Appendix C

Biological Resources Materials

Appendix C-1

Ecological Baseline Studies

ECOLOGICAL BASELINE STUDIES FOR THE HATCHET RIDGE WIND ENERGY PROJECT, SHASTA COUNTY, CALIFORNIA

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EXECUTIVE SUMMARY

Hatchet Ridge Wind, LLC is evaluating the feasibility of a wind energy development in Shasta County, California. The proposed site, *Hatchet Ridge*, is located approximately 6 miles west of Burney, California and along the primary ridgeline of Hatchet Mountain north of California State Highway 299. The proposed development would be located on private land and would consist of the installation, operation, maintenance, and eventual decommissioning of approximately 100 MW of turbines and supporting facilities.

In support of the environmental impact evaluation for the project, a detailed 12-month biological resources study plan was developed and implemented at the site. The study protocol was developed in cooperation with the California Department of Fish and Game 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. Objectives of the study were to provide data that was useful in evaluating potential impacts from the proposed project and assist in siting of project facilities within the project area. The field surveys were designed to: (1) describe and quantify seasonal avian use of the proposed project area; (2) describe and quantify raptor use of the proposed project; (3) describe and quantify seasonal bat use of the proposed project; (4) describe vegetation types and rare plant occurrence in the proposed project area.

Fixed-point avian use surveys were conducted to estimate the seasonal, spatial, and temporal use of the site by birds and in particular raptors. Surveys were conducted at six fixed survey stations located within the study area approximately once each week between November 15, 2005 and November 9, 2006, resulting in 270 30-minute point count surveys during the study. Seventy-nine avian species were observed during the fixed-point surveys. Passerines were the most numerous group and comprised 64% of all birds observed; dark-eyed junco, common raven, American robin, and mountain bluebird were the most numerous passerines observed. Raptors comprised approximately 10% of all birds observed. The most common raptors were red-tailed hawk, American kestrel, bald eagle, and Cooper's hawk. Waterfowl comprised only 1% of all groups but 16% of all individual birds primarily because they tended to occur in large flocks. The most numerous waterfowl were tundra swan, greater white-fronted goose, and snow goose. Other birds (waterbirds, upland gamebirds, doves, and other non-passerine species) comprised approximately 9% of all birds observed.

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. Over all seasons based on use, passerines were the most abundant group observed (6.2/survey), followed by waterfowl (1.3/survey), and raptors (1.0/survey). Waterfowl use was strongly influenced by observations of a few large flocks flying over the site. Over all seasons, dark-eyed junco was the most common bird observed with 0.98 detections per survey, followed by common raven (0.64), turkey vulture (0.51) and American robin (0.50). These four species comprised 28% of all bird use of the site for the year. Passerine and raptor use was significantly lower in the winter than in the summer and fall. There were no significant differences in use between seasons for all birds combined.

During the study 533 single birds or flocks totaling 1,581 individuals were observed flying during point count surveys. For all species combined, 25.1% of all flying birds observed were below the rotor-swept height, 63.4% were within the rotor-swept height, and 11.5% of birds were observed flying above the rotor-swept height of typical turbines that could be used in the project. Avian groups most often observed flying within the turbine rotor-swept height were buteos (98.5%), vultures (98.4%), doves (96.2%), and eagles (85.7%). For all flying raptors combined, 94.9% were observed flying within the rotor-swept height. For species with at least five separate observations of flying birds, those most often observed at rotor-swept heights were red-tailed hawk (98.4%), turkey vulture (98.4%), band-tailed pigeon (98.1%), unidentified bluebird (96.4%), and tree swallow (95.0%). Based on the use (measure of abundance) of the site by each species and the flight characteristics observed for that species, turkey vulture, common raven, snow goose, tree swallow and American robin had the highest probability of turbine exposure. The only raptor with a relatively high exposure index was red-tailed hawk, which ranked 7th of all species.

For all bird species combined, use was relatively uniform along Hatchet Mountain and no obvious flyways or concentration areas were observed. No strong association of use with topographic features of the site was noted for raptors or other large birds. The majority of large birds flew perpendicular to and across the prominent ridgeline, rather than parallel with the ridge, suggesting that the ridge is not an important migratory route for diurnal migrants. Although some differences in avian use were detected among survey points, the differences are not large enough to suggest that any portions of the project area should be avoided when siting turbines.

An aerial survey for raptor nests was conducted via helicopter on April 21, 2006. The nest survey area included the development area and the area within an approximate 2-mile buffer of the site, which totaled approximately 32,000 acres. Three active raptor nests were located in the project area, including two osprey nests located approximately 1.2 and 2.4 miles southeast of the development area and a bald eagle nest on the north side of Lake Margaret approximately 2 miles northeast of the turbine development area. Based on a survey area of 32,000 acres, active raptor nest density was 0.06/mi^2, which is low compared to most other wind resource areas in the western U.S.

The objective of the bat use surveys was to estimate the seasonal and spatial use of the site by bats. Two Anabat® II echolocation detectors were used to monitor bat use at the project site on 78 nights during the period May 26 – October 18, 2006, resulting in a total of 145 detector nights. One AnaBat was placed on a met tower approximately 50 m above ground, and the other was placed on the ground at the base of the met tower. A total of 625 bat calls was recorded during 145 bat detector nights. Most (87%) of the calls were >35 kHz in frequency (e.g., *Myotis* bat species), and the remaining 13% were <35 kHz (e.g., big brown bat, hoary bat). The mean number of bat calls recorded per night per detector was higher for the AnaBat unit placed on the ground (5.6) than for the one placed 50 m in the air on the met tower (3.0). The number of bat calls per detector-night was similar in the summer breeding season (4.5) and fall migration (4.1). Peak activity levels for both detectors were in late-May to early-June and again from late-July through early-September. These periods correspond to bat migration periods and it is likely some bats migrate through the project area.

The objectives of the vegetation mapping were to identify the vegetation types (communities) that may be directly impacted by the project and characterize the habitat suitability of the study area for listed species and possible occurrence of rare plants. The vegetation of the project area was mapped on 1:24,000 scale USGS topographic maps based on aerial photos. Ten habitat types were identified within the entire mapping area; these included ceanothus scrub, clear cut/mixed conifer, developed, mixed conifer, oak scrub, open water, pasture, plantation-mixed conifer sapling, plantation-mixed conifer sapling/manzanita, and spring/seep-riparian scrub.

A pre-field evaluation was conducted to determine the number of and potential of rare plants possibly occurring in the project area. Field surveys were conducted for six rare plant species potentially occurring in the project area based on habitat and elevation. A large population of one species, Butte County morning glory, was located in the northern portion of the project area in an area composed of reddish, rocky volcanic soils with low overall plant cover. The majority of individuals encountered on site were observed in the barren interspaces between shrubs and other forbs, although some plants had established beneath manzanita shrubs. Tens of thousands of individuals were observed over a survey area comprising approximately 144 acres, and more plants are presumed to occur beyond this area to the south and west in similar habitat. Construction activity will impact individuals and patches of the plant but will not affect the viability of the population due to the large area over which it occurs.

Based on site specific avian use data collected for the Hatchet Ridge site, mean annual raptor use (adjusted as number of raptors observed per 20-minute survey to be comparable with other studies) was 0.69/survey with 50% of this value composed of turkey vulture use. Raptor/vulture use at Hatchet ridge is lower than 10 other wind resource areas (WRA) but higher than 17 other WRA evaluated in the U.S. using similar protocols. A regression analysis of raptor use and raptor collision mortality for several new-generation wind farms where similar methods were used to obtain raptor use estimates showed a significant ($r^2 = 90.3\%$) correlation between raptor use and raptor collision mortality. Using this regression to predict raptor collision mortality at the Hatchet Ridge project yields an estimated fatality rate of 0.06/MW/year, or 6 raptors per year for a 100-MW project. Based on species composition of the most common raptor fatalities at other western wind farms and species composition and timing of raptors observed at Hatchet Ridge during the studies, the majority of the fatalities of diurnal raptors would likely consist of red-tailed hawk and American kestrels during the summer and fall seasons.

Use of the Hatchet Ridge site by all bird species combined is low compared to 24 other WRA evaluated using similar protocols, as 20 of the 24 sites had higher bird use than that observed at Hatchet Ridge while only four sites had lower use. The data collected during this study suggest that the Hatchet Ridge project is not within a major migratory pathway, either for diurnal or nocturnal migrants. The project area also does not appear to provide important stopover habitat for migrant songbirds based on point count studies. Based on all survey data, song bird mortality at Hatchet Ridge would likely be lower than the national average of 2.3 birds/turbine/year or 3.1birds/MW/year. Although construction and operation of the wind farm may displace some groups of birds, because the Hatchet Ridge Wind Farm will be sited in previously altered habitats, and similar habitats are common in the region, it is unlikely that displacement of birds would result in any population impacts.

The mean number of bat passes per detector per night was compared to existing data at five WRA where both bat activity and mortality levels have been measured. The level of bat activity documented at the Hatchet Ridge site is much lower than the eastern and Midwestern U.S. wind farm sites, all of which had fairly high levels of bat mortality. However, it is higher than the

Buffalo Ridge, Minnesota and Foote Creek Rim, Wyoming wind farms, both of which had relatively low levels of bat mortality. The data collected on site do not indicate that substantial numbers of bats migrate through the Hatchet Ridge Project Area. Some bat mortality will likely occur at the site, however, the available data indicate it would be lower than that experienced in the East, but potentially somewhat higher than that documented at other western U.S. sites.

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INTRODUCTION

Hatchet Ridge Wind, LLC (HRW) is evaluating the feasibility of a wind energy development in Shasta County, California. The proposed site, *Hatchet Ridge*, is located approximately 6 miles west of Burney, California and along the primary ridgeline of Hatchet Mountain north of California State Highway 299 (Figure 1). The proposed development would be located on private land and would consist of the installation, operation, maintenance, and eventual decommissioning of approximately 100 MW of turbines and supporting facilities. The power would be sold to one or more regional utilities for delivery to regional consumers. The turbine model and size has not been finalized at this time. The most likely turbine types that will be utilized will have a capacity of 2.3-2.4 MW each with a rotor diameter of approximately 87-104 m. The turbines will be mounted on 70-100 m tubular towers, for a range of heights of approximately 122-154 m from the ground to the tip of the blade. Each turbine would be connected to adjacent turbines by an underground electrical collector system; short stretches of overhead electrical collector cable may be used to avoid certain topographic or geological features. Wind turbines would be grouped in a single turbine string along Hatchet Ridge, however, the final layout for the turbines will not be known until a specific model is chosen for the project.

The primary natural resource issues for wind development typically include concern over direct impacts to avian and bat resources and the potential for impacts to listed or sensitive species. Secondary concerns often center around a general lack of knowledge about a proposed development area, habitat loss, or indirect impacts to wildlife such as displacement or disturbance. Total annual mortality estimates for birds at wind projects in the U.S. range from less than 1 to approximately 10 birds per turbine (see Erickson *et al.* 2001), with passerines and raptors appearing most susceptible to collision (AWEA 1995, Erickson *et al.* 2001). Collision fatality of bats has been recognized as a concern for some eastern wind projects (see Nicholson 2003, Kerns and Kerlinger 2004, Kerns *et al.* 2005); however, bat mortality at western wind projects is not as high (see Erickson *et al.* 2004; Young *et al.* 2003; Smallwood and Thelander 2004; Johnson 2005).

Pre-project or baseline studies are typically conducted at proposed wind power sites to collect data that may be used to describe avian and bat resources in the context of the proposed development; assist in addressing potential impacts from the development; assess the relative risk of the development to birds and bats; and to the extent possible, assist in wind plant design and siting that minimizes risk to avian and bat resources. HRW requested that Western EcoSystems Technology, Inc. (WEST) conduct a one-year study to address the typical concerns and provide site specific data for the resources of concern. The principal objectives of the study were to:

1) provide information on avian and bat resources and use of the study area that is useful in evaluating the potential impacts and the relative risk from the proposed wind project;
2) provide information on avian and bat use of the study area that would help in designing a wind plant that is less likely to expose species to potential collisions with turbines, and;

3) provide recommendations for further monitoring studies and potential mitigation measures, if appropriate.

Specific study components were designed to: (1) describe and quantify seasonal avian use of the proposed project area; (2) describe and quantify raptor use of the proposed project; (3) describe and quantify seasonal bat use of the proposed project; and (4) describe and quantify vegetation types and rare plant occurrence in the proposed project.

STUDY AREA

Hatchet Mountain is situated along the southern edge of the Cascade Range, in Shasta County, California. It is located approximately 40 miles northeast of Redding and five miles west of Burney, California. The Hatchet Ridge project site includes a long, broad ridge that comprises a portion of Hatchet Mountain, extending north from State Highway 299. The site boundary extends approximately six miles along the ridge, and ranges between one-half mile and one mile wide. The project site occurs entirely on private land owned by Sierra Pacific Industries and Fruit Growers Supply Company and has been managed as a tree plantation. Several communications towers are located within the project area. In August 1992, the project site was burned in the Fountain Fire. It was subsequently replanted with white fir and ponderosa pine.

Elevations on site range from 5,470 feet in the northwestern portion of the site near a radio tower facility to approximately 4,300 feet in the southern portion of the site near Hatchet Mountain Pass on State Highway 299. The regional climate is subhumid, featuring warm dry summers and cold moist winters. Average annual precipitation in the area is 50 inches and average annual temperature is 42^{o}F. Sierran mixed conifer is the dominant vegetation community in the area. Structure and composition of this habitat type vary greatly with slope, aspect, elevation, and disturbance (including timber management). Dominant overstory species typically include a combination of white fir, incense cedar, sugar pine, ponderosa pine, Douglas-fir, and black oak. Topography on site ranges from relatively flat, on top of the broad ridge, to steep (30-50%), along the side slopes. The majority of the project site is underlain with soils of the obie-mounthat complex. These gravelly, sandy loam soils are formed in material weathered from andesite and ash. They are moderately-deep to deep, well drained soils.

METHODS

Study Plan Development

A study plan was prepared based on input from the California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service (USFWS) and on the expertise and experience of WEST implementing and conducting similar studies for wind energy development throughout the U.S. The overall approach to the studies was consistent with past and current pre-project studies of wind projects in the West and Midwest and the methods described in the document "Studying Wind Energy/Bird Interactions: A Guidance Document" (Anderson *et al.* 1999).

The draft of the study plan was circulated to CDFG and USFWS representatives whose jurisdiction covered the project area or wind power proposals in general. Comments were solicited during the initial study phase (Fall 2005) to insure that concerns were addressed. An agency meeting was held on November 29, 2005 at the CDFG office in Redding to discuss the proposed project, the study plan, and agency questions, comments and/or concerns about the project. The final study plan incorporated agency recommended changes that were within the context of the study objectives.

Avian Use Surveys

The objective of the avian use surveys was to estimate the seasonal, spatial, and temporal use of the site by birds and in particular raptors. Point counts (variable circular plots) were conducted on the development area using methods similar to those described by Reynolds *et al.* (1980) and Bibby *et al*. (1992).

Survey Plots

Six survey points were established over the study area and selected to provide good coverage of the vegetation types, topographic features, and areas proposed for turbines and good visibility in 360^{o} around the point (Figure 2). Points were established so that each point covered a unique area. Survey stations were established to maximize visibility over long distances in an effort to locate and identify raptors and other large birds.

Survey periods at each point were 30-minutes long. All birds observed were recorded, although the survey effort concentrated within an 800 m (0.5 mi) radius circle centered on the observation point. Observations of birds beyond 800 m were recorded, but were not included in the calculation of the standard metrics. All raptors and other large birds observed during the survey were assigned a unique observation number and marked on a map of the survey plot. Approximate flight paths were mapped for raptors and large birds and given a corresponding unique observation number. 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 (observation station) when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each raptor observed.

The behavior of each bird observed and the vegetation type in which or over which the bird occurred were recorded. Behavior categories included perched, circling/soaring, flying, foraging, singing, and other (noted in comments). Vegetation types (habitats) included scrub oak, mixed forest, coniferous forest, rock outcrop/cliff, open, and other (noted in comments). The initial behavior and habitat (when first observed) were uniquely identified on the data sheet and subsequent behaviors displayed and habitats used (if any) were also recorded. Approximate flight height at first observation and the approximate lowest and highest flight heights were recorded to the nearest meter or 5-meter interval. Any comments or unusual observations were described on the datasheet.

Observation Schedule

Sampling intensity was designed to document avian use and behavior by habitat and season within the project area. Weekly surveys at each of the survey points took place for 12 months. Seasons were based roughly on the calendar seasons and were defined as spring: March 15 –

June 15; summer: June 15 – September 15; fall: September 15 – December 15; and winter: December 15 - March 15. Surveys were conducted during daylight hours and survey periods were scheduled to approximately cover all daylight hours during a season. To the extent practicable, each survey point was surveyed during a different time of day from the previous week to vary the time of day during which plots were surveyed and distribute observations over all daylight periods throughout the year.

Observations of raptors, other large birds, any bird species of concern, large flocks, and bird species not previously recorded on site were recorded while traveling between points. These data were coded as in-transit or incidental observations. For each incidental raptor observation, additional details on behavior and habitat were recorded.

Raptor Nest Survey

The objective of the raptor nest survey was to locate nests that may be subject to disturbance and/or displacement effects from wind plant construction and/or operation. The nest survey gathered information on species nesting in the area including nest locations, nesting season (timing), and nest success. The nest survey area included the development area and the area within an approximate 2-mile buffer of the site, which totaled approximately 32,000 acres (Figure 3).

The raptor nest survey was conducted via helicopter on April 21, 2006 when buteos (e.g., red-tailed hawk), golden eagles, and bald eagles would be actively incubating eggs or brooding/attending young. GPS coordinates were recorded for all nests located of all raptors, unoccupied large stick nests, or other large bird species, and mapped on a GIS ArcView project utilizing USGS topographic maps (1:24,000 scale) as the base. Locations of inactive nests were recorded as they may be occupied during future years. All nests, whether active or inactive, were given a unique identification number.

Bat Use Surveys

The objective of the bat use surveys was to estimate the seasonal and spatial use of the site by bats. Bats in the project area were surveyed using ultrasonic sensors that detect bat echolocation calls. Bat detectors are widely used to index and compare habitat use by bats. The use of bat detectors for calculating an index to bat impacts has been used at several wind projects, and is currently being recommended by Bat Conservation International (E. Arnett, BCI, pers. comm.) as a primary and economically feasible bat risk assessment tool. Anabat® II bat detectors (Titley Electronics Pty Ltd., NSW, Australia) coupled with a ZCAIM (zero crossings analysis interface module) were used to record bat echolocation calls in the project area at a single fixed survey location (Figure 2). Anabat® II detectors record bat echolocation calls with a broadband microphone. The echolocation sounds are then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of eight (8) was used for the study. Bat echolocation detectors also detect other ultrasonic sounds made by insects, raindrops hitting vegetation, and other sources. A sensitivity level of six (6) was used to reduce interference from these other sources of ultrasonic noise. The calls were recorded via the ZCAIM which uses a compact flash memory cards with large storage capacity, eliminating the need for tape recorders. The Anabat® II detectors were placed inside a plastic Rubbermaid® container with a hole cut in the side of the container for the microphone to extend through.

Microphones were encased in PVC tubing with drain holes that curved vertically outside the container to minimize the potential for water damage due to rain.

Bat use at the sampling location was monitored on 78 nights during the period May 26 – October 18, 2006, resulting in a total of 145 detector nights. The primary met tower in the project area was outfitted with a pulley system, and an Anabat® II unit with ZCAIM were hoisted in the air to a height of 50 m. A second AnaBat unit was placed on the ground at the base of the met tower.

For this study, bat passes were the units of activity. Except at isolated roost locations such as caves, the absolute abundance or population sizes of bats cannot be determined in most cases, and bat pass data represent levels of bat activity rather than numbers of individuals. A pass is defined as a series of echolocation calls produced by an individual bat, and consists of a continuous series of ≥ 2 call notes with no pauses between call notes of > 1 second. The number of bat passes was determined by downloading the data files to a computer and tallying the number of echolocation passes recorded. Bat calls were grouped as high frequency (>35 kHz) calls which are generally given by small bats (e.g., *Myotis* spp.) and low frequency (<35 kHz) calls which are generally given by larger bats (e.g., big brown bat, Brazilian free-tailed bats, hoary bats). Bat activity was summarized by summer breeding season (May 26–July 27) and fall migration (August 5–October 18).

The total number of bat calls, regardless of species, was used as an index to bat use of the project area. To predict potential for bat mortality (i.e., low, moderate, high), the mean number of bat passes per detector-night was compared to existing data at wind farms where both bat activity and mortality levels have been measured.

Vegetation Mapping

The objectives of the vegetation mapping were to identify the vegetation types (communities) that may be directly impacted by the project and characterize the habitat suitability of the study area for listed species (e.g., bald eagle and northern spotted owl) and possible occurrence of rare plants. The vegetation of the project area was mapped on 1:24,000 scale USGS topographic maps based on aerial photos. Ground reconnaissance observations were used to identify the vegetation type signature on the aerial photos and confirm polygon boundaries or transitions to other types. Information from the vegetation mapping was used to determine need for additional surveys for species of concern (e.g., rare plants) and evaluate the probability of occurrence for listed species. The vegetation mapping study area included the project area and a 2-mile buffer around the site.

Rare Plant Surveys

The objective of the rare plant survey was to identify listed, sensitive, or otherwise rare plants that occur in the development area and that may be impacted by construction or operation of the wind project. The initial rare plant evaluation was based on existing available information about rare plant distribution and occurrence in California. The California Natural Heritage database was queried for records of rare plant species potentially occurring in the general region where the project area occurs. Further information regarding the natural history of each species was evaluated to determine the potential occurrence in the project area based on vegetation communities (habitats) present, soils, and elevation.

Survey Area

The rare plant survey area included all lands that would be occupied by proposed facilities and a 164-foot (50 meter) buffer, based on the facility layout design as of June 2007. This included the proposed turbine strings and access roads.

Although for the purposes of impact analysis only the development corridors were considered, a larger area was addressed during the pre-field review to determine which special-status plant species had potential for occurrence within the project area. This was necessary to analyze the project area in a regional context, and ensure that the target species list for the investigation was complete.

Target Species

The target species included all plant taxa listed as endangered or threatened by the USFWS under the Endangered Species Act (ESA) that potentially occur in the project area. In addition, taxa that have been formally proposed or are candidate species for federal listing, or taxa listed as "species of concern" that potentially occur within the project area were also considered as target species. The species of concern status is an unofficial status for species that appear to be in jeopardy, but information is insufficient to support listing. Target species also included all plant taxa defined as "Rare, Threatened, or Endangered" by the California Native Plant Society (CNPS) (i.e., all taxa listed as CNPS 1B and CNPS 2).

Prefield Review

A query was conducted of the California Department of Fish and Game's Natural Diversity Database (CNDDB 2007), for all special-status plant species known to occur within the Chalk Mountain USGS topographic quadrangle map on which the project site occurs, and the 8 surrounding quadrangle maps including Big Bend, Burney, Burney Falls, Burney Mountain West, Hatchet Mountain Pass, Montgomery Creek, Roaring Creek, and Skunk Ridge. Additionally, a list was obtained from the CNPS's *Inventory of Rare, Threatened and Endangered Plant Species* (2001) for all known special-status plant species occurring in Shasta County. Information regarding the known distribution and habitats of these special-status plant species was obtained from several sources including the CNDDB Rarefind Database (2007), the CNPS Inventory (2001), and *The Jepson Manual* (Hickman 1993).

Field Investigation

Pedestrian (walking) surveys were performed by qualified botanists and timed to locate as many target species as possible, and particularly those most likely to occur in the affected habitats. The survey was accomplished by conducting meander transects, zigzagging back and forth across the survey corridor. The intensity of the pattern, and the speed at which the surveyor walked, was variable, and depended upon the structural complexity of the habitat, the visibility of the target species, and the probability of sensitive species occurrence in a given area. In habitats of low visibility with a high probability of sensitive species occurrence, a tighter grid pattern was walked. Care was taken to thoroughly search all unique features and habitats encountered with high probability of occurrence of sensitive species. A GPS unit showing the access roads and turbine locations was used for navigation and to insure that the development corridors were thoroughly covers. Aerial photographs and 7.5 U.S. topographic maps of the site were also used to aid in navigation.

A list of vascular plant species encountered during the surveys was maintained (Appendix A). *The Jepson Manual* (Hickman 1993) was the primary authority used for plant identification.

Data Compilation and Storage

Databases were established to store, retrieve and organize all 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 were retained for future reference.

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, field observers were responsible for inspecting his/her data forms for completeness, accuracy, and legibility. A sample of records from the electronic database files was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable, were discussed with the observer. Any errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Statistical Analysis and Products

Statistics/data generated for the study included the following:

- Species lists and observations by season;
- Relative use by species, species group, and observation point;
- Mean frequency of occurrence and species composition;
- Relative abundance (use) by season and observation points for species and species group;
- Mapped summary of raptor observations and flight paths by species or group;
- Raptor nests location mapping;
- Flight characteristics by species and species group; and turbine exposure indices by species and species group;
- Mean relative abundance of echo-locating bats per survey period and location;
- Comparisons of avian use, raptor nest density, and bat detections between the proposed project and other new or existing wind plants with similar data.

The number of species seen during each point count survey was standardized to a unit area and unit time. Avian use by species was calculated as the mean number of observations per 30-minute survey within 800 m of the survey point. Avian use estimates were also calculated as the mean number of observation per 20-minute survey to compare to other studies using similar methods but with different survey durations. Because of the relative close proximity of points to each other, the variability of estimates of avian use was based on survey to survey variability (i.e., temporal variability). Standardizing the data to a unit area and unit time allows comparison of avian use data between sample locations (habitats), seasons, proposed developments, and to other wind projects where use data exist.

Bonferoni adjusted 90% confidence intervals (Neter *et al.* 1996) were applied to use estimates by season and survey station to investigate significant spatial and seasonal differences in use. Overlapping confidence intervals indicate no statistical differences between the means.

The frequency of occurrence by species was calculated as the percent of surveys in which a particular species was observed. Species composition is represented by the mean use for a species divided by the total use for all species. 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 for 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 (*E*) was calculated for bird species observed flying during the fixed-point surveys using the formula:

$$E = A*Pf*Pt$$

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).

The relative abundances of echo-locating bats was reported as the number of detections per night per AnaBat detector and sampling station (ground level or 50 m level). Data were plotted to illustrate variation over time (date). Risk to bats was estimated by the relative abundance of bat detections compared to studies of existing wind farms where mortality estimates and AnaBat detection surveys were conducted.

RESULTS

Avian Use Surveys

Surveys were conducted at six fixed-point count stations located within the study area (Figure 2) approximately once each week between November 15, 2005 and November 9, 2006, resulting in 270 30-minute point count surveys during the study.

Seventy-nine avian species were observed during the fixed-point surveys (Table 1). A total of 2683 observations in 1320 different groups[1] was 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 and the numbers of observation. These counts likely contain duplicate sightings of the same birds.

[1] Group is defined as an observation of a species of bird regardless of number seen together. For example, a flock of 8 dark-eyed juncos flying together is a group as well as an individual dark-eyed junco observed by itself.

Passerines were the most numerous group; dark-eyed junco, common raven, American robin, and mountain bluebird were the most numerous passerines observed. Passerines comprised 71% of all groups observed and 64% of the total number of birds observed. Raptors comprised approximately 17% of all groups and 10% of all birds observed. The most common raptors were red-tailed hawk, American kestrel, bald eagle and Cooper's hawk. Waterfowl comprised 1% of all groups but 16% of all individual birds primarily because they tended to occur in large flocks observed flying over the area. The most numerous waterfowl were tundra swan, greater white-fronted goose, and snow goose. Other birds (waterbirds, upland gamebirds, doves, and other non-passerine species) comprised approximately 11% of all groups and 9% of all birds observed (Table 1).

Avian Use

Avian use by species was calculated as the mean number of observations per 30-minute survey within 800 m of the survey point (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 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 frequently red-tailed hawks occur in the study area, and therefore are at risk of being impacted by the proposed project. Reference to abundance refers to the use estimates and not absolute density or numbers of individuals.

Use varied across seasons (Table 2). In spring, the four most abundant species in the study area were common raven (1.29 detections/30-minute survey), dark-eyed junco (1.16), sandhill crane (0.50), and fox sparrow (0.45). Together these species comprised 38% of the total bird use during the spring (Table 2). During the summer, the four most abundant species were dark-eyed junco (1.78 detections/survey), tree swallow (1.10), mountain bluebird (1.04), and lesser goldfinch (0.90). These species comprised 41% of the total bird use during the summer (Table 2). In the fall, the four most abundant species were American robin (1.14 detections/survey), greater white-fronted goose (1.13), dark-eyed junco (0.96) and band-tailed pigeon (0.67), which comprised 36% of the total bird use (Table 2). The high greater white-fronted goose use estimate was due to two large flocks seen flying over survey points. In the winter, the four most abundant species were snow goose (1.44), common raven (0.54), northern pintail (0.51), and American robin (0.45). These species comprised 48% of the total bird use for the winter (Table 2). Over all seasons, dark-eyed junco was the most common bird observed with 0.98 detections per survey, followed by common raven (0.64), turkey vulture (0.51) and American robin (0.50). These four species comprised 28% of all bird use of the site for the year (Table 2).

Over all seasons based on use, passerines were the most abundant group observed followed by waterfowl, raptors and other birds (primarily woodpeckers) (Table 2, Figure 4). Passerine use in the spring, summer and fall was fairly similar, ranging from 6.48–9.50/survey. Passerine use in the winter (1.92/survey) was significantly lower than fall and summer use (Figure 4). A 90% confidence interval around the mean winter passerine use did not overlap with mean fall or summer use 90% confidence interval (see Figure 4). Most waterfowl use occurred in winter (3.74/survey) followed by fall (1.14/survey); no waterfowl use occurred in spring or summer. Raptor use in the spring, summer and fall was very similar, ranging from 1.05–1.53/survey during these seasons; raptor use in the winter was significantly lower (0.18/survey) than fall and summer raptor use (Figure 4).

Weekly use estimates for all birds fluctuated throughout the year with the highest use recorded in early October and the lowest estimates occurring in the winter (Figure 5). Weekly use for raptors was highly variable throughout the year but was generally lower in the winter from about mid-October through early-April (Figure 5). There did not appear to be a substantial increase in raptor use during the spring migration season but the highest raptor use estimate was recorded in September and may have been influenced by fall migrants. For passerines the highest use estimates were in May, July, and November and the lowest occurred in the winter (Figure 5). As with raptors there did not appear to be a substantial increase in use during the migration seasons with the greatest overall abundance coming in the June and July breeding season.

Species Percent Composition and Frequency of Occurrence

Percent composition is represented by the mean use for a species divided by the total use for all species and multiplied by 100 (Table 3). Frequency of occurrence was calculated as the percent of surveys where a particular species was observed (Table 4). Percent composition provides a relative estimate of the avian diversity of the study area, whereas frequency of occurrence provides information on how often species occur in the study area. Avian diversity on the site was relatively high, as only one species (dark-eyed junco) comprised more than 10% of all birds observed (10.3%), and only three species comprised more than 5% of all birds observed, including common raven (6.78%), turkey vulture (5.4%) and American robin (5.3%). All other species comprised <5% of all avian use of the site.

Passerines were the most frequently observed group, as they were seen during 85% of all surveys. Raptors had the second highest frequency of occurrence and were observed during 50% of the surveys. Even though waterfowl were the second most abundant group in terms of numbers of individuals observed (Table 1), they were observed only during 4.4% of the surveys (Table 4). The species of birds most frequently observed included dark-eyed junco (48.0% of surveys), common raven (31.8%), turkey vulture (30.0%) and fox sparrow (22.6%). After turkey vulture, the most frequently observed raptor was red-tailed hawk, which was observed during 19.9% of the surveys.

An additional index of species diversity is the mean number of species observed per survey. Species diversity was highest in the summer (7.1 species/survey), lower but similar in the spring (4.8) and fall (4.1), and lowest in the winter (1.7).

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 18 m above ground level (AGL) to 152 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.

During the study 533 single birds or flocks totaling 1581 individuals were observed flying during point count surveys (Table 6). For all species combined, 25.1% of all flying birds observed were below the rotor-swept height, 63.4% were within the rotor-swept height, and 11.5% of birds were observed flying above the rotor-swept height (Table 6). For groups with at least five separate observations of flying birds, those most often observed flying within the turbine rotor-swept height were buteos (98.5%), vultures (98.4%), doves (96.2%), and eagles (85.7%). For all flying raptors combined, 94.9% were observed flying within the rotor-swept height. Groups with the lowest percent of observations within the rotor-swept height were passerines (54.0%) and waterfowl (57.2%). For species with at least five separate observations of flying birds, those most often observed at rotor-swept heights were red-tailed hawk (98.4%), turkey vulture (98.4%), band-tailed pigeon (98.1%), unidentified bluebird (96.4%), and tree swallow (95.0%) (Table 5).

Exposure index

The exposure index is a relative measure of the risk of each species observed on-site during the 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. Turkey vulture, common raven, snow goose, tree swallow and American robin had the highest exposure indices (Table 7). All five of these species had relatively high use in the study area and were frequently seen in the zone of risk (78.4%–98.8% of the time). The only other raptor with a relatively high exposure index was red-tailed hawk, which ranked 7th of all species (Table 7).

Spatial Use

Mean use was plotted by avian survey point for the most abundant avian groups in the study area and for all birds combined. Passerine use was relatively consistent across all six survey points, ranging from 4.14–8.84/survey (Figure 6). Raptor use was also very consistent among survey points, ranging from 0.79–1.35/survey. Waterfowl were observed at all survey points except point 3. Use among the other points ranged from 0.39–2.56/survey. For all bird species combined, use was relatively uniform along Hatchet Mountain and no obvious flyways or concentration areas were observed. Highest use was observed at Points 2, 4, and 6, with lower use at points 1, 3 and 5. There were no significant differences in use between stations for any bird groups or all birds based on comparison of 90% confidence intervals (Figure 6).

Point of first observation, approximate flight paths, and perch locations were mapped for raptors and other large birds observed in the project area (Figure 7). The objective of mapping observed bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns within the study area. After turkey vultures, red-tailed hawks were the most common raptor observed. Most red-tailed observations (as well as other raptors) were fairly evenly distributed across the study area (Figure 7). Although few eagles were observed during surveys, those that were observed were fairly evenly distributed across the survey area (Figure 6). Waterfowl and waterbird observations also were relatively uniform across the study area. No strong association of use with topographic features of the site was noted for raptors or other large birds. The majority of large birds flew perpendicular to and across the prominent ridgeline, rather than parallel with the ridge suggesting that the ridge is not an important migratory route for diurnal migrants (Figure 7). Although some differences in avian use were detected among survey points, the differences are not large enough to suggest that any portions of the project area should be avoided when siting turbines.

Raptor Nest Survey

Three active raptor nests were located in the survey area all of which occurred in the buffer; no raptor nests were found in the project area (Figure 3). The nests included two active osprey nests in tree snags, located approximately 1.2 and 2.4 miles southeast of the project area [T35N, R3E, Sec 3 , NW1/4; T34N, R3E, Sec 2, NE1/4]. An active bald eagle nest was also noted on the north side of Lake Margaret on March 21, 2006, prior to the aerial survey [T35N, R2E, Sec 8, NE1/4]. This nest was empty during the aerial survey conducted April 21, 2006. The nest is approximately 2 miles northeast of the project area and is located in a Douglas fir tree. There is also an alternate bald eagle nest located on the south side of Lake Margaret that was not used in 2006 [T35N, R2E, Sec 8, SE1/4]. This nest is 1.5 miles from the project area. One old, inactive nest was also located in the project area, but was in the process of falling out of the tree. Based on the survey area of 32,000 acres, active raptor nest density was $0.06/mi^2$.

Bat Use Surveys

A total of 625 bat calls were recorded during 145 bat detector nights. Most (87%) of the calls were >35 kHz in frequency (e.g., *Myotis* bat species), and the remaining 13% were <35 kHz (e.g., big brown bat, Brazilian free-tailed bat) (Table 8). The mean number of bat calls recorded per night per detector was higher for the ground level AnaBat unit (5.6) than for the one placed 50 m in the air on the met tower (3.0). The number of bat calls per detector-night was similar in the summer breeding season (4.5) and fall migration (4.1). Peak activity levels for both detectors placed on met towers and on the ground were in late-May to early-June and again from late-July through early-September (Figure 8). The late peak activity period corresponds to the fall bat migration period and it is likely some bats migrate through the project area.

Bat calls that had five or more pulses were evaluated for possible species identification. A total of 257 calls were recorded that had sufficient number of pulses and quality to attempt species identification. From these calls, seven species were positively identified with a high degree of confidence (Table 9). As is typical however, the majority of the calls still contained characteristics that overlapped more than one species so could not be positively identified. Three additional species were possibly recorded on the site (Table 9); however, the number of calls from these species were very few and it is likely that they were actually variant calls of the more common species recorded on the site.

Vegetation Mapping

Field surveys for vegetation mapping were conducted in September 2006. Based on the California Department of Fish and Game Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986), ten habitat types were identified within the entire mapping area (Figure 9). Habitat types include ceanothus scrub, clear cut/mixed conifer, developed, mixed conifer, oak scrub, open water, pasture, plantation-mixed conifer sapling, plantation-mixed conifer sapling/manzanita, and spring/seep-riparian scrub. The majority of the project area occurs within plantation-mixed conifer sapling or sapling/manzanita vegetation types (Figure 9).

Ceanothus scrub

Ceanothus scrub was encountered in one location within the project area, along the perimeter of the northeast, north, and northwest shoreline of Lake Margaret, on the eastern toeslope of Hatchet Mountain. This monotypic habitat was composed of a dense shrub layer of ceanothus (*Ceanothus* spp.), ranging between 1-1.5 meters in height, that formed a band up to several hundred feet wide around the lake shoreline. Other than a few, scattered conifers, little to no other vegetation occurred within this habitat. Ceanothus species identified in the area include mountain whitethorn (*Ceanothus cordulatus*), buck brush (*C. cuneatus*), and deer brush (*C. integerrimus*). Below the ceanothus, barren shoreline extended up to 100 feet to the water's edge. Habitat along the outer edge of the scrub abruptly intergraded to mixed conifer, dominated by sugar pine (*Pinus lambertiana*) and incense cedar (*Calocedrus decurrens*).

Clear cut/mixed conifer
Areas that had been clear cut were mapped in the northern and extreme southeastern portions of the project area. These areas had presumably been cut at different times, and were in various stages of regeneration. Vegetation primarily consisted of herbaceous grasses and forbs, low shrubs, and scattered, mixed conifer seedlings and saplings. Some of these clear cuts were recent enough that they did not feature any seedlings or saplings.

Developed
Areas mapped as developed included 2 timber harvesting facilities located in the east-central portion of the project area, adjacent to State Highway 299.

Mixed conifer
Large tracts of native, mixed conifer habitat were mapped in the northern and southeastern portions of the project area. This habitat type is also the dominant habitat in the surrounding region. As the name implies, it is composed of coniferous forest dominated by mature trees of sugar pine, incense cedar, Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and ponderosa pine (*Pinus ponderosa*). Mixed conifer forests are typically composed of closed stands with multi-layered canopies creating nearly 100 percent canopy cover. Canopy closure and density and composition of understory vegetation are variable, and dependent upon microsite characteristics including soils, slope, aspect, and history of disturbance. Ceanothus, manzanita (*Arctostaphylos* spp.), chinquapin (*Chrysolepis sempervirens*), gooseberry (*Ribes* spp.), rose (*Rosa* spp.), and dogwood (*Cornus* spp.) are common shrub species in the understory. Patches of black oak (*Quercus kelloggii*) are typically scattered within this habitat, often occupying areas that had undergone some sort of previous disturbance (e.g. wildfire). As a result, the black oak often forms even-age stands.

Oak scrub
Two areas mapped as oak scrub occurred within the central and western portions of the project area. They were similar in composition to the scattered patches of black oak that were encountered throughout the mixed conifer, but were much larger in size. These areas had presumably experienced previous disturbance, either in the form of wildfire or timber harvesting. The high density of black oak within the scrub habitat precluded the establishment of understory vegetation. Sparse understory vegetation observed included snowberry (*Symphoricarpos* sp.), California brome (*Bromus carinatus*), and ripgut brome (*B. diandrus*).

Open water
Habitat mapped as open water included Lake Margaret, a small pond adjacent to an irrigated meadow on the southwest side of State Highway 299, and a larger pond within the mixed conifer habitat mapped in the southern portion of the project area.

Pasture

A large meadow was mapped as pasture in the eastern portion of the project area, adjacent to State Highway 299. It is unknown if this pasture is maintained for agricultural purposes (e.g., haying) or strictly used for grazing livestock, but it was irrigated. Species composition could not be determined during the mapping effort but the pasture was presumably composed of common pasture grasses (e.g., smooth brome, timothy, orchard grass) and some hydrophytic species (e.g., sedges and rushes). Irrigation water was conveyed into a small impoundment/pond, immediately adjacent the highway. Portions of the pond featured marsh vegetation including cattail (*Typha* spp.) and bulrush (*Scirpus* spp.).

Plantation/mixed conifer sapling

The majority of habitat within the project boundary (including some habitat within the 2-mile buffer) was composed of a mosaic of relatively even-age stands of ponderosa pine and white fir. Although these 2 species were typically dominant, this habitat also included incense cedar, red fir and Douglas fir. Many of the trees had been planted by Sierra Pacific Industries and the Fruit Growers Supply Company following a wildfire in August of 1992. This habitat showed considerable variation in composition, density, and size of both saplings and understory vegetation. Despite this variability it was decided to combine everything into one category rather than creating many subcategories (with the exception of *plantation/mixed conifer sapling/manzanita* below).

Saplings, defined as young trees ranging in height from approximately 1.5-7 m (5-25 feet), typically occurred in mixed stands throughout the site but occasionally were monotypic in composition. Understory vegetation included both shrubs and herbaceous grasses and forbs, again, with considerable variability in their composition, density and size. Portions of the plantation/mixed conifer sapling habitat featured predominantly shrub species while other areas were mostly composed of herbaceous vegetation. Common shrub species observed within this habitat include mountain whitethorn, deer brush, buck brush, manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), chinquapin, barberry (*Berberis aquifolium* var. *aquifolium*), Sierra gooseberry (*Ribes roezlii*), and bitter cherry (*Prunus emarginata*). Dominant herbaceous vegetation observed includes bottlebrush (*Elymus elymoides*), needle-and-thread (*Hesperostipa comata* ssp. *intermedia*), penstemon (*Penstemon* sp.), bracken (*Pteridium aquilinum* var. *pubescens*), false Solomon's seal (*Smilacina racemosa*), sedge (*Carex* sp.), and balsam-root (*Balsamorhiza* sp.).

Plantation/mixed conifer sapling/manzanita

This habitat was mapped in the northwest portion of the project site, in the vicinity of the radio facility, and differed significantly from areas mapped as *plantation/mixed conifer sapling* habitat. Saplings observed within this area occurred at a lower density and were overall much shorter in height. The substrate in this area was significantly rockier than in other areas on site, and this habitat featured several small rock outcrops. The rocky substrate was primarily composed of low-stature manzanita with scattered herbaceous grasses and forbs.

Spring/seep – riparian scrub

Several springs were identified on USGS quad maps as occurring within the project area. Two of these springs were visited during the habitat mapping effort and one additional spring/seep (not identified on USGS maps) was encountered (Figure 9). All of these springs supported riparian scrub habitat. Bear Spring (mapped on USGS quad) was located in the northwest portion of the project site below the radio facility. It comprised an area of at least 1 acre in size and was blanketed in a thicket of mesic shrub species. The dominant shrub species observed at Bear Spring was mountain ash (*Sorbus* sp.), but other common shrubs include dogwood (*Cornus* sp.), interior rose (*Rosa woodsii* var. *ultramontana*), bitter cherry, and serviceberry (*Amelanchier alnifolia*). The other spring identified on USGS quads that was visited during the survey effort was unnamed and was located on the south-facing side slope of Hatchet Mountain, approximately one-half mile north of State Highway 299 near the project site entrance. It occurred within a narrow drainage that featured a thin band of mesic shrub species along the immediate channel, and a dense thicket of ceanothus species around the perimeter. Mesic shrub species observed here include shining willow (*Salix lucida* ssp. *lasiandra*), blue elderberry (*Sambucus mexicana*), elderberry (*S. melanocarpa*), mountain ash, and blackcap raspberry (*Rubus leucodermis*). Dominant hydrophytic herbaceous species observed along the channel include fowl mannagrass (*Glyceria elata*), monkeyflower (*Mimulus* sp.), hedgenettle (*Stachys* sp.), and reed grass (*Calamagrostis* sp.).

A third spring/seep, not identified on USGS quad maps, was encountered adjacent to a logging road on the west-facing slope of Hatchet Mountain (Figure 9). It occurred within a narrow drainage dominated by Scouler willow (*Salix scouleriana*) and blue elderberry. Beneath this shrub canopy a variety of herbaceous hydrophytes were observed, including fringed willow herb (*Epilobium ciliatum*), swordleaf rush (*Juncus ensifolius*), Baltic rush (*Juncus balticus*), monkeyflower, and bleeding heart (*Dicentra Formosa*).

Additional riparian scrub habitat was mapped immediately below Lake Margaret, along the perennial drainage of Goose Creek. This drainage featured a corridor of extensive riparian vegetation encompassed by a mature stand of mixed conifers including sugar pine (*Pinus lambertiana*), ponderosa pine, incense cedar, and Douglas fir. Riparian vegetation observed along Goose Creek, in addition to the riparian shrub and herbaceous species discussed above, includes alder (*Alnus* sp.), willow (*Salix* spp.), and mountain maple (*Acer glabrum*).

Rare Plant Surveys

The pre-field review identified 22 special-status plant species as potentially occurring in the project area (Table 10). The majority of these species occur in habitats not present within the project area (e.g., bogs and fens, vernal pools, alpine boulder and rockfield). It was determined that a total of six special-status plant species had potential to occur within the project site and they were targeted for surveys (Table 1). The pedestrian surveys for special-status plant species were conducted from June 1-4 and from July 30-August 3, 2007.

No USFWS Endangered, Threatened, Proposed, or Candidate plant species were encountered during the field surveys. Only one federal-listed plant species occurred on the Shasta County list, slender Orcutt grass (*Orcuttia tenuis*). This federally threatened annual herb occurs in vernal pool habitat. Such habitat was not encountered within the project area and no individuals of the species were observed during the surveys.

One of the targeted species, Butte County morning glory (*Calystegia atriplicifolia* ssp. *buttensis*), was detected throughout a large area in the northwest portion of the site (Figure 10). The morning glory is considered a CNPS 1B.2 meaning that the species is “fairly threatened in California”. The species typically occurs on dry, open slopes, roadsides, clearings, disturbed areas with open canopy in lower-montane coniferous forests. Within the project area, the morning glory occupied an area composed of reddish, rocky volcanic soils with low overall plant cover (Figure 10). The majority of individuals encountered on site were observed in the barren interspaces between shrubs and other forbs, although some plants had established beneath manzanita shrubs. Tens of thousands of individuals were observed over a survey area comprising approximately 144 acres, and more plants are presumed to occur beyond this area to the south and west in similar habitat (reddish-tan signature on the site aerial photograph). To estimate overall density (abundance) of the morning glory in the survey area, GPS data was recorded for individual plant locations and polygons around plant clusters within a 300-foot buffer around two representative turbine (T40 and T42) locations (Figure 11). The overall percent cover for morning glory within the detailed survey areas was approximately 5.1% and 8.5% and represents thousands of individual plants.

DISCUSSION AND IMPACT ASSESSMENT

The most probable impact to birds resulting from wind projects is direct mortality or injury due to collisions with the turbines or guy wires of meteorological towers (met towers). Collisions may occur with resident birds foraging and flying within the project area or with migrant birds moving through the project area. Project construction could affect birds through loss of habitat, potential fatalities from construction equipment, and disturbance/displacement effects from construction activities. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance and equipment. Potential mortality from construction equipment is expected to be very low. Equipment used in wind facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality from construction to birds is most likely limited to potential destruction of a nest for ground- and shrub-nesting species during initial site clearing. Disturbance-type impacts can be expected if construction activity occurs near an active nest or a primary foraging area. Birds displaced from these areas might move to areas with fewer disturbances, depending on the stage of nesting; however, breeding effort and fledging success could be affected, and foraging opportunities might be altered during the construction period. Constructing outside the breeding season or limiting construction within predefined buffers around special status bird nests during the breeding season may be effective in minimizing direct and indirect impacts.

The assessment of operational impacts to birds from wind projects can be based on the site-specific measures of bird use and species composition compared to the same metrics at projects with direct measures of impact (e.g., mortality and displacement). Measured bird use of the Hatchet Ridge site in addition to measured use and mortality estimates from other existing wind farms were used to predict mortality of birds for the project.

Substantial data on avian mortality at wind facilities are available from studies in California and throughout the west and midwest. Of 841 avian fatalities reported from California studies (>70% from Altamont Pass, CA), 39% were diurnal raptors, 19% were passerines (excluding house sparrows and European starlings), and 12% were owls. Non-protected birds including house sparrows, European starlings, and rock doves comprised 15% of the fatalities. Other avian groups generally made up <10% of the fatalities (Erickson et al. 2002). During 12 fatality monitoring studies conducted outside of California, diurnal raptor fatalities comprised only 2%

of the wind project-related fatalities and raptor mortality averaged 0.03/turbine/year. Passerines (excluding house sparrows and European starlings) were the most common collision victims, comprising 82% of the 225 fatalities documented. No other group (e.g., raptors, waterfowl) comprised more than 5% of the fatalities. Many of these projects that were studied are small in scale and have more modern turbines than the older California projects.

For all avian species combined, estimates of the number of bird fatalities per turbine per year from individual studies have ranged from 0 at the Searsburg, Vermont (Kerlinger 1997) and Algona, Iowa sites (Demastes and Trainer 2000) to 7.7 at the Buffalo Mountain, Tennessee site (Nicholson 2003). Using mortality data from the last 10 years from wind projects throughout the entire U.S., the average number of avian collision fatalities is 3.1 per megawatt per year or 2.3 per turbine per year (NWCC 2004).

Raptors

Based on site specific avian use data collected for the Hatchet Ridge site, mean annual raptor use (adjusted as number of raptors observed per 20-min survey within an 800 m radius of the point count location) was 0.69/survey with 50% of this value composed of turkey vulture use. Turkey vultures have shown very low susceptibility to turbine collision at other California wind farms (e.g., Orloff and Flannery 1992). Use of the Hatchet Ridge site by raptors excluding vultures was 0.35/survey. Based on studies of 28 other WRAs using similar protocols, mean annual raptor use (number per 20-min survey 800 m radius) typically ranged from 0.10/survey to 1.3/survey (Figure 12). Raptor use at Hatchet ridge fell generally within the mid-range of other wind resource areas studied using similar protocols (Figure 12). The only areas studied with higher than typical raptor use are Altamont Pass, California, where annual use averaged 2.4/survey, and the High Winds site in Solano County, California, where annual raptor use averaged 3.5/survey. Raptor use at the Hatchet Ridge site is 20% of that observed at High Winds and 29% of that observed at Altamont.

Exposure indices analysis may provide insight into what species might be the most likely turbine casualties; however, the index only considers relative probability of exposure based on abundance, proportion of daily activity spent flying, and flight height of each species. This analysis is based on observations of birds during the daylight period and does not take into consideration flight behavior or abundance of nocturnal migrants. It also does not take into consideration varying ability among species to detect and avoid turbines, habitat selection and other factors that may influence exposure to turbine collision; therefore, the actual risk may be lower or higher than indicated by these data. For example, in the Altamont Pass wind resource area (APWRA) in California, mortality among the five most common species was not related to their abundance. American kestrels, red-tailed hawks, and golden eagles were killed more often, and turkey vultures and common ravens were killed less often than predicted based on abundance (Orloff and Flannery 1992). Similarly, at the Tehachapi Pass WRA in California, common ravens were found to be the most common large bird in the WRA, yet no fatalities for this species were documented during intensive studies (Anderson et al. 1996).

The APWRA contains 5,400 turbines, most of which are small, older, lattice tower, Kenetech turbines. The latest raptor fatality estimates at Altamont based on searches using 30-90 day search intervals indicate that annual mortality averages 1.5 to 2.2 raptor fatalities per MW per year when adjusted for searcher efficiency and scavenging bias. The High Winds Project is a modern wind farm with 1.8 MW turbines, and estimated mortality was 0.30 raptors per MW per year (unadjusted for scavenger removal or searcher efficiency). Most of the raptor mortality at the High Winds Project involved American kestrels, and the relative use of the High Winds site by kestrels was approximately 6 times higher than at the Altamont Pass. With the exception of American kestrels at the High Winds Project in California, raptor mortality at new-generation wind projects both within and outside California has been relatively low (Table 11).

A regression analysis of raptor use and mortality for several new-generation wind projects where similar methods were used to estimate raptor use found that the correlation between use and mortality was significant (r^2 = 90.3%; Figure 13). Using this regression to predict raptor collision mortality at the Hatchet Ridge project based on an adjusted mean raptor use of 0.69 per 20-min survey yields an estimated fatality rate of 0.06 raptors/MW/year, or six raptor fatalities per year for a 100-MW project. A 90% confidence interval around this estimate is 0 to 0.17 raptors/MW/year, or 0 to 17 raptor fatalities per year for the project.

This estimate should be considered tentative, as no comparable fatality data exist for 2.3-2.4 MW turbines and the estimate assumes raptor mortality would be 2.3 and 2.4 times higher than a 1-MW turbine, which may not be accurate. Although the 2.3-2.4 MW turbines have a larger rotor diameter, which may increase risk to raptors, the rotor-swept area is higher off the ground and the turbine rotates at slower speeds, which may reduce risk to some raptors. Based on species composition of the most common raptor fatalities at other western wind farms and species composition of raptors observed at Hatchet Ridge during the studies, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawk and American kestrels. Small numbers of other raptors, including accipiters, harriers, and eagles may also occur as fatalities over the life of the project. Also based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons with the lowest risk in the winter and spring seasons and highest risk during the summer.

Other Birds

While waterbirds had low use estimates, waterfowl as a group had the second highest use estimate for the project area due to observations of several large flocks flying high over the site. Frequency of occurrence for waterfowl was relatively low (see Table 4) and less than all other groups except waterbirds due to the small number of groups seen. A few of the waterfowl groups observed were within the zone of risk indicating that some waterfowl mortality could occur at the Hatchet Ridge site over the life of the project, however, it would probably be very low in comparison to the number of birds flying over the project area. Most wind farms have low levels of waterbird and waterfowl use and mortality. Of 1033 avian carcasses collected at U.S. wind farms, waterbirds comprised 2% and waterfowl comprised 3% (Erickson *et al*. 2002). At the Klondike, Oregon wind farm, only two Canada goose fatalities were documented (Johnson *et al*. 2003) although 43 flocks totaling 4845 Canada geese were observed during pre-construction surveys (Johnson *et al.* 2002a). The Top of Iowa Wind Project is located in cropland between three Wildlife Management Areas (WMAs) with historically high bird use, including migrant and resident waterfowl. During a recent study, approximately 1 million goose-use days and 120,000 duck-use days were recorded in the WMAs during the fall and early winter, and no waterfowl fatalities were documented during concurrent and standardized wind project fatality studies (Koford *et al.* 2005). Similar findings were observed at the Buffalo Ridge Wind Project in southwestern Minnesota, which is located in an area with relatively high waterfowl-waterbird use. Snow geese, Canada geese and mallards were the most common waterfowl observed. Three of the 55 fatalities observed during the fatality monitoring studies were waterfowl, two mallards and one blue-winged teal (Johnson *et al*. 2002b). Because waterfowl and other waterbird mortality has been low at most wind farms studied, there are not enough data available to develop a regression model to predict mortality as with raptors. In any event, waterfowl mortality at Hatchet Ridge is expected to be minor.

Due perhaps to their abundance, passerines have been the most common fatality of all avian groups at other wind projects studied. Both migrant and resident passerine fatalities have been observed. Therefore, it is expected that passerines will make up the largest proportion of fatalities at the Hatchet Ridge site. When all species of birds are considered, mean use data expressed as the number of birds observed per 20-minute survey per plot (800 m radius) are available for 24 other WRAs in the U.S. (Figure 14). Use of the Hatchet Ridge site by all bird species combined is low compared to these other WRAs, as 20 of the 24 sites had higher bird use than that observed at Hatchet Ridge while only four sites had lower use.

Fatalities of nocturnal migrating birds have been observed at wind projects in the U.S. (Erickson et al. 2001), although the rates of fatalities at individual wind farms appear to be relatively low compared to estimates of the numbers of migrants flying over the sites (Young and Erickson 2006). Most nocturnal songbird migration is believed to occur at altitudes greater than 150 m (500 ft) above ground level (Longcore *et al*. 2005, Young and Erickson 2006). There are several records of large mortality events at tall guyed communications towers (Kerlinger 2000, Kemper 1996) and these events are typically associated with bad weather conditions (low ceilings, fog). There has been no reported large episodic mortality event (e.g., >50 birds during a single night) at a U.S. wind farm. The largest mortality events reported at U.S. wind energy projects to date have been 14 migrant songbirds found at two turbines during spring migration at the Buffalo Ridge, Minnesota Wind Project (Johnson et al. 2002b) and 33 spring migrants at the Mountaineer Wind Project in West Virginia (Kerns and Kerlinger 2004). The West Virginia mortalities apparently occurred during inclement weather and the fatalities occurred at a turbine near a heavily lit substation. Most migrant songbird casualties recorded during systematic carcass searches at turbines have been a single fatality found during a single search (Erickson et al. 2001). Most searches at individual turbines result in no documented fatalities.

The data collected during this study suggest that the Hatchet Ridge project is not within a major migratory pathway, either for diurnal or nocturnal migrants. Mean raptor and passerine use during the spring and fall migration periods was lower than during the summer breeding season. The project area also does not appear to provide important stopover habitat for migrant songbirds based on the point count surveys, which did not record increased use during the migration seasons. Based on the survey data, it is expected that passerines mortality at Hatchet Ridge would likely be lower than the national average of 2.3 birds/turbine/year or 3.1 birds/MW/year (NWCC 2004).

Indirect Effects

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the project facilities and suitable habitat. In Europe, displacement effects related to some wind projects are considered to have a greater impact on birds than collision mortality. Avian displacement associated with wind power development has not received as much attention in North America. For example, the only published report of avoidance of wind turbines by raptors occurred at Buffalo Ridge, Minnesota, where raptor nest density on 101 square miles (mi^2) of land surrounding a wind project was 0.15 per mi^2, yet no nests were present in the 12 mi^2 wind project itself, even though habitat was similar (Usgaard *et al.* 1997). No red-tailed hawks or golden eagles are known to nest within the APWRA, suggesting that the large numbers of turbines present within that area may discourage nesting by raptors or that collision mortality prevents nesting in the APWRA. At the Foote Creek Rim wind farm in southern Wyoming, one pair of red-tailed hawks nested within 0.3 miles of the turbine strings, and seven red-tailed hawk, one great horned owl, and one golden eagle nests located within 1 mile of the wind farm successfully fledged young (Johnson *et al*. 2000a). The golden eagle pair successfully nested 0.5 mile from the wind farm for three different years after it became operational. A Swainson's hawk nested within 0.5 miles of the Klondike, Oregon Wind Project (Johnson *et al.* 2003). Studies at the Stateline Wind Project in Oregon and Washington have not shown any measurable short-term effects to nesting raptors (Erickson *et al.* 2004).

Based on the survey area of 32,000 acres, active raptor nest density was 0.06/mi^2 which is low compared to most other wind resource areas in the western U.S. Of 10 other WRA in the western U.S. with raptor nest density data, only 2 had $\leq$0.06 nests/mi^2. Raptor nest density at these 10 WRA ranged from 0.03–0.30/mi^2, and averaged 0.15/mi^2 (Erickson et al. 2002). Because of the low nest density and distance to the nearest nests, no impacts are expected to nesting raptors from the proposed Hatchet Ridge wind project.

At the Buffalo Ridge Wind Project, Minnesota, the abundance of shorebirds, waterfowl, upland game birds, woodpeckers, and several groups of passerines was found to be statistically significantly lower at survey plots with turbines than at plots without turbines. There were fewer differences in avian use as a function of distance from turbines, however, suggesting that the area of reduced use was limited primarily to those areas within 100 meters of the turbines (Johnson *et al*. 2000b). These results are similar to those of Osborn *et al.* (1998), who reported that birds at Buffalo Ridge avoided flying in areas with turbines. Some birds apparently did become accustomed to turbines, as Osborn *et al*. (1998) also reported a mallard nest within 31 m of a turbine. Also at Buffalo Ridge, Leddy *et al*. (1999) found that densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines. Grasslands without turbines and portions of grasslands located at least 180 meters from turbines had bird densities four times greater than grasslands located near turbines. Reduced avian use near turbines was attributed to avoidance of turbine noise and maintenance activities and reduced habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996; Johnson *et al*. 2000b).

Results from the Stateline Wind Project, Oregon and Washington (Erickson *et al.* 2004) and the Combine Hills project, Oregon (Young et al. 2005) suggest a relatively small-scale impact of the wind facilities on grassland nesting passerines. Transect surveys conducted prior to and after construction of the wind projects indicated that grassland songbird use was significantly reduced within approximately 50 m of turbine strings; areas further away from turbine strings did not have reduced avian use. The reduced use was attributed to temporary and permanent habitat disturbance near the turbines. Because the Hatchet Ridge project will be sited in previously altered habitats, and similar habitats are common in the region, it is unlikely that displacement of birds would result in any population impacts.

Bats

The mean number of bat passes per detector per night was compared to existing data at wind farms where both bat activity and mortality levels have been measured in West Virginia (Kerns et al. 2005), Tennessee (Fiedler 2004), Iowa (Koford et al. 2005), Minnesota (Johnson et al. 2004), and Wyoming (Gruver 2002) (Table 12). Only data collected with AnaBat units placed on the ground were used to make the data comparable to the other studies. The level of bat activity documented at the Hatchet Ridge site is much lower than the Eastern and Midwestern wind projects, all of which had fairly high levels of bat mortality (Table 12). However, it is higher than the Buffalo Ridge, Minnesota and Foote Creek Rim, Wyoming wind farms, both of which had relatively low levels of bat mortality. In all studies the species most affected were long distance foliage (tree) dwelling species (see above references; Johnson 2005). The data collected on site indicate that some bats migrate through the Hatchet Ridge project Area. While relatively few calls of migratory species (e.g., hoary bat, silver-haired bat, Brazilian free-tailed bat) were positively identified, there were numerous calls in the 25 kHz range of unknown species. Several species that call in this range are migratory. Some bat mortality will likely occur at the Hatchet Ridge site. However, the available data indicate it would probably be lower than that experienced in the Eastern U.S, but potentially somewhat higher than that documented at Foote Creek Rim or Buffalo Ridge. Based on previous mortality studies at wind projects, it is expected that bats that are foliage or forest dwelling long distance migrants such as hoary bat and silver-haired bat would make up the majority of the bat fatalities (see Johnson 2005). *Myotis* species and big brown bat would make up a much smaller proportion of the bat mortality.

Rare Plants

One rare plant species Butte County morning glory was found in the project area. The morning glory is listed as a CNPS 1B.2 defined as “fairly threatened in California”. Individuals and small populations (clusters) of plants of the species observed on site typically occurred in areas devoid of other plant species. However, plant species commonly encountered within the vicinity of the *Calystegia* include manzanita (*Arctostaphylos patula*), false Solomon’s-seal (*Smilacina racemosa*), beavertail-grass (*Calochortus coeruleus*), bracken (*Pteridium aquilinum* var. *pubescens*), arrow-leaf balsamroot (*Balsamorhiza sagittata*), barberry (*Berberis aquifolium* var. *aquifolium*), vetch (*Vicia* sp.), and silene (*Silene* sp.).

Butte County morning glory occurs in six counties in California, including Butte, Contra Costa, Del Norte, Mendocino, Shasta, and Tehama. Of all six counties in which the species is known to occur, Shasta has the highest number of occurrences, 45, as compared to the next highest, 28 in Butte County (CNDDB 2007). Many of the element occurrences in the CNDDB are listed as *areas* over which the morning glory occurs rather than numbers of individuals encountered. The Shasta County localities where Butte County morning glory occur vary in size from 4 to 700 acres (CNDDB 2007). The Hatchet Ridge population identified in this effort (144 acres) is the third largest locality based on acreages reported in the CNDDB for Shasta County and represents a substantial increase in the known population of the species.

The density of Butte County morning glory in the area where it was located was high. In an effort to classify density or relative abundance of plants, 300-foot radius plots were surveyed around two proposed turbines within the area in which the plant occurs. Within these plots the species accounted for approximately 5-8% of the vegetal ground cover (see Figure 11) and 10-15% of all plants. Potentially tens of thousands of individuals of the species occur in the project area and it is unlikely that the project could be designed to avoid individuals or patches of the plant. The density of the plant and propensity for it to occur in disturbed areas, precludes implementing effective avoidance mitigation measures. Construction activity will impact individuals and patches of the plant but will not affect the population viability due to the large area over which the species occurs. It is likely that natural recruitment of plants in disturbed construction areas will include Butte County morning glory throughout the area where it occurs. Reclamation measures should include consideration for maintaining low overall vegetative plant cover in this area to facilitate the natural recruitment of the species.

In addition to the Butte County morning glory, two non-targeted special-status plant species were encountered during the 2007 survey, including long-stoloned sedge (Carex inops ssp. inops: CNPS 3) and yellow tritelia (Tritelia crocea var. crocea: CNPS 4). Neither species were mapped within the survey area because: 1) they were not targeted species (i.e., they did not have a CNPS ranking of 2 or higher), and 2) they were scattered throughout a large area within the project site. Mat-like patches of long-stoloned sedge, some comprising an area as large as 0.25 acres, were observed all along the ridge between turbines 3 and 35. Large and small patches of the sedge were scattered throughout this range within and beyond the survey corridor. Individuals of yellow tritelia, likely totaling between 500 and 1,000 plants, were observed scattered throughout the southern half of the turbine corridor (only a few individuals were encountered in the northern half). Both species typically occur in lower-montane coniferous forests, the sedge on rocky areas and the tritelia on dry slopes. No avoidance or mitigation measures are proposed for these species due to their abundance and low concern status.

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Table 1. Avian Species Observed During Fixed-Point Surveys.

	Fall		Winter		Spring		Summer		Total	
Species/Group	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups
Waterbirds	**0**	**0**	**0**	**0**	**41**	**3**	**0**	**0**	**41**	**3**
American white pelican	0	0	0	0	10	1	0	0	10	1
sandhill crane	0	0	0	0	30	1	0	0	30	1
unidentified gull	0	0	0	0	1	1	0	0	1	1
Waterfowl	**89**	**3**	**328**	**9**	**7**	**1**	**0**	**0**	**424**	**13**
Canada goose	0	0	30	1	0	0	0	0	30	1
gr. white-fronted goose	88	2	0	0	0	0	0	0	88	2
northern pintail	0	0	40	1	0	0	0	0	40	1
snow goose	0	0	78	3	7	1	0	0	85	4
tundra swan	0	0	100	2	0	0	0	0	100	2
unidentified goose	1	1	80	2	0	0	0	0	81	3
Raptors	**106**	**76**	**11**	**11**	**45**	**37**	**119**	**98**	**281**	**222**
Accipiters	*8*	*7*	*0*	*0*	*1*	*1*	*6*	*6*	*15*	*14*
Cooper's hawk	7	6	0	0	0	0	4	4	11	10
sharp-shinned hawk	1	1	0	0	1	1	2	2	4	4
Buteos	*35*	*29*	*2*	*2*	*19*	*15*	*20*	*19*	*76*	*65*
Swainson's hawk	0	0	0	0	2	1	0	0	2	1
ferruginous hawk	0	0	0	0	1	1	0	0	1	1
red-tailed hawk	34	28	2	2	16	13	20	19	72	62
rough-legged hawk	1	1	0	0	0	0	0	0	1	1
Eagles	*6*	*5*	*5*	*5*	*3*	*3*	*0*	*0*	*14*	*13*
bald eagle	5	4	4	4	3	3	0	0	12	11
golden eagle	0	0	1	1	0	0	0	0	1	1
unidentified eagle	1	1	0	0	0	0	0	0	1	1
Falcons	*2*	*2*	*0*	*0*	*5*	*5*	*16*	*16*	*23*	*23*
American kestrel	2	2	0	0	4	4	16	16	22	22
gyrfalcon	0	0	0	0	1	1	0	0	1	1
Owls										
northern pygmy-owl	1	1	0	0	0	0	0	0	1	1
Other Raptors										
northern harrier	4	3	2	2	1	1	2	2	9	8
osprey	0	0	0	0	1	1	1	1	2	2
unidentified hawk	0	0	1	1	1	1	0	0	2	2
Vultures										
turkey vulture	50	29	1	1	14	10	74	54	139	94
Passerines	**546**	**215**	**120**	**65**	**319**	**194**	**741**	**463**	**1726**	**937**
American goldfinch	0	0	0	0	2	1	0	0	2	1
American robin	89	15	33	5	7	4	14	10	143	34
Bewick's wren	2	2	4	4	9	7	3	3	18	16
Black-headed grosbeak	0	0	0	0	0	0	1	1	1	1
bushtit	6	1	0	0	0	0	0	0	6	1
Cassin's finch	0	0	0	0	0	0	3	2	3	2
chipping sparrow	9	4	0	0	5	4	22	16	36	24
Clark's nutcracker	0	0	0	0	0	0	1	1	1	1
cliff swallow	0	0	0	0	0	0	24	4	24	4
common raven	41	22	30	20	70	28	28	20	169	90
common yellowthroat	0	0	0	0	0	0	2	1	2	1
cordilleran flycatcher	3	3	16	15	17	16	16	14	52	48
dark-eyed junco	73	37	4	4	54	32	139	85	270	158
European starling	0	0	0	0	1	1	0	0	1	1

	Fall		Winter		Spring		Summer		Total	
Species/Group	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups
fox sparrow	3	3	0	0	25	18	52	47	80	68
golden-crowned sparrow	8	4	0	0	0	0	0	0	8	4
green-tailed towhee	4	3	0	0	15	13	67	57	86	73
house finch	0	0	0	0	0	0	3	2	3	2
house wren	3	2	0	0	0	0	8	6	11	8
lazuli bunting	0	0	0	0	0	0	6	6	6	6
lesser goldfinch	21	10	0	0	0	0	70	43	91	53
MacGillivray’s warbler	0	0	0	0	2	1	10	7	12	8
mountain bluebird	43	14	0	0	19	11	81	37	143	62
mountain chickadee	5	4	10	6	7	7	5	2	27	19
olive-sided flycatcher	0	0	0	0	1	1	8	7	9	8
orange-crowned warbler	4	3	0	0	0	0	0	0	4	3
purple finch	9	3	0	0	0	0	2	2	11	5
red-breasted nuthatch	0	0	0	0	0	0	3	2	3	2
rock wren	0	0	0	0	0	0	11	11	11	11
ruby-crowned kinglet	4	3	1	1	0	0	0	0	5	4
song sparrow	0	0	0	0	3	2	1	1	4	3
spotted towhee	12	12	0	0	9	7	20	19	41	38
Steller's jay	2	2	2	2	13	8	6	6	23	18
Townsend's solitaire	2	1	0	0	1	1	0	0	3	2
tree swallow	4	1	0	0	9	7	86	22	99	30
unidentified bluebird	32	7	0	0	1	1	0	0	33	8
unidentified flycatcher	0	0	0	0	2	2	5	5	7	7
unidentified finch	4	3	4	1	0	0	1	1	9	5
unidentified passerine	34	8	15	6	15	1	0	0	64	15
unidentified sparrow	3	3	0	0	0	0	4	1	7	4
unidentified swallow	0	0	1	1	12	5	16	2	29	8
unidentified warbler	0	0	0	0	1	1	0	0	1	1
western bluebird	9	2	0	0	1	1	0	0	10	3
western meadowlark	1	1	0	0	0	0	0	0	1	1
western scrub-jay	42	10	0	0	7	5	0	0	49	15
western tanager	1	1	0	0	0	0	4	4	5	5
western wood-pewee	0	0	0	0	1	1	0	0	1	1
white-breasted nuthatch	0	0	0	0	1	1	0	0	1	1
white-crowned sparrow	46	19	0	0	0	0	0	0	46	19
Wilson's warbler	0	0	0	0	0	0	1	1	1	1
yellow warbler	0	0	0	0	1	1	11	10	12	11
yellow-rumped warbler	27	12	0	0	8	6	7	5	42	23
Upland Gamebirds	**5**	**5**	**0**	**0**	**32**	**20**	**34**	**26**	**71**	**51**
mountain quail	5	5	0	0	32	20	32	24	69	49
unidentified quail	0	0	0	0	0	0	2	2	2	2
Doves	**52**	**14**	**0**	**0**	**0**	**0**	**3**	**3**	**55**	**17**
band-tailed pigeon	52	14	0	0	0	0	0	0	52	14
mourning dove	0	0	0	0	0	0	3	3	3	3
Other Birds	**36**	**32**	**16**	**16**	**1**	**1**	**30**	**26**	**83**	**75**
Anna's hummingbird	0	0	1	1	0	0	1	1	2	2
Lewis's woodpecker	6	4	0	0	0	0	1	1	7	5
Nuttall's woodpecker	0	0	0	0	0	0	1	1	1	1
acorn woodpecker	1	1	0	0	0	0	0	0	1	1
downy woodpecker	0	0	1	1	0	0	0	0	1	1
hairy woodpecker	4	4	9	9	0	0	17	14	30	27

	Fall		Winter		Spring		Summer		Total	
Species/Group	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups	Number of Individuals	Number Groups
northern flicker	21	21	0	0	0	0	5	5	26	26
unidentified hummingbird	0	0	0	0	1	1	5	4	6	5
unidentified swift	3	1	0	0	0	0	0	0	3	1
unidentified woodpecker	1	1	4	4	0	0	0	0	5	5
white-headed woodpecker	0	0	1	1	0	0	0	0	1	1
Unidentified Birds										
unidentified bird	1	1	1	1	0	0	0	0	2	2
Total	**835**	**346**	**476**	**102**	**445**	**256**	**927**	**616**	**2683**	**1320**

Table 2. Estimated Mean Use for Avian Species Observed During Fixed-Point Surveys.

Species/Group	Fall Use	Winter Use	Spring Use	Summer Use	Overall Use
Waterbirds	**0.000**	**0.000**	**0.717**	**0.000**	**0.146**
American white pelican	0.000	0.000	0.200	0.000	0.041
sandhill crane	0.000	0.000	0.500	0.000	0.102
unidentified gull	0.000	0.000	0.017	0.000	0.003
Waterfowl	**1.141**	**3.744**	**0.000**	**0.000**	**1.296**
Canada goose	0.000	0.385	0.000	0.000	0.102
greater white-fronted goose	1.128	0.000	0.000	0.000	0.299
northern pintail	0.000	0.513	0.000	0.000	0.136
snow goose	0.000	1.436	0.000	0.000	0.381
tundra swan	0.000	0.385	0.000	0.000	0.102
unidentified goose	0.013	1.026	0.000	0.000	0.276
Raptors	**1.364**	**0.179**	**1.047**	**1.526**	**1.028**
Accipiters	**0.103**	**0.000**	**0.020**	**0.077**	**0.052**
Cooper's hawk	0.090	0.000	0.000	0.051	0.037
sharp-shinned hawk	0.013	0.000	0.020	0.026	0.014
Buteos	**0.449**	**0.026**	**0.377**	**0.256**	**0.271**
Swainson's hawk	0.000	0.000	0.050	0.000	0.010
ferruginous hawk	0.000	0.000	0.017	0.000	0.003
red-tailed hawk	0.436	0.026	0.310	0.256	0.254
rough-legged hawk	0.013	0.000	0.000	0.000	0.003
Eagles	**0.077**	**0.077**	**0.058**	**0.000**	**0.053**
bald eagle	0.064	0.038	0.058	0.000	0.039
golden eagle	0.000	0.038	0.000	0.000	0.010
unidentified eagle	0.013	0.000	0.000	0.000	0.003
Falcons	**0.026**	**0.000**	**0.133**	**0.205**	**0.088**
American kestrel	0.026	0.000	0.117	0.205	0.085
Gyrfalcon	0.000	0.000	0.017	0.000	0.003
Owls					
northern pygmy-owl	0.013	0.000	0.000	0.000	0.003
Other Raptors					
northern harrier	0.056	0.026	0.025	0.026	0.034
Osprey	0.000	0.000	0.017	0.013	0.007
unidentified hawk	0.000	0.013	0.017	0.000	0.007
turkey vulture	0.641	0.038	0.400	0.949	0.514
Passerines	**7.090**	**1.915**	**6.482**	**9.500**	**6.232**
American goldfinch	0.000	0.000	0.050	0.000	0.010
American robin	1.144	0.449	0.145	0.179	0.500
Bewick's wren	0.026	0.103	0.247	0.038	0.095
black-headed grosbeak	0.000	0.000	0.000	0.013	0.003
Bushtit	0.092	0.000	0.000	0.000	0.024
Cassin's finch	0.000	0.000	0.000	0.038	0.010
chipping sparrow	0.115	0.000	0.090	0.282	0.124
Clark's nutcracker	0.000	0.000	0.000	0.013	0.003
cliff swallow	0.000	0.000	0.000	0.308	0.082
common raven	0.526	0.541	1.292	0.359	0.642
common yellowthroat	0.000	0.000	0.000	0.026	0.007
cordilleran flycatcher	0.038	0.262	0.367	0.205	0.209
dark-eyed junco	0.962	0.051	1.155	1.782	0.977
European starling	0.000	0.000	0.017	0.000	0.003
fox sparrow	0.038	0.000	0.448	0.667	0.279
golden-crowned sparrow	0.108	0.000	0.000	0.000	0.029
green-tailed towhee	0.051	0.000	0.262	0.859	0.295
house finch	0.000	0.000	0.000	0.038	0.010
house wren	0.041	0.000	0.000	0.103	0.038

Species/Group	Fall Use	Winter Use	Spring Use	Summer Use	Overall Use
lazuli bunting	0.000	0.000	0.000	0.077	0.020
lesser goldfinch	0.269	0.000	0.000	0.897	0.310
MacGillivray’s warbler	0.000	0.000	0.033	0.128	0.041
mountain bluebird	0.551	0.000	0.350	1.038	0.493
mountain chickadee	0.067	0.162	0.170	0.064	0.112
olive-sided flycatcher	0.000	0.000	0.017	0.103	0.031
orange-crowned warbler	0.051	0.000	0.000	0.000	0.014
purple finch	0.115	0.000	0.000	0.026	0.037
red-breasted nuthatch	0.000	0.000	0.000	0.038	0.010
rock wren	0.000	0.000	0.000	0.141	0.037
ruby-crowned kinglet	0.051	0.015	0.000	0.000	0.018
song sparrow	0.000	0.000	0.075	0.013	0.019
spotted towhee	0.159	0.000	0.177	0.256	0.146
Steller's jay	0.026	0.051	0.337	0.077	0.110
Townsend's solitaire	0.026	0.000	0.017	0.000	0.010
tree swallow	0.051	0.000	0.190	1.103	0.345
unidentified bluebird	0.421	0.000	0.017	0.000	0.115
unidentified flycatcher	0.000	0.000	0.033	0.064	0.024
unidentified finch	0.051	0.051	0.000	0.013	0.031
unidentified passerine	0.456	0.192	0.250	0.000	0.223
unidentified sparrow	0.038	0.000	0.000	0.051	0.024
unidentified swallow	0.000	0.038	0.367	0.205	0.139
unidentified warbler	0.000	0.000	0.025	0.000	0.005
western bluebird	0.115	0.000	0.017	0.000	0.034
western meadowlark	0.013	0.000	0.000	0.000	0.003
western scrub-jay	0.538	0.000	0.125	0.000	0.168
western tanager	0.013	0.000	0.000	0.051	0.017
western wood-pewee	0.000	0.000	0.017	0.000	0.003
white-breasted nuthatch	0.000	0.000	0.017	0.000	0.003
white-crowned sparrow	0.590	0.000	0.000	0.000	0.156
Wilson's warbler	0.000	0.000	0.000	0.013	0.003
yellow warbler	0.000	0.000	0.017	0.141	0.041
yellow-rumped warbler	0.346	0.000	0.162	0.090	0.149
Upland Gamebirds	**0.064**	**0.000**	**0.597**	**0.436**	**0.254**
mountain quail	0.064	0.000	0.597	0.410	0.248
unidentified quail	0.000	0.000	0.000	0.026	0.007
Doves/Pigeons	**0.667**	**0.000**	**0.000**	**0.038**	**0.187**
band-tailed pigeon	0.667	0.000	0.000	0.000	0.177
mourning dove	0.000	0.000	0.000	0.038	0.010
Other Birds	**0.467**	**0.310**	**0.025**	**0.385**	**0.313**
Anna's hummingbird	0.000	0.038	0.000	0.013	0.014
Lewis's woodpecker	0.077	0.000	0.000	0.013	0.024
Nuttall's woodpecker	0.000	0.000	0.000	0.013	0.003
acorn woodpecker	0.013	0.000	0.000	0.000	0.003
downy woodpecker	0.000	0.013	0.000	0.000	0.003
hairy woodpecker	0.051	0.192	0.000	0.218	0.122
northern flicker	0.274	0.000	0.000	0.064	0.090
unidentified hummingbird	0.000	0.000	0.025	0.064	0.022
unidentified swift	0.038	0.000	0.000	0.000	0.010
unidentified woodpecker	0.013	0.054	0.000	0.000	0.018
white-headed woodpecker	0.000	0.013	0.000	0.000	0.003
unidentified bird	**0.013**	**0.038**	**0.000**	**0.000**	**0.014**

Table 3. Percent Composition for Avian Species Observed During Fixed-Point Surveys.

Species/Group	Fall % Comp	Winter % Comp	Spring % Comp	Summer % Comp	Overall % Comp
Waterbirds	**0.00**	**0.00**	**8.08**	**0.00**	**1.54**
American white pelican	0.00	0.00	2.26	0.00	0.43
sandhill crane	0.00	0.00	5.64	0.00	1.08
unidentified gull	0.00	0.00	0.19	0.00	0.04
Waterfowl	**10.56**	**60.51**	**0.00**	**0.00**	**13.68**
Canada goose	0.00	6.22	0.00	0.00	1.08
greater white-fronted goose	10.44	0.00	0.00	0.00	3.16
northern pintail	0.00	8.29	0.00	0.00	1.44
snow goose	0.00	23.21	0.00	0.00	4.02
tundra swan	0.00	6.22	0.00	0.00	1.08
unidentified goose	0.12	16.58	0.00	0.00	2.91
Raptors	**12.62**	**2.90**	**11.80**	**12.84**	**10.85**
Accipiters	**0.95**	**0.00**	**0.23**	**0.65**	**0.55**
Cooper's hawk	0.83	0.00	0.00	0.43	0.40
sharp-shinned hawk	0.12	0.00	0.23	0.22	0.15
Buteos	**4.15**	**0.41**	**4.25**	**2.16**	**2.86**
ferruginous hawk	0.00	0.00	0.19	0.00	0.04
rough-legged hawk	0.12	0.00	0.00	0.00	0.04
red-tailed hawk	4.03	0.41	3.50	2.16	2.68
Swainson's hawk	0.00	0.00	0.56	0.00	0.11
Eagles	**0.71**	**1.24**	**0.66**	**0.00**	**0.56**
bald eagle	0.59	0.62	0.66	0.00	0.41
golden eagle	0.00	0.62	0.00	0.00	0.11
unidentified eagle	0.12	0.00	0.00	0.00	0.04
Falcons	**0.24**	**0.00**	**1.50**	**1.73**	**0.93**
American kestrel	0.24	0.00	1.32	1.73	0.90
gyrfalcon	0.00	0.00	0.19	0.00	0.04
Owls					
northern pygmy-owl	0.12	0.00	0.00	0.00	0.04
Other Raptors					
northern harrier	0.52	0.41	0.28	0.22	0.36
osprey	0.00	0.00	0.19	0.11	0.07
unidentified hawk	0.00	0.21	0.19	0.00	0.07
turkey vulture	5.93	0.62	4.51	7.98	5.42
Passerines	**65.61**	**30.96**	**73.10**	**79.94**	**65.81**
American goldfinch	0.00	0.00	0.56	0.00	0.11
American robin	10.58	7.25	1.64	1.51	5.28
Bewick's wren	0.24	1.66	2.78	0.32	1.00
black-headed grosbeak	0.00	0.00	0.00	0.11	0.04
bushtit	0.85	0.00	0.00	0.00	0.26
Cassin's finch	0.00	0.00	0.00	0.32	0.11
chipping sparrow	1.07	0.00	1.02	2.37	1.31
Clark's nutcracker	0.00	0.00	0.00	0.11	0.04
cliff swallow	0.00	0.00	0.00	2.59	0.86
common raven	4.86	8.74	14.57	3.02	6.78
common yellowthroat	0.00	0.00	0.00	0.22	0.07
cordilleran flycatcher	0.36	4.23	4.14	1.73	2.21
dark-eyed junco	8.90	0.83	13.03	14.99	10.32
European starling	0.00	0.00	0.19	0.00	0.04
fox sparrow	0.36	0.00	5.06	5.61	2.94
golden-crowned sparrow	1.00	0.00	0.00	0.00	0.30
green-tailed towhee	0.47	0.00	2.95	7.23	3.11
house finch	0.00	0.00	0.00	0.32	0.11

Species/Group	Fall % Comp	Winter % Comp	Spring % Comp	Summer % Comp	Overall % Comp
house wren	0.38	0.00	0.00	0.86	0.40
lazuli bunting	0.00	0.00	0.00	0.65	0.22
lesser goldfinch	2.49	0.00	0.00	7.55	3.27
MacGillivray’s warbler	0.00	0.00	0.38	1.08	0.43
mountain bluebird	5.10	0.00	3.95	8.74	5.21
mountain chickadee	0.62	2.61	1.92	0.54	1.19
olive-sided flycatcher	0.00	0.00	0.19	0.86	0.32
orange-crowned warbler	0.47	0.00	0.00	0.00	0.14
purple finch	1.07	0.00	0.00	0.22	0.40
red-breasted nuthatch	0.00	0.00	0.00	0.32	0.11
rock wren	0.00	0.00	0.00	1.19	0.40
ruby-crowned kinglet	0.47	0.25	0.00	0.00	0.19
song sparrow	0.00	0.00	0.85	0.11	0.20
spotted towhee	1.47	0.00	1.99	2.16	1.54
Steller's jay	0.24	0.83	3.80	0.65	1.16
Townsend's solitaire	0.24	0.00	0.19	0.00	0.11
tree swallow	0.47	0.00	2.14	9.28	3.64
unidentified bluebird	3.89	0.00	0.19	0.00	1.21
unidentified flycatcher	0.00	0.00	0.38	0.54	0.25
unidentified finch	0.47	0.83	0.00	0.11	0.32
unidentified passerine	4.22	3.11	2.82	0.00	2.36
unidentified sparrow	0.36	0.00	0.00	0.43	0.25
unidentified swallow	0.00	0.62	4.14	1.73	1.47
unidentified warbler	0.00	0.00	0.28	0.00	0.05
western bluebird	1.07	0.00	0.19	0.00	0.36
western meadowlark	0.12	0.00	0.00	0.00	0.04
western scrub-jay	4.98	0.00	1.41	0.00	1.78
western tanager	0.12	0.00	0.00	0.43	0.18
western wood-pewee	0.00	0.00	0.19	0.00	0.04
white-breasted nuthatch	0.00	0.00	0.19	0.00	0.04
white-crowned sparrow	5.46	0.00	0.00	0.00	1.65
Wilson's warbler	0.00	0.00	0.00	0.11	0.04
yellow warbler	0.00	0.00	0.19	1.19	0.43
yellow-rumped warbler	3.20	0.00	1.82	0.76	1.57
Upland Gamebirds	**0.59**	**0.00**	**6.73**	**3.67**	**2.69**
mountain quail	0.59	0.00	6.73	3.45	2.61
unidentified quail	0.00	0.00	0.00	0.22	0.07
Doves/Pigeons	**6.17**	**0.00**	**0.00**	**0.32**	**1.98**
band-tailed pigeon	6.17	0.00	0.00	0.00	1.87
mourning dove	0.00	0.00	0.00	0.32	0.11
Other Birds	**4.32**	**5.01**	**0.28**	**3.24**	**3.31**
acorn woodpecker	0.12	0.00	0.00	0.00	0.04
Anna's hummingbird	0.00	0.62	0.00	0.11	0.14
downy woodpecker	0.00	0.21	0.00	0.00	0.04
hairy woodpecker	0.47	3.11	0.00	1.83	1.29
Lewis's woodpecker	0.71	0.00	0.00	0.11	0.25
northern flicker	2.54	0.00	0.00	0.54	0.95
Nuttall's woodpecker	0.00	0.00	0.00	0.11	0.04
unidentified swift	0.36	0.00	0.00	0.00	0.11
unidentified hummingbird	0.00	0.00	0.28	0.54	0.23
unidentified woodpecker	0.12	0.87	0.00	0.00	0.19
white-headed woodpecker	0.00	0.21	0.00	0.00	0.04
unidentified bird	**0.12**	**0.62**	**0.00**	**0.00**	**0.14**

Table 4. Frequency of Occurrence for Avian Species Observed During Fixed-Point Surveys.

Species/Group	Fall % Freq	Winter % Freq	Spring % Freq	Summer % Freq	Overall % Freq
Waterbirds	**0.00**	**0.00**	**5.33**	**0.00**	**1.09**
American white pelican	0.00	0.00	2.00	0.00	0.41
sandhill crane	0.00	0.00	1.67	0.00	0.34
unidentified gull	0.00	0.00	1.67	0.00	0.34
Waterfowl	**3.85**	**12.82**	**0.00**	**0.00**	**4.42**
Canada goose	0.00	1.28	0.00	0.00	0.34
greater white-fronted goose	2.56	0.00	0.00	0.00	0.68
northern pintail	0.00	1.28	0.00	0.00	0.34
snow goose	0.00	6.41	0.00	0.00	1.70
tundra swan	0.00	1.28	0.00	0.00	0.34
unidentified goose	1.28	2.56	0.00	0.00	1.02
Raptors	**63.08**	**16.67**	**47.00**	**74.36**	**50.48**
Accipiters	**8.97**	**0.00**	**2.00**	**7.69**	**4.83**
Cooper's hawk	7.69	0.00	0.00	5.13	3.40
sharp-shinned hawk	1.28	0.00	2.00	2.56	1.43
Buteos	**32.05**	**2.56**	**28.50**	**21.79**	**20.78**
ferruginous hawk	0.00	0.00	1.67	0.00	0.34
rough-legged hawk	1.28	0.00	0.00	0.00	0.34
red-tailed hawk	32.05	2.56	24.33	21.79	19.93
Swainson's hawk	0.00	0.00	2.50	0.00	0.51
Eagles	**5.13**	**7.69**	**5.83**	**0.00**	**4.59**
bald eagle	3.85	3.85	5.83	0.00	3.23
golden eagle	0.00	3.85	0.00	0.00	1.02
unidentified eagle	1.28	0.00	0.00	0.00	0.34
Falcons	**2.56**	**0.00**	**10.83**	**17.95**	**7.65**
American kestrel	2.56	0.00	9.17	17.95	7.31
gyrfalcon	0.00	0.00	1.67	0.00	0.34
Owls	**1.28**	**0.00**	**0.00**	**0.00**	**0.34**
northern pygmy-owl	1.28	0.00	0.00	0.00	0.34
Other Raptors					
northern harrier	4.10	2.56	2.50	2.56	2.96
osprey	0.00	0.00	1.67	1.28	0.68
unidentified hawk	0.00	1.28	1.67	0.00	0.68
turkey vulture	32.05	3.85	21.83	60.26	29.97
Passerines	**93.33**	**62.56**	**83.33**	**100.00**	**84.90**
American goldfinch	0.00	0.00	2.50	0.00	0.51
American robin	15.64	7.69	7.83	12.82	11.19
Bewick's wren	2.56	10.26	17.67	3.85	8.03
black-headed grosbeak	0.00	0.00	0.00	1.28	0.34
bushtit	1.54	0.00	0.00	0.00	0.41
Cassin's finch	0.00	0.00	0.00	2.56	0.68
chipping sparrow	5.13	0.00	7.33	19.23	7.96
Clark's nutcracker	0.00	0.00	0.00	1.28	0.34
cliff swallow	0.00	0.00	0.00	5.13	1.36
common raven	28.21	27.18	52.17	24.36	31.80
common yellowthroat	0.00	0.00	0.00	1.28	0.34
cordilleran flycatcher	3.85	20.77	34.17	17.95	18.27
dark-eyed junco	44.36	5.13	55.67	88.46	47.96
European starling	0.00	0.00	1.67	0.00	0.34
fox sparrow	3.85	0.00	30.83	57.69	22.62
golden-crowned sparrow	5.38	0.00	0.00	0.00	1.43
green-tailed towhee	3.85	0.00	19.50	62.82	21.67
house finch	0.00	0.00	0.00	2.56	0.68

Species/Group	Fall % Freq	Winter % Freq	Spring % Freq	Summer % Freq	Overall % Freq
house wren	2.82	0.00	0.00	7.69	2.79
lazuli bunting	0.00	0.00	0.00	7.69	2.04
lesser goldfinch	12.82	0.00	0.00	44.87	15.31
MacGillivray’s warbler	0.00	0.00	1.67	8.97	2.72
mountain bluebird	17.95	0.00	18.50	35.90	18.06
mountain chickadee	5.38	10.77	17.00	2.56	8.44
olive-sided flycatcher	0.00	0.00	1.67	8.97	2.72
orange-crowned warbler	3.85	0.00	0.00	0.00	1.02
purple finch	3.85	0.00	0.00	2.56	1.70
red-breasted nuthatch	0.00	0.00	0.00	2.56	0.68
rock wren	0.00	0.00	0.00	10.26	2.72
ruby-crowned kinglet	3.85	1.54	0.00	0.00	1.43
song sparrow	0.00	0.00	5.00	1.28	1.36
spotted towhee	15.90	0.00	13.50	24.36	13.44
Steller's jay	2.56	5.13	18.67	7.69	7.89
Townsend's solitaire	1.28	0.00	1.67	0.00	0.68
tree swallow	1.28	0.00	14.83	28.21	10.85
unidentified bluebird	9.23	0.00	1.67	0.00	2.79
unidentified flycatcher	0.00	0.00	3.33	6.41	2.38
unidentified finch	3.85	1.28	0.00	1.28	1.70
unidentified passerine	9.23	7.69	1.67	0.00	4.83
unidentified sparrow	3.85	0.00	0.00	1.28	1.36
unidentified swallow	0.00	3.85	10.00	2.56	3.74
unidentified warbler	0.00	0.00	2.50	0.00	0.51
western bluebird	2.56	0.00	1.67	0.00	1.02
western meadowlark	1.28	0.00	0.00	0.00	0.34
western scrub-jay	11.54	0.00	9.17	0.00	4.93
western tanager	1.28	0.00	0.00	5.13	1.70
western wood-pewee	0.00	0.00	1.67	0.00	0.34
white-breasted nuthatch	0.00	0.00	1.67	0.00	0.34
white-crowned sparrow	16.67	0.00	0.00	0.00	4.42
Wilson's warbler	0.00	0.00	0.00	1.28	0.34
yellow warbler	0.00	0.00	1.67	11.54	3.40
yellow-rumped warbler	12.82	0.00	7.83	6.41	6.70
Upland Gamebirds	**6.41**	**0.00**	**37.17**	**33.33**	**18.13**
mountain quail	6.41	0.00	37.17	30.77	17.45
unidentified quail	0.00	0.00	0.00	2.56	0.68
Doves/Pigeons	**16.67**	**0.00**	**0.00**	**3.85**	**5.44**
band-tailed pigeon	16.67	0.00	0.00	0.00	4.42
mourning dove	0.00	0.00	0.00	3.85	1.02
Other Birds	**33.59**	**27.18**	**2.50**	**28.21**	**24.12**
acorn woodpecker	1.28	0.00	0.00	0.00	0.34
Anna's hummingbird	0.00	3.85	0.00	1.28	1.36
downy woodpecker	0.00	1.28	0.00	0.00	0.34
hairy woodpecker	5.13	17.95	0.00	15.38	10.20
Lewis's woodpecker	5.13	0.00	0.00	1.28	1.70
northern flicker	24.62	0.00	0.00	6.41	8.23
Nuttall's woodpecker	0.00	0.00	0.00	1.28	0.34
unidentified swift	1.28	0.00	0.00	0.00	0.34
unidentified hummingbird	0.00	0.00	2.50	5.13	1.87
unidentified woodpecker	1.28	5.38	0.00	0.00	1.77
white-headed woodpecker	0.00	1.28	0.00	0.00	0.34
unidentified bird	**1.28**	**3.85**	**0.00**	**0.00**	**1.36**

Table 5. Flight Height Characteristics of Avian Species Observed During Fixed-Point Surveys.

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<18 m	18-152 m	> 152 m
greater white-fronted goose	2	88	100.00	0.00	100.00	0.00
northern pintail	1	40	100.00	0.00	100.00	0.00
Canada goose	1	30	100.00	0.00	100.00	0.00
sandhill crane	1	30	100.00	0.00	100.00	0.00
American white pelican	1	10	100.00	0.00	100.00	0.00
Lewis's woodpecker	2	3	42.86	0.00	100.00	0.00
unidentified swift	1	3	100.00	0.00	100.00	0.00
American goldfinch	1	2	100.00	0.00	100.00	0.00
osprey	2	2	100.00	0.00	100.00	0.00
Swainson's hawk	1	2	100.00	0.00	100.00	0.00
Clark's nutcracker	1	1	100.00	0.00	100.00	0.00
ferruginous hawk	1	1	100.00	0.00	100.00	0.00
golden eagle	1	1	100.00	0.00	100.00	0.00
gyrfalcon	1	1	100.00	0.00	100.00	0.00
rough-legged hawk	1	1	100.00	0.00	100.00	0.00
unidentified bird	1	1	50.00	0.00	100.00	0.00
unidentified eagle	1	1	100.00	0.00	100.00	0.00
unidentified gull	1	1	100.00	0.00	100.00	0.00
unidentified hawk	1	1	50.00	0.00	100.00	0.00
unidentified warbler	1	1	100.00	0.00	100.00	0.00
snow goose	4	85	100.00	0.00	98.82	1.18
red-tailed hawk	54	64	88.89	1.56	98.44	0.00
turkey vulture	85	121	87.05	1.65	98.35	0.00
band-tailed pigeon	14	52	100.00	1.92	98.08	0.00
unidentified bluebird	6	28	84.85	3.57	96.43	0.00
tree swallow	30	99	100.00	5.05	94.95	0.00
cliff swallow	4	24	100.00	16.67	83.33	0.00
bald eagle	11	12	100.00	8.33	83.33	8.33
American robin	16	111	77.62	18.02	81.98	0.00
common raven	66	134	79.29	21.64	78.36	0.00
American kestrel	9	9	40.91	22.22	77.78	0.00
northern harrier	8	9	100.00	22.22	77.78	0.00
sharp-shinned hawk	4	4	100.00	25.00	75.00	0.00
unidentified swallow	7	28	96.55	28.57	71.43	0.00
Cooper's hawk	6	7	63.64	28.57	71.43	0.00
western tanager	3	3	60.00	33.33	66.67	0.00
northern flicker	8	8	30.77	50.00	50.00	0.00
unidentified passerine	13	62	96.88	53.23	46.77	0.00
mountain bluebird	13	56	39.16	55.36	44.64	0.00
western scrub-jay	9	28	57.14	78.57	21.43	0.00
unidentified finch	2	5	55.56	80.00	20.00	0.00
Steller's jay	3	8	34.78	87.50	12.50	0.00
lesser goldfinch	39	70	76.92	91.43	8.57	0.00
dark-eyed junco	50	84	31.11	96.43	3.57	0.00
tundra swan	2	100	100.00	0.00	0.00	100.00
unidentified goose	2	80	98.77	0.00	0.00	100.00
yellow-rumped warbler	10	18	42.86	100.00	0.00	0.00
white-crowned sparrow	4	17	36.96	100.00	0.00	0.00
mountain chickadee	2	5	18.52	100.00	0.00	0.00
unidentified hummingbird	4	5	83.33	100.00	0.00	0.00
cordilleran flycatcher	3	3	5.77	100.00	0.00	0.00
Townsend's solitaire	2	3	100.00	100.00	0.00	0.00

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<18 m	18-152 m	> 152 m
fox sparrow	2	2	2.50	100.00	0.00	0.00
green-tailed towhee	2	2	2.33	100.00	0.00	0.00
hairy woodpecker	2	2	6.67	100.00	0.00	0.00
red-breasted nuthatch	1	2	66.67	100.00	0.00	0.00
unidentified sparrow	2	2	28.57	100.00	0.00	0.00
common yellowthroat	1	2	100.00	100.00	0.00	0.00
acorn woodpecker	1	1	100.00	100.00	0.00	0.00
Bewick's wren	1	1	5.56	100.00	0.00	0.00
chipping sparrow	1	1	2.78	100.00	0.00	0.00
mourning dove	1	1	33.33	100.00	0.00	0.00
spotted towhee	1	1	2.44	100.00	0.00	0.00
unidentified flycatcher	1	1	14.29	100.00	0.00	0.00
unidentified woodpecker	1	1	20.00	100.00	0.00	0.00
Anna's hummingbird	0	0	0.00	N/A	N/A	N/A
black-headed grosbeak	0	0	0.00	N/A	N/A	N/A
bushtit	0	0	0.00	N/A	N/A	N/A
Cassin's finch	0	0	0.00	N/A	N/A	N/A
downy woodpecker	0	0	0.00	N/A	N/A	N/A
European starling	0	0	0.00	N/A	N/A	N/A
golden-crowned sparrow	0	0	0.00	N/A	N/A	N/A
house finch	0	0	0.00	N/A	N/A	N/A
house wren	0	0	0.00	N/A	N/A	N/A
lazuli bunting	0	0	0.00	N/A	N/A	N/A
MacGillivray’s warbler	0	0	0.00	N/A	N/A	N/A
mountain quail	0	0	0.00	N/A	N/A	N/A
northern pygmy-owl	0	0	0.00	N/A	N/A	N/A
Nuttall's woodpecker	0	0	0.00	N/A	N/A	N/A
olive-sided flycatcher	0	0	0.00	N/A	N/A	N/A
orange-crowned warbler	0	0	0.00	N/A	N/A	N/A
purple finch	0	0	0.00	N/A	N/A	N/A
rock wren	0	0	0.00	N/A	N/A	N/A
ruby-crowned kinglet	0	0	0.00	N/A	N/A	N/A
song sparrow	0	0	0.00	N/A	N/A	N/A
unidentified quail	0	0	0.00	N/A	N/A	N/A
western bluebird	0	0	0.00	N/A	N/A	N/A
western meadowlark	0	0	0.00	N/A	N/A	N/A
western wood-pewee	0	0	0.00	N/A	N/A	N/A
white-breasted nuthatch	0	0	0.00	N/A	N/A	N/A
white-headed woodpecker	0	0	0.00	N/A	N/A	N/A
Wilson's warbler	0	0	0.00	N/A	N/A	N/A
yellow warbler	0	0	0.00	N/A	N/A	N/A
Overall	533	1581	58.93	25.05	63.44	11.51

Table 6. Flight Height Characteristics of Avian Groups Observed During Fixed-Point Surveys.

Species/Group	Number groups flying	Number birds flying	Percent of birds flying	<18 m	18-152 m	> 152 m
Waterbirds	3	41	100.00	0.00	100.00	0.00
Waterfowl	12	423	99.76	0.00	57.21	42.79
Raptors Subtotal	186	236	83.99	4.66	94.92	0.42
Accipiters	10	11	73.33	27.27	72.73	0.00
Buteos	57	68	89.47	1.47	98.53	0.00
Northern Harriers	8	9	100.00	22.22	77.78	0.00
Eagles	13	14	100.00	7.14	85.71	7.14
Falcons	10	10	43.48	20.00	80.00	0.00
Owls	0	0	0.00	N/A	N/A	N/A
Other Raptors	3	3	75.00	0.00	100.00	0.00
Vultures	85	121	87.05	1.65	98.35	0.00
Passerines	297	804	46.58	46.02	53.98	0.00
Upland Gamebirds	0	0	0.00	N/A	N/A	N/A
Doves	15	53	96.36	3.77	96.23	0.00
Other Birds	19	23	27.71	56.52	43.48	0.00
Unidentified Birds	1	1	50.00	0.00	100.00	0.00
Subtotal	533	1581	58.93	25.05	63.44	11.51

Table 7. Exposure Indices Calculated for Avian Species Observed During Fixed-Point Surveys.

Species/Group	Mean Use	Percent flying	Percent flying within RSA	Exposure Index
turkey vulture	0.514	87.05	98.35	0.440
common raven	0.642	79.29	78.36	0.399
Snow goose	0.381	100.00	98.82	0.376
tree swallow	0.345	100.00	94.95	0.327
American robin	0.500	77.62	81.98	0.318
greater white-fronted goose	0.299	100.00	100.00	0.299
red-tailed hawk	0.254	88.89	98.44	0.222
Band-tailed pigeon	0.177	100.00	98.08	0.173
northern pintail	0.136	100.00	100.00	0.136
Canada goose	0.102	100.00	100.00	0.102
sandhill crane	0.102	100.00	100.00	0.102
unidentified passerine	0.223	96.88	46.77	0.101
unidentified swallow	0.139	96.55	71.43	0.096
unidentified bluebird	0.115	84.85	96.43	0.094
mountain bluebird	0.493	39.16	44.64	0.086
cliff swallow	0.082	100.00	83.33	0.068
American white pelican	0.041	100.00	100.00	0.041
bald eagle	0.039	100.00	83.33	0.033
American kestrel	0.085	40.91	77.78	0.027
northern harrier	0.034	100.00	77.78	0.026
western scrub-jay	0.168	57.14	21.43	0.021
lesser goldfinch	0.310	76.92	8.57	0.020
Cooper's hawk	0.037	63.64	71.43	0.017
northern flicker	0.090	30.77	50.00	0.014
dark-eyed junco	0.977	31.11	3.57	0.011
Sharp-shinned hawk	0.014	100.00	75.00	0.011
Lewis's woodpecker	0.024	42.86	100.00	0.010
American goldfinch	0.010	100.00	100.00	0.010
golden eagle	0.010	100.00	100.00	0.010
Swainson's hawk	0.010	100.00	100.00	0.010
unidentified swift	0.010	100.00	100.00	0.010
western tanager	0.017	60.00	66.67	0.007
unidentified bird	0.014	50.00	100.00	0.007
osprey	0.007	100.00	100.00	0.007
unidentified warbler	0.005	100.00	100.00	0.005
Steller's jay	0.110	34.78	12.50	0.005
unidentified finch	0.031	55.56	20.00	0.003
unidentified hawk	0.007	50.00	100.00	0.003
Clark's nutcracker	0.003	100.00	100.00	0.003
ferruginous hawk	0.003	100.00	100.00	0.003
gyrfalcon	0.003	100.00	100.00	0.003
rough-legged hawk	0.003	100.00	100.00	0.003
unidentified eagle	0.003	100.00	100.00	0.003
unidentified gull	0.003	100.00	100.00	0.003
Green-tailed towhee	0.295	2.33	0.00	0.000
fox sparrow	0.279	2.50	0.00	0.000
unidentified goose	0.276	98.77	0.00	0.000
cordilleran flycatcher	0.209	5.77	0.00	0.000
White-crowned sparrow	0.156	36.96	0.00	0.000
yellow-rumped warbler	0.149	42.86	0.00	0.000
spotted towhee	0.146	2.44	0.00	0.000
chipping sparrow	0.124	2.78	0.00	0.000

Species/Group	Mean Use	Percent flying	Percent flying within RSA	Exposure Index
Hairy woodpecker	0.122	6.67	0.00	0.000
mountain chickadee	0.112	18.52	0.00	0.000
tundra swan	0.102	100.00	0.00	0.000
Bewick's wren	0.095	5.56	0.00	0.000
unidentified flycatcher	0.024	14.29	0.00	0.000
unidentified sparrow	0.024	28.57	0.00	0.000
unidentified hummingbird	0.022	83.33	0.00	0.000
unidentified woodpecker	0.018	20.00	0.00	0.000
mourning dove	0.010	33.33	0.00	0.000
red-breasted nuthatch	0.010	66.67	0.00	0.000
Townsend's solitaire	0.010	100.00	0.00	0.000
common yellowthroat	0.007	100.00	0.00	0.000
acorn woodpecker	0.003	100.00	0.00	0.000
mountain quail	0.248	0.00	N/A	N/A
MacGillivray’s warbler	0.041	0.00	N/A	N/A
yellow warbler	0.041	0.00	N/A	N/A
house wren	0.038	0.00	N/A	N/A
purple finch	0.037	0.00	N/A	N/A
rock wren	0.037	0.00	N/A	N/A
western bluebird	0.034	0.00	N/A	N/A
olive-sided flycatcher	0.031	0.00	N/A	N/A
golden-crowned sparrow	0.029	0.00	N/A	N/A
bushtit	0.024	0.00	N/A	N/A
lazuli bunting	0.020	0.00	N/A	N/A
song sparrow	0.019	0.00	N/A	N/A
ruby-crowned kinglet	0.018	0.00	N/A	N/A
Anna's hummingbird	0.014	0.00	N/A	N/A
orange-crowned warbler	0.014	0.00	N/A	N/A
Cassin's finch	0.010	0.00	N/A	N/A
house finch	0.010	0.00	N/A	N/A
unidentified quail	0.007	0.00	N/A	N/A
black-headed grosbeak	0.003	0.00	N/A	N/A
downy woodpecker	0.003	0.00	N/A	N/A
European starling	0.003	0.00	N/A	N/A
northern pygmy-owl	0.003	0.00	N/A	N/A
Nuttall's woodpecker	0.003	0.00	N/A	N/A
western meadowlark	0.003	0.00	N/A	N/A
western wood-pewee	0.003	0.00	N/A	N/A
white-breasted nuthatch	0.003	0.00	N/A	N/A
white-headed woodpecker	0.003	0.00	N/A	N/A
Wilson's warbler	0.003	0.00	N/A	N/A

Table 8. Mean Number of Bat Passes per AnaBat Detector per Night.

Season	Ground			Met Tower		
	>35 kHz	<35 kHz	All bats	>35 kHz	<35 kHz	All bats
Summer	1.0	5.1	6.1	0.1	2.8	2.9
Fall	1.1	3.9	5.0	0.0	3.2	3.2
Overall	1.1	4.5	5.6	0.04	3.0	3.0

Table 9. Bat Species Recorded On-Site Based on Call Characteristics from Recorded AnaBat Call Sequences.

Species	Ground Level AnaBat	50m Level AnaBat	Total
California Myotis (*Myotis californicus*)	16	0	16
Yuam Myotis (*Myotis yumanensis*)	2	0	2
Small-footed myotis (*Myotis ciliolabrum*)	1	1	2
Little brown bat (*Myotis lucifugus*)	4	0	4
Unknown *Myotis*(40-50 kHz) bats	14	1	18
Possible long-eared myotis (*Myotis evotis*)	1	0	1
Possible Pallid bat (*Antrozous pallidus*)	2	0	2
Unknown 30kHz bats	3	0	3
Big brown bat (*Eptesicus fuscus*)	9	7	16
Silver-haired bat (*Lasionycteris noctivagans*)	2	0	2
Brazilian free-tailed bat (*Tadarida braziliensis*)	21	27	48
Unknown 25kHz bats	105	39	140
Possible hoary bat (*Lasiurus cinereus*)	0	2	2
Total	180	77	257

Table 10. Special-status plant species potentially occurring in the project area.

Species	Status[2]	Habitat	Potential for Occurrence
Scabrid alpine tarplant [1] (*Anisocarpus scabridus*)	CNPS 1B	Upper montane coniferous forest (metamorphic, rocky); July-August	Suitable habitat in project area
Rattlesnake fern (*Botrychium virginianum)*	CNPS 1B	Bogs and fens; June (fertile)	No suitable habitat in project area
Long-haired star tulip (*Calochortus longebarbatus* var. *longebarbatus*)	CNPS 1B	Great Basin scrub, lower montane coniferous forest (openings and drainages), meadows and seeps, vernal pools / clay, mesic; June-August	Suitable habitat in project area
Callahan's mariposa lily (*Calochortus syntrophus*)	CNPS 3	Cismontane woodland, lower montane coniferous forest; May-June	Suitable habitat in project area, although species is known to occur at much lower elevations
Butte County morning glory (*Calystegia atriplicifolia* ssp. *buttensis*)	CNPS 1B	Lower montane coniferous forest; May-July	Suitable habitat in project area
Bristly sedge (*Carex comosa*)	CNPS 2	Coastal prairie, marshes and swamps, valley and foothill grassland;May-September	No suitable habitat in project area
Long-stoloned sedge (*Carex inops* ssp. *inops)*	CNPS 3	Lower montane coniferoud forest (rocky); April-June	Suitable habitat in project area
Slender sedge (*Carex lasiocarpa)*	CNPS 2	Bogs and fens, marshes and swamps; June-July	No suitable habitat in project area
Northern clarkia (*Clarkia borealis* ssp. *borealis*)	CNPS 1B	Chaparral, cismontane woodland, lower montane coniferous forest; June-Sept	Suitable habitat in project area
English sundew (*Drosera anglica*)	CNPS 2	Bogs and fens, meadows and seeps; June-Aug	No suitable habitat in project area
Little hulsea (*Hulsea nana*)	CNPS 2	Alpine boulder and rock field, subalpine coniferous forest / rocky or gravelly, volcanic; July-Aug	No suitable habitat in prject area
Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*)	FSC/ CNPS 1B	Chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools / vernally mesic; March-May	No suitable habitat in project area
Bellinger's meadowfoam (*Limnanthes floccosa* ssp. *bellingeriana*)	FSC/ CNPS 1B	Cismontane woodland, meadows and seeps / mesic; April-June	No suitable habitat in project area
Egg Lake monkeyflower (*Mimulus pygmaeus*)	FSC/ CNPS 4	Great Basin scrub, lower montane coniferous forest, meadows and seeps, pinyon and juniper woodland / vernally mesic, volcanic, clay; May-Aug	No suitable habitat in project area
Shasta snow-wreath (*Neviusia cliftonii*)	CNPS 1B	Lower montane coniferous forest, riparian woodland / carbonate; May-June	No suitable habitat in project area
Slender Orcutt grass (*Orcuttia tenuis*)	FT/ CNPS 1B	Vernal pools; May-Oct	No suitable habitat in project area
Engelmann spruce (*Picea engelmannii*)	CNPS 2	Upper montane coniferous forest; evergreen	Suitable habitat in project area

Species	Status[2]	Habitat	Potential for Occurrence
Profuse-flowered pogogyne (*Pogogyne floribunda*)	FSC/ CNPS 1B	Vernal pools; May-Aug	No suitable habitat in project area
Long-stiped campion (*Silene occidentalis* ssp. *longistipita*)	FSC/ CNPS 1B	Chaparral, lower montane coniferous forest, upper montane coniferous forest; July-Aug	Suitable habitat in project area
English Peak greenbriar (*Smilax jamesii*)	CNPS 1B	Lower montane coniferous forest, marshes and swamps, North Coast coniferous forest; May-July	No suitable habitat in project area
Marsh hedge nettle (*Stachys palustris* ssp. *pilosa*)	CNPS 2	Great Basin scrub (mesic); June-Aug	No suitable habitat in project area
Long-leaved starwort (*Stellaria longifolia*)	CNPS 2	Meadows and seeps, riparian woodlands; May-July	No suitable habitat in project area
Salmon Mountains wakerobin (*Trillium ovatum* ssp. *oettingeri*)	CNPS 4	Lower montane coniferous forest, upper montane coniferous forest / mesic; Feb-July	No suitable habitat in project area
Yellow tritelia (*Tritelia crocea* var. *crocea*)	CNPS 4	Open coniferous forest, dry slopes; May-June	Suitable habitat in project area

[1] Species in bold were targeted for field surveys.
[2] Status codes
FT=Federal Threatened; possibility of becoming endangered in the U.S.
FSC=Federal species of concern
CNPS 1B=Rare, threatened, or endangered in California and elsewhere
CNPS 2=Rare, threatened, or endangered in California, but more common elsewhere
CNPS 3=Plants about which more information is needed to determine the status of a species
CNPS 4=Plants of limited distribution

Table 11. Regional Annual Mortality Estimates for Wind Projects in California and the Western U.S.

Wind Energy Project	All birds #/MW	Raptors #/MW
Altamont Pass, CA	3.0 - 8.14[a]	1.5 - 2.24[a]
High Winds, CA	0.74[b]	0.30[b]
San Gorgonio, CA	2.31	0.01
Tehachapi Pass, CA West Ridge	0.15[b]	0.06[b]
Tehachapi Pass, CA Middle Ridge	0.05[b]	0.01[b]
Tehachapi Pass, CA East Slope	0.04[b]	0.01[b]
Foote Creek Rim, WY	2.3	0.05
Combine Hills, OR	2.6	0
Stateline, OR/WA	2.9	0.10
Vansycle, OR	1.0	0.00
Klondike, OR	1.4	0.00
Nine Canyon, WA	2.8	0.05

[a] range provided in Smallwood and Thelander (2004)
[b] unadjusted for scavenger removal and searcher efficiency. High winds site was based on 14-day and Tehachapi Pass was based on approximately 90-day carcass search intervals.

Table 12. Comparison of Bat Echolocation Activity and Collision Mortality Wind Projects Across the U.S.

Study Area	Bat Mortality (#/turbine/year)	Bat activity (#/detector/night)	Total detector nights
Mountaineer, WV(1 fall season)	38.0	38.2	33
Buffalo Mountain, TN (2 years)	20.8	23.7	149
Top of Iowa (2 years)	10.2	34.9	42
Buffalo Ridge, MN (2 years)	2.2	2.1	216
Foote Creek Rim, WY (2 years)	1.3	2.2	39
Hatchet Ridge (1 year)	?	5.6	145

Figure 1. Proposed Hatchet Ridge Wind Project Location.

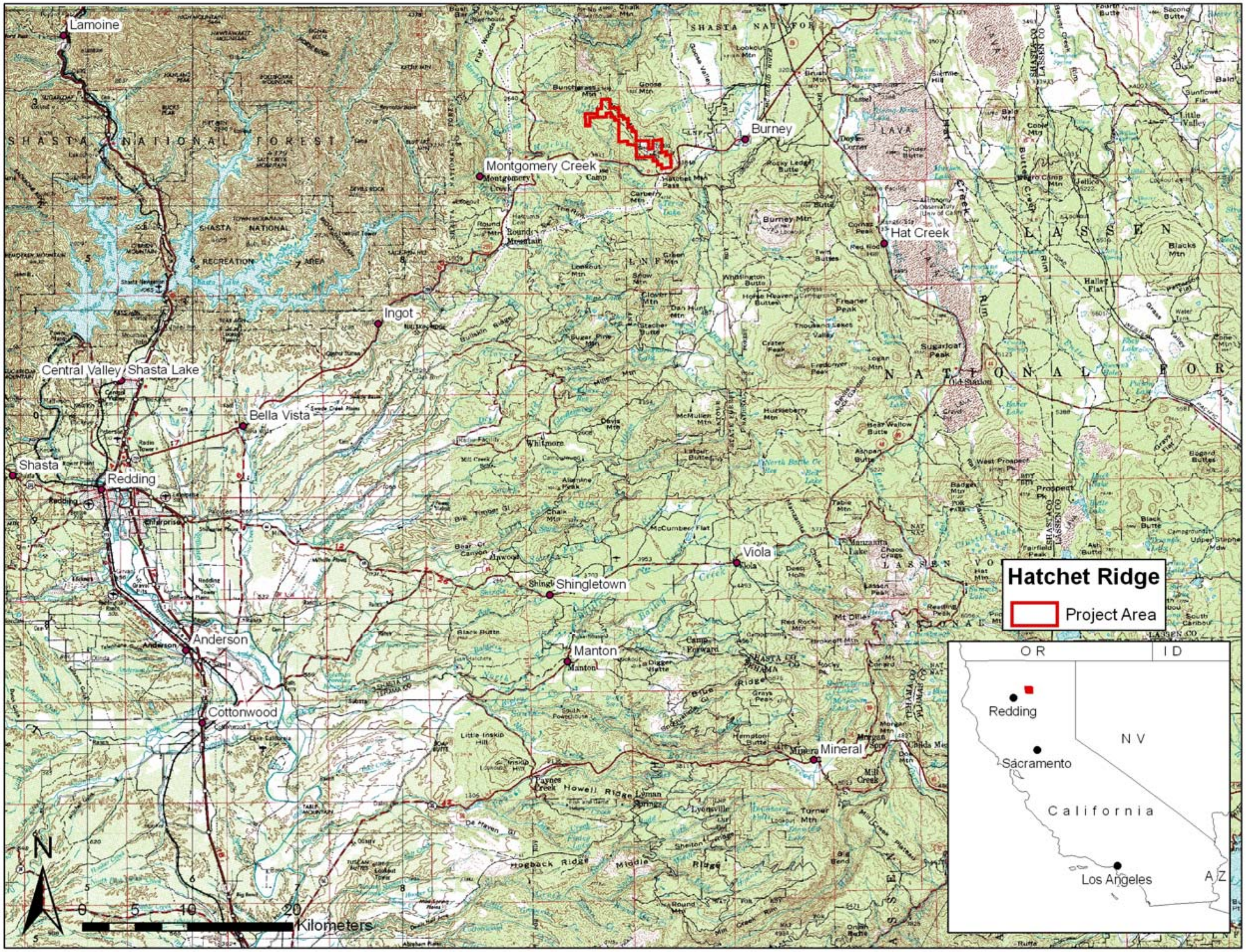


Figure 2. Fixed-Point Bird Survey Stations and the AnaBat Sampling Location in the Project Area.

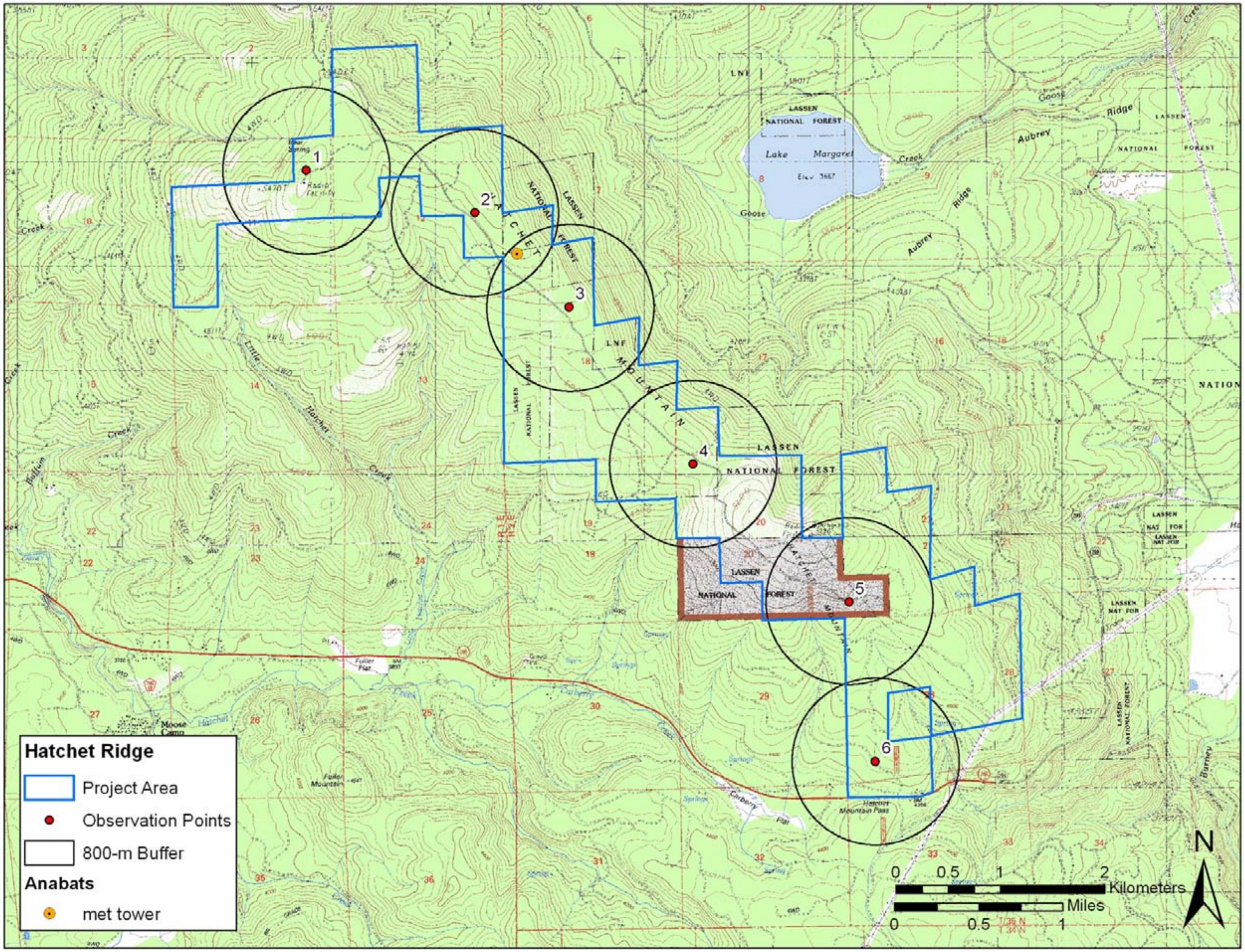


Figure 3. Raptor Nest Survey Area.

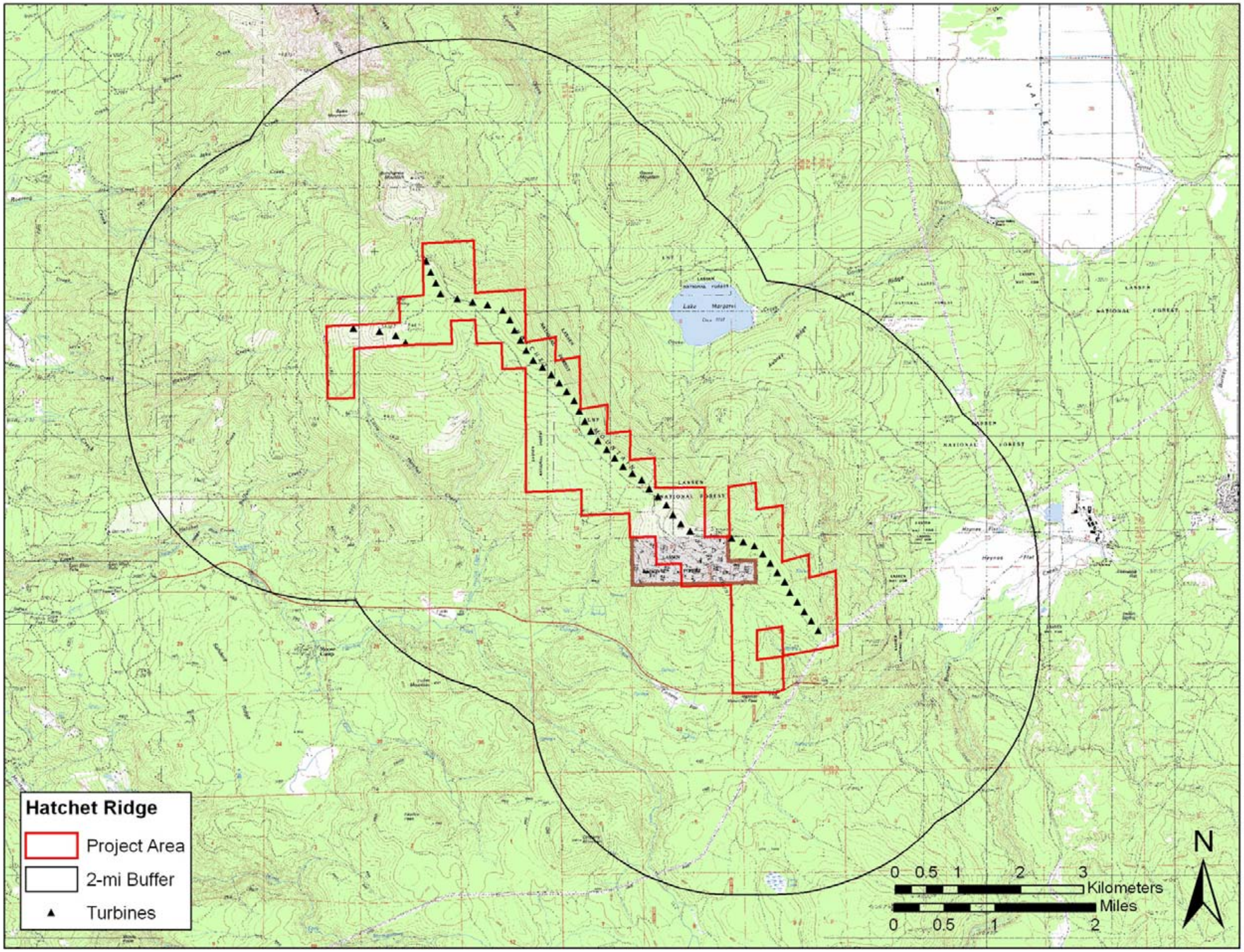


Figure 4. Mean Avian Use and 90% Confidence Interval by Season.

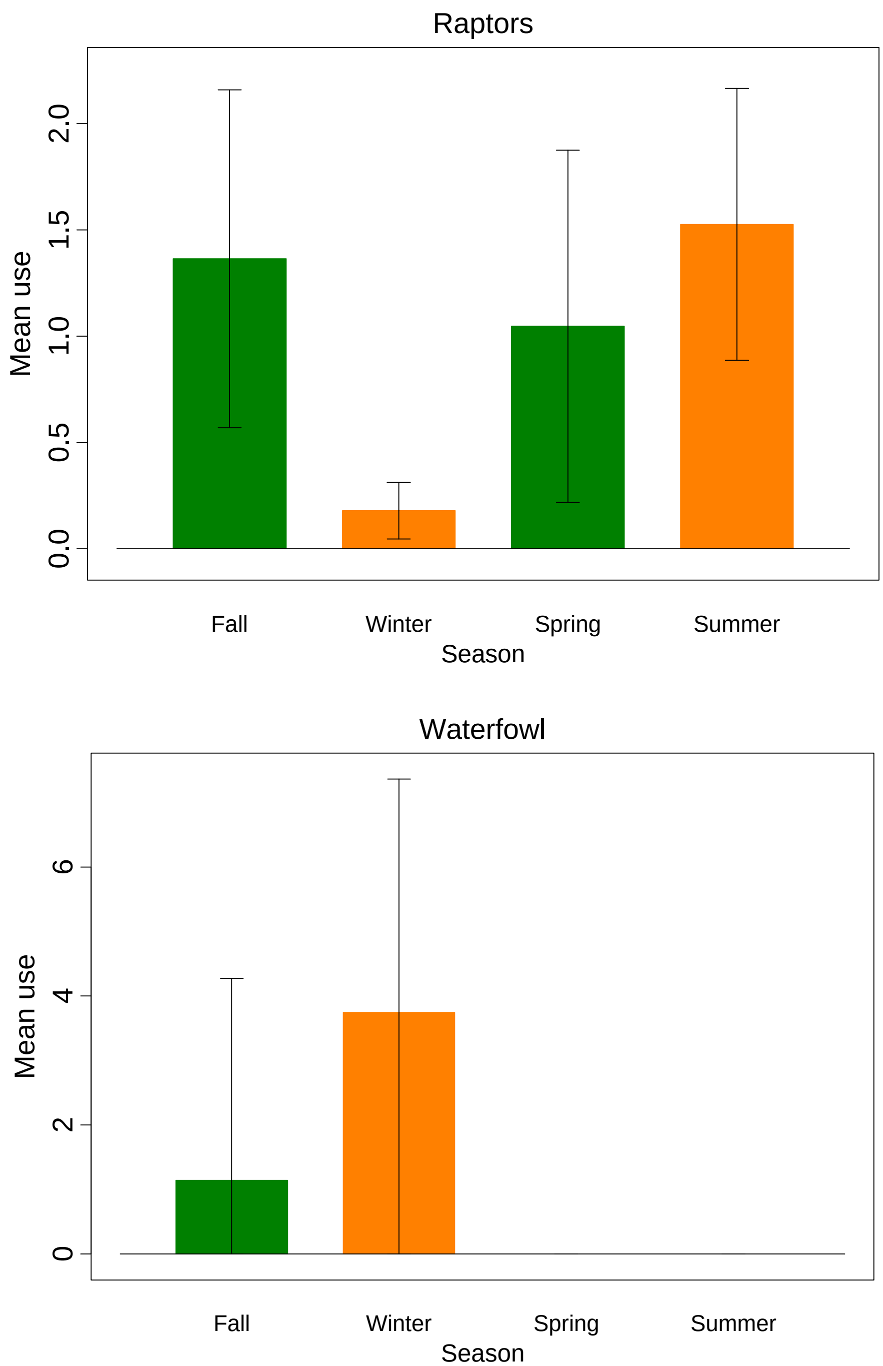
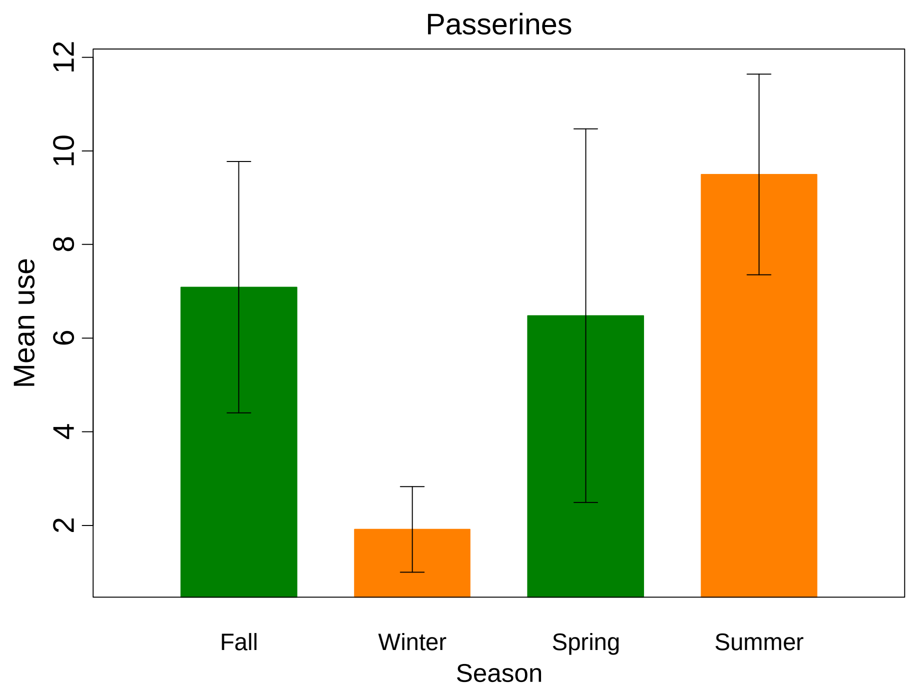


Figure 4 (continued). Mean Avian Use and 90% Confidence Interval by Season.



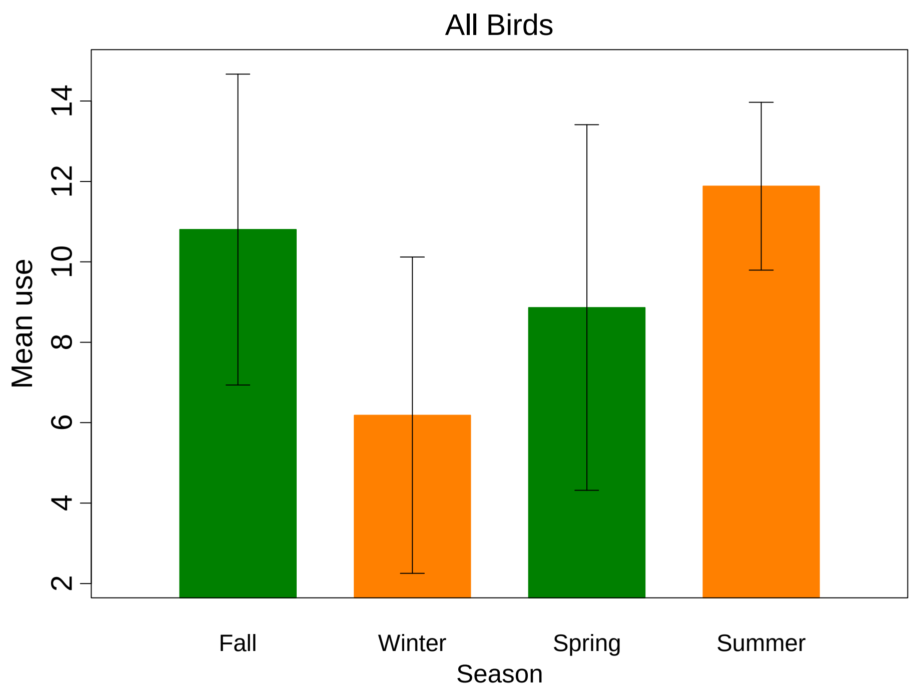
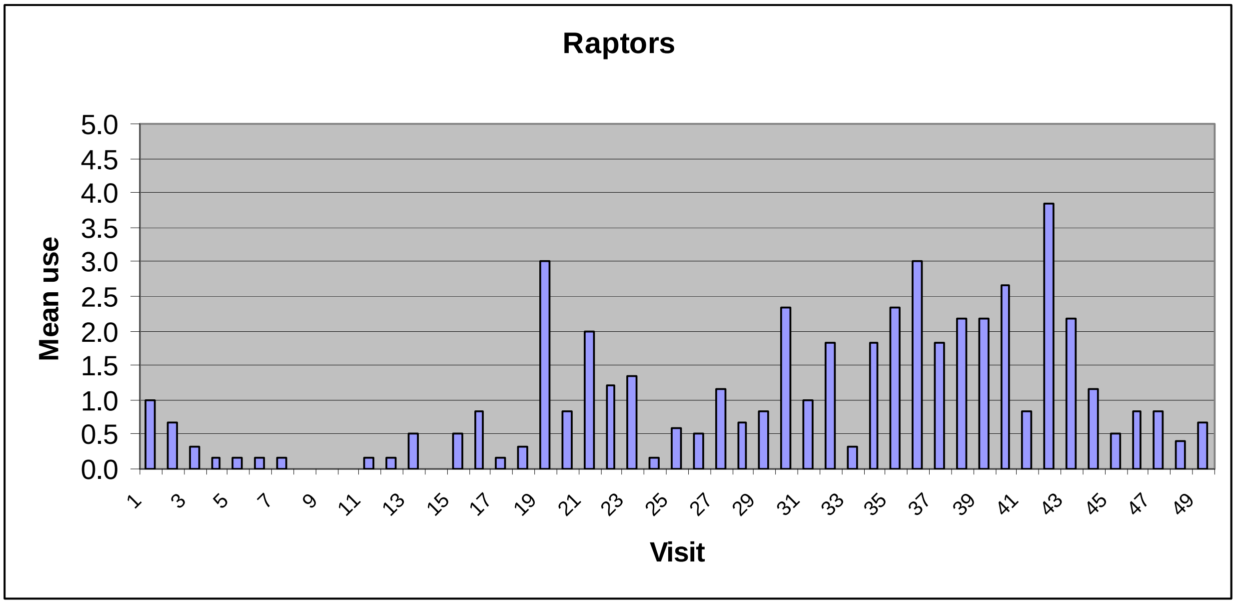
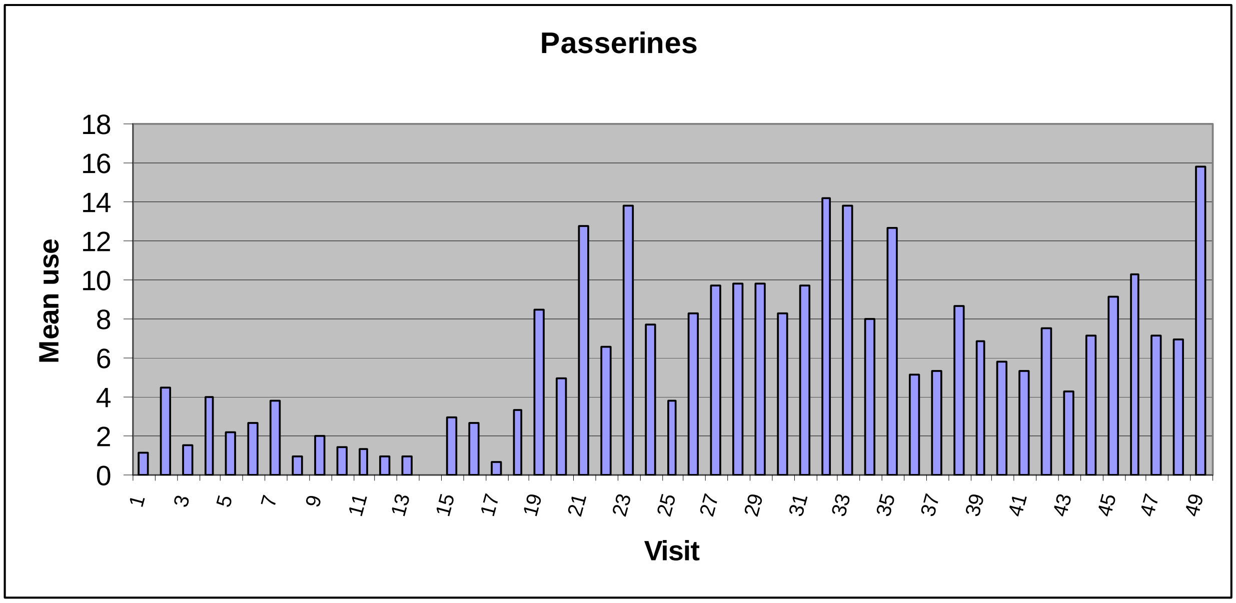


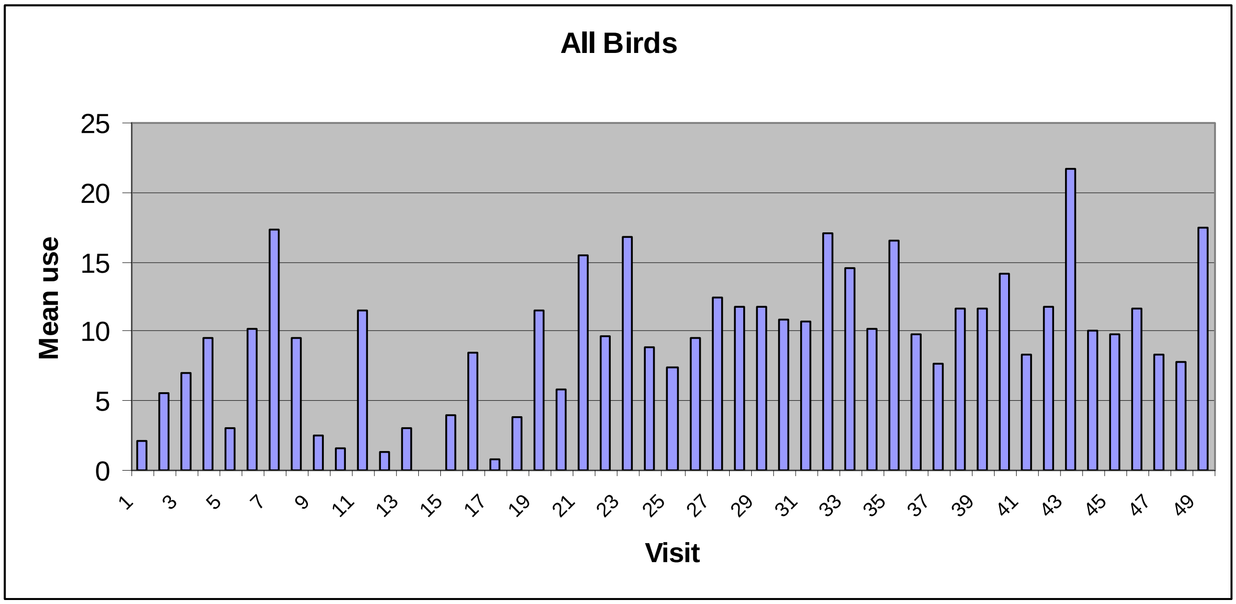
Figure 5. Weekly Mean Avian Use.





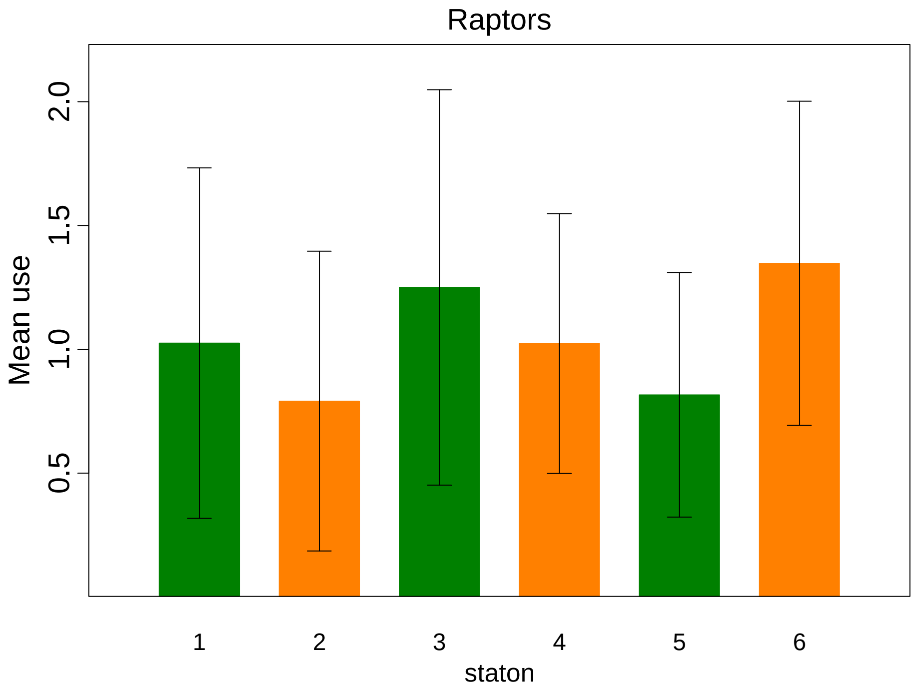
Visits 1-2; 48-49: November
Visits 3-7: December
Visits 8-11: January
Visits 12-15: February
Visits 16-18: March
Visits 19-21: April
Visits 22-25: May
Visits 26-30:June
Visits 31-34: July
Visits 35-38: August
Visits 39-43: September
Visits 44-47: October

Figure 5 (continued). Weekly Mean Avian Use.



Visits 1-2; 48-49: November
Visits 3-7: December
Visits 8-11: January
Visits 12-15: February
Visits 16-18: March
Visits 19-21: April
Visits 22-25: May
Visits 26-30:June
Visits 31-34: July
Visits 35-38: August
Visits 39-43: September
Visits 44-47: October

Figure 6. Avian Use and 90% Confidence Interval by Survey Point.



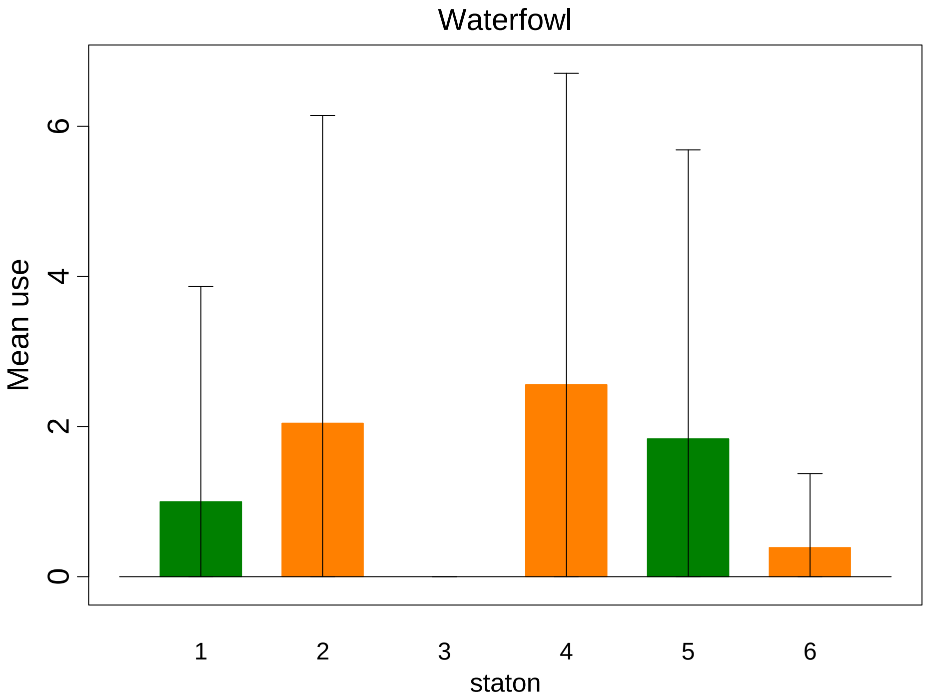
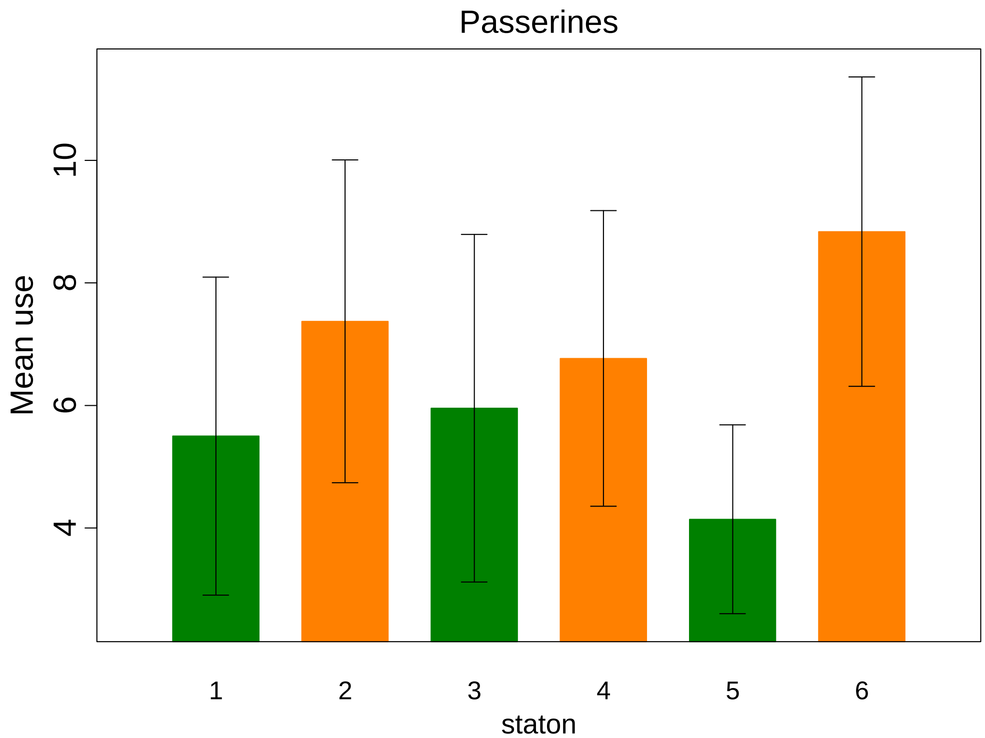


Figure 6 (continued). Avian Use and 90% Confidence Interval by Survey Point.



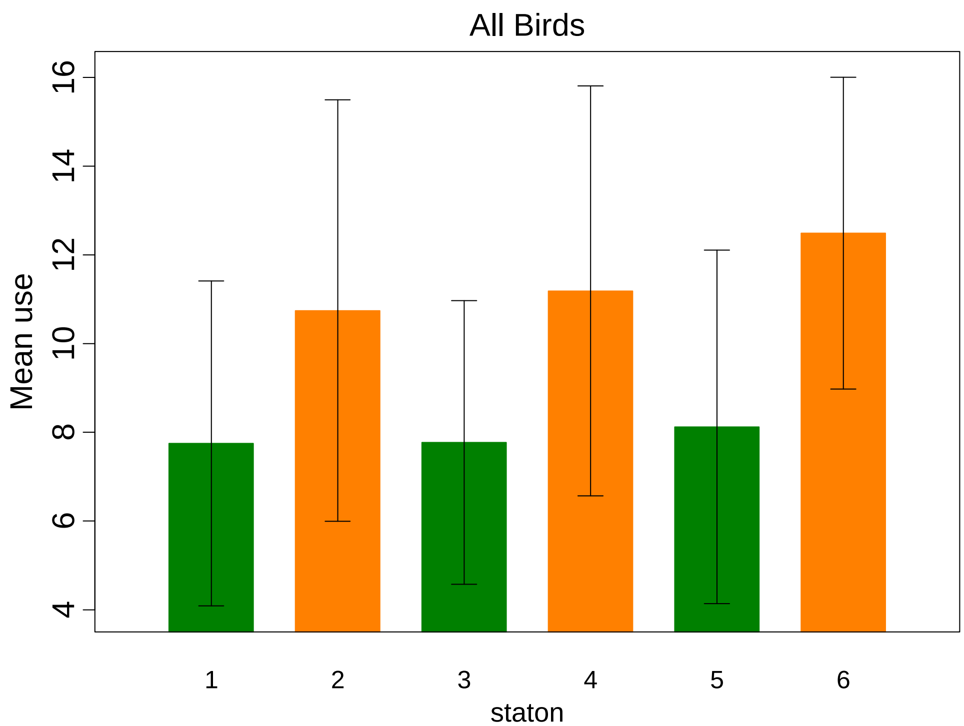


Figure 7. Flight Paths of Raptors and Other Large Birds – Buteos.

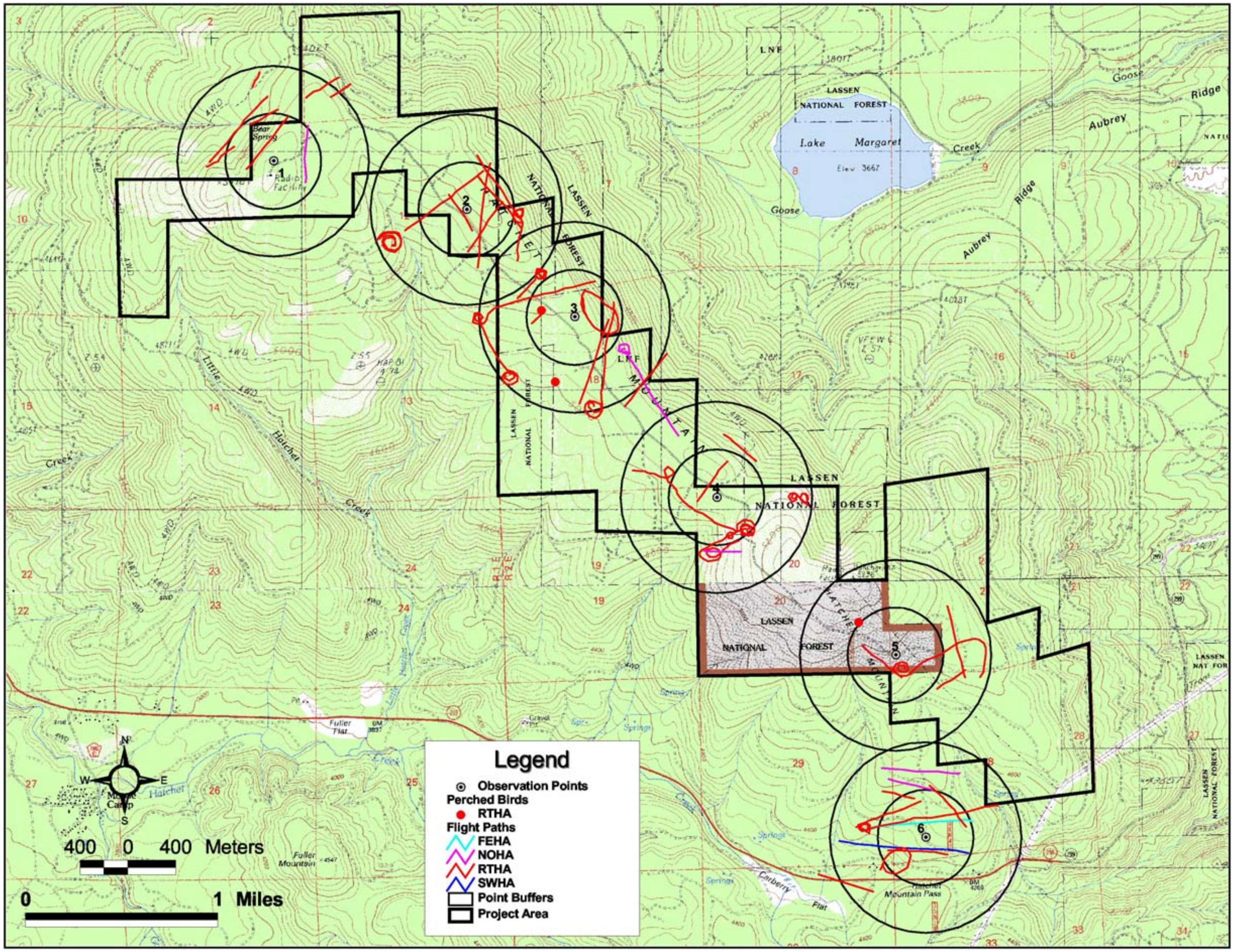


Figure 7 (continued). Flight Paths of Raptors and Other Large Birds - Eagles

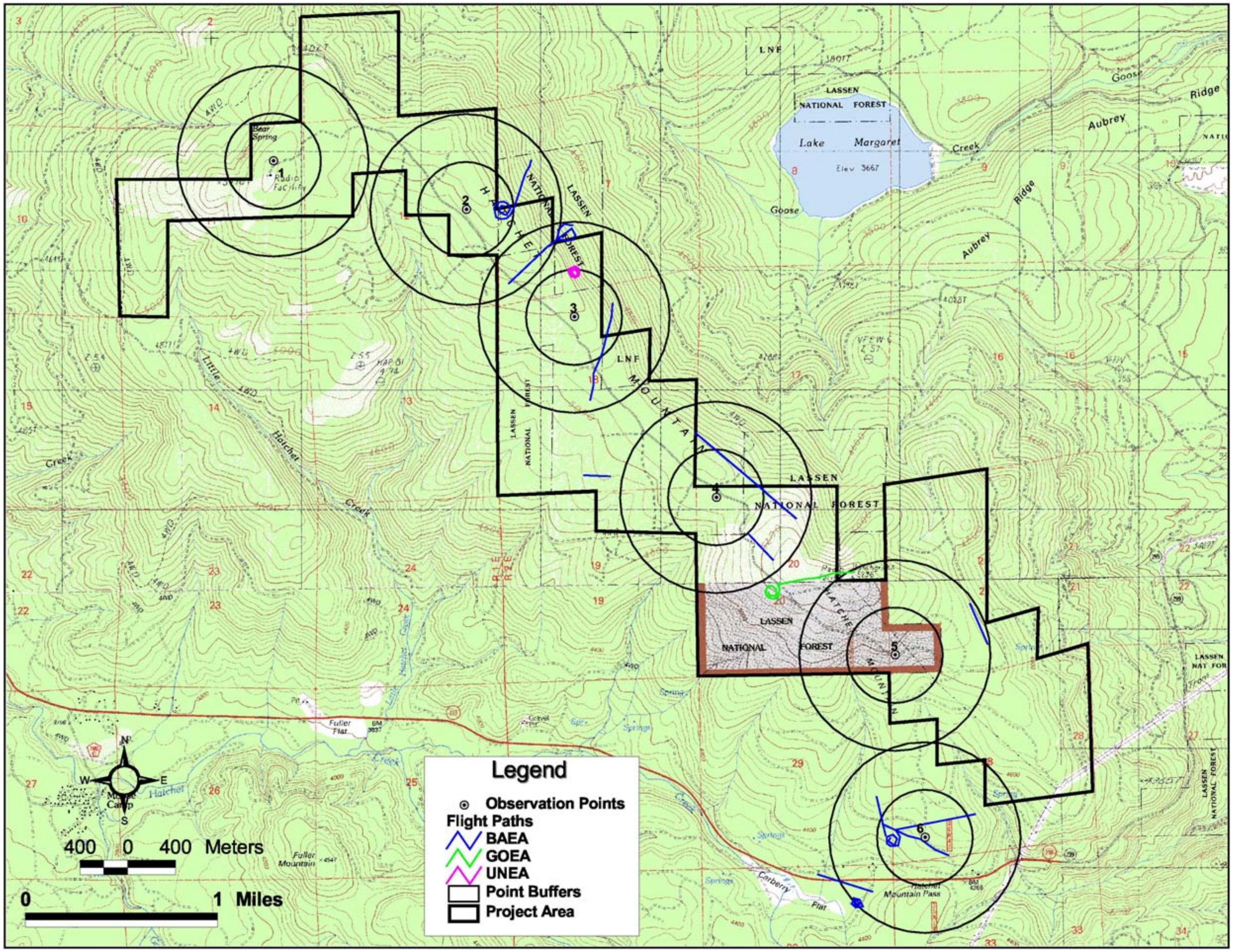


Figure 7 (continued). Flight Paths of Raptors and Other Large Birds - Other Raptors

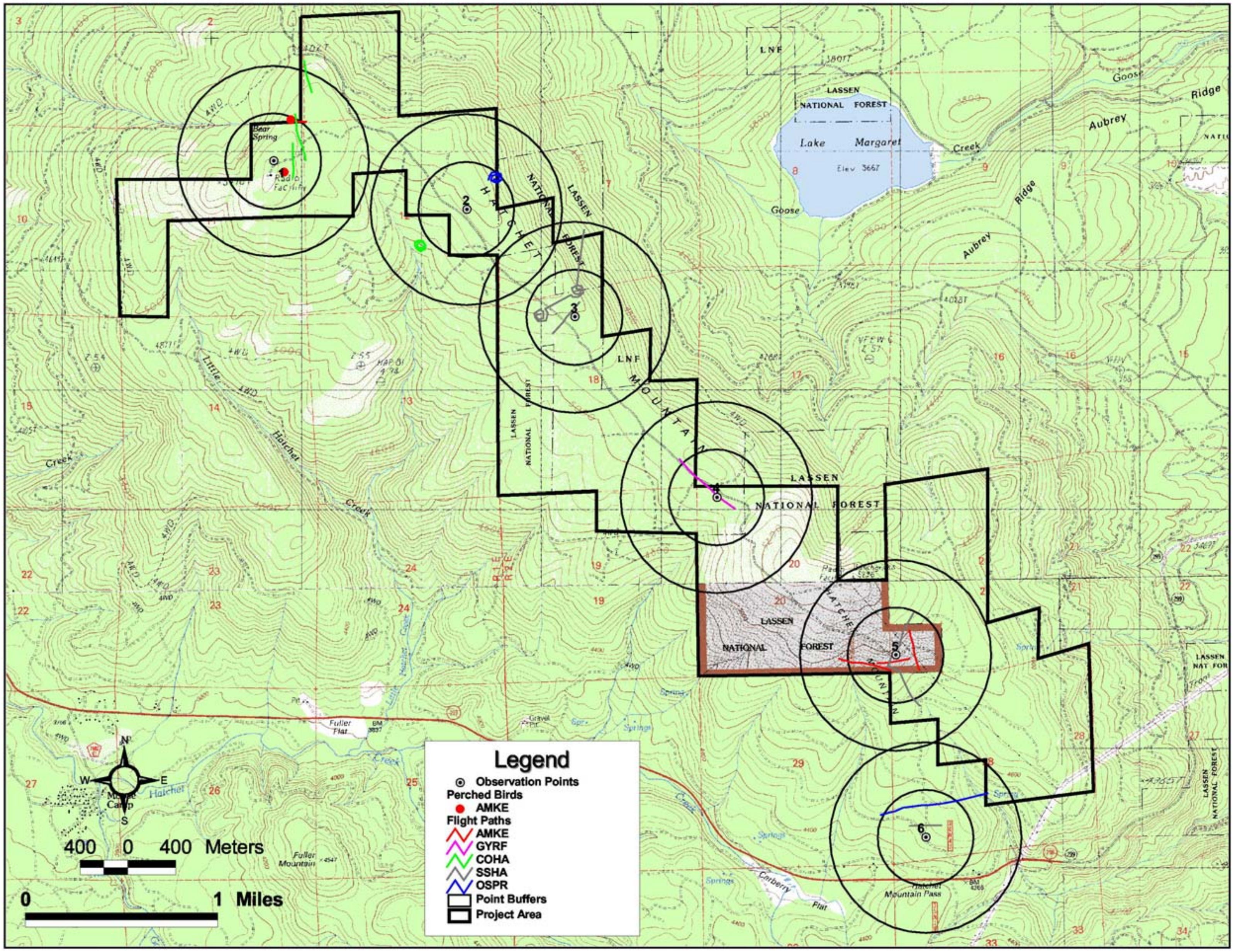


Figure 7 (continued). Flight Paths of Raptors and Other Large Birds - Other Large Birds

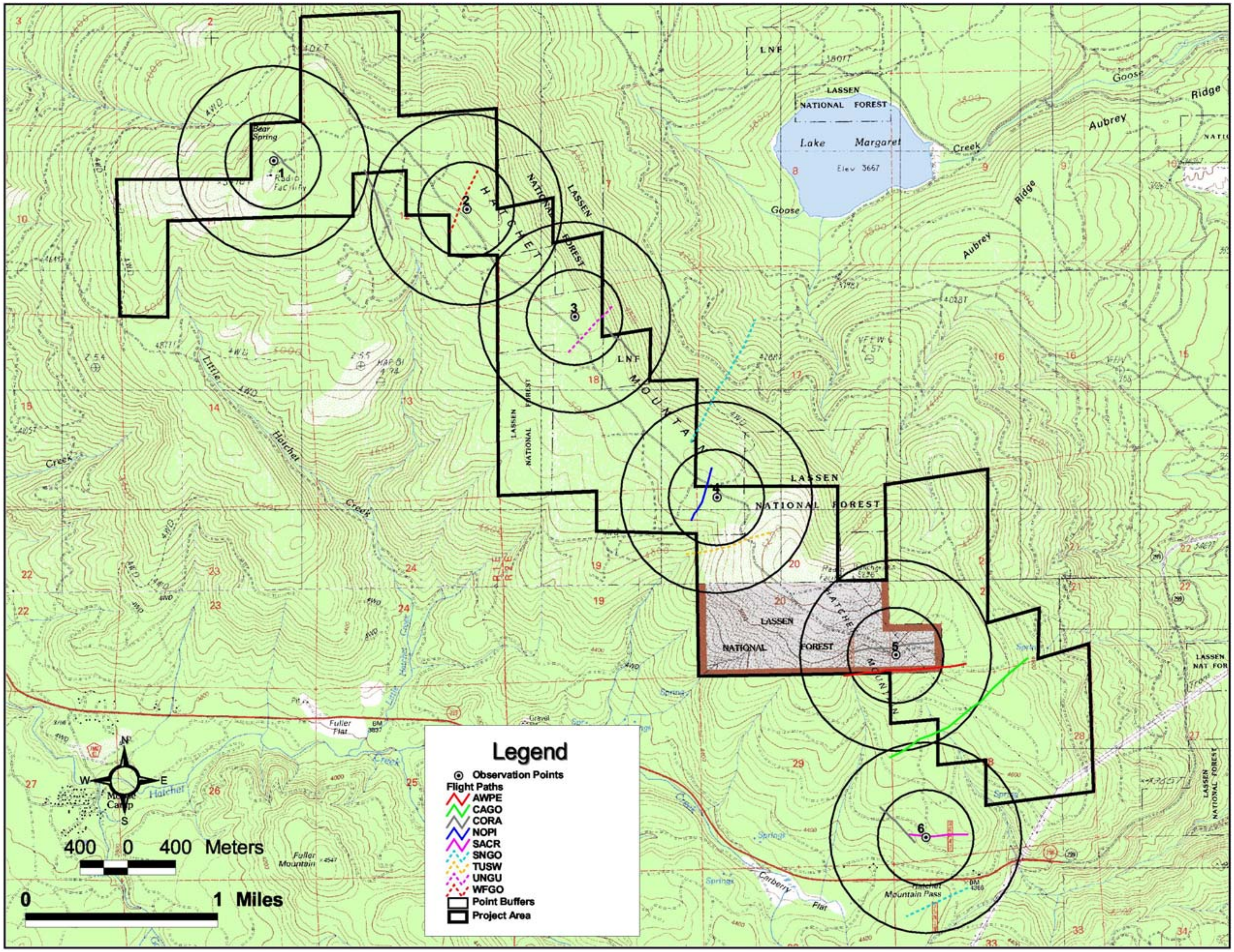
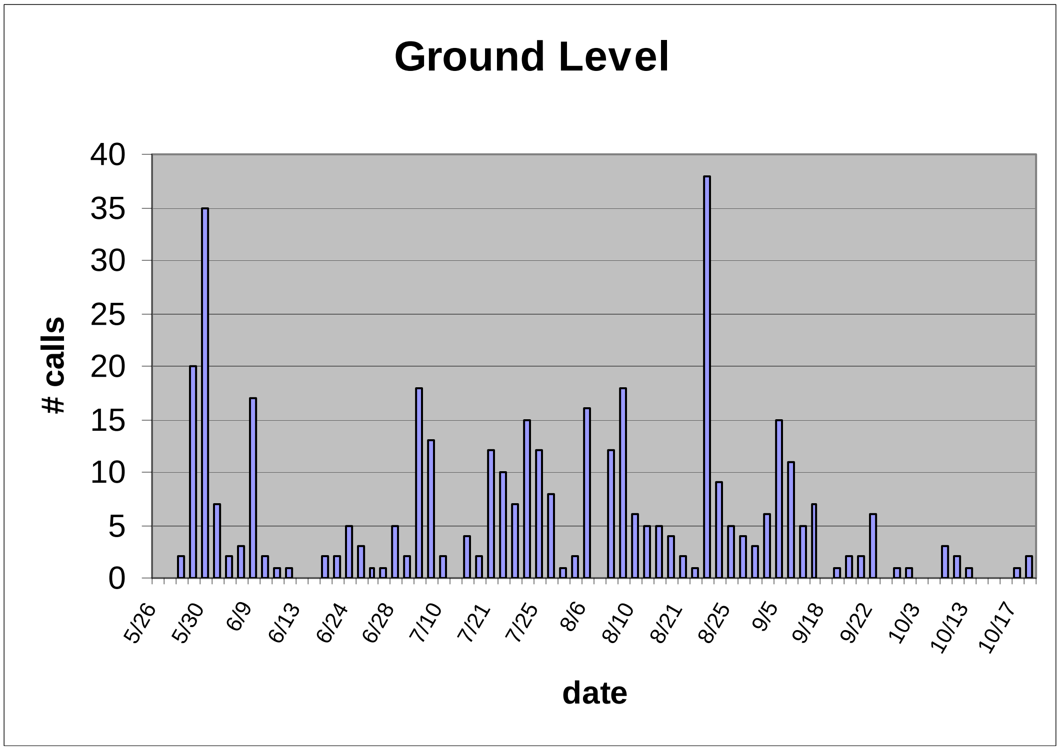


Figure 8. Bat Echolocation Activity by Date.



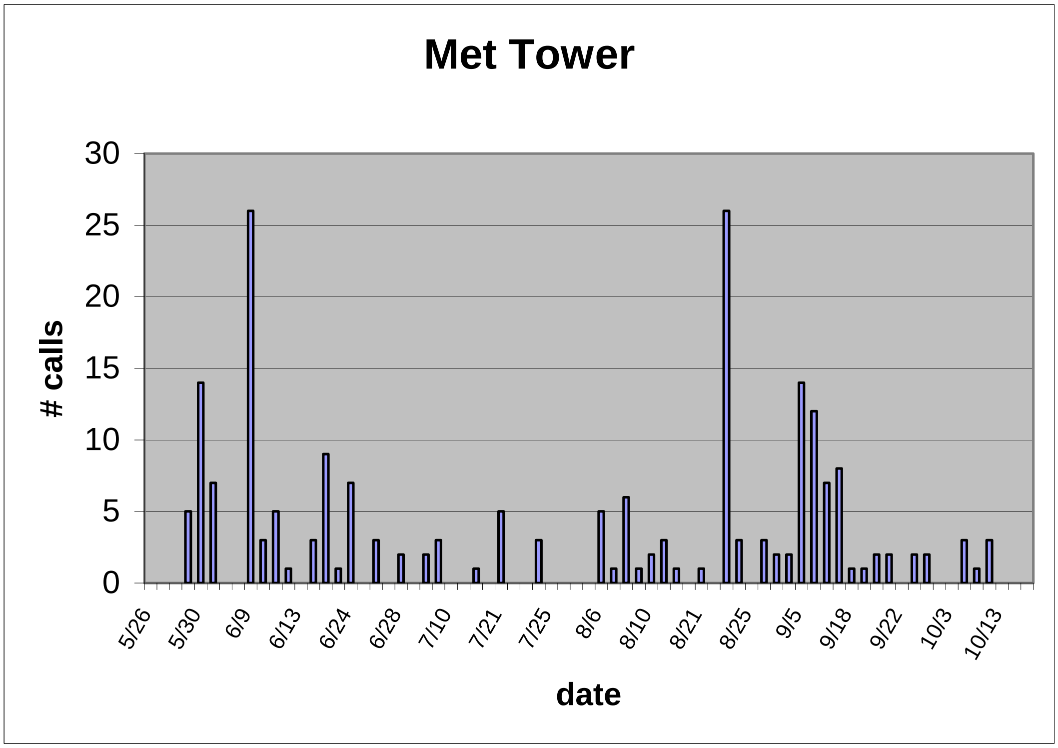


Figure 9. Vegetation Types of the Project Area and Surrounding Region.

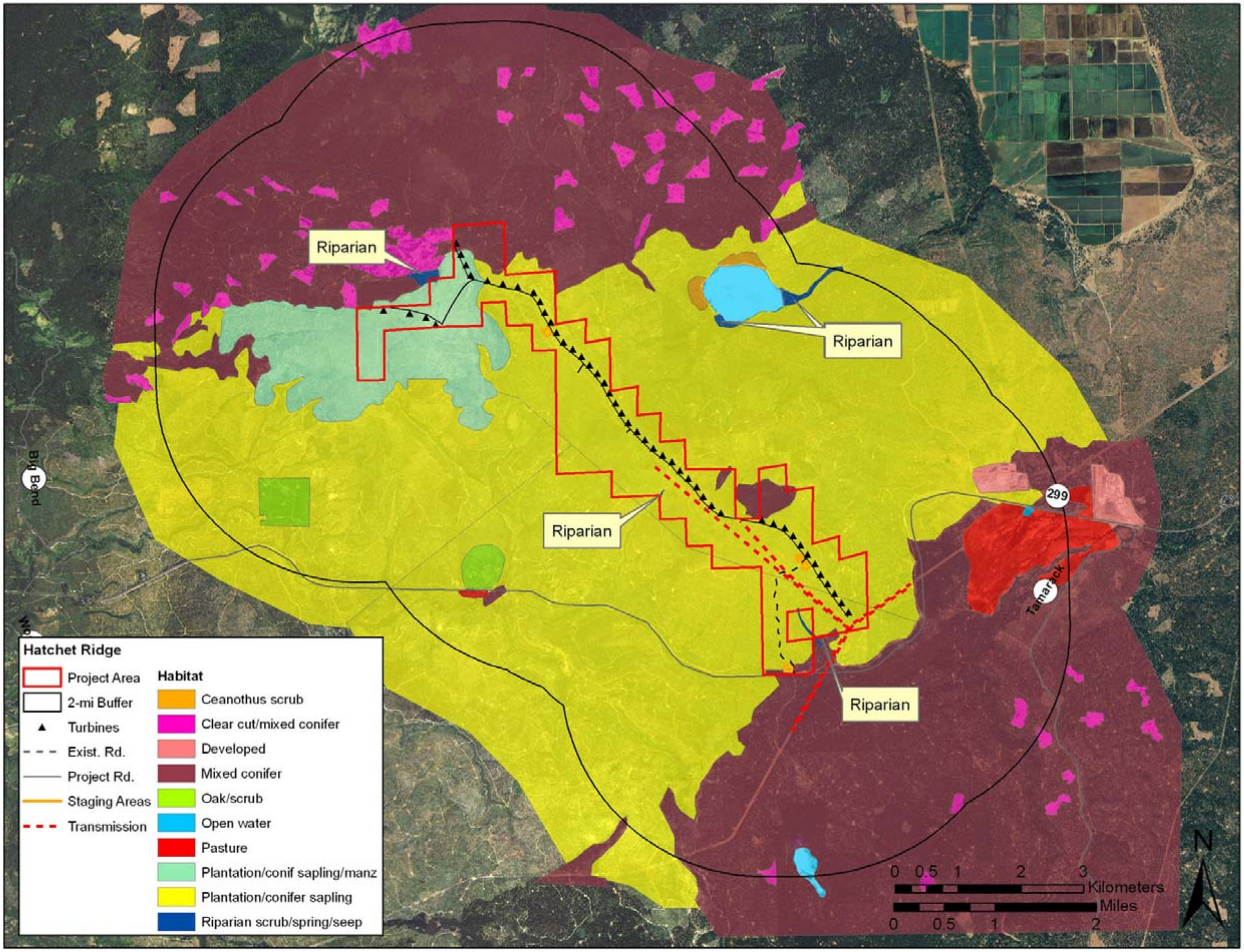


Figure 10. Location of Butte County morning glory population in the study area.

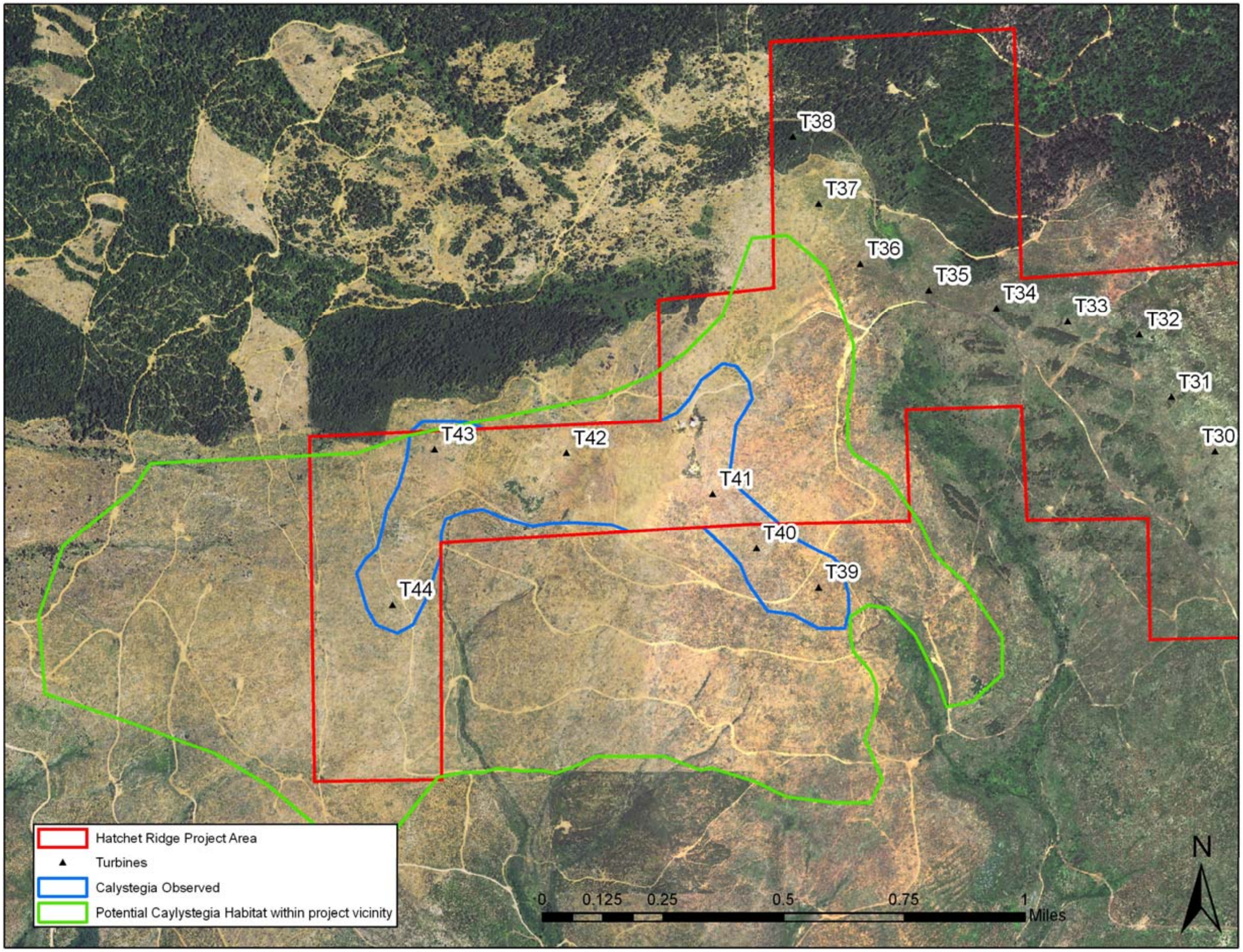


Figure 11. Density of Butte County morning glory within two detailed survey plots at proposed turbine locations.

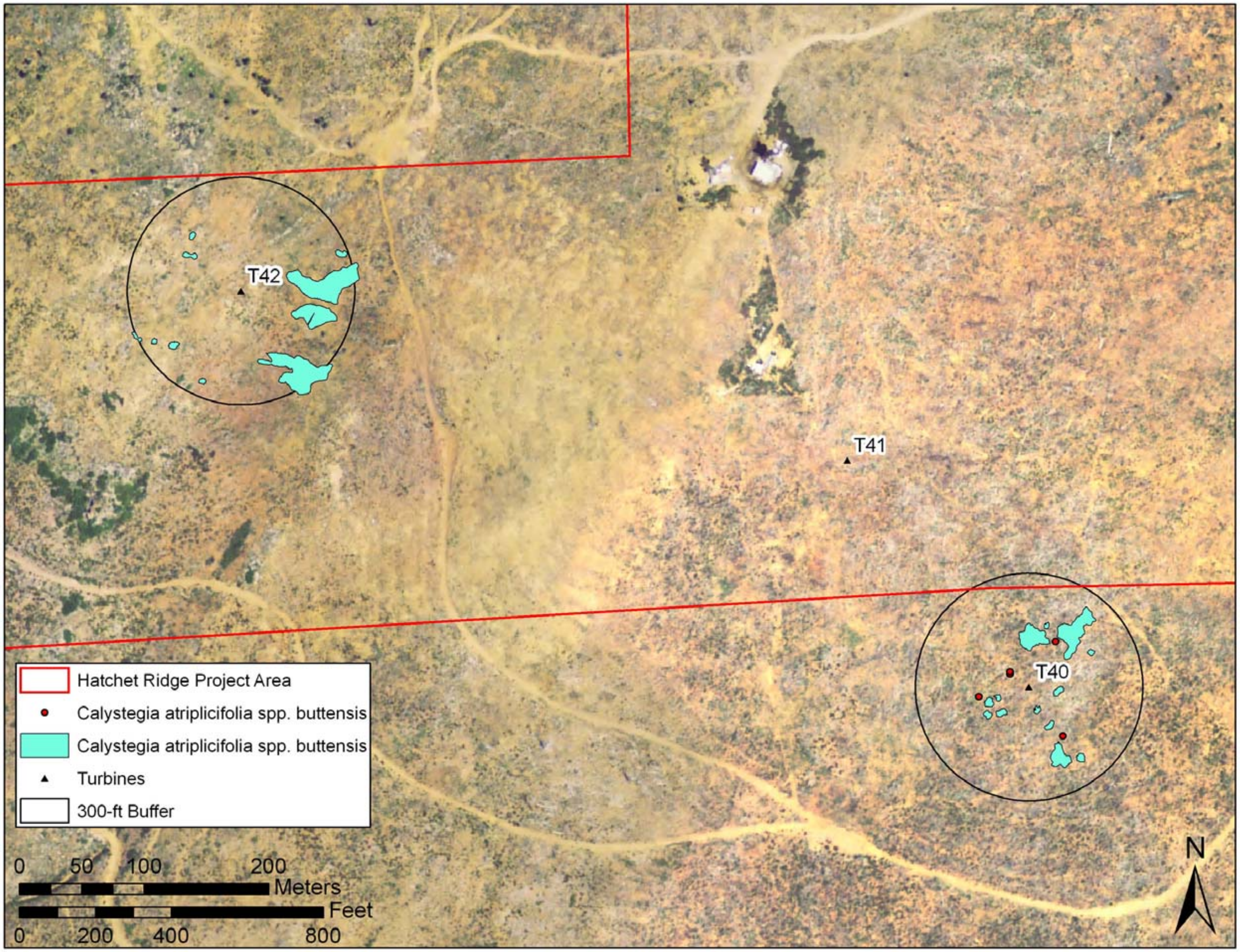


Figure 12. Annual Raptor Use Estimates at Western and Midwestern Wind Projects and Wind Resource Areas.

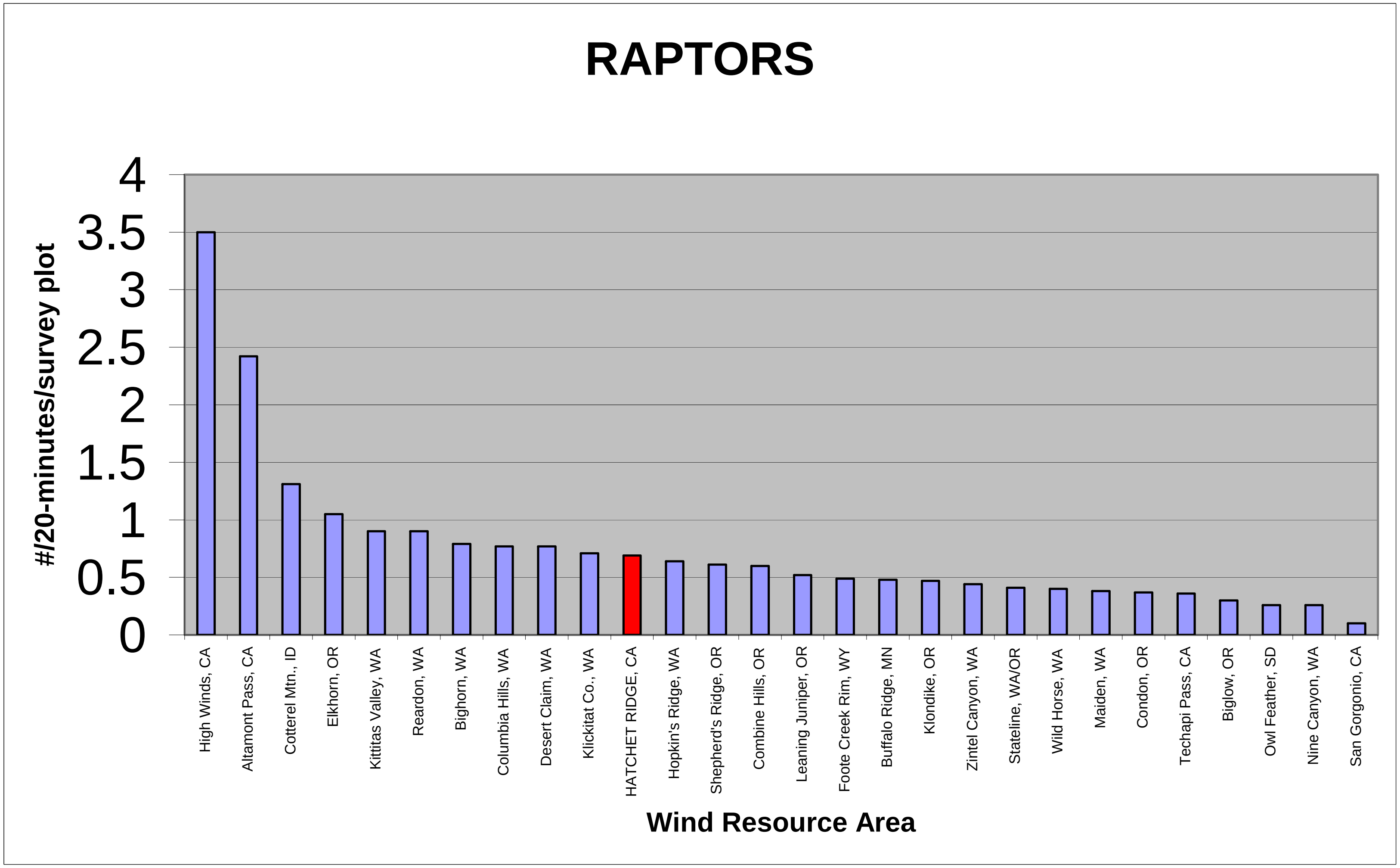
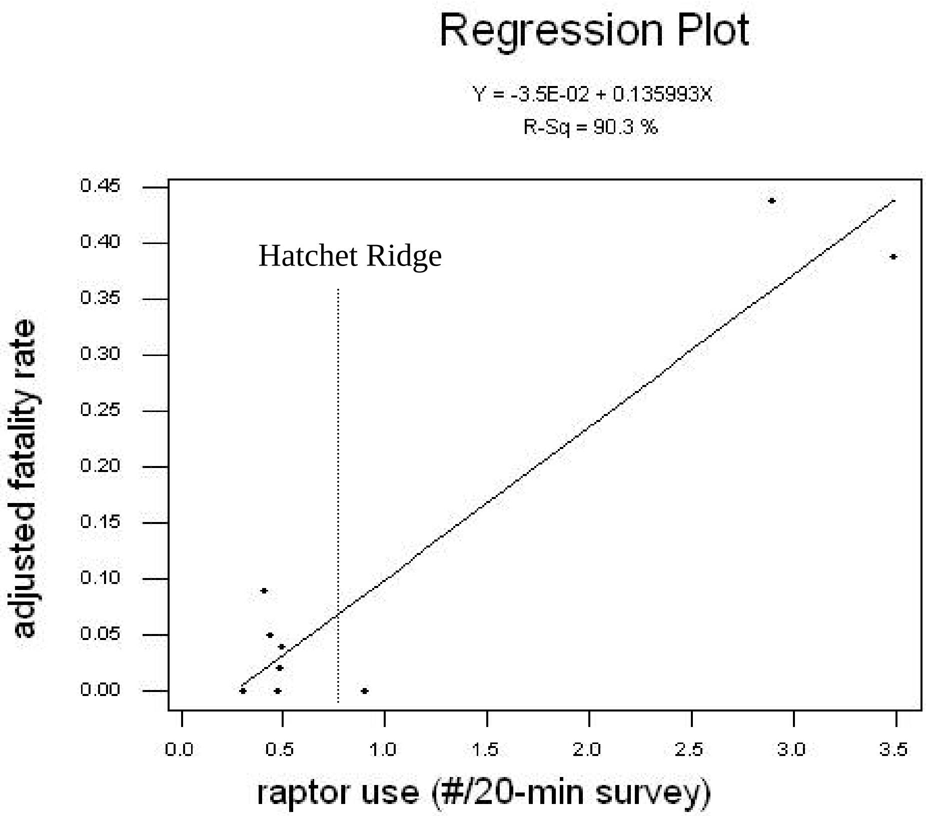
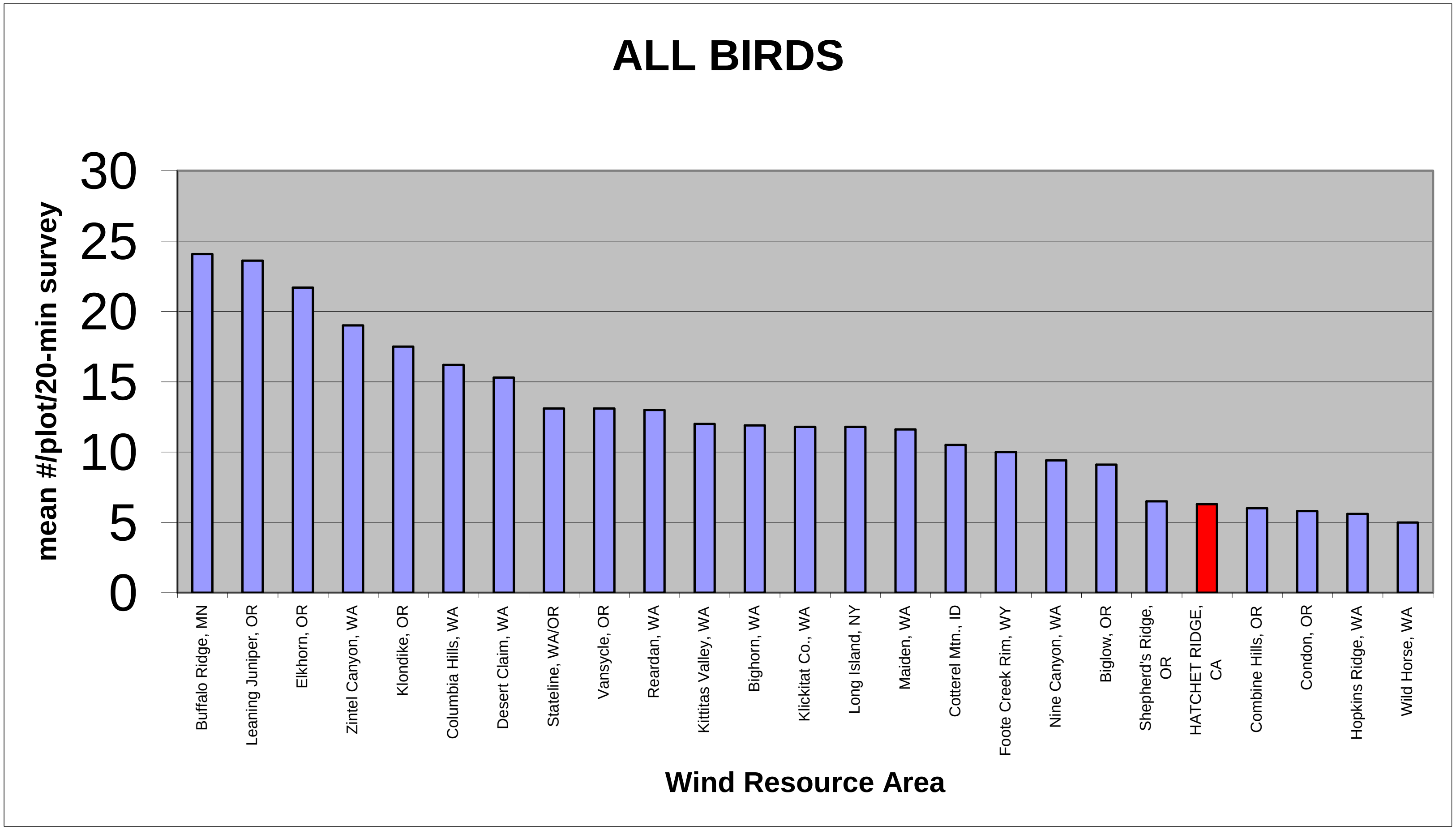


Figure 13. Regression Analysis Between Raptor Use and Adjusted Raptor Fatality Rates for Nine Newer Wind Projects[2]



[2] Data are from the High Winds project, Solano County, California; Diablo Winds re-powering project, Altamont Pass, California; Buffalo Ridge, Minnesota; Foote Creek Rim, Wyoming; Stateline Wind Project, Washington/Oregon; Combine Hills, Oregon; Vansycle, Oregon; Klondike Wind Project, Oregon; Nine Canyon Wind Project, Washington.

Figure 14. Annual Avian Use Estimates (all species) at Western and Midwestern Wind Project and Wind Resource Areas.



Appendix A - List of Vascular Plant Species Encountered During the 2007 Hatchet Ridge Wind Project Special-Status Plant Survey.

Family	Scientific Name	Common Name
ACERACEAE	*Acer glabrum*	mountain maple
APIACEAE	*Angelica* sp.	angelica
	Lomatium spp.	lomatium
	Osmorhiza sp.	sweet-root
APOCYNACEAE	*Apocynum androsaemifolium*	bitter dogbane
ASTERACEAE	*Achillea millefolium*	common yarrow
	Agoseris sp.	agoseris
	Artemisia tridentata	big sagebrush
	Balsamorhiza sagittata	arrow-leaf balsamroot
	Centaurea solstitialis	yellow starthistle
	Chrysothamnus nauseosus ssp. albicaulis	rubber rabbitbrush
	Cirsium vulgare	bull thistle
	Erigeron sp.	fleabane
	Madia sp.	tarweed
	Senecio sp.	groundsel
	Solidago sp.	goldenrod
	Taraxacum officinale	common dandelion
	Tragopogon dubius	yellow salsify
BERBERIDACEAE	*Berberis aquifolium* var. *aquifolium*	barberry
BORAGINACEAE	*Cryptantha* spp.	cryptantha
	Cynoglossum officinale	hound’s tongue
BRASSICACEAE	*Lepidium perfoliatum*	peppergrass
	Physaria sp.	twinpod
CAPRIFOLIACEAE	*Sambucus mexicana*	blue elderberry
	Symphoricarpos oreophilus var. *utahensis*	mountain snowberry
CARYOPHYLLACEAE	*Silene* sp.	silene
	Spergularia rubra	sand spurrey
CHENOPODIACEAE	*Chenopodium album*	lamb’s quarters
CONVOLVULACEAE	*Calystegia atriplicifolia* ssp. *buttensis*	Butte County morning glory
	Calystegia sp.	morning glory
	Convolvulus sp.	morning glory
CUPRESSACEAE	*Calocedrus decurrens*	incense cedar
CYPERACEAE	*Carex inops* ssp. *inops*	long-stoloned sedge
DENNSTAEDTIACEAE	*Pteridium aqualinum* var. *pubescens*	bracken
DROSERACEAE	*Drosera rotundifolia*	round-leaved sundew
ERICACEAE	*Arctostaphylos manzanita* ssp. *manzanita*	manzanita
	Arctostaphylos patula	manzanita
FABACEAE	*Lupinus* sp.	lupine

Appendix A - List of Vascular Plant Species Encountered During the 2007 Hatchet Ridge Wind Project Special-Status Plant Survey.

	Vicia sp.	vetch
FAGACEAE	*Chrysolepis sempervirens*	chinquapin
	Quercus kelloggii	California black oak
GROSSULARIACEAE	*Ribes roezlii*	Sierra gooseberry
	Ribes sp.	gooseberry
HYPERICACEAE	*Hypericum perforatum*	Klamathweed
IRIDACEAE	*Iris missouriensis*	western blue flag
LAMIACEAE	*Monardella* sp.	monardella
LILIACEAE	*Allium* sp.	onion
	Calochortus coeruleus	beavertail-grass
	Lilium paradalinum	leopard lily
	Lilium washingtonianum	Washington lily
	Smilacina racemosa	false Solomon's seal
	Triteleia crocea var. *crocea*	yellow triteleia
	Veratrum californicum var. *californicum*	corn lily
	Zigadenus venenosus	death camas
MALVACEAE	*Sidalcea* sp.	checkermallow
ONOGRACEAE	*Epilobium angustifolium*	fireweed
	Epilobium brachycarpum	willow herb
	Epilobium canum ssp. *canum*	California fuchsia
OPHIOGLOSSACEAE	*Botrychium multifidum*	leather grape-fern
OROBANCHACEAE	*Boschniakia strobilacea*	California ground-cone
	Orobanche sp.	broomrape
PAPAVERACEAE	*Dicentra formosa*	bleeding heart
PINACEAE	*Abies concolor*	white fir
	Pinus lambertiana	sugar pine
	Pinus ponderosa	ponderosa pine
	Pseudotsuga macrocarpa	bigcone Douglas-fir
PLANTAGINACEAE	*Plantago lanceolata*	English plantain
POACEAE	*Bromus carinatus*	mountain brome
	Bromus diandrus	ripgut bromw
	Bromus marginatus	
	Bromus mollis	
	Bromus tectorum	cheatgrass
	Elymus elymoides	bottlebrush
	Hesperostipa comata ssp. *intermedia*	needle-and-thread
	Poa pratensis	Kentucky bluegrass
	Poa secunda	Sandberg's bluegrass
	Pseudoroegneria spicata	blue-bunch wheatgrass
POLEMONIACEAE	*Collomia* sp.	collomia
	Gilia aggregata	scarlet gilia
	Phlox sp.	phlox
POLYGONACEAE	*Eriogonum lobbii*	buckwheat
	Eriogonum ovalifolium	cushion buckwheat
	Eriogonum umbellatum	sulfur buckwheat

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	Eriogonum sp.	buckwheat
	Polygonum aviculare	prostrate knotweed
	Rumex acetosella	field sorrel
RANUNCULACEAE	*Aquilegia* sp.	columbine
	Delphinium sp.	larkspur
	Thalictrum sp.	meadow-rue
RHAMNACEAE	*Ceanothus cordulatus*	mountain whitethorn
	Ceanothus cuneatus	buck brush
	Ceanothus integerrimus	deer brush
	Ceanothus velutinus	snowbrush
ROSACEAE	*Amelanchier alnifolia*	serviceberry
	Geum sp.	avens
	Prunus emarginata	bitter cherry
	Rosa woodsii var. *ultramontana*	interior rose
	Rubus discolor	Himalayan blackberry
	Rubus parviflorus	thimbleberry
	Sorbus californica	mountain ash
	Spiraea douglasii	spiraea
SALICACEAE	*Salix scouleriana*	Scouler willow
SANTALACEAE	*Comandra umbellata*	bastard toad flax
SCROPHULARIACEAE	*Castilleja* sp.	paintbrush
	Mimulus torreyi	monkeyflower
	Pedicularis sp.	lousewort
	Pentemon neotericus	Plumas County beardtongue
	Penstemon spp.	penstemon
	Verbascum thapsus	common mullein
VIOLACEAE	*Viola* sp.	violet