	Agriculture	11	26

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Survey Plot	Habitat Type	Number of Species	Number of Observations
CR21	Tallgrass prairie	12	22
CR22	Tallgrass prairie	11	15
CR23	Tallgrass prairie	15	24
CR24	Agriculture	12	16
CR25	Agriculture	11	17
CR26	Tallgrass prairie	14	27
CR27	Agriculture	18	31
CR28	Agriculture	12	17
CR29	Tallgrass prairie	10	15
CR30	Agriculture	16	25
CR31	Agriculture	16	22
CR32	Agriculture	20	27
CR33	Agriculture	18	22
CR34	Agriculture	17	26
CR35	Agriculture	20	30
CR36	Agriculture	15	24
CR37	Agriculture	8	9
CR38	Agriculture	14	22
CR39	Agriculture	14	17
CR40	Agriculture	19	31
CR41	Agriculture	13	21
CR44	Agriculture	9	16
CR50	Tallgrass prairie	12	30
CR51	Agriculture	21	35
CR52	Agriculture	6	10
CR53	Tallgrass prairie	15	30
CR58	Agriculture	15	19
Summary	Agriculture	35	515
	Tallgrass prairie	53	122

Fifty-two of the 54 (96.3%) species had an equal or higher number of observations in agricultural point count locations than in tallgrass prairie locations (Table 14). Three species—Baltimore oriole, black-billed magpie, and chestnut-collard longspur—were observed only on tallgrass prairie-dominated point count locations; however, there were only three observations total of those species.

**Table 14. Number of Observations per Species per Habitat Type**

Small Bird Species	Number of Observations	
	Agriculture	Tallgrass Prairie
American goldfinch	17	4

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Small Bird Species	Number of Observations	
	Agriculture	Tallgrass Prairie
American pipit	4	1
American robin	31	5
Baltimore oriole	0	1
Barn swallow	18	4
Black-billed magpie	0	1
Brown-headed cowbird	13	5
Blue jay	1	1
Bobolink	8	2
Brewer's blackbird	11	1
Clay-colored sparrow	3	1
Cedar waxwing	1	1
Chestnut-collard Longspur	0	1
Chipping sparrow	5	1
Cliff swallow	3	1
Common grackle	27	2
Common redpoll	1	0
Common yellowthroat	3	0
Dickcissel	4	2
Downy woodpecker	2	0
Eastern kingbird	10	2
European starling	11	2
Field sparrow	3	0
Fox sparrow	1	0
Franklin's gull	2	0
Grasshopper sparrow	10	3
House finch	1	0
Horned lark	30	6
House sparrow	14	4
House wren	1	0
Killdeer	22	4
Lapland longspur	4	0
Mourning dove	16	2
Northern rough-winged swallow	2	0
Pine siskin	2	0
Red-winged blackbird	69	14
Rock pigeon	2	0
Savannah sparrow	13	6
Sedge wren	1	0

Small Bird Species	Number of Observations	
	Agriculture	Tallgrass Prairie
Snow bunting	1	1
Song sparrow	18	5
Spotted sandpiper	1	0
Spotted towhee	1	0
Swamp sparrow	2	0
Tree sparrow	15	3
Unknown blackbird	3	0
Unknown longspur	1	0
Unknown sparrow	5	2
Unknown yellowlegs	1	0
Upland sandpiper	6	1
Vesper sparrow	12	3
Western kingbird	3	1
Western meadowlark	73	27
Yellow warbler	3	0
Yellow-headed blackbird	2	1
Yellow-rumped warbler	1	0
Yellow-throated vireo	1	0
<b>Total</b>	<b>515</b>	<b>122</b>

## 5 DISCUSSION

Numerous studies have been conducted across the United States to allow for better prediction of the potential of avian mortality associated with wind energy facilities. Multiple variables could affect avian species' risk at wind energy facilities, including vegetation type(s) and habitat suitability, overall landscape and geographic characteristics, avian population densities, migration paths, or a species' use of an area. The objective of the avian point count surveys was to characterize the activity, spatial distribution, and relative abundance of avian species within the study area.

### 5.1 Large Bird Use Surveys

The large bird use survey results are summarized below:

- SWCA conducted monthly surveys at 29 point count locations from April 1, 2017, to November 30, 2017.
- In all, 232 surveys were completed for a total of 13,920 survey-minutes.
- A total of 471 large bird or flock observations were recorded during 165 of the 232 surveys.
- Nine raptor species and 24 non-raptor species were recorded.
- Flight altitudes for 270 of the 471 observations occurred within the potential for collision zone (0–200 m aboveground); however, 209 of the 471 observations (44.4%) occurred below 30 m aboveground, which is outside the typical turbine rotor-swept area.

- Six observations of bald eagles were recorded across the 29 survey plots. One bald eagle was observed at the CR29 point count location, and the other five observations were recorded at point count location CR33.
  - All six bald eagle observations were made of individuals in flight in the potential zone for collisions between raptors and infrastructure (0–200 m). However, one (16.6%) of these observations occurred below 30 m aboveground and therefore may be considered outside the rotor swept zone for wind turbine models typically used at commercial wind energy facilities (31–200 m).
  - No observations were made of bald eagles in flight above the potential zone for collisions between raptors and infrastructure (>200 m).
  - The 38 recorded eagle flight minutes during the 13,920 minutes of survey across the 8-month study period equates to 0.00273 flight minute per survey minute.
- No golden eagle or unidentified eagle observations were recorded across the 29 survey plots.
- The bald eagle is the only USFWS BCC large bird species recorded by biologists within the study area.
- All species observed during the 8-month survey period were typical for the region and seasons.

## 5.2 Small Bird Use Surveys

The small bird use survey results are summarized below:

- SWCA conducted monthly surveys at 29 point count locations from April 1, 2017 to November 30, 2017.
- In all, 232 surveys were completed.
- A total of 637 observations were recorded during 198 of the 232 surveys.
- Fifty-four species were identified during the surveys.
- All 637 small bird observations occurred within the 0–200 m aboveground zone; however, 604 of these 637 observations (94.8%) occurred below 30 m, which is outside the typical turbine rotor-swept area (31–200 m).
- Western meadowlark accounted for 100 (15.7%) of the 637 observations. Three species (western meadowlark, red-winged blackbird, and American robin) accounted for 219 (34.4%) of the 637 observations.
- The biologists recorded higher numbers of observations (515 versus 122) in point count locations dominated by locations in an agriculture setting than in locations dominated by tallgrass prairie. Thirty-five species were recorded on survey locations in an agriculture dominant setting, and 53 species were recorded in locations dominated by tall grass prairie.
- The biologists recorded three small bird species recognized by the USFWS as BCC within the study area: the chestnut-collard longspur, grasshopper sparrow, and upland sandpiper.
- All species observed during the 8-month survey period were typical for the region and seasons.

## 6 LITERATURE CITED

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