

BASELINE AVIAN STUDIES FOR THE PROPOSED HOPKINS RIDGE WIND PROJECT, COLUMBIA COUNTY, WASHINGTON

FINAL REPORT

April 2003



Prepared for:



RES North America. LLC
Portland, Oregon

Prepared by:



Western EcoSystems Technology, Inc.
Cheyenne, Wyoming & Walla Walla, Washington

**BASELINE AVIAN STUDIES FOR THE
PROPOSED HOPKINS RIDGE WIND PROJECT,
COLUMBIA COUNTY, WASHINGTON**

FINAL REPORT

March 2002 - March 2003

Prepared For:

RES North America, LLC
One SW Columbia Street, Suite 790
Portland, Oregon 97258

Prepared By:

David P. Young, Jr.
Wallace P. Erickson
Kimberly J. Bay
Jay D. Jeffrey
Beth G. Lack
Rhett E. Good
H. Hall Sawyer
Western EcoSystems Technology, Inc.
2003 Central Avenue
Cheyenne, Wyoming 82001

April 30, 2003

EXECUTIVE SUMMARY

RES North America, LLC is evaluating the feasibility of wind power development in Columbia County, Washington. The proposed *Hopkins Ridge Wind Project* is located in the rolling hills northeast of the town of Dayton, Washington. The proposed development will be approximately 200 MW, depending on turbine model selected, electricity markets, transmission constraints, and results of site surveys. While there are currently no plans for developing more than 200 MW, the area studied for the project was larger than the current proposed development to insure that possible changes to the proposed development would be covered and to encompass surrounding area for potential future wind plant expansion.

In support of the environmental impact evaluation for the project, a detailed 12-month baseline avian resources study plan was developed and implemented at the site to assist in project design and for use in evaluating potential avian impacts from the project. The study protocol was developed in cooperation with the Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service and based on expertise and experience of WEST, Inc. studying wind power effects on birds and wildlife. Information and results from the baseline avian study will be used in the overall environmental impact assessment for the project.

Studies conducted for the project include fixed-point surveys that targeted raptors and large birds, roadside surveys for bald eagles, raptor nest surveys, vegetation/habitat mapping, rare plant surveys, and general wildlife observations. The principal goals of the baseline studies were to: (1) quantitatively describe the temporal and spatial use by birds of the study area; and (2) provide baseline information on avian species and their habitat sufficient to use in evaluating the probable impact of the development. Methodology of the surveys for each study component is provided below in the text of the report.

For the avian use surveys (fixed-point surveys), use estimates of the study area by species and groups were calculated as the number of detections per survey (30 minutes) standardized to a fixed plot (800 m radius). Two measures of species diversity in the study area were also calculated. Frequency of occurrence was calculated as the percent of surveys where a particular species was observed. Species composition was represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition. An exposure index was calculated by species and group which was a relative measure of the risk of each species coming in contact with a turbine based on use of the study area, the proportion of observations of a species flying, and the proportion of observations of a species flying within the rotor swept area.

A total of 252 30-minute point count surveys were conducted between March 26, 2002 and March 14, 2003. Based on these fixed-point surveys, passerines comprised slightly more than 65% of all birds observed; raptors comprised approximately 12% of all birds observed; corvids (magpies, crows, and ravens) comprised approximately 8% of all birds observed; and all other groups combined (e.g., upland game birds, doves, waterfowl, shorebirds, and others) comprised approximately 15% of all birds observed. Based on the use estimates from the fixed-point

surveys, the four most abundant species in the study area were horned lark (2.6 detections/30-minute survey), American robin (0.86 detection/survey), common raven (0.48 detection/survey), and red-tailed hawk (0.38 detection/survey). Together these species comprised more than 52% of the total bird use during the fixed-point surveys. The most abundant raptors observed were red-tailed hawk (102 observations), northern harrier (61 observations), rough-legged hawk (40), and American kestrel (19). On average approximately one red-tailed hawk was observed every 2.6 surveys, one northern harrier every 4.5 surveys, one rough-legged hawk every 7.4 surveys, and one American kestrel every 12.0 surveys. As a group, approximately one raptor was observed per 30-minute survey (0.96).

Ten roadside surveys were conducted for bald eagles from January 29 to March 12, 2002 and from December 28, 2002 to February 11, 2003 along the Tucannon River Road, which parallels the Tucannon River riparian corridor. No bald eagles were observed during the surveys, however, one bald eagle was observed during a fixed-point surveys in the project area on October 5, 2002.

Two aerial surveys for raptor nests were conducted (April 30-May 2 and June 6, 2002) within the raptor nest study area (the study area plus two-mile radius buffer). The total area surveyed was approximately 122 square miles (315 km²). A total of 104 raptor or large stick nests were located, 53 of which were classified as active nests during the first survey. Nest density for buteos (ferruginous hawk, red-tailed hawk, Swainson's hawk) was approximately 0.34 nest/mi² (0.13 nest/km²). Nest density for all raptors located (buteos, falcons, owls) was approximately 0.43 nest/mi² (0.16 nest nest/km²). One active ferruginous hawk nest, a state threatened species, was located approximately 2 miles (3.2 km) north of the Project; however, this nest failed to produce chicks in 2002.

Seven basic vegetation types (cropland, grassland, CRP, pine forest, riparian, developed, orchard) occur in the study area. The cropland type (wheat fields) was the most abundant and made up approximately 52% of the study area (approximately 14,485 acres). The grassland type made up approximately 39% of the study area (approximately 10,840 acres). The remaining types were minor components of the study area comprising less than 10% of the area combined. The CRP vegetation type (5%) was found in the northwest portion of the study area and the riparian type (0.9%) was found primarily along Willow Creek within the study area. The proposed development for 200 MW will only affect the cropland vegetation type. The grassland and riparian vegetation types occur in draws and ravines running towards the Tucannon River and Willow Creek, and will not be directly affected by the project. The pine forest stands are located in the southern part of the study area and the CRP land is located in the northwest portion. Neither of these vegetation types will be affected by the proposed project. The Tucannon River riparian corridor was located outside the proposed development area and will not be directly affected by the project.

Four species of mammals (coyote, mule deer, elk, and white-tailed deer) and one species of reptile (gopher snake) were recorded in the study area during the studies. Other than a single bald eagle, no federally listed threatened or endangered species were observed in the study area. State listed species recorded during the studies included golden eagle, ferruginous hawk, peregrine falcon, and merlin.

The estimates of avian use from the study area were similar to other sites studied for wind development in the western U.S. The species diversity was relatively low with several common species comprising the majority of observations. Raptor use and raptor nest density were higher than estimates for other wind sites that have been studied in Washington and Oregon due to the abundance of red-tailed hawk nests in the study area. Estimated impacts from the project are not expected to exceed what has been reported from other newer generation wind plants that have been studied. Additional discussion topics and potential mitigation measures to off-set or minimize impacts are addressed in the text below.

TABLE OF CONTENTS

1.0 INTRODUCTION..... 1

2.0 STUDY AREA..... 2

3.0 METHODS 3

3.1 FIXED-POINT SURVEY..... 3

 3.1.1 *Survey Plots*..... 3

 3.1.2 *Observation Schedule*..... 4

 3.1.3 *Big Game Observations* 5

3.2 RAPTOR NEST SURVEY 5

3.3 BALD EAGLE SURVEYS..... 5

3.4 GENERAL WILDLIFE OBSERVATIONS..... 6

3.5 HABITAT SURVEYS..... 6

 3.5.1 *Vegetation Mapping*..... 6

 3.5.1 *Rare Plant Survey*..... 7

3.6 DATA COMPILATION AND REPORT PREPARATION 7

 3.6.1 *Data Compilation and Storage* 7

 3.6.2 *Quality Assurance/Quality Control*..... 7

3.7 STATISTICAL ANALYSIS AND PRODUCTS 8

4.0 RESULTS 9

4.1 FIXED-POINT RAPTOR AND LARGE BIRD SURVEYS..... 9

 4.1.1 *Avian Use* 10

 4.1.2 *Species Composition and Frequency of Occurrence* 11

 4.1.3 *Flight Height Characteristics*..... 11

 4.1.4 *Exposure index*..... 12

 4.1.5 *Spatial Use* 12

 4.1.6 *Big Game Observations* 12

4.2 RAPTOR NEST SURVEY..... 13

4.3 BALD EAGLE SURVEYS..... 13

4.4 GENERAL WILDLIFE AND IN-TRANSIT OBSERVATIONS 14

 4.4.1 *Avian species*..... 14

 4.4.2 *Threatened, Endangered, Candidate Species* 14

 4.4.3 *Non avian species*..... 14

4.5 VEGETATION MAPPING..... 14

 4.5.1 *Rare Plant Survey*..... 16

5.0 SUMMARY AND DISCUSSION 17

5.1 AVIAN USE AND SPECIES DIVERSITY..... 17

5.2 RISK OF TURBINE COLLISION 17

 5.2.1 *Exposure Index*..... 17

 5.2.2 *Raptors* 18

 5.2.3 *Passerines*..... 18

5.2.5 Other Groups/Species	20
5.3 RAPTOR NESTING	20
5.4 BALD EAGLES.....	20
5.5 BIG GAME SPECIES.....	21
5.6 MITIGATION AND MONITORING.....	22
5.6.1 Technical Advisory Committee.....	22
5.6.2 Mitigation Measures	22
5.6.3 Monitoring.....	23
6.0 REFERENCES & LITERATURE CITED	23

LIST OF TABLES

Table 1. Avian species observed while conducting fixed-point surveys (March 26, 2002 – January 28, 2003) on the Hopkins Ridge Project Site.....	25
Table 2. Estimated mean use (number of observations per 30-minute survey) for each species observed within 800 m of the survey point for fixed-point surveys (March 26, 2002 – January 28, 2003).....	27
Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point (March 26, 2002 – January 28, 2003).....	29
Table 4. Estimated frequency of occurrence (percent of surveys species/group is recorded) for each species observed within 800 m of the survey point (March 26, 2002 – January 28, 2003) ..	31
Table 5. Flight characteristics of bird species observed during fixed-point surveys.....	33
Table 6. Flight characteristics of avian groups observed during fixed-point surveys	35
Table 7. Exposure indices calculated for species observed during fixed-point surveys.....	36
Table 8. Big game species observed while conducting fixed-point surveys (March 26, 2002 – January 28, 2003) on the Hopkins Ridge Project Site	38
Table 9. Estimated mean use (number of observations per 30-min survey) for each big game species observed within 800 m of the survey point for fixed-point surveys (March 26, 2002- January 28, 2003).....	38
Table 10. Raptor and large bird nests located in the raptor nest survey area (study area plus area within a two-mile radius buffer)	39
Table 11. Number of groups and total number of individuals of avian species of interest, mammals, and reptiles observed incidentally on site.....	40
Table 12. Vegetation types in the study area	41

Table 13. Rare plants potentially occurring in the project area based on range and habitat requirements.....42

LIST OF FIGURES

Figure 1. Proposed Hopkins Ridge Wind Project location.....43

Figure 2. Fixed-point survey plots with 800 m buffer and bald eagle survey route.....44

Figure 3. Raptor nest survey area and nests located.....45

Figure 4. Vegetation type mapping for the study area.....46

Figure 5. Mean use and frequency of occurrence for avian groups by survey period.....47

Figure 6. Mean use and frequency of occurrence for avian groups by survey station.....49

Figure 7. Mean number of species per survey.....51

Figure 8. Buteo flight paths and perch locations recorded during the fixed-point surveys and incidentally in the study area.....52

Figure 9. Northern harrier flight paths and perch locations recorded during the fixed-point surveys and incidentally in the study area.....53

Figure 10. Other raptor and large bird flight paths and perch locations recorded during the fixed-point surveys and incidentally in the study area.....54

Figure 11. Big game species observations recorded during the fixed-point surveys and incidentally in the study area.....55

LIST OF APPENDICES

Appendix A - Example Fixed-Point Survey Field Data Sheet

1.0 INTRODUCTION

RES North America, LLC (RES) is evaluating the feasibility of wind power development in Columbia County, Washington. The proposed site, *Hopkins Ridge*, is located in the rolling hills approximately 10 miles northeast of Dayton, Washington and roughly parallels and is southwest of the Tucannon River (Figure 1). The proposed development will be approximately 200 MW, depending on turbine model selected, electricity markets, transmission constraints, and results of site surveys. While there are currently no plans for developing more than 200 MW, the area studied for the project (see Section 2.0) was larger than the current proposed development to insure that possible changes to the proposed development would be covered and to encompass surrounding area for potential future wind plant expansion.

RES has committed to characterizing the avian use and resources at the Hopkins Ridge site to estimate the level of potential impacts the project could have on these resources. Subsequently, RES contracted Western EcoSystems Technology, Inc. (WEST) to develop a study protocol and conduct a twelve-month baseline study of avian use of the project area.

The principal goals of the baseline studies were to:

- 1) quantitatively and qualitatively describe the temporal and spatial use of the study area by avian species;
- 2) describe the vegetation types present on the site;
- 3) list the occurrence and potential use of the site by special status species of plants and wildlife; and
- 4) provide baseline information on these resources that is sufficient to use in evaluating the probable impact of wind power development in the area.

Key questions addressed by the studies included:

- What species of birds and other wildlife use the study area during different seasons?
- What vegetation types are present in the study area and what are the dominant plant species in each type?
- Where in the study area (spatial use) do species occur and what habitats do they use?
- What is the seasonal and daily (temporal) use of the study area for given species or species groups?
- Are there key habitat features (biotic and/or abiotic) which increase the probability of species use of an area?
- How do indices of use of the study area by birds compare to other wind plants that have been studied in the region (primarily Oregon and Washington)?
- Based on avian use, habitat, and other factors at the site and by comparing with avian use, habitat, and mortality at existing wind plants, what are the expected impacts from the proposed project?

The protocol follows similar avian studies conducted at numerous wind plants and proposed wind plants across the west and mid-west including the Vansycle and Stateline Wind Plant in Oregon and Washington (Erickson *et al.* 2000), the Buffalo Ridge Wind Plant in southwest

Minnesota (Johnson *et al.* 2000a), the Foote Creek Rim Wind Plant in Wyoming (Johnson *et al.* 2000b), the Nine Canyon Wind Project, Washington (Erickson *et al.* 2001), and the Klondike Wind Project, Oregon (Johnson *et al.* 2002) and other proposed wind plants in Oregon and Washington (e.g., Combine Hills Turbine Ranch, Oregon; the Maiden Wind Farm, Washington; Zintel Canyon, Washington). The Washington Department of Fish and Wildlife (WDFW) and the U.S. Fish and Wildlife Service (USFWS) were provided a copy of the study protocol for review and comment prior to study implementation and a meeting was held with agency representatives in Dayton, Washington to discuss the studies and issues or concern.

The following report contains the results of the avian baseline study for the one-year period from March 2002 to March 2003. This baseline study provides data for describing the temporal and spatial use by birds of the study area and for evaluating the probable impact of wind power development in the study area. Results from the baseline avian study may be used in the overall environmental impact assessment for the project.

2.0 STUDY AREA

The Hopkins Ridge project area is within the Columbia Basin physiographic province and immediately adjacent to the northernmost reach of the Blue Mountains subprovince (Franklin and Dyrness 1988). This dual land platform consists of incised rivers, extensive plateaus and ridges, and basaltic outcrops and cliffs. The Hopkins Ridge project area abuts the transition zone between grassland/shrub-steppe and coniferous vegetation zones. The Tucannon River corridor borders the proposed development area to the north and east. The project area ranges in elevation from approximately 1600 to 3400 feet.

Dominant vegetation of the Hopkins Ridge project area is either a mix of steppe types (grassland steppe) or dryland agriculture. The majority of the site is dryland agriculture (cropland) planted in wheat. Some areas of Conservation Reserve Program (CRP) land occur mainly in the northwest part of the project area with a few small parcels scattered elsewhere. Steppe types are primarily grass dominated areas with predominantly native bunchgrasses [e.g., Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*)] and exotic annuals such as the introduced cheatgrass (*Bromus tectorum*), or areas with small isolated patches of shrubs or shrub thickets, typically located in drainages, ravines, and areas with north aspects. Typical shrubs include sagebrush (*Artemisia spp.*) and rabbitbrush (*Chrysothamnus spp.*). Bands of coniferous forest are present in the southeastern region of area, as are several small islands of deciduous trees or mixed stands of coniferous and deciduous trees. Stands of deciduous trees and riparian wetlands of various sizes exist along the Willow Creek corridor as well as in the nearby Tucannon River floodplain.

The study area includes the proposed wind power development area and an adjacent buffer of variable width depending on the study component. The primary study area includes the proposed development area or the location of the wind turbines and associated facilities such as met towers, substations, new roads, operations and maintenance facility, underground and overhead powerlines, and construction permit areas for gravel/borrow material, plant sites,

equipment storage or lay-down areas, parking areas, and the area within a buffer of approximately 1 mile (1.6 km) from all project facilities. At the time of the project set-up, a conceptual wind project design and a list of participating landowner were available which were used to define the boundaries of the primary study area (see Figure 2). This boundary does not necessarily follow landowner boundaries but does encompass areas leased by RES for this project and potentially developable.

All avian use surveys, general wildlife observations, and vegetation surveys occurred within the primary study area. The raptor nest study area included the primary study area and the surrounding area within two miles. The helicopter surveys for raptor and other large bird nests occurred within this area.

3.0 METHODS

The biological resources baseline studies consisted of five components:

- 1) Fixed-point Surveys - point count surveys for all birds but which target raptors, other large birds, and big game species;
- 2) Aerial Raptor Nest Survey - aerial surveys to locate raptor nests on and within two miles of the site;
- 3) Bald Eagle surveys - winter roadside surveys for bald eagles along the Tucannon River riparian corridor;
- 4) Habitat/Vegetation Mapping and Rare Plant Survey; and
- 5) General Wildlife Observations.

3.1 Fixed-point Survey

The primary objective of the fixed-point surveys was to estimate the spatial and temporal use of the site by birds and in particular raptors and other large birds. Point counts (variable circular plots) were conducted on the development area using methods described by Reynolds et al. (1980). The points were selected to survey as much of the project area as possible while also providing relatively even coverage with minimal overlap of surveyed area. All birds seen during the point counts were recorded, however, the emphasis of the surveys was locating and counting raptors and other large birds (waterfowl, shorebirds, waterbirds, corvids, and upland gamebirds).

3.1.1 Survey Plots

Twelve survey plots were established over the study area (Figure 2). Each survey plot was a variable circular plot centered on an observation point marked in the field. All birds observed were recorded, however, the survey effort was concentrated within an approximate 800 m (0.5 mi) radius circle centered on the observation point. Observations of birds beyond the 800 m radius were recorded, but were not included in the analysis so that results were standardized to previous studies as well as between survey locations at the site. Observation points were established to provide good coverage of the habitats and topographic features of the area and, to the extent possible, so that the 800 m radius buffers around each point did not overlap.

Survey periods at each point were 30 minutes long. All raptors and other large birds observed during the survey were assigned a unique observation number and plotted on a map of the survey plot. The date; start and end time of the observation period; and weather information such as temperature, wind speed, wind direction, and cloud cover were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, height above ground, activity (behavior), and habitat(s) were recorded for each bird observed. Flight or movement paths were mapped for all raptors and large birds and given the corresponding unique observation number.

Four instantaneous counts were made during each 30-minute observation period. The first instantaneous count was made at the beginning of the observation period and the remaining counts occurred at 10-minute intervals. An instantaneous count consists of a summary of all birds present in and near the plot at a particular time. During the instantaneous count, the observer scanned the full survey plot recording all birds seen at that moment. For each raptor/large bird seen during an instantaneous count, the approximate height above ground and distance to the observer were recorded.

The behavior of each raptor/large bird observed and the habitat in or over which the bird occurred were recorded. Behavior categories recognized include perched, soaring, flapping, flushed, circle soaring, hunting, gliding, and other (noted in comments). Habitats were recorded as grassland-steppe, deciduous shrub, conifer forest, rock/rock outcrop, riparian, agriculture, CRP, and other (noted in comments). The initial flight patterns and habitats (first observation) were uniquely identified on the data sheet and subsequent patterns and habitats (if any) also recorded. The flight direction of observed birds was recorded on the data sheet map (Appendix A). Approximate flight height at first observation was recorded to the nearest meter or 5-meter increment and the approximate lowest and highest flight heights observed were also recorded. Any comments or unusual observations were noted in the comments section.

Raptors, other large birds, any species of concern, and species not previously seen on site that were observed between point counts were coded as in-transit observations and also recorded on field maps with unique observation numbers. Mapped information such as point of first observation and flight paths were digitized for describing spatial use of the site.

3.1.2 Observation Schedule

Sampling intensity was designed to document avian use and behavior by habitat and season within the project area. Approximately, weekly surveys took place for one full year. Six of the 12 plots were surveyed each week and alternated so that each plot was surveyed once every 14-day period. At least one observer was at the site one day per week. Seasons were defined as spring: March 15 - May 31; summer: June 1- August 14; fall: August 15-October 31; and winter: November 1-March 14. Surveys were conducted during daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practicable, each station was surveyed about the same number of times each season; however, the schedule varied in response to adverse weather conditions (e.g., fog), which caused delays and/or missed surveys.

3.1.3 Big Game Observations

Observations of big game species seen while conducting fixed-point surveys were also recorded. Preliminary project investigations indicated the project area is yearlong and winter range for elk (*Cervis elaphus*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*Odocoileus virginianus*). Observations of these species were plotted on the data sheet maps and the number of individuals in each group recorded. The objective of recording this data was to provide baseline information about big game in the project area and estimate seasonal variation in use by these species.

3.2 Raptor Nest Survey

The objective of the raptor nest survey was to gather information on species nesting in the area including nest locations, nesting season (timing), and nest success as well as locate nests which may be subject to disturbance and/or displacement effects from wind plant construction and operation. The nest survey area included the development area and the area within an approximate 2-mile buffer of the site excluding extensive tracts of dense coniferous forest (Figure 3).

The focal species for the nest survey was ferruginous hawk (*Buteo regalis*) a state threatened species. Richardson (1996) reports that ferruginous hawks in Washington initiate their nesting activity in late-March and early-April. The initial nest survey was conducted via helicopter from April 30 - May 2, 2002 when ferruginous hawks in the study area would be actively incubating eggs or brooding/attending young (Richardson 1996). GPS coordinates were recorded for all nests located of all raptor or other large bird species and mapped on a GIS ArcView project utilizing USGS topographic maps (1:24000 scale) as the base. A follow up survey was conducted on June 6, 2002 to visit located nests and look for evidence of nest success (e.g., fledged young nearby, full grown chicks in the nest) and to gather data on later nesting species [e.g., Swainson's hawk (*Buteo swainsoni*)].

Locations of all nests, including inactive nests, were recorded as they may be occupied during other years. Survey methods involved flying over the area while searching for suitable nesting areas and substrate (e.g., trees, rock outcrops, cliffs, and other structures, such as power poles and old windmills). Once suitable nesting areas were found they were searched thoroughly from the air and all nests found, whether active or inactive, were given a unique identification number and their locations recorded in Universal Transverse Mercator (UTM) coordinates. The surveys were conducted by a biologist experienced in raptor nest surveys. Additional data about raptor nest sites that were visible from routes regularly traveled by observers were opportunistically gathered during other surveys in the study area.

3.3 Bald Eagle Surveys

Information from the WDFW PHS database indicated that the Tucannon River may be important habitat for wintering bald eagles (*Haliaeetus leucocephalus*) and, therefore, a potential concern for the proposed project. The objective of the bald eagle surveys was to determine the

abundance and location of wintering bald eagles near the proposed development area. Surveys were conducted which were designed to locate bald eagles, concentration areas, and/or potential roost sites near the project.

A survey route was established along the Tucannon River Road (Figure 2) which was surveyed on an approximately weekly basis from mid-February to mid-March 2002 and again from late December 2002 to mid February 2003. A survey consisted of driving slowly (. 20 mph) the predetermined route while visually scanning all areas visible from the road. Periodic stops were made in safe locations to scan areas of large cottonwoods and conifer trees with binoculars or spotting scope to look for perched eagles. Depending on the traffic and safe pull-off availability, when an eagle or species of interest was spotted, the observer stopped the vehicle to record the appropriate data and location. Surveys were conducted primarily in the morning hours to look for perched eagle but a few evening surveys were also conducted. Other special status wildlife and species of local interest observed during the surveys were also recorded.

3.4 General Wildlife Observations

The objective of recording general wildlife observations on the site was to document wildlife other than avian species that may be affected by the proposed development. General wildlife observations were made year round while observers were on site conducting other surveys. All raptors, unusual or unique avian sightings, sensitive species, mammals, reptiles, and amphibians sighted while field observers were on site or traveling between plots were recorded on data sheets for incidental observations. The data recorded were similar to those recorded during the plot studies. The observation number, date, time, species, number, sex/age class, height above ground (for birds), and habitat were recorded. Observations of uncommon species and species of concern were mapped on a project map by observation number.

3.5 Habitat Surveys

The objective of the habitat surveys was to characterize the dominant vegetation and vegetation communities of the study area that may be directly impacted by the proposed project. Information from the vegetation mapping is used to characterize habitat used by wildlife species observed, determine the need for more detailed vegetation impact analyses, and determine areas where rare plant surveys would be needed.

3.5.1 Vegetation Mapping

The vegetation of the project area was mapped on black and white aerial photography at a scale of approximately 1:38000. Field surveys were conducted to ground truth the mapping and correlate vegetation types with the signature observed on the aerial photography. The vegetation map was then digitized using ArcView for area calculations.

3.5.1 Rare Plant Survey

The area surveyed included the proposed development areas (e.g., access roads, turbine strings, substations, etc.) and a buffer of 50 m (. 150 ft) in all directions (100 m corridor) in all native habitats (e.g., grassland-steppe, riparian).

The objective of the rare plant survey was to identify listed, sensitive, or otherwise rare plants that occur in the development area that may be impacted by construction or operation of the wind plant. A list of rare plants with the potential to occur in the project area was developed by reviewing federal and state lists of special status plant species known to occur or potentially occurring in Columbia County and in the habitats (vegetation types) found at the site. In order to become familiar with the rare plants potentially occurring at the site, information was gathered from available literature sources and from a visit to the Washington State University herbarium in Pullman to observe specimens (WNHP website, Hitchcock and Cronquist 1973). Information gathered included habitat preferences, morphological characteristics, phenological development time-lines, and species ranges. *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) was used as the authority for plant identification and scientific names.

The rare plant survey was conducted from May 30 to June 1, 2002. Methods for surveying for rare plants followed guidelines and recommendations of the WDFW and the Washington Natural Heritage Program. The areas surveyed included those areas of native habitat within the study area in which one or more of the rare plant species could occur. Surveys were not conducted on gravel or paved roads or other developed areas (e.g., farms, equipment storage areas, gravel pits) or in agriculture (e.g., wheat fields, plowed areas) or planted CRP lands. Surveys were conducted by a qualified botanist walking meandering transects approximately 5 m (15 ft) apart (roughly parallel) while scanning the ground for evidence of the focal species.

3.6 Data Compilation and Report Preparation

3.6.1 Data Compilation and Storage

A database was created to store, retrieve and organize field observations. Data from field forms were keyed into electronic data files using a pre-defined format that made subsequent data analysis straightforward. All field data forms, field notebooks, and electronic data files have been retained for future reference.

3.6.2 Quality Assurance/Quality Control

QA/QC measures were implemented at all stages of the study, including in the field, during data entry, during data analysis, and report writing. Each observer was responsible for inspecting his or her data forms for completeness, accuracy, and legibility. The study team leader periodically reviewed data forms to ensure completeness and legibility. Problems detected were corrected and changes made to the data forms were initialed and dated by the person making the change.

The electronic database was compared to the original data sheets by randomly choosing electronic records and verifying these with the field data sheet. Any errors detected were corrected by referencing the raw data forms and/or consulting the observer(s) who collected the data. Any irregular codes detected, or any data suspected as questionable, were discussed with

the observer and study team leader. Any errors or suspect data identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

3.7 Statistical Analysis and Products

Statistics/data generated for the study include the following:

- Species lists and observations by season;
- Relative use by species, species group, season, and observation point (habitat);
- Mean frequency of occurrence and species composition;
- Mapped summary of raptor observations and flight paths by species or group;
- Mean flight characteristics by species and species group;
- Exposure indices by species and species group;
- Other wildlife and sensitive species lists and locations mapping;
- Vegetation type/rare plant mapping;
- Raptor nest location by species mapping;
- Table of raptor nests and success by species;
- Comparisons of avian use, raptor nest density, and habitat composition between the proposed project and other new or existing wind plants.

The number of raptors and other species seen during each point count survey was standardized to a unit area and unit time searched. Avian use by species was calculated as the mean number of observations per 30-minute survey within 800 m of the survey point. Standardizing the data to a unit area and unit time allows comparison of avian use within the site between survey plots (habitat) and from the site to other wind plants which have been studied.

The frequency of occurrence by species was calculated as the percent of surveys in which a particular species was observed. Species composition was represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition. Frequency of occurrence and percent composition provide relative estimates of the avian diversity of the study area. For example, a particular species may have high use estimates of the site based on just a few observations of large flocks, however, the frequency of occurrence will indicate that it occurs during very few of the surveys and therefore, may be less likely affected by the project.

A relative index to collision exposure (R) was calculated for bird species observed flying during the fixed-point surveys using the formula:

$$R = A * P_f * P_t$$

Where A = mean relative use for species i (observations within 800 m of observer) averaged across all surveys, P_f = proportion of all observations of species i where activity was recorded as flying (an index to the approximate percentage of time species i spends flying during the daylight period), and P_t = proportion of all flight height observations of species i within the rotor-swept

area. This index does not account for differences in behavior other than flight characteristics (i.e., flight heights and percent of birds observed flying).

Data were plotted (means and 90% confidence intervals) to illustrate differences in raptor and other bird use between survey period (seasons) and stations (habitat). Because of the relative close proximity of points to each other, the variability of estimates of avian use and other endpoints were based on survey to survey variability (i.e., temporal variability). Maps of bird use (perches and flight paths) by observation point were developed to identify, to the extent possible, habitats or other topographic features that appeared related to bird use.

4.0 RESULTS

4.1 Fixed-point Raptor and Large Bird Surveys

Surveys were conducted at 12 fixed-point count stations located within the study area (Figure 2) approximately once each week between March 26, 2002 and March 14, 2003. A total of 252 30-minute point count surveys were conducted.

A total of 57 avian species and an additional 8 unidentified bird types (best possible identifications, e.g., unidentified buteo) were observed during the fixed-point surveys (Table 1). 2,139 total observations in 920 different groups¹ were recorded during the fixed-point surveys (Table 1). These are simply raw counts of observations, that are not standardized by the number of hours of observation, but do provide an overall list of what was observed. These counts likely contain duplicate sightings of the same birds.

Passerines were the most numerous group; horned lark (*Eremophila alpestris*), American robin (*Turdus migratorius*), western meadowlark (*Sturnella neglecta*), and Brewer's blackbird (*Euphagus cyanocephalus*) were the most numerous passerines observed. Passerines comprised 51% of all groups observed and 65% of the total number of birds observed. Raptors comprised approximately 27% of all groups and 12% of all birds observed. Corvids (magpies, crows, and ravens) comprised approximately 13% of all groups and 9% of all birds observed. Upland gamebirds comprised approximately 4% of all groups and 4% of all birds observed. Other birds (waterfowl, shorebirds, doves, and other non-passerine species) comprised approximately 5% of all groups and 7% of all birds observed due in part to a few large flocks of Canada goose (*Branta canadensis*) and snow goose (*Chen caerulescens*) observed flying over the study area (Table 1). Six species of upland gamebird were observed on the site including three introduced species, ring-necked pheasant (*Phasianus colchicus*), chukar (*Alectoris chukar*), and gray (Hungarian) partridge (*Perdix perdix*), and three native species, California quail (*Callipepla californica*), blue grouse (*Dendragapus obscurus*), and wild turkey (*Meleagris gallopavo*).

¹ Group is defined as an observation of a species of bird regardless of number seen together. For example, a flock of 8 horned larks flying together is a group as well as an individual horned lark observed by itself.

4.1.1 Avian Use

To standardize the data for comparison between points, seasons, and with other studies, avian use, frequency of occurrence, and species composition were calculated from observations within 800 m of the survey point. Avian use by species was calculated as the mean number of observations per 30-minute survey (Table 2). Because individual birds were not marked, counts do not distinguish between individuals; rather, they provide an estimate of avian use of the study area. For example, if one red-tailed hawk (*Buteo jamaicensis*) was observed during five surveys, it is unknown if this was the same bird seen five times or five different birds seen once. But this does provide an index of how often or frequent red-tailed hawks occur in the study area, and therefore are at risk of being impacted by the proposed project. Any reference to abundance refers to the use estimates and not absolute density or numbers of individuals.

Use varied across seasons (Table 2). For spring, based on use, the four most abundant species in the study area were horned lark (2.21 detections/30-minute survey), Brewer's blackbird (1.17 detections/survey), gray-crowned rosy finch (*Leucosticte tephrocotis*) (0.98 detections/survey), and western meadowlark (0.73 detections/survey). Together these species comprised slightly more than 50% of the total bird use during the spring (Table 3). During the summer, the four most abundant species were horned lark (1.76 detections/survey), red-tailed hawk (0.57), western meadowlark (0.41), and European starling (*Sturnus vulgaris*) (0.36). These species comprised 50% of the total bird use during the summer (Table 3). In the fall, the four most abundant species were horned lark (2.14 detections/survey), mourning dove (*Zenaida macroura*) (1.06), Canada goose (0.93) and American pipit (*Anthus cervinus*) (0.50), which comprised more than 56% of the total bird use (Table 3). The high Canada goose use estimate was due to two large flocks seen flying over survey points. In the winter, the four most abundant species were horned lark (3.52), American robin (1.93), common raven (*Corvus corax*) (0.89), and rough-legged hawk (*Buteo lagopus*) (0.35). These species comprised more than 83% of the total bird use for the winter (Table 2). Overall seasons, horned lark was the most common bird observed with 2.59 detections per survey, followed by American robin (0.86), common raven (0.48), and red-tailed hawk (0.38) (Table 2). These four species comprised more than 52% of all bird use of the site for the year (Table 3)

Over all seasons based on use, passerines were the most abundant group observed followed by raptors, corvids and upland gamebirds (Table 2). Raptors as a group had the second highest use in the summer and the third highest use in the spring, fall, and winter. Waterfowl had the second highest use in the fall due to the few large flocks of geese seen flying over. Gamebirds had the second highest use in the spring and corvids the second highest use in the winter (Table 2). Mean use for passerines and raptors, the two most abundant groups based on use, was plotted by survey period. Passerine use was highest in the spring early summer and decreased through the summer and was fairly low through the fall and winter (Figure 5). Only six different species of passerines (other than corvids) were seen in the winter (Table 2). One spike in the early winter was due to several large flocks of American robins observed in the study area (Figure 5). Raptor use fluctuated throughout the study period with the highest use occurring in mid-fall. Raptor use did not drop in winter due mainly to an increase in rough-legged hawk observations (Figure 5). Mean use for these two groups was also plotted by survey station (Figure 6). Passerine use was highest in the survey plots in the southeast portion of the study area (points J, K,L) where habitat

diversity was the highest (Figure 6). Raptor use was fairly constant across plots except for peaks in use at plots F and J (Figure 6). Survey plot J was fairly diverse from a habitat standpoint and plot F overlooked the Tucannon River corridor.

4.1.2 Species Composition and Frequency of Occurrence

Species composition is represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition (Table 3). Frequency of occurrence was calculated as the percent of surveys where a particular species was observed (Table 4). Frequency of occurrence and percent composition provide relative estimates of the avian diversity of the study area. For example, only one species, horned lark (61.7% of surveys), was observed in more than one-half of the surveys, and three others, red-tailed hawk (27.8%), common raven (25.3%), and western meadowlark (22.1%) were observed in approximately one-quarter of the surveys. These four species made up nearly half of all bird use (45.7%). Seven other species, northern harrier (*Circus cyaneus*) (20.0%), American robin (11.6%), rough-legged hawk (10.7%), ring-necked pheasant (8.9%), mourning dove (7.9%), black-billed magpie (*Pica hudsonia*) (7.8%), and American kestrel (*Falco sparverius*) (6.6%) were observed in more than 5% of the surveys. The majority of species were observed in less than 5% of the surveys (Table 4). The most frequently observed raptors were red-tailed hawk and northern harrier comprising 4.6% and 2.8% of the total use (Table 3). In contrast, horned larks were observed during slightly more than 61% of all surveys and comprised approximately 31.2% of the total use (Table 3).

As a group, and due primarily to the abundance of horned larks, passerines comprised more than 67.6% of the avian use and were observed in nearly 78.5% of all the surveys (Table 4). Raptors as a group comprised approximately 11.6% of the avian use of the site and were observed in approximately 56.5% of the surveys (Table 4).

Frequency of occurrence for passerines and raptors was plotted by survey period. Passerine occurrence was variable with the lowest in early fall (Figure 5). Raptor occurrence increased slowly through spring and summer and was highest in the fall and winter (Figure 5). Frequency of occurrence for these two groups was also plotted by survey station (Figure 6). Passerine occurrence was variable but lowest in plot G a point in a wheat field and highest at point K where vegetation diversity was high (see Figure 4). Raptor occurrence was similar to use being highest at points F and J, two plots topographically or vegetatively diverse (Figure 6).

An additional index of species diversity is the mean number of species observed per survey. In general, the mean number of species per survey peaked in early summer and decreased steadily over the summer and fall to early winter (Figure 7).

4.1.3 Flight Height Characteristics

The proportion of observations of a bird species flying within the rotor swept area provides a rough estimate of the propensity of that species to fly within the area occupied by the turbine rotors (Table 5). Several potential turbines and tower heights have been identified for possible use in the project. Using the range of tower heights and rotor diameters, the “zone of risk” included the area from approximately 25 m above ground level (AGL) to 125 m AGL, which is the union of rotor swept area heights for smaller and larger turbines as well as variable tower

heights. This range was a conservative estimate that included a small buffer of approximately 2 m on the upper and lower limits. Most of the passerines observed, with the exception of some finches, were regularly observed flying less than 10 meters above the ground (Table 5). The larger birds tend to fly higher, and frequently flew greater than 25 meters high, which is within the primary zone of influence for turbine blades for most newer generation turbines. As a group, 54.6% of buteos were observed in the zone of risk, followed by large falcons (50.0%) and corvids (35.9%), whereas passerines were not likely to be observed within the zone of risk (13.1%) (Table 6). Eagles were observed in the zone of risk 40% of the time, however, only five total eagles were observed during the study.

4.1.4 Exposure index

The exposure index is a relative measure of the risk of each species observed on-site during the fixed-point surveys coming in contact with a turbine, based on the use (measure of abundance) of the site by the species and the flight characteristics observed for that species. Horned lark, red-tailed hawk, and common raven had the highest exposure indices (Table 7). Horned lark was the most abundant species observed, but was nearly always observed below the zone of risk. Red-tailed hawk was the most common raptor observed and frequently seen in the zone of risk. Common raven also had relatively high use of the area and was commonly seen flying in the zone of risk.

4.1.5 Spatial Use

Point of first observation, approximate flight paths, and perch locations were mapped for raptors and other large birds observed in the project area (Figures 8-10). The objective of mapping observed bird locations was to look for areas of concentrated use by raptors and other large birds. Red-tailed hawks were the most common raptor observed. Most red-tailed observations (and other buteos) were fairly evenly distributed across the study area (Figure 8). Northern harrier was the second most common raptor observed. Harrier observations occurred throughout the project area but appeared to be concentrated in the southern half and in areas dominated by cropland (Figure 9). No strong association of use with topographic features of the site were noted by raptors or other large birds. The southern portion of the project area, which had the highest diversity of vegetation types, also had the most use by raptors and other large birds (Figures 8-10).

4.1.6 Big Game Observations

Three species of big game were commonly observed in the project area, elk, mule deer, and white-tailed deer. In general, white-tailed and mule deer were seen throughout the year, but most elk were observed in the fall and winter (Table 8). The numbers of mule deer observed also increased in the fall and winter. Use estimates were calculated by survey point to estimate abundance and look at spatial distribution across the study area (Table 9). Mule deer had the highest use estimates and were most commonly seen at points near the ravines and deep draws running towards the Tucannon River (Figure 11). Elk were most common in the southern portions of the project area near the bands of conifer trees (Figure 11). White-tailed deer observations were scattered across the study area but they tended to be most common in the northern part of the project area near the CRP land (Figure 11).

4.2 Raptor Nest Survey

Two aerial surveys for raptor nests were completed within the raptor nest study area (the study area plus two-mile radius buffer). The total area searched was approximately 122 square miles (315 km²) (Figure 3). A total of 100 raptor or large stick nests, one common raven, and three great blue heron (*Ardea herodias*) colonies were located. Fifty-two active raptor nests were located during the first survey (Table 10). By far the most common nesting raptor in the study area was red-tailed hawk with 33 active nests. There were also six unknown buteo nests which were active. Generally these were nests with young or eggs present, but where no adult was observed at the nest or near by to provide species identification. It is likely that most of these were also red-tailed hawks. Nest density for buteos [ferruginous hawk, red-tailed hawk, Swainson's hawk] was 0.34 nest/mi² (0.13 nest/km²). Nest density for all raptors located (buteos, falcons, owls) was approximately 0.43 nest/mi² (0.16 nest/km²).

The second survey was intended to gain as much information as possible about nest success from the active nests located during the first survey and search for new nests to the extent practical. During the second raptor nest survey, an active Swainson's hawk nests was located which was not found during the first survey. Based on the second survey, red-tailed hawk, great horned owl, and great blue heron, were confirmed producing or fledging chicks in the study area (Table 10). The single active ferruginous hawk nest located during the first survey apparently did not fledge any young. During the second survey only one adult was present and there were no chicks in the nest. Swainson's hawks generally nest later than other buteos. During the second survey the single Swainson's hawk nest had one adult sitting on the nest presumably incubating eggs. The calculated nest success rates (Table 10) are based on relatively small sample sizes but they provide an estimate of approximate nest success (i.e., percent of nests that are successful by species), and a record of successful breeding by several raptor species in the study area.

In general, the raptor nest survey area contained good habitat in terms of nest site availability due to the Tucannon River and Willow Creek riparian corridors. The majority of nests located were in cottonwood trees along these waterways. Other, suitable raptor nesting structures consisted primarily of isolated trees, rocky outcrops, and low rocky cliffs also along the Tucannon River corridor. The aerial survey method enables/facilitates locating nests that are easily seen from the air and generally focuses on locating suitable raptor nest structures. Ground nesting species are generally missed with this type of survey. It is likely that some ground nesting species such as northern harriers and short-eared owls nest within the survey area. The number of these species is unknown. A single short-eared owl was flushed from a stubble field as the helicopter passed over and it is likely that a nest was present. However, due to the difficulty of locating a nest on the ground from the air, no nest was found.

4.3 Bald Eagle Surveys

The WDFW PHS database indicates that the northwest portions of the Tucannon River riparian corridor near the study area may be important winter bald eagle habitat. The bald eagle survey route established along the Tucannon River Road (Figure 2) was surveyed seven times between

January 29 and March 12, 2002 and three times between December 28, 2002 and February 11, 2003. In addition, Washington State Highway 261, which roughly parallels the Tucannon River north and west of U.S. Highway 12, was surveyed twice to the junction of the Tucannon River and the Snake River. Approximately 30 total survey hours were conducted, however, no bald eagles were observed along the survey route.

4.4 General Wildlife and In-Transit Observations

4.4.1 Avian species

Avian species of interest were recorded when observed on-site during periods when observers were traveling to survey points, in-transit between survey points, or on-site for other purposes (Table 11). Several raptor species were observed on-site outside of the scheduled surveys (fixed-point or bald eagle surveys), including golden eagle (*Aquila chrysaetos*), red-tailed hawk, Swainson's hawk, northern harrier, American kestrel, prairie falcon (*Falco mexicanus*), Cooper's hawk (*Accipiter cooperii*), osprey (*Pandion haliaetus*), great-horned owl (*Bubo virginianus*), and long-eared owl (*Asio otus*). Other avian species of interest observed incidentally included three upland game birds, gray partridge, ring-necked pheasant, and wild turkey, and three waterbirds, great-blue heron, Canada goose, and mallard (*Anas platyrhynchos*).

4.4.2 Threatened, Endangered, Candidate Species

One bald eagle, a federally threatened species, was observed in the study area on October 5, 2002, during a point count survey. The bald eagle was observed flying through the project area near the southern end of the study area (survey point J, Figure 2).

One state endangered species, peregrine falcon (*Falco peregrinus*), was also observed on-site during the fixed-point surveys on September 17, 2002. One state threatened species, ferruginous hawk, was observed on-site on several occasions. Several observations of ferruginous hawk were made during fixed-point surveys, and an active ferruginous nest was located north of the Tucannon River during the April 30, 2002 raptor nest survey. Two state candidate species, golden eagle and merlin (*Falco columbarius*), were also recorded on the site.

4.4.3 Non avian species

Four species of mammals, elk, mule deer, white-tailed deer, and coyote (*Canis latrans*); and one species of reptile, gopher snake (*Pituophis melanoleucus*) were observed in the study area during the studies. Elk and deer were fairly common on-site (see Big Game estimates above). A total of 26 elk, 52 mule deer, and 56 white-tailed deer were observed in the study area in addition to the observations made during the fixed-point surveys (Table 11).

4.5 Vegetation Mapping

The vegetation in the study area was classified into seven types (Table 12). In general, a vegetation type refers to the generally recognizable assemblage of plant species that exist in a pattern across the landscape including areas altered by man, such as cropland and developed

areas. Vegetation types were determined based on a visual assessment of dominant and co-dominant plant species. Vegetation types vary in quality from site to site depending on land use, aspect, soil depth, and percentage of non-native plants, all of which can influence the extent of wildlife use within the habitat.

Cropland. This vegetation type consists of all lands within the study area used for the production of crops, primarily wheat. This type makes up 52 percent of the study area. These areas provide foraging and cover areas for some common wildlife species, notably birds such as upland game birds and songbirds. Cropland also provides foraging areas for raptors due, presumably, to a concentration or abundance of small mammals.

Grassland. The grassland vegetation type encompasses those areas where grass species are dominant, along with a mix of forbs and shrubs. In the study area, grasslands primarily occur on the slopes that are too steep to farm. Grasslands make up 39 percent of the study area. Common grasses found in the grasslands include bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa sandbergii*), and the non-native cheatgrass (*Bromus tectorum*). Common forbs observed include sulphur lupine (*Lupinus sulphureus*), yarrow (*Achillea millefolium*), and balsamroot (*Balsamorhiza* sp). Cattle were observed on some of the grassland areas. The grasslands provide cover, breeding habitat, and forage for a variety of birds and other wildlife.

CRP. CRP lands are areas included in the Conservation Reserve Program administered by the U.S. Department of Agriculture, Farm Service Agency. Five percent of the study area is CRP land. The Conservation Reserve Program is a voluntary long-term land retirement program that provides farmers and ranchers an annual rent to establish a permanent land cover on highly erodible or environmentally sensitive cropland. CRP contracts are generally for 10 to 15 years. In the study area, CRP lands are primarily planted in crested wheatgrass (*Agropyron cristatum*) and bluebunch wheatgrass and provide valuable cover for upland game birds.

Pine Forest. Pine forests occur in disjunct patches at the southern end of the project area, which is the northern extent of the Blue Mountains. Pine forests make up three percent of the project area. The pine forests are dominated by Ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). The understory consists of a variety of shrubs and forbs including wild rose (*Rosa woodsii*), snowberry (*Symphoricarpos* sp.), ocean-spray (*Holodiscus discolor*), and bracken (*Pteridium aquilinum*). The pine forests provide food, cover, and water for wildlife. Logging activity was observed in the forest to the south of the study area.

Riparian. Riparian habitat includes those areas adjacent to streams, springs, and seeps within the study area. Riparian habitat is typically narrow and often confined within the walls of drainages. Riparian areas make up just under one percent of the study area and is primarily along Willow Creek². Tree and shrub species are common in most riparian habitat. Common tree and shrub species include black cottonwood (*Populus trichocarpa*), hawthorn (*Crataegus douglasii*), wild

² Note: No portion of the nearby Tucannon River Riparian corridor will be within the area proposed for development and it was considered outside the study area for vegetation mapping.

rose, snowberry, and various willows (*Salix* spp.). Riparian areas are of high value to wildlife for water, food, and shelter throughout the year. Where trees are present, riparian areas provide habitat for nesting birds, particularly raptors. They may also serve as travel corridors for some species of wildlife.

Developed. Developed areas include those areas occupied by the farmsteads and small communities in the study area, including houses, outbuildings, equipment storage areas, etc. This type also includes two cemeteries located in the study area. Developed areas make up less than one-half percent of the study area. Due to the scale used to map vegetation, roads are not included under developed areas.

Orchards. One 5-acre orchard and several small stands of hawthorn trees were observed in the study area. These areas comprise approximately 0.02 percent of the study area. The orchard appeared to be abandoned. The stands of deciduous trees were included in this type because of their structural similarity. This vegetation type provides food and cover for passerines, upland gamebirds, and other wildlife and provides nesting opportunities for a variety of birds.

4.5.1 Rare Plant Survey

Based on a review of federal and state lists of plant species of concern, five species could occur in the study area based on the type of habitats found there (Table 13). Three of the species are found in grassland habitats and two occur in riparian habitats. None are federally listed threatened or endangered species, however two are federal species of concern, broad-fruit mariposa and northwest raspberry. At the state level, northwest raspberry is a state-endangered species, and broad-fruit mariposa and Spalding's silene are state-threatened species. Diffuse stickseed and Snake Canyon desert parsley are state sensitive species.

At the time of the survey, a preliminary map showing proposed turbine locations was available. This map was used in the field to locate areas where proposed turbines might occur in grassland or riparian habitats. No proposed turbines were located in riparian habitat and very few were in native grassland habitat. The proposed turbine locations in native grassland habitats were searched for broad-fruit mariposa, Snake Canyon desert parsley, and Spalding's silene. None were found.

Several sites were visited in riparian habitats along Hartsock Road and the canyon south of Marengo (Willow Creek) during the vegetation mapping. During these visits, the riparian habitat was searched for northwest raspberry and diffuse stickseed; none were found.

Once project design plans are finalized, should any project facilities, such as roads or transmission lines, cross riparian habitats or encroach on native grasslands, additional rare plant surveys may be warranted. Any additional surveys should be focused on the areas that would be disturbed.

5.0 SUMMARY AND DISCUSSION

5.1 Avian Use and Species Diversity

Avian use varied by season, however, over all seasons, the four most common species based on the fixed-point surveys were horned lark (2.59 observations per survey), American robin (0.86), common raven (0.48), and red-tailed hawk (0.38). Together these four species made up more than one-half (52.4%) of all birds observed during the fixed-point surveys. While American robin was observed in all seasons, the high use estimate was based largely on some large flocks observed in the winter. American robin was observed in approximately 11.6% of all surveys. In contrast, red-tailed hawk (27.8% of surveys), common raven (25.3%) and western meadowlark (22.1%), were all observed more frequently but had lower use estimates. For avian species groups, passerines were by far the most common group with approximately 5.61 observations per survey, followed by raptors (0.96) and corvids (0.71). These statistics reflect common results from other wind plants and proposed wind plants that have been studied. That is, relatively low species diversity with several common open-land species comprising the majority of avian use.

Over all seasons, the most abundant raptors observed in order were red-tailed hawk, northern harrier, and rough-legged hawk, although rough-legged hawks were not observed during the summer season. On average approximately one red-tailed hawk was observed every 2.6 surveys, one northern harrier every 4.5 surveys and one rough-legged hawk every 7.4 surveys. Raptor use varied by season but was highest in the fall (1.16) and due to the influx of rough-legged hawks remained relatively high in the winter (0.99).

Frequency of occurrence provides a relative estimate of the avian diversity of the study area. As with the use, there was relatively low species diversity on the site with only four species, horned lark (61.7%), red-tailed hawk (27.8%), common raven (25.3%), and western meadowlark (22.1%) being observed in approximately one-quarter or more of the surveys. The majority of species recorded were observed in less than 5% of the surveys (252 total surveys). Other commonly observed species (observed in >5% of surveys) were northern harrier (20.0%), American robin (11.6%), rough-legged hawk (10.7%), ringed-necked pheasant (8.9%), mourning dove (7.9%), black-billed magpie (7.8%), and American kestrel (6.6%).

The relatively low species diversity for the area is likely the result of the dominant vegetation type being agriculture. While the survey points were established in a fashion that allowed observation in native habitats, agriculture made up over 50% of the study area.

5.2 Risk of Turbine Collision

5.2.1 Exposure Index

The species with the highest exposure indices for the site in order were horned lark, red-tailed hawk and common raven. Horned lark was by far the most abundant species observed, but was nearly always observed below the zone of risk. Red-tailed hawk was the most common raptor observed and frequently observed flying within the zone of risk. Similarly common raven was relatively common and frequently seen flying within the zone of risk. Mortality studies at other

wind plants have commonly found horned-lark and red-tailed hawk casualties but few common ravens (see Erickson *et al.* 2001). Although ravens are often observed at wind plants within the zone of risk, they appear to be less susceptible to collision with wind turbines than other similar size birds (e.g., raptors, waterfowl). Horned lark is, however, a common casualty observed at other wind plants most likely due primarily to the abundance of this species in habitats commonly found at wind plants.

5.2.2 Raptors

Compared to other wind plants that have been studied, raptor use for the site is relatively high with nearly one raptor (0.96) observed each survey. The vast majority of these sightings were red-tailed hawks during the spring, summer, and fall and rough-legged hawks during the winter. In addition, a fair number of unidentified buteos were observed, the majority of which were likely red-tails due to their common presence in the area and high nesting density. For comparison, raptor use at several wind plants studied with the same methods³ was generally lower. For example, raptor use (per 30-minute survey) at the Vansycle Wind Plant (OR) was approximately 0.55 raptors; Condon Wind Plant (OR) was approximately 0.49 raptors; at the Stateline Wind Plant (WA/OR) approximately 0.90; at the Klondike Wind Plant (OR) approximately 0.70; at the Buffalo Ridge Wind Plant (MN) approximately 0.74; and at the Foote Creek Rim Wind Plant (WY) raptor use was approximately 1.10 raptors.

Raptor mortality at other newer generation wind plants is very low. The estimate of raptor mortality at the Foote Creek Rim Wind Plant (WY) is one of the highest observed and is approximately 0.03 raptors per turbine per year based on a three-year study of 69 turbines (Young *et al.* 2003). No raptor mortality was observed at the Vansycle Wind Plant (Erickson *et al.* 2000) or the Klondike Wind Plant (Johnson *et al.* 2003) during the first years of study; and 0.001 raptors per turbine per year were found at the Buffalo Ridge Wind Plant (MN) during a four-year study (Erickson *et al.* 2001).

Considering these mortality results as well as raptor use estimates at these wind plants, it is estimated that potential raptor mortality at the proposed project would be approximately that of the Foote Creek Rim wind plant, or approximately 0.03 raptors per turbine per year. Using these raptor mortality rates, a range of approximately 4 to 8 raptor fatalities per year at the Hopkins Ridge wind project could occur if the smaller 1.3 MW turbines are selected so that approximately 150 turbines are constructed.

5.2.3 Passerines

Passerines have been the most abundant avian fatality at other wind plants studied (see Johnson *et al.* 2000, Young *et al.* 2003, Erickson *et al.* 2000), often comprising more than 80% of the avian fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines make up the vast majority of the avian observations on-site, it is expected passerines would make up the largest proportion of fatalities. Common species such as horned larks,

³ Fixed-point surveys were conducted following the same methods at all wind plants but had variable survey duration. The calculated use at these wind plants was standardized to 30-minute duration surveys under the assumption that raptor observations were uniform across time for each survey period.

western meadowlarks and American robin (all confirmed casualties at other wind plants) would be most at risk. Nocturnal migrating species may also be affected, but would not be expected to be found in large numbers based on data collected at other wind plants [i.e., no large mortality events documented at wind plants (Erickson *et al.* 2001)].

Carcass search studies at Foote Creek Rim (WY) have found avian casualties associated with guyed met towers. Based on searches of five permanent met towers at Foote Creek Rim over a three-year period, it was estimated that these towers resulted in approximately 8.0 avian casualties per tower per year, the majority of which were passerines (Young *et al.* 2003). During searches of a free-standing met tower at the Klondike Wind Plant (OR), no avian fatalities were found after one-year of study (Johnson *et al.* 2003). As currently planned, the proposed project would have one permanent met tower for approximately every 80MW of turbines. Currently, three permanent met towers are proposed for the project, which would be free standing un-guyed structures. No avian mortality is expected from the met towers.

Based on post-construction mortality monitoring at other newer generation wind plants, passerine mortality has been somewhat variable. Projected impacts for the proposed project are primarily based on data collected at the Vansycle Wind Plant (Erickson *et al.* 2000), the Foote Creek Rim Wind Plant (Young *et al.* 2003), the Buffalo Ridge Wind Plant (Johnson *et al.* 2000); and the more recently studied Klondike Wind Plant (Johnson *et al.* 2003) where fatality estimates have been made for all birds, including passerines, and adjusted for scavenging and searcher efficiency.

An extensive post-construction study of two wind plants on Buffalo Ridge (MN) with 350 total turbines was conducted from 1996 through 1999. Total annual mortality was estimated to average approximately 2.8 birds per turbine. Most of the mortality documented involved nocturnal migrant passerines (Johnson *et al.* 2000). Based on a three year study at Foote Creek Rim (WY), the total annual mortality associated with 69 turbines was estimated to be approximately 1.5 birds per turbine per year (Young *et al.* 2003). At the Vansycle Wind Project, only 12 avian fatalities were located during the first year of operation of 38 turbines. The casualties were comprised of at least six species, and most (58%) were passerines. Total estimated mortality was 24 birds per year or approximately 0.6 bird per turbine per year (Erickson *et al.* 2000). Estimates from the Klondike Wind Plant are 1.42 birds per turbine per year for all birds (Johnson *et al.* 2003) based on one year of study.

If these estimates are applied to the proposed project, the range of potential bird mortality would be expected to fall between approximately 90 and 425 birds per year if 1.3 MW turbines are selected so that approximately 150 turbines are constructed. Actual levels of mortality that would result from the proposed project are unknown and could be higher or lower depending on patterns of movements through the area. The per turbine mortality rate for all birds for the proposed project is expected to be between approximately 0.5 and 2.5 birds per turbine per year. Because of the relatively monotypic vegetation type (agriculture) in which the turbines will occur, projected passerine mortality for the project is expected to be on the low end of the estimate range.

5.2.4 Waterfowl

Some waterfowl mortality has been documented at other wind plants (Johnson *et al.* 2000), and the new Klondike Wind Plant (OR) has documented Canada geese fatalities (Johnson *et al.* 2003), the most common waterfowl species observed flying over the Hopkins Ridge study area. However, because of the low frequency of occurrence by waterfowl, no waterfowl mortality would be expected from the project.

5.2.5 Other Groups/Species

Other avian groups (e.g., upland game birds, doves, shorebirds) occur in relatively low numbers within the study area and mortality would be expected to be low. Other species only observed during migration may be at risk; however, mortality would be expected to be low given the low use estimates by other species.

5.3 Raptor Nesting

The total study area surveyed for raptor nests was approximately 122 square miles (315 km²). Nest density for buteos (ferruginous hawk, red-tailed hawk, Swainson's hawk) in this area was approximately 0.34 nest/mi² (0.13 nest/km²) and for all raptors (buteos, falcons, owls) was approximately 0.43 nest/km² (0.16 nest/km²). This index of raptor nest density is higher than other wind plants that have been studied in the Oregon/Washington region. For example, raptor nest density within a 2-mile buffer around the Stateline Wind Plant (WA/OR) is 0.20 nest/mi² (0.08 nest/km²) (URS and WEST 2001). Nest density within a 5-mile buffer around the proposed Maiden wind farm was approximately 0.16 nest/mi² (0.06 nest/km²) (Young *et al.* 2002a) and nest density around the proposed Combine Hills wind plant (Umatilla County, Oregon) is approximately 0.24 nest/mi² (0.09 nest/km²) (Young *et al.* 2002b).

The higher raptor nest density appears to be due to the proximity of the Tucannon River and Willow Creek, which have good raptor nesting habitat in the form of large cottonwood trees and rocky cliffs lining the valley. There are also some raptor nests in trees located in the steep draws leading from the flat agriculture areas on top of the ridges down to the river. These nests will be in closer proximity to the proposed turbines and more likely affected by the project through disturbance or displacement. Once a final project layout is established, the proximity of raptor nests to turbines can be determined.

5.4 Bald Eagles

The WDFW Priority Habitats and Species database indicated that the Tucannon River riparian corridor and in particular along the river's lower reaches, may be important bald eagle winter habitat. Winter surveys conducted in 2002 and 2003 did not locate any bald eagles in this area. One bald eagle was observed on site during a fixed-point survey. The WDFW personnel have also indicated there is occasional bald eagle use at the Tucannon Fish Hatchery located just south and east of the project area. Based on the data collected, it appears as if bald eagles may

occasionally use the project area and Tucannon River area but do not occur there in substantial numbers. The project is not expected to affect bald eagles.

5.5 Big Game Species

Based on the surveys conducted on the site, three species of big game inhabit the project area, mule deer, white-tailed deer, and Rocky Mountain elk. In general, the elk appear to be distributed closer to the Blue Mountains (the southern portions of the project area) and the deer species appear to have broader distribution. There is little information regarding wind plant effects on big game species. The Foote Creek Rim Wind Plant (WY) appeared to have no effect on pronghorn (*Antilocapra americana*) (Johnson *et al.* 2000a). Pronghorn occurred in the area in low numbers and continued to use the wind plant area following construction of the project. It is expected that deer and elk in the project area could potentially be disturbed by project construction. Deer and elk that use the site occupy most vegetation types in the area. They were observed in the native grassland and riparian habitats as well as the cropland and CRP. During the construction period, deer and elk would likely be displaced from the project site due to the influx of humans and heavy construction equipment and associated disturbance. Individuals of these species would likely seek more remote areas with less disturbance, such as the deep ravines leading to the Tucannon River and riparian corridor. Construction-related disturbance and displacement would be temporary in nature. Because of the extent of suitable habitat in the region, temporary loss of habitat from project construction is considered a minor effect and once construction is complete it is expected that deer and elk would become habituated to the wind turbines and again occupy and potentially seek un-hunted areas within the wind plant.

The primary disturbances to big game associated with operation and maintenance of the proposed project would be vehicle and associated human traffic. While activities on site may periodically displace elk and mule deer, it is expected that they would return to the site. The level of use could be lower during the first few years of operation; however, it is likely that over the long-term, they would become accustomed to the project facilities and would use areas in and around the wind plant. Should the facility eventually result in a refuge for deer and elk due to reduced hunting pressure, seasonal use of the wind plant by big game may increase.

The WDFW receives crop damage claims for big game losses from the proposed wind plant area. The primary management tool for the WDFW to maintain herd size objectives is through public hunting. Farmers/ranchers must allow public hunting on their property to be eligible for big game crop damage claim benefits. There is concern that the presence of the wind plant may affect the number and distribution of crop damage claims by altering the current hunting patterns in the area. For example, landowners who are within the wind plant are likely to discontinue allowing public hunting and thus reduce the ability of the WDFW to manage the big game herds by reducing harvest in the wind plant area. In addition to the loss of population control methods, the WDFW is also concerned over the loss of recreational opportunities (i.e., hunting) within the wind plant. A number of solutions may be available to minimize the impact of the wind plant on the concerns of the WDFW including control hunts within the wind plant, fencing, or special landowner permits to cull the herds or scare them from the area.

5.6 Vegetation Impacts

While there were seven distinct vegetation types in the study area, two types, cropland (dryland wheat) and grassland (steppe), made up approximately 91 percent of the study area. In addition, only one type, cropland, will be impacted by the project. There are typically distinct boundaries between the cropland and the grassland areas. The cropland is located on areas which are flat enough to be tilled which is generally the higher lands on top of the hills between ravines and draws running toward the Tucannon River. The grassland type is typically located in the draws and ravines that ran toward the river and Willow Creek. Because of the distinct topography associated with each vegetation type, all the direct impacts associated with the proposed project will be in cropland areas, or the highest flatter areas in the project where wind speed is maximized. No project features will be located in the draws and ravines where the native vegetation occurs. In addition, no impacts are expected to the riparian, CRP, or pine forest vegetation types. The riparian habitat within the project boundaries is associated primarily with Willow Creek and at the bottom of this drainage. The CRP land is mostly in the northwest part of the study area, outside the current proposed development. The pine forest stands are located in the south east portion of the study area, also outside the current proposed development.

5.7 Mitigation and Monitoring

As currently proposed the wind plant will be constructed in agriculture vegetation types, primarily wheat fields. The native grassland and riparian vegetation types in the area occur primarily in the ravines and deep draws leading down to the Tucannon River. Based on the final wind project layout, little native vegetation types should be affected by the project. Mitigation and monitoring recommendations are therefore based on impacts to avian and other wildlife resources. The following mitigation and monitoring recommendations are based primarily on measures that have been implemented at other newer generation wind plants and in particular those in the Washington and Oregon region.

5.6.1 Technical Advisory Committee

It is recommended that a Technical Advisory Committee (TAC) be formed to implement and evaluate a mitigation and monitoring program and determine the need for further studies or mitigation measures once the project is operational. The TAC should be composed of representatives from Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Columbia County, landowners, and the project owner/developer. The role of the TAC will be to determine and coordinate appropriate mitigation measures, monitor impacts to wildlife (and habitat if needed), and address issues that arise regarding wildlife impacts during construction and operation of the wind plant. The post-construction monitoring plan (if needed) should be developed in coordination with the TAC.

5.6.2 Mitigation Measures

The primary impacts associated with the project are expected to be fatalities of birds and potential displacement effects on big game species. The following are potential mitigation measures for impacts to wildlife from construction and operation of the proposed wind project:

- Sensitive wildlife areas such as the riparian corridors and raptor nest sites should be mapped, flagged, and/or identified to all contractors working on-site and should be designated as no disturbance zones during the construction phase.
- During project construction, best management practices should be employed to reduce peripheral impacts to adjacent native vegetation and habitats and to minimize the construction footprint.
- A site management plan should be developed to, at a minimum, identify sensitive wildlife areas (e.g., raptor nests), provide adequate on-site waste disposal, and establish fire management and erosion control procedures.
- Raptor nests within ½ mile of construction areas should be monitored for activity prior to construction to determine the need for construction timing restrictions around the nests should a nest be active.
- All power and communication lines on-site should be buried underground where feasible.
- All overhead power lines should be equipped with anti perching devices.
- Permanent met towers on-site should utilize free-standing non-guyed towers.

5.6.3 Monitoring

A post construction monitoring study is recommended for the project to quantify impacts to avian species and assess the need for additional mitigation measures. The monitoring plan for the project should, at a minimum, contain the following components:

- One year of standardized fatality monitoring involving carcass searches, scavenger removal trials, and searcher efficiency trials.
- A standardized procedure for operations and maintenance personnel for reporting incidental fatalities or injured birds for the life of the project.

The protocol for the fatality monitoring study should be similar to protocols used at other newer generation wind plants in northeastern Oregon and southwestern Washington.

6.0 REFERENCES & LITERATURE CITED

Erickson, W. P., G. D. Johnson, M. Dale Strickland, and Karen Kronner. 2000. Avian and bat mortality associated with the Vansycle Wind Project, Umatilla County Oregon. 1999 study year. Technical report submitted to Umatilla County Department of Resource Services and Development, Pendleton, Oregon. 22 pp.

- Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr., K.J. Sernka, R.E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee (NWCC) Resource Document. August 2001.
- FPL Energy Inc., W.P. Erickson and K. Kronner. 2001. Avian and bat monitoring plan for the Washington portion of the Stateline Wind Project. Technical Report prepared for Walla Walla Regional Planning Department. May, 2001.
- Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, Oregon. 452 pp.
- Johnson, G.D., W. P. Erickson, M. D. Strickland, M. F. Shepherd and D. A. Shepherd. 2000a. Avian Monitoring Studies. Buffalo Ridge, Minnesota Wind Resource Area, 1996-1999, Results of a 4-year Study. Technical Report prepared for Northern States Power Co., Minneapolis, MN. 212 pp.
- Johnson, G.D., D. P. Young, Jr., W.P. Erickson, C.E. Derby, M.D. Strickland, and R.E. Good. 2000b. Final Report, Wildlife Monitoring Studies, SeaWest Windpower Project, Carbon County, Wyoming, 1995-1999. Technical report prepared for: SeaWest Energy Corporation, San Diego, California and Bureau of Land Management, Rawlins, Wyoming. August 9, 2000.
- Johnson, G., W. Erickson, J. White, R. McKinney. 2003. Draft Avian and Bat Mortality During the First Year of Operation at the Klondike Phase I Wind Plant, Sherman County, Oregon. Technical report prepared for Northwestern Wind Power, Goldendale, Washington. March 2003
- Richardson, S.A. 1996. Washington State Recovery Plan for the Ferruginous Hawk, August 1996. Washington Department of Fish and Wildlife, Olympia, Washington.
- Reynolds, R.T., J.M. Scott, and R.A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. *Condor* 82(3): 309-313.
- The Nature Conservancy (TNC). 1999. Biodiversity Inventory and Analysis of the Hanford Site. Final Report: 1994-1999. The Nature Conservancy of Washington, The Bullitt Foundation, and The Northwest Fund for the Environment, Seattle Washington.
- URS and WEST. 2001. Avian baseline study for the Stateline Project, Vansycle Ridge, Oregon and Washington. Technical report prepared for ESI Vansycle Partners, L.P.
- Young, Jr., D.P., W.P. Erickson, R.E. Good, M.D. Strickland, and G.D. Johnson. 2003. Final Report, Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming. November 1998 – June 2002. Technical report prepared by WEST, Inc. for Pacificorp, Inc., Portland, Oregon; SeaWest Windpower, Inc, San Diego, California and Bureau of Land Management, Rawlins, Wyoming. January 10, 2003.
- Young, Jr., D.P., W. P. Erickson, J. D. Jeffrey, K. Bay, M. Bourassa. 2002a. Avian and Sensitive Species Baseline Study Plan and Interim Report TPC Combine Hills Turbine Ranch, Umatilla County, Oregon. Technical report prepared by WEST, Inc. for Eurus Energy America Corporation, San Diego, California and Aeropower Services, Inc., Portland, Oregon. August 20, 2002.
- Young, Jr., D.P., W. P. Erickson, K. Bay, and R. Good. 2002b. Baseline Avian Studies for the Proposed Maiden Wind Farm, Yakima and Benton Counties, Washington, Final Report, April 2001- April 2002. Technical report prepared by WEST, Inc. for Bonneville Power Administration, Portland Oregon. November 20, 2001.

Table 1. Avian species observed during fixed-point surveys (March 26, 2002 – March 14, 2003).

Species/Group	Spring		Summer		Fall		Winter		Total	
	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups
Waterfowl	0	0	0	0	116	3	0	0	116	3
Canada goose	0	0	0	0	100	2	0	0	100	2
snow goose	0	0	0	0	16	1	0	0	16	1
Shorebirds										
killdeer	3	1	0	0	0	0	2	2	5	3
Corvids	25	19	8	5	43	20	109	75	185	119
American crow	4	1	0	0	13	2	0	0	17	3
black-billed magpie	5	5	0	0	10	6	24	8	39	19
common raven	16	13	8	5	20	12	85	67	129	97
Upland Gamebirds	57	26	9	4	8	3	5	4	75	34
California quail	0	0	0	0	1	1	0	0	1	1
blue grouse	6	1	0	0	0	0	0	0	6	1
chukar	1	1	0	0	0	0	0	0	1	1
gray partridge	7	4	6	1	6	1	2	1	21	7
ring-necked pheasant	18	18	3	3	1	1	3	3	25	25
wild turkey	25	2	0	0	0	0	0	0	25	2
Doves										
mourning dove	14	8	7	5	53	8	3	1	77	22
Raptors	61	58	35	31	68	64	104	99	268	252
<i>Accipiters</i>										
sharp-shinned hawk	1	1	0	0	2	2	1	1	4	4
<i>Buteos</i>	38	35	23	19	37	35	75	71	173	160
Swainson's hawk	2	2	0	0	1	1	0	0	3	3
ferruginous hawk	2	2	0	0	0	0	0	0	2	2
red-tailed hawk	29	26	23	19	25	24	25	25	102	94
rough-legged hawk	1	1	0	0	1	1	38	36	40	38
unidentified buteo	4	4	0	0	10	9	12	10	26	23
<i>Eagles</i>	0	0	0	0	3	2	2	2	5	4
bald eagle	0	0	0	0	1	1	0	0	1	1
golden eagle	0	0	0	0	2	1	1	1	3	2
unidentified eagle	0	0	0	0	0	0	1	1	1	1
<i>Falcons</i>	5	5	7	7	8	7	2	2	22	21
American kestrel	4	4	7	7	6	5	2	2	19	18
merlin	0	0	0	0	1	1	0	0	1	1
peregrine falcon	0	0	0	0	1	1	0	0	1	1
prairie falcon	1	1	0	0	0	0	0	0	1	1
<i>Other Raptors</i>	17	17	5	5	18	18	24	23	64	63
barn owl	0	0	0	0	0	0	1	1	1	1
northern harrier	17	17	5	5	17	17	22	21	61	60

Table 1. Avian species observed during fixed-point surveys (March 26, 2002 – March 14, 2003).

Species/Group	Spring		Summer		Fall		Winter		Total	
	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups
osprey	0	0	0	0	1	1	0	0	1	1
unidentified hawk	0	0	0	0	0	0	1	1	1	1
Passerines	496	158	191	89	196	46	512	177	1395	470
American goldfinch	1	1	0	0	4	2	0	0	5	3
American pipit	3	1	0	0	27	2	0	0	30	3
American robin	28	5	9	5	6	1	174	26	217	37
American tree sparrow	0	0	0	0	0	0	1	1	1	1
Brewer's blackbird	77	13	6	2	0	0	0	0	83	15
European starling	21	5	15	4	11	2	8	2	55	13
Say's phoebe	2	1	4	2	1	1	0	0	7	4
brown-headed cowbird	18	1	0	0	0	0	0	0	18	1
cedar waxwing	0	0	13	5	0	0	0	0	13	5
chipping sparrow	1	1	10	3	0	0	0	0	11	4
cliff swallow	22	2	0	0	0	0	0	0	22	2
dark-eyed junco	32	1	0	0	0	0	0	0	32	1
eastern kingbird	0	0	5	3	0	0	0	0	5	3
grasshopper sparrow	0	0	4	4	0	0	0	0	4	4
gray-crowned rosy finch	65	1	0	0	9	1	0	0	74	2
horned lark	143	74	73	28	115	25	312	133	643	260
northern shrike	1	1	0	0	1	1	3	3	5	5
purple finch	0	0	8	1	0	0	0	0	8	1
red-winged blackbird	0	0	0	0	7	1	0	0	7	1
rock wren	0	0	0	0	1	1	0	0	1	1
savannah sparrow	3	2	4	3	0	0	0	0	7	5
song sparrow	0	0	2	1	0	0	0	0	2	1
unidentified passerine	1	1	0	0	6	1	0	0	7	2
unidentified sparrow	2	1	1	1	2	2	0	0	5	4
unidentified swallow	3	1	3	1	0	0	0	0	6	2
vesper sparrow	8	5	5	4	1	1	0	0	14	10
violet-green swallow	6	2	0	0	0	0	0	0	6	2
western bluebird	10	5	9	5	0	0	0	0	19	10
western kingbird	2	2	1	1	0	0	0	0	3	3
western meadowlark	47	32	17	15	5	5	14	12	83	64
western wood-pewee	0	0	2	1	0	0	0	0	2	1
Other / Unidentified	1	1	3	3	5	5	5	5	14	14
common nighthawk	0	0	3	3	2	2	0	0	5	5
northern flicker	1	1	0	0	2	2	0	0	3	3
unidentified bird	0	0	0	0	0	0	3	3	3	3
unidentified large bird	0	0	0	0	1	1	2	2	3	3
Total	657	271	253	137	489	149	740	363	2139	920

Table 2. Estimated mean use (number of observations per 30-minute survey) for species observed within 800m of the survey point for fixed-point surveys (March 26, 2002 – March 14, 2003).

Species/Group	Spring Use		Summer Use		Fall Use		Winter Use		Overall Use	
	mean	st dev	mean	st dev	mean	st dev	mean	st dev	mean	st dev
Waterfowl	0.000	0.000	0.000	0.000	1.222	3.667	0.000	0.000	0.262	1.697
Canada goose	0.000	0.000	0.000	0.000	0.926	2.778	0.000	0.000	0.198	1.286
snow goose	0.000	0.000	0.000	0.000	0.296	0.889	0.000	0.000	0.063	0.411
Shorebirds										
killdeer	0.045	0.151	0.000	0.000	0.000	0.000	0.022	0.086	0.020	0.092
Corvids	0.379	0.373	0.176	0.179	0.789	0.923	1.160	0.823	0.712	0.768
American crow	0.061	0.201	0.000	0.000	0.241	0.722	0.000	0.000	0.067	0.347
black-billed magpie	0.076	0.087	0.000	0.000	0.211	0.390	0.267	0.587	0.160	0.400
common raven	0.242	0.292	0.176	0.179	0.337	0.526	0.893	0.837	0.484	0.645
Upland Gamebirds	1.000	1.356	0.219	0.369	0.152	0.386	0.058	0.123	0.352	0.812
blue grouse	0.091	0.302	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.154
California quail	0.000	0.000	0.000	0.000	0.022	0.067	0.000	0.000	0.005	0.031
chukar	0.015	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.026
gray partridge	0.106	0.214	0.143	0.378	0.111	0.333	0.022	0.086	0.083	0.242
ring-necked pheasant	0.273	0.336	0.076	0.136	0.019	0.056	0.036	0.097	0.101	0.212
wild turkey	0.515	1.367	0.000	0.000	0.000	0.000	0.000	0.000	0.135	0.713
Doves										
mourning dove	0.212	0.237	0.190	0.366	1.056	1.637	0.040	0.155	0.328	0.847
Raptors	0.811	0.517	0.886	0.305	1.156	0.605	0.993	0.353	0.962	0.456
<i>Accipiters</i>										
sharp-shinned hawk	0.015	0.050	0.000	0.000	0.037	0.111	0.011	0.043	0.016	0.062
<i>Buteos</i>	<i>0.470</i>	<i>0.407</i>	<i>0.571</i>	<i>0.335</i>	<i>0.600</i>	<i>0.604</i>	<i>0.692</i>	<i>0.320</i>	<i>0.594</i>	<i>0.413</i>
ferruginous hawk	0.030	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.051
red-tailed hawk	0.364	0.340	0.571	0.335	0.448	0.554	0.267	0.225	0.382	0.366
rough-legged hawk	0.015	0.050	0.000	0.000	0.019	0.056	0.354	0.340	0.135	0.261
Swainson's hawk	0.030	0.067	0.000	0.000	0.019	0.056	0.000	0.000	0.012	0.043
unidentified buteo	0.030	0.067	0.000	0.000	0.115	0.222	0.071	0.134	0.058	0.136
<i>Eagles</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.056</i>	<i>0.167</i>	<i>0.013</i>	<i>0.052</i>	<i>0.017</i>	<i>0.082</i>
bald eagle	0.000	0.000	0.000	0.000	0.019	0.056	0.000	0.000	0.004	0.026
golden eagle	0.000	0.000	0.000	0.000	0.037	0.111	0.013	0.052	0.013	0.059
<i>Small Falcons</i>	<i>0.068</i>	<i>0.097</i>	<i>0.186</i>	<i>0.223</i>	<i>0.130</i>	<i>0.274</i>	<i>0.028</i>	<i>0.075</i>	<i>0.087</i>	<i>0.172</i>
American kestrel	0.068	0.097	0.186	0.223	0.111	0.276	0.028	0.075	0.083	0.172
merlin	0.000	0.000	0.000	0.000	0.019	0.056	0.000	0.000	0.004	0.026
<i>Large Falcons</i>	<i>0.015</i>	<i>0.050</i>	<i>0.000</i>	<i>0.000</i>	<i>0.019</i>	<i>0.056</i>	<i>0.000</i>	<i>0.000</i>	<i>0.008</i>	<i>0.036</i>
peregrine falcon	0.000	0.000	0.000	0.000	0.019	0.056	0.000	0.000	0.004	0.026
prairie falcon	0.015	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.026
<i>Other Raptors</i>										
barn owl	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.043	0.004	0.026
northern harrier	0.242	0.228	0.129	0.131	0.315	0.231	0.227	0.236	0.233	0.219
unidentified hawk	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.043	0.004	0.026

Table 2. Estimated mean use (number of observations per 30-minute survey) for species observed within 800m of the survey point for fixed-point surveys (March 26, 2002 – March 14, 2003).

Species/Group	Spring Use		Summer Use		Fall Use		Winter Use		Overall Use	
	mean	st dev	mean	st dev	mean	st dev	mean	st dev	mean	st dev
Passerines	7.583	6.104	4.657	2.639	3.707	2.505	5.750	6.462	5.610	5.253
American goldfinch	0.015	0.050	0.000	0.000	0.089	0.267	0.000	0.000	0.023	0.125
American pipit	0.045	0.151	0.000	0.000	0.500	1.173	0.000	0.000	0.119	0.561
American robin	0.424	0.923	0.224	0.290	0.111	0.333	1.933	6.353	0.863	3.832
Am. tree sparrow	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.065	0.006	0.039
Brewer's blackbird	1.167	2.572	0.143	0.311	0.000	0.000	0.000	0.000	0.329	1.373
brown-headed cowbird	0.273	0.905	0.000	0.000	0.000	0.000	0.000	0.000	0.071	0.463
cedar waxwing	0.000	0.000	0.314	0.555	0.000	0.000	0.000	0.000	0.052	0.243
chipping sparrow	0.015	0.050	0.238	0.450	0.000	0.000	0.000	0.000	0.044	0.195
cliff swallow	0.333	1.106	0.000	0.000	0.000	0.000	0.000	0.000	0.087	0.566
dark-eyed junco	0.485	1.608	0.000	0.000	0.000	0.000	0.000	0.000	0.127	0.823
eastern kingbird	0.000	0.000	0.129	0.175	0.000	0.000	0.000	0.000	0.021	0.083
European starling	0.318	0.732	0.357	0.656	0.222	0.441	0.089	0.266	0.222	0.518
grasshopper sparrow	0.000	0.000	0.095	0.131	0.000	0.000	0.000	0.000	0.016	0.062
gray-crowned rosy finch	0.985	3.266	0.000	0.000	0.167	0.500	0.000	0.000	0.294	1.672
horned lark	2.212	0.913	1.762	1.633	2.144	1.712	3.518	2.148	2.589	1.804
northern shrike	0.015	0.050	0.000	0.000	0.019	0.056	0.038	0.109	0.021	0.074
purple finch	0.000	0.000	0.190	0.504	0.000	0.000	0.000	0.000	0.032	0.206
red-winged blackbird	0.000	0.000	0.000	0.000	0.130	0.389	0.000	0.000	0.028	0.180
rock wren	0.000	0.000	0.000	0.000	0.019	0.056	0.000	0.000	0.004	0.026
savannah sparrow	0.045	0.108	0.105	0.180	0.000	0.000	0.000	0.000	0.029	0.095
Say's phoebe	0.030	0.101	0.100	0.191	0.019	0.056	0.000	0.000	0.029	0.098
song sparrow	0.000	0.000	0.048	0.126	0.000	0.000	0.000	0.000	0.008	0.051
unidentified passerine	0.015	0.050	0.000	0.000	0.133	0.400	0.000	0.000	0.033	0.186
unidentified sparrow	0.030	0.101	0.029	0.076	0.037	0.073	0.000	0.000	0.021	0.068
unidentified swallow	0.045	0.151	0.071	0.189	0.000	0.000	0.000	0.000	0.024	0.108
vesper sparrow	0.121	0.248	0.133	0.220	0.019	0.056	0.000	0.000	0.058	0.162
violet-green swallow	0.091	0.302	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.154
western bluebird	0.152	0.174	0.238	0.371	0.000	0.000	0.000	0.000	0.079	0.192
western kingbird	0.030	0.067	0.024	0.063	0.000	0.000	0.000	0.000	0.012	0.043
western meadowlark	0.735	0.602	0.410	0.404	0.100	0.162	0.156	0.299	0.338	0.464
western wood-pewee	0.000	0.000	0.048	0.126	0.000	0.000	0.000	0.000	0.008	0.051
Other Birds	0.015	0.050	0.071	0.131	0.074	0.121	0.000	0.000	0.032	0.084
common nighthawk	0.000	0.000	0.071	0.131	0.037	0.073	0.000	0.000	0.020	0.066
northern flicker	0.015	0.050	0.000	0.000	0.037	0.111	0.000	0.000	0.012	0.057
<i>Unidentified Birds</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.044</i>	<i>0.133</i>	<i>0.016</i>	<i>0.081</i>
unidentified bird	0.000	0.000	0.000	0.000	0.000	0.000	0.033	0.129	0.012	0.077
unidentified large bird	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.043	0.004	0.026
Overall	10.045	1.985	6.200	1.049	8.156	1.393	8.235	2.471	8.369	0.762

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point (March 26, 2002 – March 14, 2003).

Species/Group	Spring % Comp	Summer % Comp	Fall % Comp	Winter % Comp	Overall % Comp
Waterfowl	0.00	0.00	14.99	0.00	3.16
Canada goose	0.00	0.00	11.35	0.00	2.39
snow goose	0.00	0.00	3.63	0.00	0.77
Shorebirds					
killdeer	0.45	0.00	0.00	0.28	0.24
Corvids	3.77	2.84	9.67	14.38	8.58
American crow	0.60	0.00	2.95	0.00	0.81
black-billed magpie	0.75	0.00	2.59	3.31	1.93
common raven	2.41	2.84	4.13	11.07	5.84
Upland Gamebirds	9.95	3.53	1.86	0.72	4.24
blue grouse	0.90	0.00	0.00	0.00	0.29
California quail	0.00	0.00	0.27	0.00	0.06
chukar	0.15	0.00	0.00	0.00	0.05
gray partridge	1.06	2.30	1.36	0.28	1.00
ring-necked pheasant	2.71	1.23	0.23	0.44	1.22
wild turkey	5.13	0.00	0.00	0.00	1.63
Doves					
mourning dove	2.11	3.07	12.94	0.50	3.95
Raptors	8.07	14.29	14.17	12.31	11.60
<i>Accipiters</i>					
sharp-shinned hawk	0.15	0.00	0.45	0.14	0.19
<i>Buteos</i>	<i>4.68</i>	<i>9.22</i>	<i>7.36</i>	<i>8.58</i>	<i>7.16</i>
ferruginous hawk	0.30	0.00	0.00	0.00	0.10
red-tailed hawk	3.62	9.22	5.50	3.31	4.60
rough-legged hawk	0.15	0.00	0.23	4.39	1.62
Swainson's hawk	0.30	0.00	0.23	0.00	0.14
unidentified buteo	0.30	0.00	1.41	0.88	0.70
<i>Eagles</i>	<i>0.00</i>	<i>0.00</i>	<i>0.68</i>	<i>0.17</i>	<i>0.20</i>
bald eagle	0.00	0.00	0.23	0.00	0.05
golden eagle	0.00	0.00	0.45	0.17	0.15
<i>Small Falcons</i>	<i>0.68</i>	<i>3.00</i>	<i>1.59</i>	<i>0.34</i>	<i>1.04</i>
American kestrel	0.68	3.00	1.36	0.34	1.00
merlin	0.00	0.00	0.23	0.00	0.05
<i>Large Falcons</i>	<i>0.15</i>	<i>0.00</i>	<i>0.23</i>	<i>0.00</i>	<i>0.10</i>
peregrine falcon	0.00	0.00	0.23	0.00	0.05
prairie falcon	0.15	0.00	0.00	0.00	0.05
<i>Other Raptors</i>	<i>2.41</i>	<i>2.07</i>	<i>3.86</i>	<i>3.09</i>	<i>2.91</i>
barn owl	0.00	0.00	0.00	0.14	0.05
northern harrier	2.41	2.07	3.86	2.81	2.81
unidentified hawk	0.00	0.00	0.00	0.14	0.05

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point (March 26, 2002 – March 14, 2003).

Species/Group	Spring % Comp	Summer % Comp	Fall % Comp	Winter % Comp	Overall % Comp
Passerines	75.49	75.12	45.46	71.27	67.65
American goldfinch	0.15	0.00	1.09	0.00	0.28
American pipit	0.45	0.00	6.13	0.00	1.44
American robin	4.22	3.61	1.36	23.96	10.70
American tree sparrow	0.00	0.00	0.00	0.21	0.07
Brewer's blackbird	11.61	2.30	0.00	0.00	3.97
brown-headed cowbird	2.71	0.00	0.00	0.00	0.86
cedar waxwing	0.00	5.07	0.00	0.00	0.63
chipping sparrow	0.15	3.84	0.00	0.00	0.53
cliff swallow	3.32	0.00	0.00	0.00	1.05
dark-eyed junco	4.83	0.00	0.00	0.00	1.53
eastern kingbird	0.00	2.07	0.00	0.00	0.26
European starling	3.17	5.76	2.72	1.10	2.68
grasshopper sparrow	0.00	1.54	0.00	0.00	0.19
gray-crowned rosy finch	9.80	0.00	2.04	0.00	3.54
horned lark	22.02	28.42	26.29	43.60	31.22
northern shrike	0.15	0.00	0.23	0.47	0.26
purple finch	0.00	3.07	0.00	0.00	0.38
red-winged blackbird	0.00	0.00	1.59	0.00	0.33
rock wren	0.00	0.00	0.23	0.00	0.05
savannah sparrow	0.45	1.69	0.00	0.00	0.35
Say's phoebe	0.30	1.61	0.23	0.00	0.34
song sparrow	0.00	0.77	0.00	0.00	0.10
unidentified passerine	0.15	0.00	1.63	0.00	0.39
unidentified sparrow	0.30	0.46	0.45	0.00	0.25
unidentified swallow	0.45	1.15	0.00	0.00	0.29
vesper sparrow	1.21	2.15	0.23	0.00	0.70
violet-green swallow	0.90	0.00	0.00	0.00	0.29
western bluebird	1.51	3.84	0.00	0.00	0.96
western kingbird	0.30	0.38	0.00	0.00	0.14
western meadowlark	7.32	6.61	1.23	1.93	4.07
western wood-pewee	0.00	0.77	0.00	0.00	0.10
Other Birds	0.15	1.15	0.91	0.00	0.38
common nighthawk	0.00	1.15	0.45	0.00	0.24
northern flicker	0.15	0.00	0.45	0.00	0.14
<i>Unidentified Birds</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.55</i>	<i>0.19</i>
unidentified bird	0.00	0.00	0.00	0.41	0.14
unidentified large bird	0.00	0.00	0.00	0.14	0.05

Table 4. Estimated frequency of occurrence (percent of surveys species/group is recorded) for each species observed within 800 m of the survey point (March 26, 2002 – March 14, 2003).

Species/Group	Spring Freq.	Summer Freq.	Fall Freq.	Winter Freq.	Overall Freq. Occur.
Waterfowl	0.00	0.00	3.70	0.00	0.79
Canada goose	0.00	0.00	1.85	0.00	0.40
snow goose	0.00	0.00	1.85	0.00	0.40
Shorebirds					
killdeer	1.52	0.00	0.00	2.22	1.19
Corvids	24.24	10.00	32.96	47.11	31.90
American crow	1.52	0.00	3.70	0.00	1.19
black-billed magpie	7.58	0.00	12.22	8.89	7.78
common raven	19.70	10.00	18.89	40.44	25.32
Upland Gamebirds	32.58	7.62	5.93	4.67	12.74
blue grouse	1.52	0.00	0.00	0.00	0.40
California quail	0.00	0.00	2.22	0.00	0.48
chukar	1.52	0.00	0.00	0.00	0.40
gray partridge	4.55	2.38	1.85	1.11	2.38
ring-necked pheasant	24.24	5.24	1.85	3.56	8.89
wild turkey	3.79	0.00	0.00	0.00	0.99
Doves					
mourning dove	12.12	10.48	11.85	1.33	7.94
Raptors	50.76	52.86	64.07	57.89	56.51
<i>Accipiters</i>					
sharp-shinned hawk	1.52	0.00	3.70	1.11	1.59
<i>Buteos</i>	<i>31.82</i>	<i>34.76</i>	<i>41.48</i>	<i>42.67</i>	<i>38.25</i>
ferruginous hawk	3.03	0.00	0.00	0.00	0.79
red-tailed hawk	27.27	34.76	34.07	21.11	27.78
rough-legged hawk	1.52	0.00	1.85	27.67	10.67
Swainson's hawk	3.03	0.00	1.85	0.00	1.19
unidentified buteo	3.03	0.00	9.63	5.78	4.92
<i>Eagles</i>	<i>0.00</i>	<i>0.00</i>	<i>3.70</i>	<i>1.33</i>	<i>1.27</i>
bald eagle	0.00	0.00	1.85	0.00	0.40
golden eagle	0.00	0.00	1.85	1.33	0.87
<i>Small Falcons</i>	<i>6.82</i>	<i>15.71</i>	<i>7.41</i>	<i>2.78</i>	<i>6.98</i>
American kestrel	6.82	15.71	5.56	2.78	6.59
merlin	0.00	0.00	1.85	0.00	0.40
<i>Large Falcons</i>	<i>1.52</i>	<i>0.00</i>	<i>1.85</i>	<i>0.00</i>	<i>0.79</i>
peregrine falcon	0.00	0.00	1.85	0.00	0.40
prairie falcon	1.52	0.00	0.00	0.00	0.40
<i>Other Raptors</i>					
barn owl	0.00	0.00	0.00	1.11	0.40
northern harrier	21.21	12.86	27.04	18.22	20.00
unidentified hawk	0.00	0.00	0.00	1.11	0.40

Table 4. Estimated frequency of occurrence (percent of surveys species/group is recorded) for each species observed within 800 m of the survey point (March 26, 2002 – March 14, 2003).

Species/Group	Spring Freq.	Summer Freq.	Fall Freq.	Winter Freq.	Overall Freq. Occur.
Passerines	85.61	79.52	63.70	83.22	79.05
American goldfinch	1.52	0.00	2.22	0.00	0.87
American pipit	1.52	0.00	3.70	0.00	1.19
American robin	7.58	12.38	1.85	20.00	11.59
American tree sparrow	0.00	0.00	0.00	1.67	0.60
Brewer's blackbird	12.12	4.76	0.00	0.00	3.97
brown-headed cowbird	1.52	0.00	0.00	0.00	0.40
cedar waxwing	0.00	12.38	0.00	0.00	2.06
chipping sparrow	1.52	4.76	0.00	0.00	1.19
cliff swallow	3.03	0.00	0.00	0.00	0.79
dark-eyed junco	1.52	0.00	0.00	0.00	0.40
eastern kingbird	0.00	7.62	0.00	0.00	1.27
European starling	4.55	9.52	4.07	2.22	4.44
grasshopper sparrow	0.00	9.52	0.00	0.00	1.59
gray-crowned rosy finch	1.52	0.00	1.85	0.00	0.84
horned lark	69.70	53.81	38.15	73.56	61.67
northern shrike	1.52	0.00	1.85	3.78	2.14
purple finch	0.00	2.38	0.00	0.00	0.40
red-winged blackbird	0.00	0.00	1.85	0.00	0.40
rock wren	0.00	0.00	1.85	0.00	0.40
savannah sparrow	3.03	5.24	0.00	0.00	1.67
Say's phoebe	1.52	5.24	1.85	0.00	1.67
song sparrow	0.00	2.38	0.00	0.00	0.40
unidentified passerine	1.52	0.00	2.22	0.00	0.87
unidentified sparrow	1.52	2.86	3.70	0.00	1.67
unidentified swallow	1.52	2.38	0.00	0.00	0.79
vesper sparrow	6.06	10.48	1.85	0.00	3.73
violet-green swallow	3.03	0.00	0.00	0.00	0.79
western bluebird	7.58	7.62	0.00	0.00	3.25
western kingbird	3.03	2.38	0.00	0.00	1.19
western meadowlark	42.42	33.81	10.00	3.33	22.06
western wood-pewee	0.00	2.38	0.00	0.00	0.40
Other Birds	1.52	4.76	7.41	0.00	2.78
common nighthawk	0.00	4.76	3.70	0.00	1.59
northern flicker	1.52	0.00	3.70	0.00	1.19
<i>Unidentified Birds</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>5.00</i>	<i>1.19</i>
unidentified bird	0.00	0.00	0.00	3.33	0.79
unidentified large bird	0.00	0.00	0.00	1.67	0.40

Table 5. Flight characteristics of bird species observed during fixed-point surveys.

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<25 m	25-125 m	> 125 m
osprey	1	1	100.0	0.0	100.0	0.0
prairie falcon	1	1	100.0	0.0	100.0	0.0
red-winged blackbird	1	7	100.0	0.0	100.0	0.0
unidentified eagle	1	1	100.0	0.0	100.0	0.0
unidentified large bird	2	2	66.7	0.0	100.0	0.0
American goldfinch	1	3	60.0	0.0	100.0	0.0
American crow	2	16	94.1	25.0	75.0	0.0
unidentified buteo	19	22	84.6	13.6	72.7	13.6
Swainson's hawk	3	3	100.0	0.0	66.7	33.3
rough-legged hawk	33	35	89.7	17.1	62.9	20.0
common nighthawk	4	4	80.0	25.0	50.0	25.0
red-tailed hawk	71	79	82.3	34.2	46.8	19.0
golden eagle	2	3	100.0	0.0	33.3	66.7
common raven	57	83	66.4	65.1	34.9	0.0
European starling	12	49	89.1	71.4	28.6	0.0
black-billed magpie	12	32	82.1	81.3	18.8	0.0
Brewer's blackbird	13	62	77.5	75.8	24.2	0.0
American kestrel	12	12	66.7	83.3	16.7	0.0
horned lark	115	422	68.3	85.3	14.7	0.0
unidentified passerine	2	7	100.0	85.7	14.3	0.0
gray-crowned rosy finch	2	74	100.0	87.8	12.2	0.0
northern harrier	58	58	98.3	84.7	11.9	3.4
American robin	13	120	55.6	94.2	5.8	0.0
mourning dove	18	44	57.1	95.5	4.5	0.0
Canada goose	2	100	100.0	0.0	0.0	100.0
bald eagle	1	1	100.0	100.0	0.0	0.0
barn owl	1	1	100.0	100.0	0.0	0.0
cliff swallow	2	22	100.0	100.0	0.0	0.0
dark-eyed junco	1	32	100.0	100.0	0.0	0.0
ferruginous hawk	2	2	100.0	100.0	0.0	0.0
merlin	1	1	100.0	100.0	0.0	0.0
peregrine falcon	1	1	100.0	100.0	0.0	0.0
purple finch	1	8	100.0	100.0	0.0	0.0
snow goose	1	16	100.0	0.0	0.0	100.0
unidentified hawk	1	1	100.0	100.0	0.0	0.0
unidentified sparrow	4	5	100.0	100.0	0.0	0.0
unidentified swallow	2	6	100.0	100.0	0.0	0.0
violet-green swallow	2	6	100.0	100.0	0.0	0.0
western kingbird	3	3	100.0	100.0	0.0	0.0
American pipit	2	27	90.0	100.0	0.0	0.0
cedar waxwing	3	11	84.6	100.0	0.0	0.0
sharp-shinned hawk	3	3	75.0	100.0	0.0	0.0
gray partridge	3	13	68.4	100.0	0.0	0.0
eastern kingbird	2	3	60.0	100.0	0.0	0.0
killdeer	1	3	60.0	100.0	0.0	0.0
unidentified bird	1	1	50.0	100.0	0.0	0.0
savannah sparrow	2	3	42.9	100.0	0.0	0.0
northern flicker	1	1	33.3	100.0	0.0	0.0
vesper sparrow	3	4	28.6	100.0	0.0	0.0
grasshopper sparrow	1	1	25.0	100.0	0.0	0.0

Table 5. Flight characteristics of bird species observed during fixed-point surveys.

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<25 m	25-125 m	> 125 m
western meadowlark	15	18	23.7	100.0	0.0	0.0
western bluebird	2	4	22.2	100.0	0.0	0.0
Say's phoebe	1	1	14.3	100.0	0.0	0.0
chipping sparrow	1	1	9.1	100.0	0.0	0.0
ring-necked pheasant	2	2	8.7	100.0	0.0	0.0
American tree sparrow	0	0	0.0	N/A	N/A	N/A
California quail	0	0	0.0	N/A	N/A	N/A
blue grouse	0	0	0.0	N/A	N/A	N/A
brown-headed cowbird	0	0	0.0	N/A	N/A	N/A
chukar	0	0	0.0	N/A	N/A	N/A
northern shrike	0	0	0.0	N/A	N/A	N/A
rock wren	0	0	0.0	N/A	N/A	N/A
song sparrow	0	0	0.0	N/A	N/A	N/A
western wood-pewee	0	0	0.0	N/A	N/A	N/A
wild turkey	0	0	0.0	N/A	N/A	N/A
Subtotal	523	1442	69.2	71.7	18.1	10.2

Table 6. Flight characteristics of avian groups observed during the fixed-point surveys.

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<25 m	25-125 m	> 125 m
Waterfowl	3	116	100.0	0.0	0.0	100.0
Shorebirds	1	3	100.0	100.0	0.0	0.0
Corvids	71	131	72.4	64.1	35.9	0.0
Accipiters	3	3	75.0	100.0	0.0	0.0
Buteos	128	141	84.9	27.0	54.6	18.4
Eagles	4	5	100.0	20.0	40.0	40.0
Large Falcons	2	2	100.0	50.0	50.0	0.0
Small Falcons	13	13	68.4	84.6	15.4	0.0
Northern harrier	47	47	97.9	87.2	10.6	2.1
Owls	1	1	100.0	100.0	0.0	0.0
Other Raptors	2	2	100.0	50.0	50.0	0.0
Raptor Subtotal	211	226	87.3	49.9	39.8	13.3
Passerines	206	899	66.2	86.9	13.1	0.0
Upland gamebirds	5	15	20.0	100.0	0.0	0.0
Doves	18	44	57.1	95.5	4.5	0.0
Other Birds	5	5	62.5	40.0	40.0	20.0
Unidentified Birds	3	3	60.0	33.3	66.7	0.0
Subtotal	523	1442	69.2	71.7	18.1	10.2

Table 7. Exposure indices calculated for species observed during fixed-point surveys.

Species/Group	Mean use	Percent flying	Percent flying within RSA	Exposure Index
horned lark	2.589	68.28	14.69	0.260
red-tailed hawk	0.382	82.29	46.84	0.147
common raven	0.484	66.40	34.94	0.112
rough-legged hawk	0.135	89.74	62.86	0.076
Brewer's blackbird	0.329	77.50	24.19	0.062
European starling	0.222	89.09	28.57	0.057
American crow	0.067	94.12	75.00	0.048
unidentified buteo	0.058	84.62	72.73	0.036
gray-crowned rosy finch	0.294	100.00	12.20	0.035
American robin	0.863	55.56	5.83	0.028
red-winged blackbird	0.028	100.00	100.00	0.028
northern harrier	0.233	98.33	11.86	0.027
black-billed magpie	0.160	82.05	18.75	0.025
American goldfinch	0.023	60.00	100.00	0.014
American kestrel	0.083	66.67	16.67	0.009
mourning dove	0.328	57.14	4.55	0.009
common nighthawk	0.020	80.00	50.00	0.008
Swainson's hawk	0.012	100.00	66.67	0.008
unidentified passerine	0.033	100.00	14.29	0.005
golden eagle	0.013	100.00	33.33	0.004
prairie falcon	0.004	100.00	100.00	0.004
unidentified large bird	0.004	66.67	100.00	0.003
western meadowlark	0.338	23.68	0.00	0.000
Canada goose	0.198	100.00	0.00	0.000
dark-eyed junco	0.127	100.00	0.00	0.000
American pipit	0.119	90.00	0.00	0.000
ring-necked pheasant	0.101	8.70	0.00	0.000
cliff swallow	0.087	100.00	0.00	0.000
western bluebird	0.079	22.22	0.00	0.000
gray partridge	0.083	68.42	0.00	0.000
snow goose	0.063	100.00	0.00	0.000
vesper sparrow	0.058	28.57	0.00	0.000
cedar waxwing	0.052	84.62	0.00	0.000
chipping sparrow	0.044	9.09	0.00	0.000
purple finch	0.032	100.00	0.00	0.000
savannah sparrow	0.029	42.86	0.00	0.000
Say's phoebe	0.029	14.29	0.00	0.000
unidentified swallow	0.024	100.00	0.00	0.000
violet-green swallow	0.024	100.00	0.00	0.000
eastern kingbird	0.021	60.00	0.00	0.000
unidentified sparrow	0.021	100.00	0.00	0.000
killdeer	0.020	60.00	0.00	0.000
grasshopper sparrow	0.016	25.00	0.00	0.000
sharp-shinned hawk	0.016	75.00	0.00	0.000
northern flicker	0.012	33.33	0.00	0.000
unidentified bird	0.012	50.00	0.00	0.000
western kingbird	0.012	100.00	0.00	0.000
ferruginous hawk	0.008	100.00	0.00	0.000
bald eagle	0.004	100.00	0.00	0.000

Table 7. Exposure indices calculated for species observed during fixed-point surveys.

Species/Group	Mean use	Percent flying	Percent flying within RSA	Exposure Index
barn owl	0.004	100.00	0.00	0.000
merlin	0.004	100.00	0.00	0.000
peregrine falcon	0.004	100.00	0.00	0.000
unidentified hawk	0.004	100.00	0.00	0.000
wild turkey	0.135	0.00	N/A	N/A
brown-headed cowbird	0.071	0.00	N/A	N/A
blue grouse	0.024	0.00	N/A	N/A
northern shrike	0.021	0.00	N/A	N/A
song sparrow	0.008	0.00	N/A	N/A
western wood-pewee	0.008	0.00	N/A	N/A
American tree sparrow	0.006	0.00	N/A	N/A
California quail	0.005	0.00	N/A	N/A
chukar	0.004	0.00	N/A	N/A
rock wren	0.004	0.00	N/A	N/A

Table 8. Big game species observed during fixed-point surveys (March 26, 2002 – January 28, 2003).

Species/Group	Spring		Summer		Fall		Winter		Total	
	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups	Number Individuals	Number Groups
Big Game Species										
Rocky Mountain elk	4	2	3	2	35	2	33	1	75	7
mule deer	78	9	7	2	107	17	108	16	300	44
white-tailed deer	38	6	12	5	7	4	24	7	81	22
Total	120	17	22	9	149	23	165	24	456	73

Table 9. Estimated mean use (number of observations per 30-min survey) for big game species observed within 800 m of the survey point for fixed-point stations (March 26, 2002- January 28, 2003).

Station	Mule Deer		Rocky Mountain Elk		White-Tailed Deer	
	Mean	st dev	Mean	st dev	Mean	st dev
A	0.273	0.883	0.091	0.426	0.818	1.680
B	0.810	1.569	0.000	0.000	1.048	2.133
C	0.000	0.000	0.000	0.000	0.182	0.664
D	1.000	4.265	0.000	0.000	0.000	0.000
E	1.800	4.262	0.000	0.000	0.000	0.000
F	1.810	5.125	0.000	0.000	0.000	0.000
G	0.579	2.524	0.000	0.000	0.105	0.459
H	1.263	4.134	0.053	0.229	0.474	1.264
I	4.389	6.749	0.000	0.000	0.000	0.000
J	0.200	0.696	0.150	0.671	0.000	0.000
K	1.550	3.268	0.000	0.000	0.300	0.979
L	0.000	0.000	0.000	0.000	0.000	0.000

Table 10. Raptor and large bird nests located in the raptor nest survey area (study area plus area within a two-mile radius buffer).

Species	Number Active Nests ^a	Number of Nests Which Produced Young ^b	Total Young Observed (young per successful nest)
Ferruginous hawk	1	0	0
Red-tailed hawk	33	23 ^c	44 (1.5)
Swainson's hawk	1	unk	unk
Unknown buteo ^d	6	2	unk
Short-eared owl ^e	1	unk	unk
Great horned owl	10	7 ^f	16 (2.3)
Common raven	1	0	0
Great blue heron	3	2	unk
Inactive nests	48	N/A	N/A

^a based on April 30- May 2 survey

^b based on June 8 survey

^c productivity calculated for 29 nests; 4 nests were not found on second visit or had adults incubating eggs

^d generally there were young or eggs present at a nest but no adults nearby for identification

^e one adult flushed from a stubble field was likely sitting on a nest which could not be located

^f productivity calculated for 7 nests on first visit; 3 nests had adults incubating eggs

Table 11. Number of groups and the total number of individuals of avian species of interest, mammals, and reptiles observed incidentally on site.

Species	Number of Groups	Number of Individuals
Birds		
great blue heron	2	2
American kestrel	23	26
prairie falcon	2	2
Cooper's hawk	1	1
golden eagle	1	1
red-tailed hawk	76	89
Swainson's hawk	1	1
northern harrier	15	15
osprey	1	1
long-eared owl	1	1
great-horned owl	1	1
Canada goose	1	50
mallard	2	8
mourning dove	1	21
common raven	4	7
gray partridge	2	4
ring-necked pheasant	1	1
wild turkey	13	278
barn swallow	1	21
Stellar's jay	1	1
Townsend's solitaire	2	2
dark-eyed junco	1	15
eastern kingbird	2	24
lark sparrow	1	1
western bluebird	1	2
Mammals		
Mule deer	6	52
elk	2	26
white-tailed deer	10	56
Reptiles		
gopher snake	2	2

Table 12. Vegetation types in the study area.

Vegetation Type	Approx. Acres	Percent of Study Area	General Habitat Description
Cropland	14,485	52	Current wheat cropland; potential to support wildlife variable depending on stage of crop or age since last tilled.
Grassland	10,840	39	Areas dominated by grasses with a mix of forbs and shrubs. Generally found on steep slopes that are not suitable for farming. Important habitat for birds and wildlife; provides cover, breeding habitat and forage. Some grassland areas are grazed.
CRP	1,433	5	Lands included in the Conservation Reserve Program; primarily planted in bluebunch wheatgrass. Valuable habitat for upland game birds.
Pine Forest	945	3	Disjunct patches of Ponderosa pine forest at the southern end of the study area, which is the northern extreme of the Blue Mountains. Important habitat for birds and wildlife for cover and forage.
Riparian	248	0.9	Vegetation located along drainages; most drainages are narrow and steep. Riparian vegetation includes an black cottonwood and hawthorn, with wild rose and snowberry common understory shrubs. Trees provide potential habitat for nesting raptors when the trees are sufficiently large to provide nest platforms. Riparian areas with dense shrub/trees also provide cover for big game and other wildlife.
Developed	114	0.4	Areas occupied by buildings, equipment storage, and general human habitation. Also includes two cemeteries located within the study area.
Orchard	5	0.02	One orchard was observed in the study area that appeared to be abandoned. This site could provide food and cover for passerines, upland gamebirds, big game species and other wildlife.
Total	28,070	100	

Table 13. Rare plants potentially occurring in the project area based on range and habitat requirements.

Species	Federal Status	State Status	Known Locations	General Habitat	Elevation	Flowering Period
broad-fruit mariposa (<i>Calochortus nitidus</i>)	SC	T	Garfield County	grasslands	1,500 - 6,400	early July
diffuse stickseed (<i>Hackelia diffusa</i>)	none	S	Columbia County	shaded areas, cliffs, talus, wooded flats and slopes, also disturbed environments	~ 1,000	May - June
Snake Canyon desert parsley (<i>Lomatium serpentinum</i>)	none	S	Columbia County	open often rocky slopes		spring
northwest raspberry (<i>Rubus nigerrimus</i>)	SC	E	Garfield County	drainages in grasslands	700 - 2,200	May - June
Spaldings' silene (<i>Silene spaldingii</i>)	T	T	eastern WA	open grasslands w/ a minor shrub and/or tree component	1,900 - 3,050	mid July - September

Federal Status

SC = Species of Concern: A taxon whose conservation standing is of concern but for which status information is still needed. Species of concern lists are not published in the Federal Register.

State Status

E = Endangered: Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree.

T = Threatened: Any taxon likely to become Endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation or loss continue.

S = Sensitive: Any taxon that is vulnerable or declining and could become Endangered or Threatened in the state without active management or removal of threats.

Figure 1. Proposed Hopkins Ridge Wind Project location.

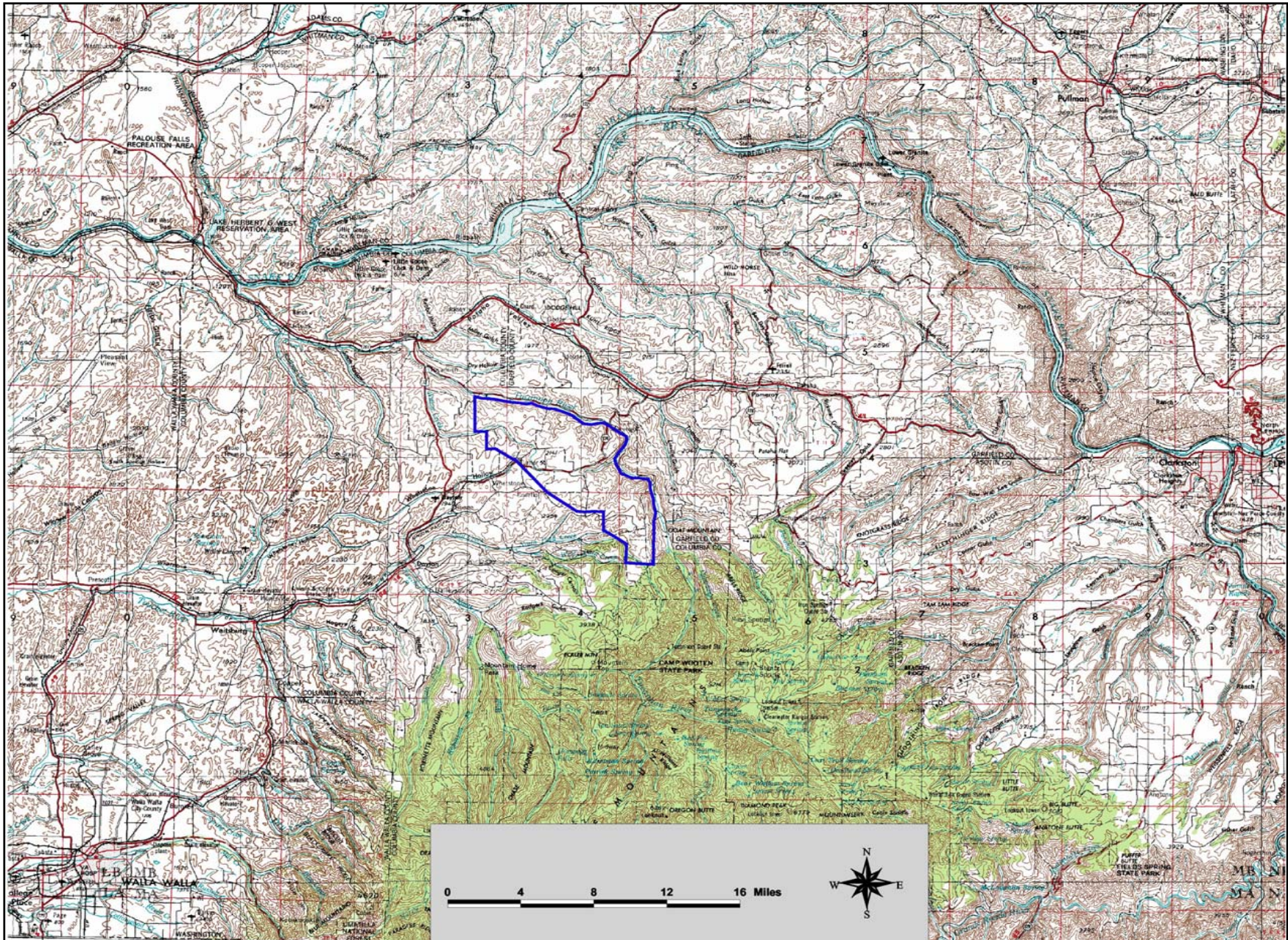


Figure 2. Fixed-point survey plots with 800 m buffer and bald eagle survey route.

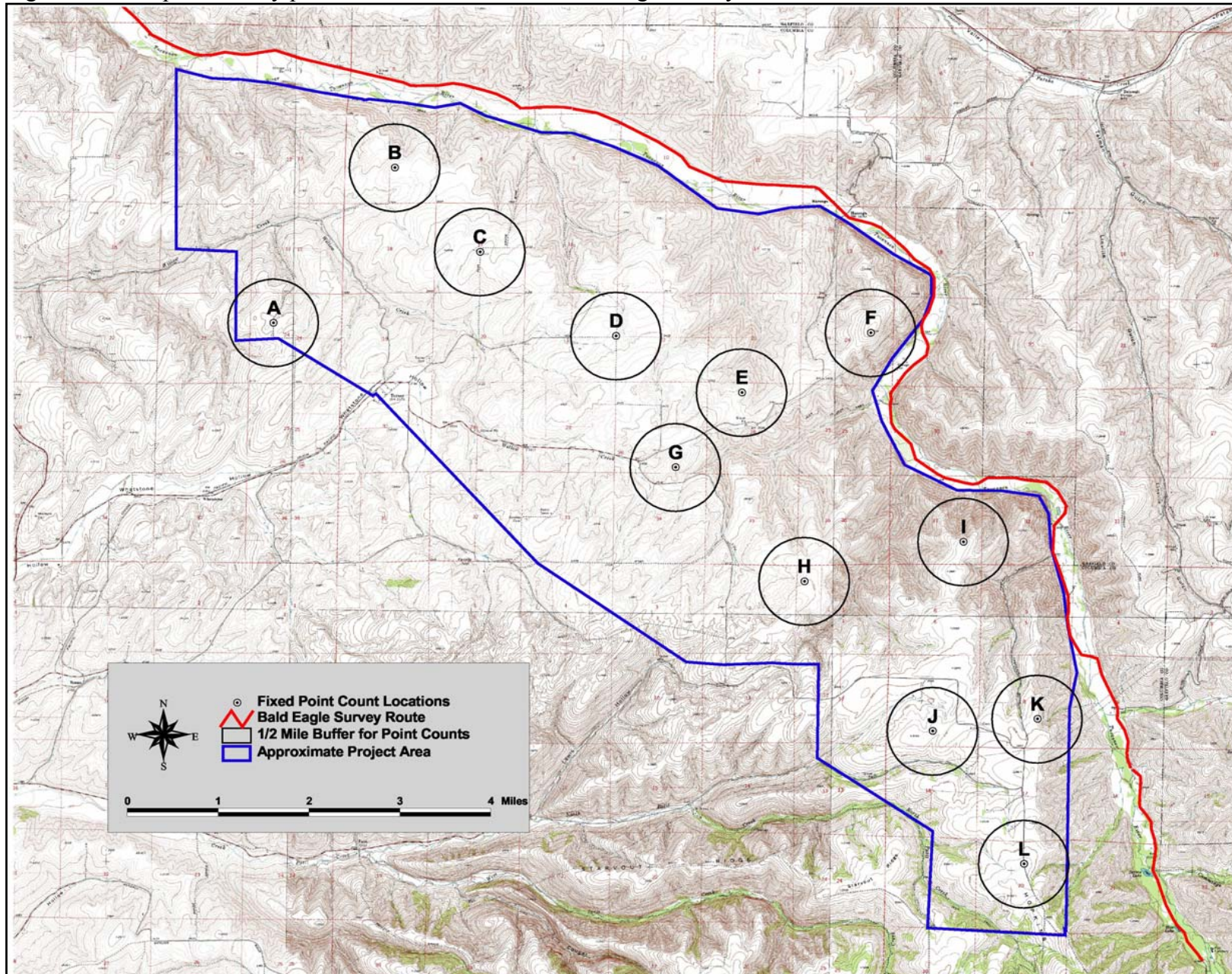


Figure 3. Raptor nest survey area and nests located.

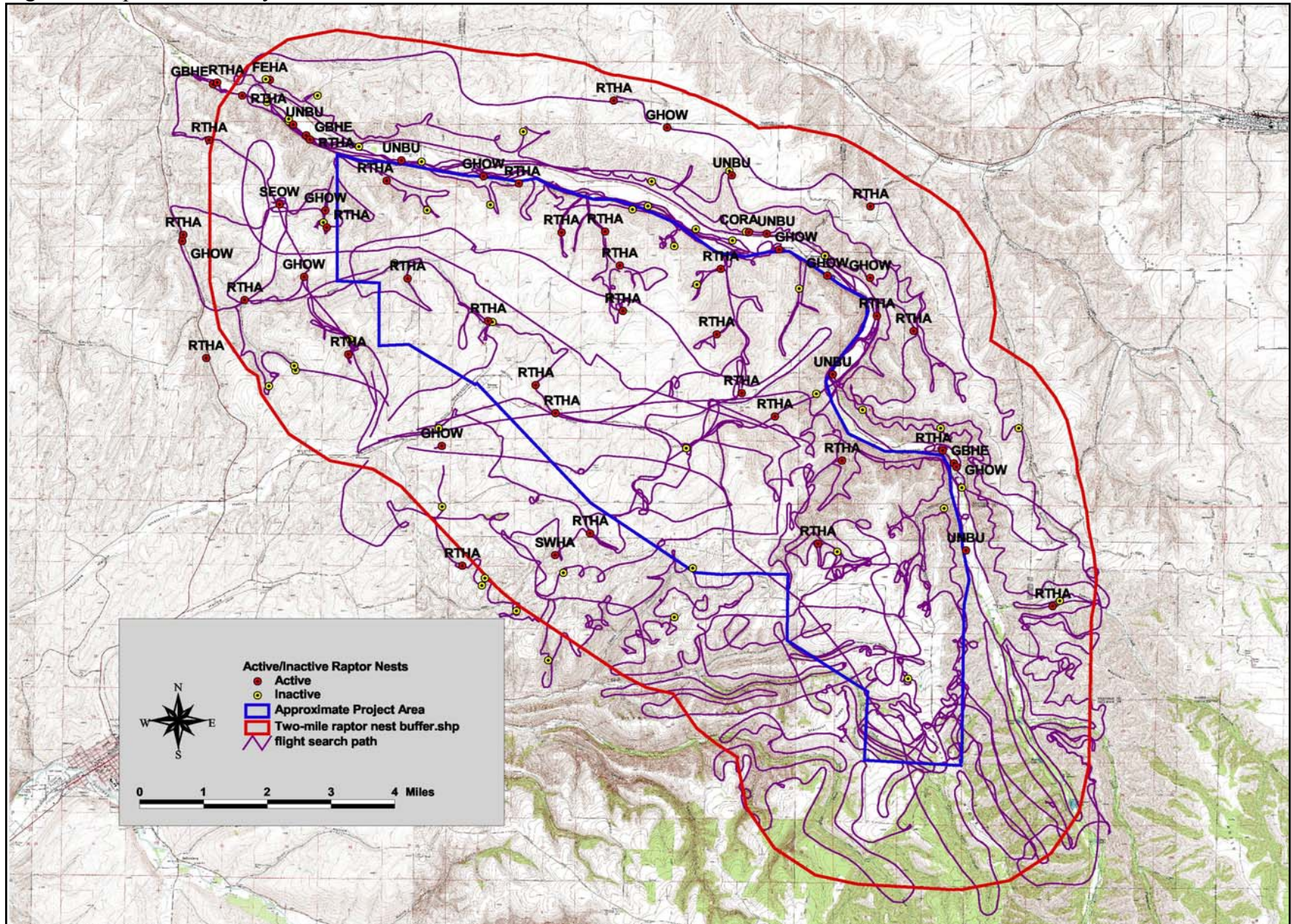


Figure 4. Vegetation mapping for the study area.

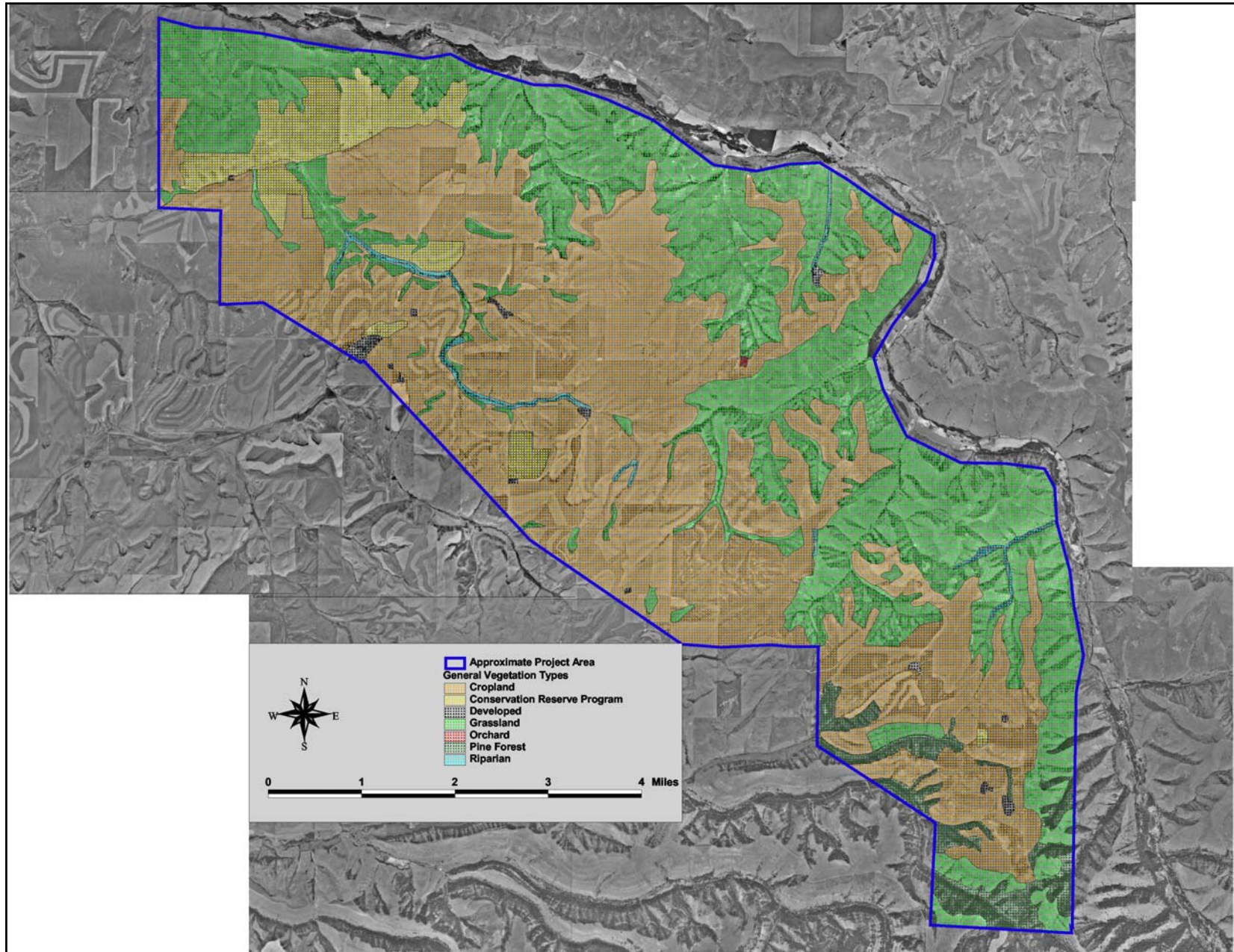


Figure 5. Mean use and frequency of occurrence for avian groups by survey period (dashed line represents a smoothed estimate).

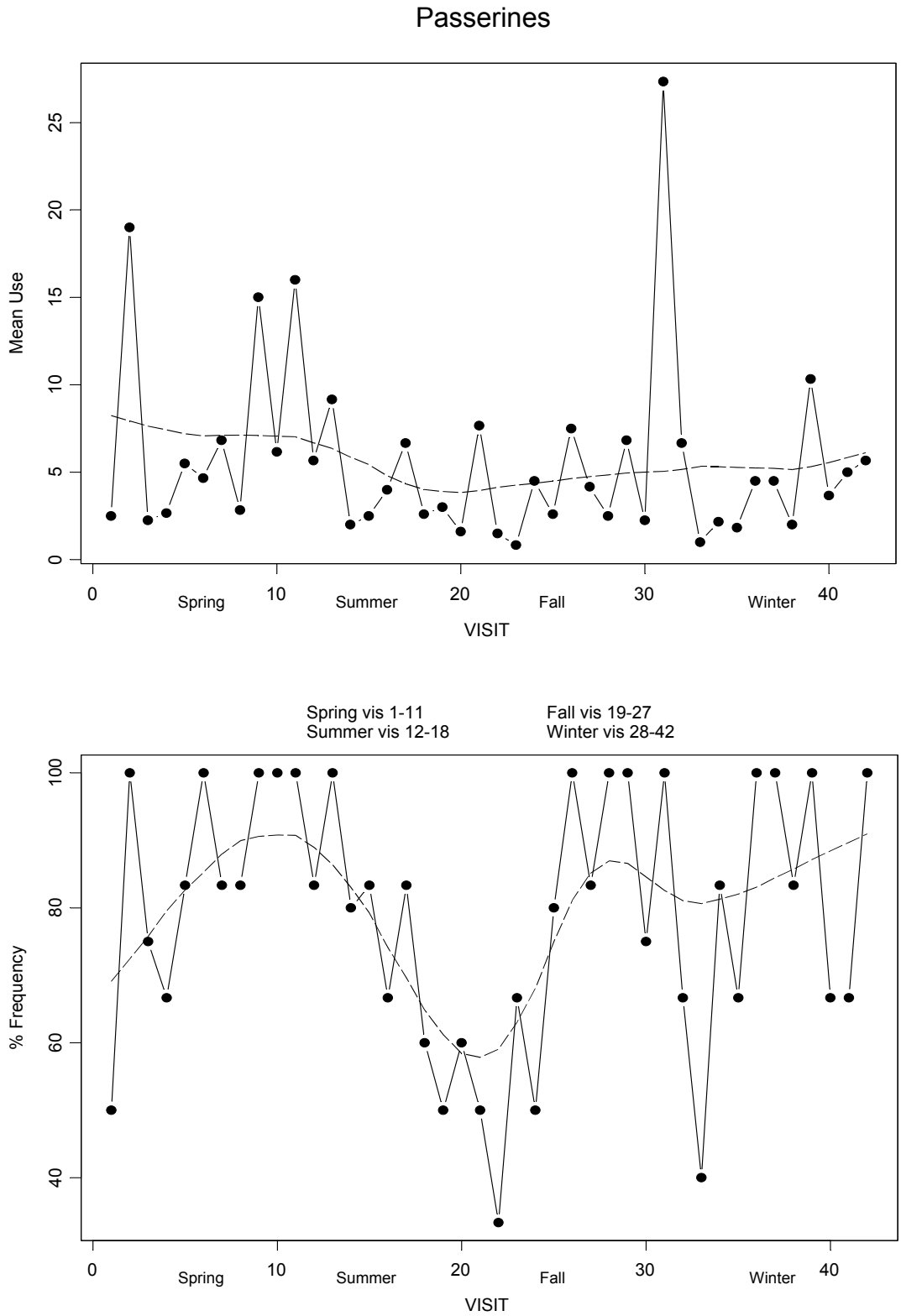


Figure 5. (continued).

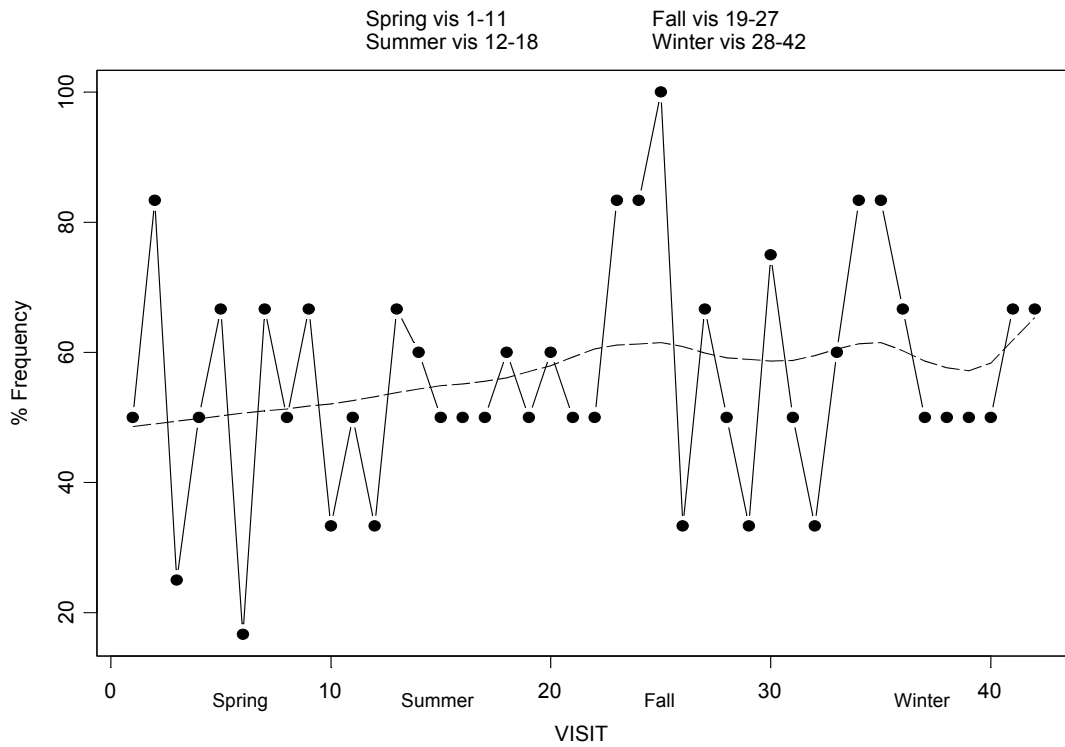
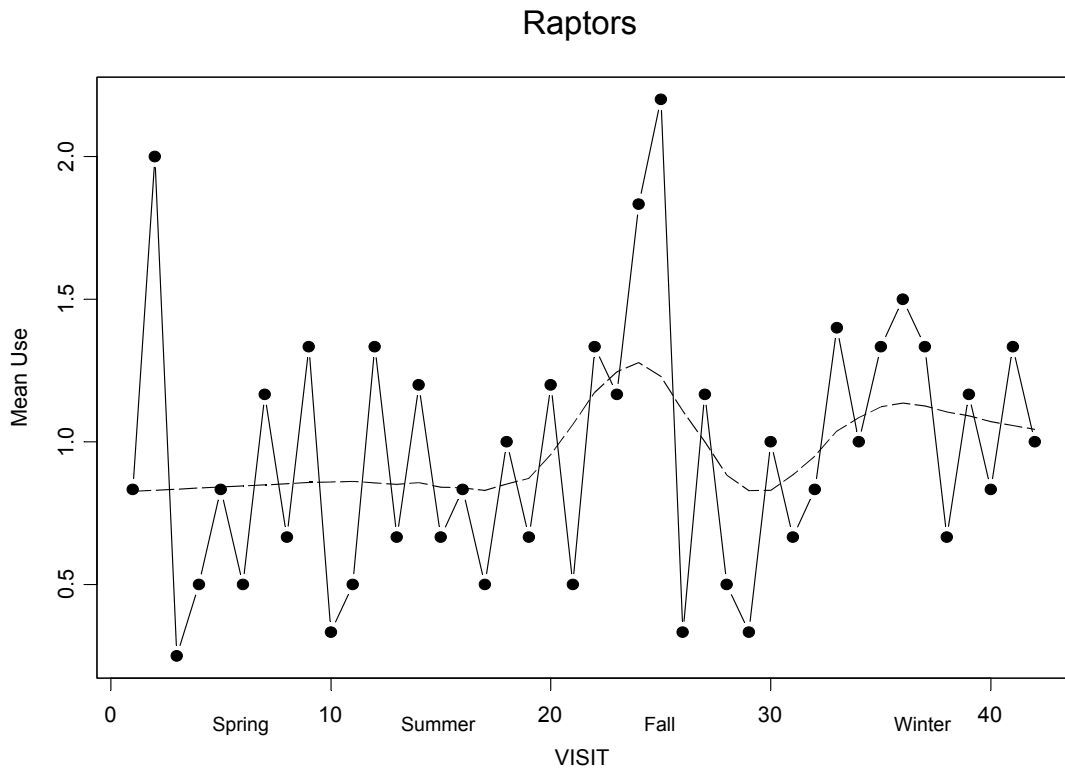


Figure 6. Mean use and frequency of occurrence for avian groups by survey station (bar represents ± 1 standard error).

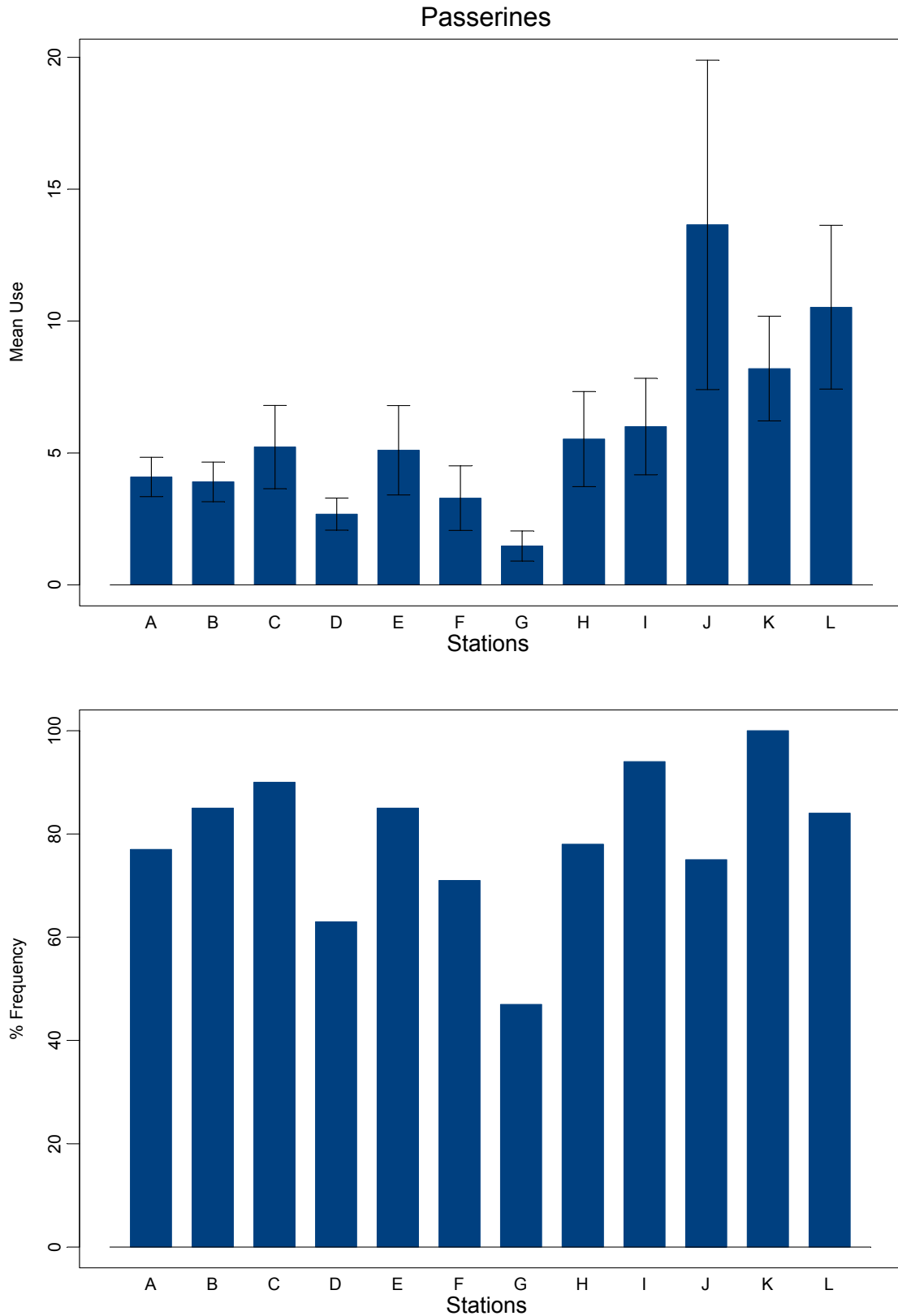


Figure 6. (continued).

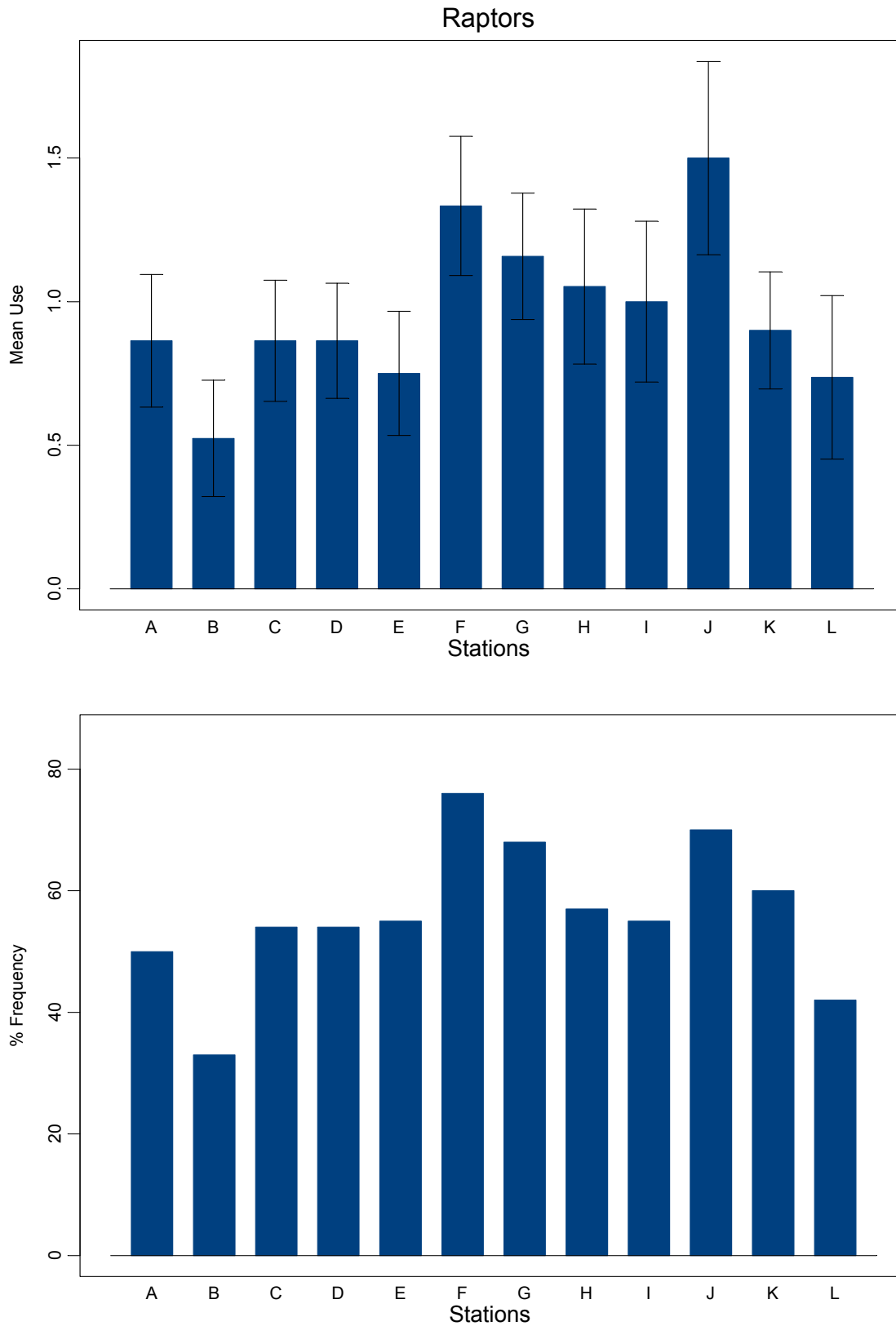


Figure 7. Mean number of species per survey (dashed line represents a smoothed estimate).

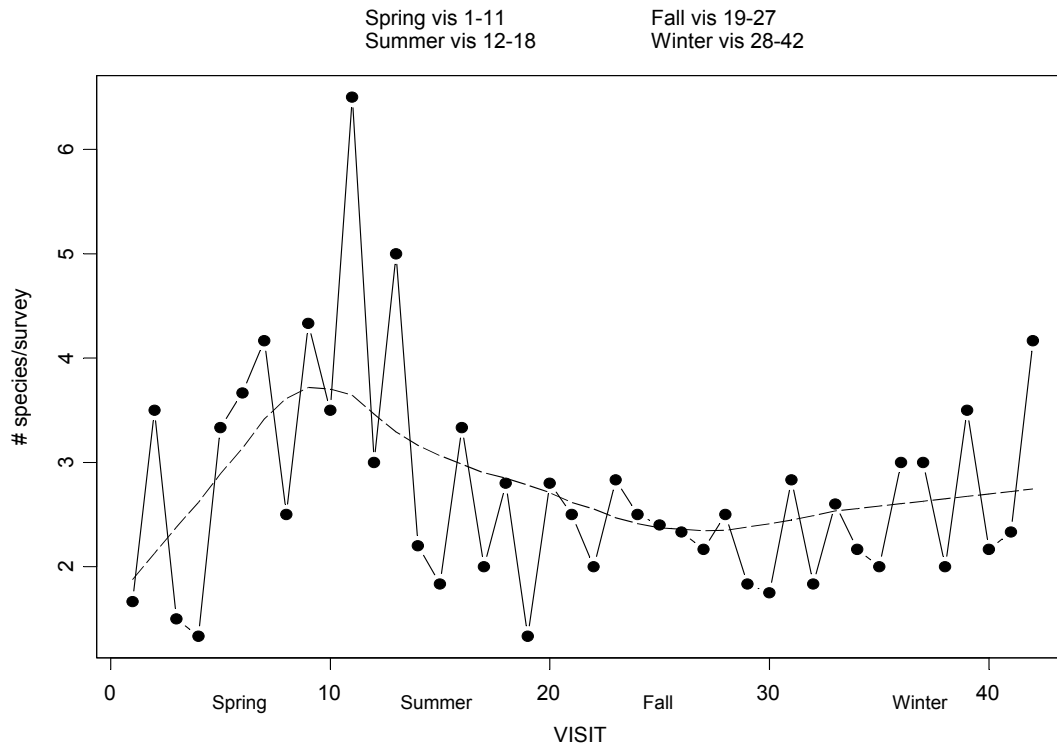


Figure 8. Buteo flight paths and perch locations recorded during fixed-point surveys and incidentally in the study area.

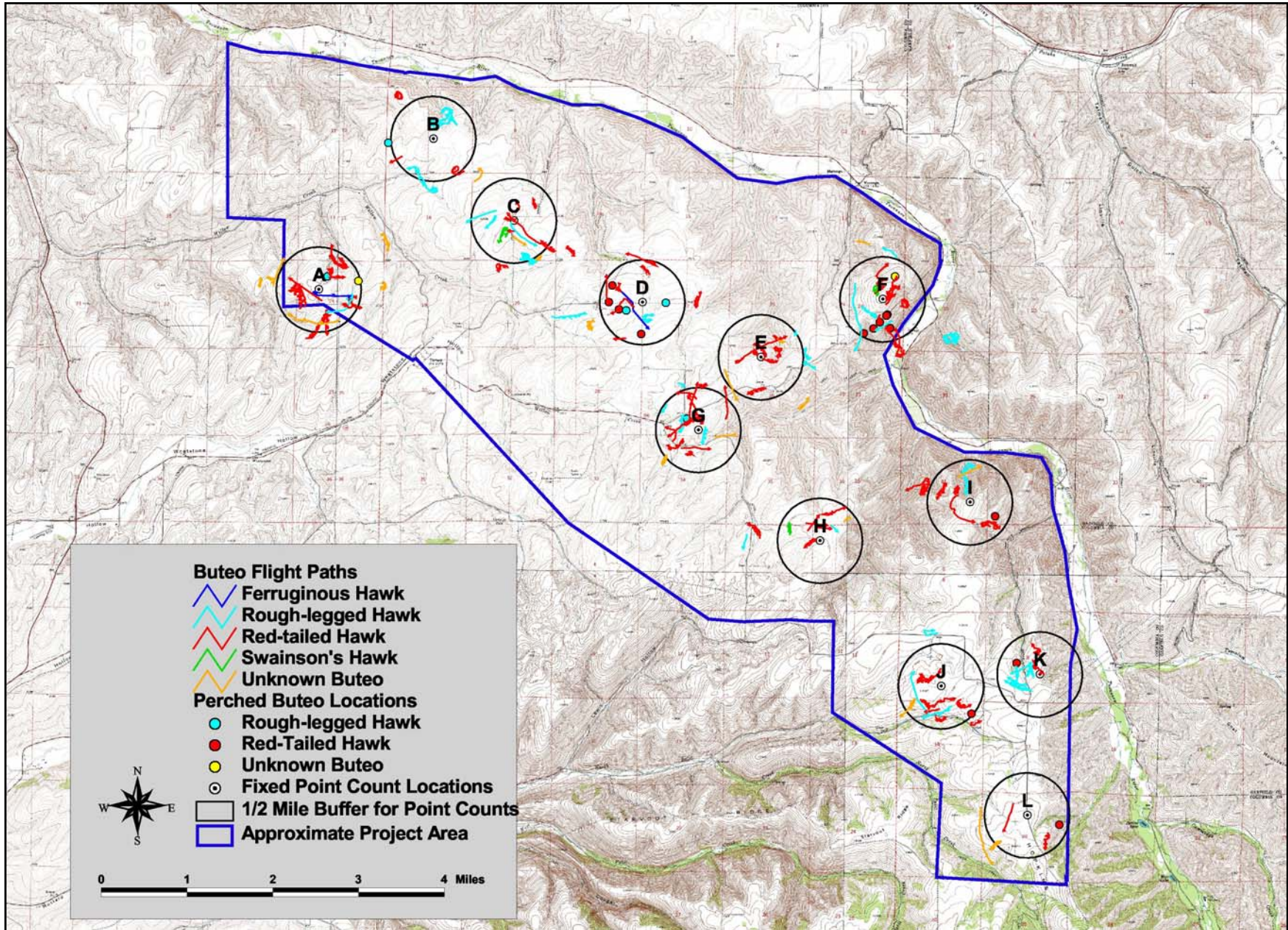


Figure 9. Northern harrier flight paths and perch locations recorded during fixed-point surveys and incidentally in the study area.

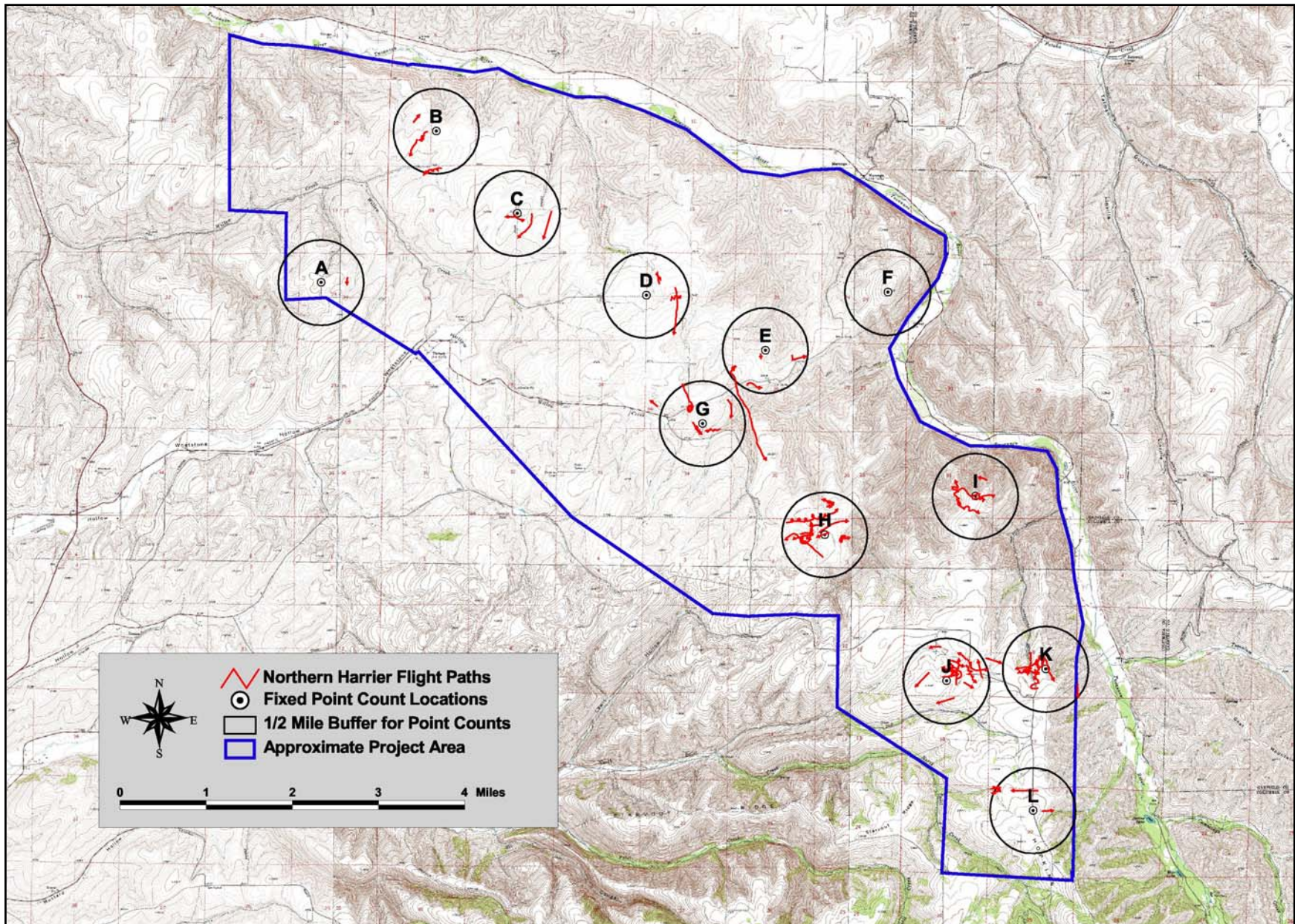


Figure 10. Other raptor and corvid flight paths and perch locations recorded during fixed-point surveys and incidentally in the study area.

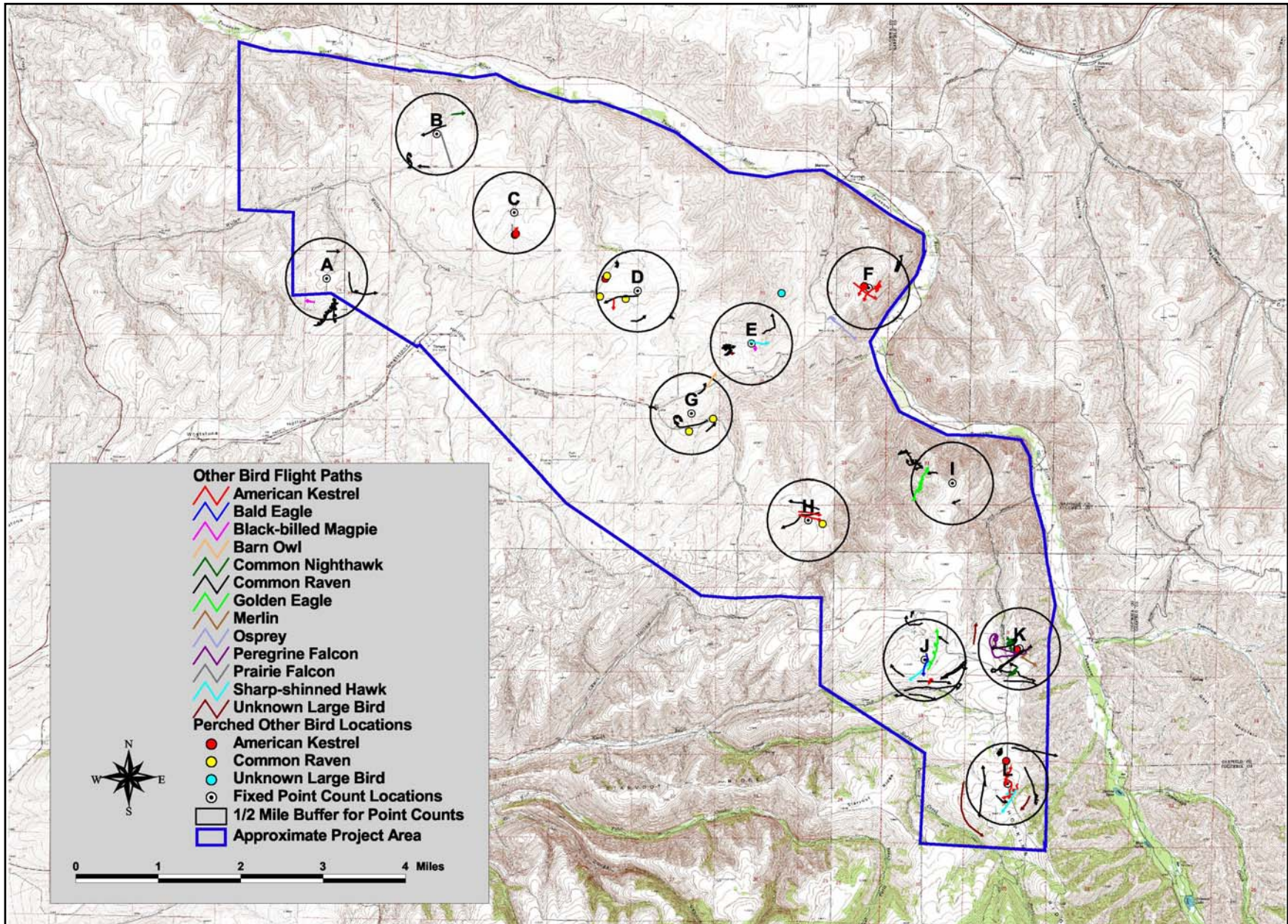
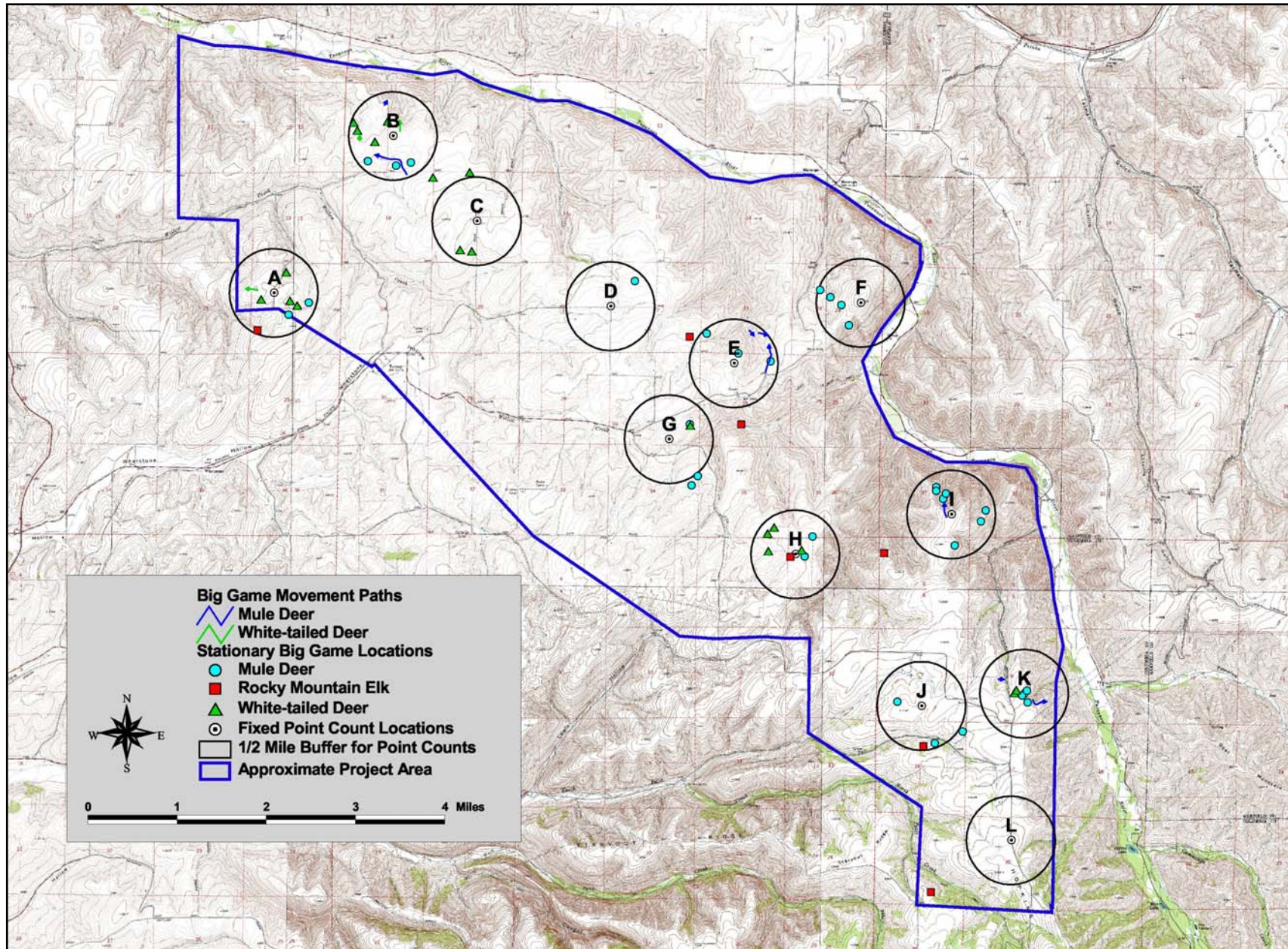


Figure 11. Big game species observations recorded during the fixed-point surveys and incidentally in the study area.



APPENDIX A
EXAMPLE
FIXED-POINT SURVEY FIELD DATA SHEET

AVIAN OBSERVATION DATA SHEET: FIXED POINT & INSTANTANEOUS COUNT

HOPKINS RIDGE WIND SITE

STATION A

DATE: _____ OBSERVER _____ START TIME _____ END TIME _____ PAGE _____ OF _____

WEATHER: VISIBILITY (CIRCLE ONE) good fair poor CLOUD COVER(%) _____ TEMP(°C) _____

WIND DIRECTION (CIRCLE ONE) N NE E SE S SW W NW n/a SPEED(KPH) Low: _____ High: _____

PRECIPITATION (CIRCLE ONE) none light rain rain light snow snow sleet hail other

Obs No.	Species	Sex	Age	# Inds.	Dist. (m) from observer 1 st /closest	Activity	Flight Characteristics				Habitat	Instantaneous Count (Height/Distance)				A ^a	10 min. Incr.	NOTES
							Flight Height (m)			Dir.		1	2	3	4			
							1st	low	high									
1						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
2						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
3						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
4						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
5						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
6						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
7						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
8						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
9						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							
10						PE :SO :FL					GS :CF :DT :CR :WW							
						CS :HO :OT					DS :SS :RK :RI :OT							

^a check if Auditory only
Comments _____

