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Avian Monitoring and Risk Assessment at the San Gorgonio Wind Resource Area

Phase I Field Work: March 3, 1997 – May 29, 1998

Phase II Field Work: August 18, 1999 – August 11, 2000

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Western EcoSystems Technology, Inc.
Cheyenne, Wyoming

Subcontract Report
NREL/SR-500-38054
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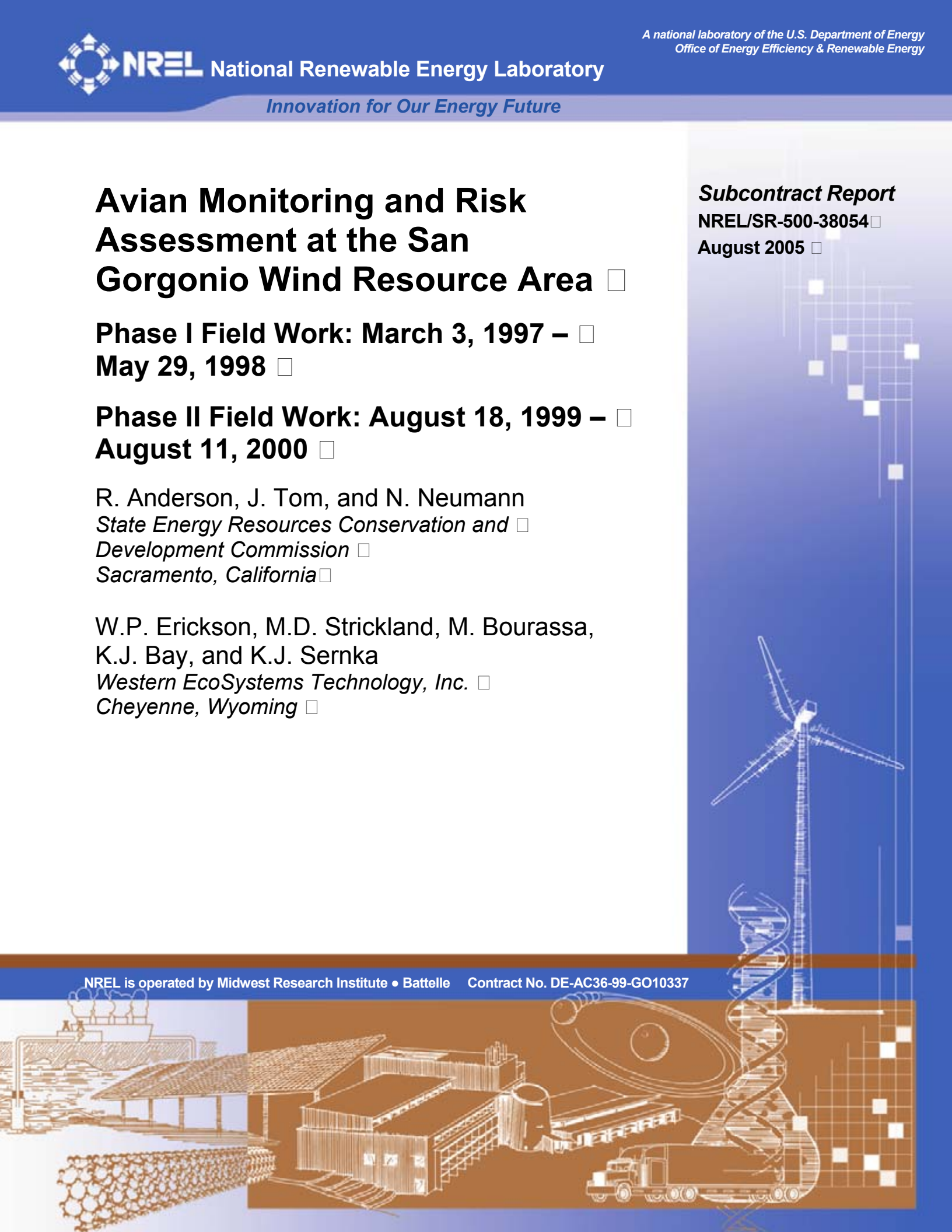

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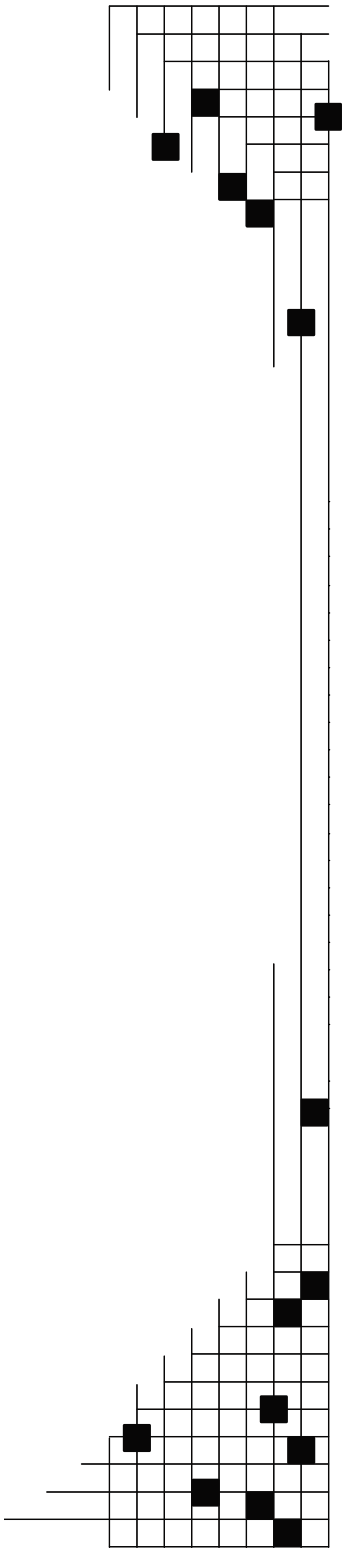

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List of Abbreviations

away-from-turbine (adj)	AFT
California Energy Commission	CEC
Geographical Information System	GIS
Global Positioning System	GPS
National Renewable Energy Laboratory	NREL
large lattice turbines	LLT
large tubular turbines	LTT
large two-bladed tubular turbines	L2TT
near-turbine (adj.)	NT
small lattice turbines	slt
small tubular turbines	stt
tag image file format	TIFF
Universal Transverse Mercator	UTM
vertical axis turbines	VATs
quality assurance and quality control	QA/QC
Wind Resource Area	WRA

1.0 Introduction

The early wind energy developments were planned, permitted, constructed, and operated with little consideration for the potential impacts to birds (Anderson *et al.* 1999). Observations of dead raptors at the Altamont Pass Wind Resource Area (WRA) (Anderson and Estep 1988, Estep 1989, and Orloff and Flannery 1992) triggered concern from regulatory agencies, environmental/conservation groups, wildlife resource agencies, and wind and electric utility industries about possible impacts to birds associated with wind energy development.

Although many bird species have experienced fatalities, raptors have received the most attention (Anderson *et al.* 1996a, 1996b, 1997, 1999, 2000; Anderson and Estep 1988; Estep 1989; Howell 1995; Howell and Noone 1992; Hunt 1994; Johnson *et al.* 2000a, 2000b; Luke and Watts 1994; Martí 1994; Orloff and Flannery 1992, 1996; and Thelander and Rugge 2000, Smallwood and Thelander 2004). Emphasis on raptor fatalities probably emerged for several reasons. Low raptor population relative to many other bird groups and the symbolic and emotional value raptors hold to the American public have both contributed to an increased awareness. Businesses have legal considerations under federal and state statutes. Raptors are protected by the Federal Migratory Bird Treaty Act. Some raptors are protected by the Bald and Golden Eagle Protection Act and the Endangered Species Act.

Other studies in WRAs have documented deaths of songbirds and other non-raptorial birds (Anderson *et al.* 2000; Erickson *et al.* 2000, 2001; Higgins *et al.* 1995; Johnson *et al.* 1998, 1999, 2000a, 2000b; Orloff and Flannery 1992; Osborn *et al.* 1996; Pearson 1992; Thelander and Rugge 2000; and Winkelman 1994) and waterbirds (Anderson *et al.* 2000; Erickson *et al.* 2001; Johnson *et al.* 2000a, 2000b, 2002; Pearson 1992; and Winkelman 1985, 1989, 1990, 1992a, 1992b, 1994). Most birds are also protected by the Federal Migratory Bird Treaty Act.

Bats also have been killed at wind energy facilities (Anderson *et al.* 2000; Erickson *et al.* 2000; Higgins *et al.* 1995, and Johnson *et al.* 1997, 1998, 1999, 2000a, 2000b, 2003). Generally, bat fatalities have included migratory species that appear to be widely distributed throughout North America. Bats, as well as other avian species, are emerging as a consideration when permitting wind energy development.

The San Gorgonio wind plant consists of approximately 3,000 turbines of various types and sizes. Previous studies conducted at the San Gorgonio wind plant documented relatively low raptor fatality, with relatively higher fatality of passerines and waterbirds. Researchers estimated 6,800 birds were killed annually at the San Gorgonio wind facility based on 38 dead birds found while monitoring nocturnal migrants (McCrary *et al.* 1986). The 38 avian fatalities included 15 passerine species. McCrary *et al.* (1983, 1984) estimated that 69 million birds pass through the Coachella Valley annually during migration; 32 million in the spring and 37 million in the fall. Considering the high number of passerines migrating through the area relative to the number of passerine fatalities, the authors concluded that this level of fatality was biologically insignificant (McCrary *et al.* 1986).

The level of concern will likely remain high until we have a better understanding of the factors related to bird fatality. Studies, such as this research conducted in the San Gorgonio WRA, should provide valuable information regarding avian use and fatality and help reduce the level of uncertainty for wind energy development.

The primary objective of this study was to estimate and compare bird utilization, fatality rate, and the risk index attributable to factors such as avian groups, turbine sizes and types, and geographic locations within the operating wind plant in the San Gorgonio WRA in south central California during two study periods (March 1997 to May 1998; August 1999 to August 2000).

2.0 Coordination and Funding

California Energy Commission (CEC) staff and Western EcoSystems Technology (WEST, Inc.) personnel worked together on this project. Funding was provided by the CEC and National Renewable Energy Laboratory (NREL).

3.0 Study Area

The San Gorgonio Pass is a narrow, low-elevation pass situated at approximately 180 - 850 m in elevation (Figures 1 and 2). The pass is bordered on the north by Mt. San Gorgonio (3,505 m) and on the south by Mt. San Jacinto (3,293 m). The great differences in elevation and topography are a result of the San Andreas and San Jacinto fault systems, which over millions of years have created a wedge in the San Bernardino Mountains. This wedge is known as the San Gorgonio Pass and is a windy area due to the natural tendency for air pressure to equalize between the Pacific coast and the interior deserts. The vegetation in the San Gorgonio Pass WRA includes vegetation-type components of both the Mojave and Colorado deserts. Vegetation types in the WRA include the following series: creosote bush, creosote bush-white bursage (*Ambrosia dumosa)*, brittlebush (*Encelia farinosa)*, and scalebroom (*Lepidospartum squamatum*) (Sawyer and Keeler-Wolf, 1995, Table 1).

We did not quantify prey abundance during our study, nor did we visually detect what we considered to be a large number of potential prey for raptors during the field work.

The WRA receives less than 25.4 cm of rain annually, with most occurring during the winter months. Temperatures range from around freezing to 49°C. The WRA is windy much of the year with the predominant wind direction from the west, with occasional easterly winds.

The WRA at San Gorgonio Pass was developed during the early 1980s. During this research project, approximately 3,000 wind turbines were operating. This WRA is the third largest developed WRA in California and produces approximately 25% of the electricity produced annually from wind energy in California. For the purpose of this study the developed WRA was subdivided into four geographic locations: the *High* elevation area, which was above 610 m above Mean Sea Level (MSL) elevation; the *Medium* elevation area, which was between 305 m and 610 m MSL elevation; the *Low* elevation area, which was below 305 m MSL elevation; and the *Water* area. The *Water* area was contained in the *Low* elevation area and includes hundreds of acres of surface water. This surface water is created by runoff from Whitewater Creek and water diverted from other sources and pumped into recharge basins. This surface water often remains year-round in some of the basins. Permanent study sites were selected at the three elevation areas and from the *Water* area. Approximately 85% of the area was available to be sampled (access granted).

3.1 High Elevation Area

The *High* elevation area included the confines of two distinct wind farms occupying the foothills northwest of Palm Springs. The two managed developments were Mesa to the northwest and Swan Mill to the adjoining southeast. *High* elevation area was predominately characterized by steep slopes, rolling hills, and an elevation greater than 610 m. Vegetation was dense and ranged from exclusive brittle bush in the lower reaches of the area to increasingly complex shrub communities at higher elevations. The Mesa development was populated solely by small turbines on lattice towers (slt). Swan Mill contained only small turbines on tubular towers (stt).

3.2 Medium Elevation Area

The *Medium* elevation area was located immediately north of Highway 10 and west of North Palm Springs. The area also extended to Painted Hills, west of Highway 62. The *Medium* elevation area included a variety of turbine types and concentrations and is a "patch work" of individual properties. Topographically, the *Medium* elevation area sloped northward to the base of the Little San Bernardino Mountains. The vegetation community was predominately creosote/white burrsage.

3.3 Low Elevation Area

The *Low* elevation area was located south of Highway 10 within the "island" created by Interstate 10, Highway 111, and Indian Avenue. The majority of the turbines in this area were located in one large area with a layout of sequential rows. A railroad track divided a small northern population of lattice turbines from the major development. The *Low* elevation area was predominately a flat sandy drainage. The lower edge of the *Medium* elevation area creosote habitat extended into the northern boundary. Vegetation was sparse to barren through the center, while scalebroom, dalea, burrsage, and other minor shrubs increased to the south.

3.4 Water Area

The southwestern portion of the *Low* elevation area contained a series of 21 parallel water recharge basins. These basins had a north-south orientation and were approximately 150 m wide and 900 m long. Each was separated by an earthen dike. Sixteen of these dikes supported a row of wind turbines. Daily water levels varied drastically and were determined by the Coachella Valley Water District. Not all of the 21 basins were full at any one time, and the easternmost basins exhibited no sign of ever holding water. The western basins were the most likely to contain water, and on a consistent basis, at least 6 of the basins contained some measure of water during this study. This region was defined by areas containing water during February 1997. Wind turbines within 100 m of standing water were included in this area. During the Phase II study, the basins contained less water than during the Phase I study.

4.0 Study Objectives and Key Research Questions

The primary objective of this study was to estimate and compare bird utilization, fatality rates, and the risk index among factors including bird taxonomic groups, wind turbine and reference

areas, wind turbine sizes and types, and geographic locations. The key questions addressed to meet this objective include:

- Are there any differences in the level of bird activity, called "utilization rate" or "use", with the operating wind plant and within the surrounding undeveloped areas (reference area)?
- Are there any differences in the rate of bird fatalities (or avian fatality) within the operating wind plant or the surrounding undeveloped areas (reference area)?
- Does bird use, fatality rates, or bird risk index vary according to the geographic location, type and size of wind turbine, and/or type of bird within the operating wind plant and surrounding undeveloped areas (reference area)?
- How do raptor fatality rates at San Gorgonio compare to other wind projects with comparable data?

5.0 Study Design

The methods used in this study were developed through a collaborative process that included biostatisticians and field methodology experts representing federal, state, utility, consulting, and environmental organizations. The methods and metrics conform to those suggested in "Studying Wind Energy/Bird Interactions: A Guidance Document" (Anderson *et al.* 1999).

This was a mensurative study (Hurlbert 1984, Morrison *et al.* 2001) designed to provide statistical evidence regarding differences in use, fatality rates, and the risk index among levels of multiple factors. In addition, confounding of some factors existed. For example, the *Medium* elevation area for Phase I had no large tubular towers when studied. Therefore, geographic location was confounded with turbine type, and significant differences observed may be due to geographic location or to turbine type. The basic study design was a stratified random design, with geographic location, turbine sizes, and tower types used in defining strata.

5.1 Sample Site Selection

Subsequent to Phase I studies and prior to Phase II studies, the *Low/Water* areas were repowered with large tubular turbines replacing many small turbines. Phase II included a sample of these large tubular turbines (LTT).

5.1.1 Phase I

One-hundred-seventy-eight sample sites were selected using a stratified random sampling selection process. Each of the 178 sample sites included zero to ten turbines, with a total of 423 turbines sampled. These sites included 20 sites >1 km from the nearest turbines, 20 sites between 400 m and 800 m from turbines, and 138 sites at turbines. The 40 sample sites selected at >1 km and between 400-m and 800-m distances from operating wind turbines were selected to allow detection of differences in bird utilization, bird fatality, or bird risk index between a site near a turbine (NT) and a site away from turbine (AFT).

Wind turbine type consisted of three stratum:

- Large tubular turbine (horizontal axis turbine >26 m rotor diameter on tubular tower)
- Small tubular turbine (horizontal axis turbine <26 m rotor diameter on tubular tower)

- Small lattice turbine (horizontal axis turbine <26 m rotor diameter on lattice tower).

The turbine sites include large and small turbines, lattice and tubular tower turbines, end-row turbines, and a variety of distinct natural and physical settings.

5.1.2 Phase II

Sixty near-turbine (NT) sites were selected in Phase II within the *Water* and *Low* areas and included a mix of small tubular turbines (stt), large tubular turbines (LTT), and a few large two-bladed tubular turbines (L2TT).

5.2 Selection of Bird Utilization and Carcass Search Sites at Turbines

5.2.1 Phase I

For each of the four geographic locations, the numbers of sites to be selected were determined according to availability of differing turbine types and numbers. Individual survey site locations were then selected considering the circumstances unique to each subset. Within each of the four subdivisions, site selections were performed in a similar but separate operation for each of the available turbine types.

Each development was stratified to insure uniform placement of survey locations within the defined area. Stratification was dependent upon factors such as property boundaries, turbine layout, turbine concentrations, vegetation type, and topography. Each stratified unit was not necessarily equal in the number of a particular turbine type.

After determining the site selection percentages for each stratified area, individual turbines from each turbine type were chosen by random selection. First, each turbine was assigned a number (one by one, row by row), starting from an assigned corner of the stratified unit. Random numbers were then generated with the use of a random numbers chart. The corresponding assigned turbine numbers were established as the initial study site locations. If selected sites were closer than 100 m, a replacement site was selected.

The sample design resulted in the following number of turbines and turbine types for the permanent study sites (Table 3): 23 LTT, 63 stt, and 52 slt. These turbines were distributed according to geographic location as follows: 21 slt, 8 stt, and 3 LTT at the *High* elevation area; 15 stt and 12 slt at the *Medium* elevation area; 25 stt, 12 slt, and 20 LTT at the *Low* elevation area; and 15 stt and 7 slt at the *Water* area (Table 2).

The carcass search plot was defined as a 50-m radius circular area centered on the selected turbine, and the bird use plot was defined as variable circular plot centered at the selected turbine. The search plot could contain more than one turbine. The permanent site search plots comprised approximately 1.94 acres.

5.2.1.1 High Elevation Area

The *High* elevation area included two distinct wind farms occupying the foothills northwest of Palm Springs. The two developments were Mesa to the northwest and Swan Mill to the adjoining southeast. The Mesa development contained only slt, while Swan Mill contained only stt turbines. No LLT or vertical axis turbines (VATs) were available for selection in the San Gorgonio study area.

Due to their homogenous turbine types, Mesa and Swan Mill were independently stratified. Each area was roughly uniform in shape. This allowed for stratified units of nearly equal size and turbine population within Swan Mill. Mesa does not have a uniform turbine layout. Therefore, units were of dissimilar sizes reflecting variations in turbine concentrations.

5.2.1.2 Medium Elevation Area

The *Medium* elevation area included a variety of turbine types and concentrations. The layout was a "patch work" of individual properties. Stratification of the *Medium* elevation area was primarily determined by the distinct property borders of individual turbine developments.

5.2.1.3 Low Elevation Area

The majority of turbines were located in one large area in a sequential row layout (Figure 2). A railroad track divided a small northern population of lattice turbines from the major development. The uniform shape of the *Low* elevation area allowed for stratification by approximately equal turbine numbers. This was especially true for stt. Slt were stratified between two major populations. The easternmost row of turbines contained the only LTT available for selection within the entire study area. Therefore, the complete row of seven turbines was selected.

5.2.1.4 Water Area

Both stt and slt were contained within distinct areas and were therefore stratified uniformly. Due to the variability of basin water fill, turbines selected in February 1997 were not necessarily within 100 m of water during the course of the study.

5.2.2 Phase II

For Phase II, new sites were selected within the *Low* and *Water* areas. Sixty sites were selected, 38 from the *Low* elevation area and 22 from the *Water* area. Twenty-six stt, 28 LTT, and six L2TT were selected (Table 3). These turbines were distributed according to geographic location as follows: 11 stt; 11 LTT in the *Water* area; and 15 stt, 17 LTT, and six L2TT in the *Low* area (Table 2).

5.3 Selection of Bird Utilization and Carcass Search Sites away from Turbines

5.3.1 Phase I

Sites far from wind turbines were also selected within each of the four previously described strata. These away-from turbine (AFT) sites, or control sites, were at least 400 m from the nearest turbine and were located in areas consistent with the definitions of the associated subdivision.

AFT sites were predominately selected based on access, as the limited number of potential locations did not provide for a random selection. Available undeveloped land provided an adequate number of acceptable sites considered representative of the *Low* and *Medium* elevation areas. The topography, access, and elevation boundaries severely limited the number of potential site locations for the *High* elevation area. Availability within the *Water* area was limited by the small size of the defined area.

5.3.2 Phase II

Only sites at turbines were selected.

5.4 Observer Detection Efficiency Site Selection

Two observer detection bias studies were conducted. Each study included representative topographical and vegetation coverage of the three main areas (*High*, *Medium*, and *Low*) within the San Gorgonio study area. Selected sites met three requirements: 1) they avoided established survey locations, 2) they were accessible, and 3) the area allowed for three 50-m radius circles for dead bird searches. Trials were conducted in September 1997 and March 1998.

A site selected in the *High* elevation area represented the rolling topography and dense vegetation of that region. The *Medium* elevation area provided a relatively flat creosote dominated environment. The *Low* elevation area presented a representative sandy area dominated by sparse scalebroom and tumbleweeds.

5.5 Scavenging Study Site Selection

Two independent scavenging studies were conducted during the project, using 215 carcasses. Up to a total of 16 brown or white (cryptic/noncryptic) chicken carcasses and 16 brown or white chick carcasses were placed within each of the four sub-areas each trial. In each sub-area, up to eight chickens and eight chicks were placed at NT turbine sites, and eight of each were placed at AFT sites (> 400 m away from nearest turbines). Selected scavenging sites had to be at least 100 m from an existing survey location.

At NT sites, the scavenging bait location was established 50 m from the selected turbine, perpendicular to the row. The direction of the perpendicular line was determined randomly by coin toss (heads = right, tails = left). The bait was placed 10 m north of the 50-m perpendicular site location.

6.0 Field Methods

6.1 Geographic Information System (GIS)

Characteristics of the San Gorgonio WRA study area were mapped using a Geographical Information System (GIS). Digital topographic maps (1:24,000) were obtained from the U.S. Geological Survey and used as base maps. These maps contained topographic information, roads, watercourses, and various other physical features. Aerial photographs of the study area were scanned into the computer in tag image file format (TIFF) and included as a GIS layer. The aerial photographs were used to identify additional features such as roads, powerlines, wind turbines, and buildings not found on the base map layer. Vegetation types were outlined on the aerial photographs and confirmed by comparing the vegetation at selected ground locations with the photo-interpreted types. The vegetation types for the study area were then digitized to create a vegetation layer. Universal Transverse Mercator (UTM) system coordinates were obtained for all the turbines using a Global Positioning System (GPS) handheld unit. The UTM coordinates collected at each turbine were used to create another GIS layer containing turbine locations. Other turbine information was attributed to each turbine in the GIS database, such as turbine manufacturer, turbine height, rotor swept area/volume, and type of tower. The GIS layers were created using Arc/Info, ArcView, and DIMPLE remote sensing image analysis software.

6.2 Vegetation Types Classification

Vegetation types (Sawyer and Keeler-Wolf 1995) were identified on the ground and on aerial photographs and transferred to a GIS information layer. The information was used for analysis of habitat influence on bird use and other parameters. The vegetation type within 50 m of each carcass search plot center was documented. This included the vegetative structure and dominant (e.g., highest percent cover overstory) and up to two sub-dominant plant species. Four vegetation structures were identified for the San Gorgonio WRA: 1) grass, 2) sub-shrub, 3) large shrub, and 4) wooded. Plant groups and/or species within each structure and each phase of the study are presented in Table 1.

6.3 Bird Utilization Count

Bird utilization counts were variable point counts modified to document behavior and other flight characteristics. Bird utilization counts were conducted for 14 months from March 4, 1997 through May 29, 1998. Each sample site was visited approximately every 6 weeks. Two 5-minute utilization counts were conducted at each site during each visit. At each of the sample sites, four 5-minute utilization counts (720) were conducted quarterly (2880 counts annually). Bird utilization counts were conducted between 07:00 and 11:00 am. The observer conducted the count from the center (or as near as possible) of the sample site. Erickson *et al.* (2002) summarized studies of the use of wind developments by birds.

Data collected during each site visit consisted of site and bird observation information. Site information included:

- Site number
- Observer
- Date
- Start and end times
- Applicable weather (precipitation, fog presence, cloud cover, temperature, wind speed and direction, and background sound levels).

Observation information included:

- Utilization count number
- Starting time
- A unique observation number
- Species
- Number of individuals
- Estimated distance from observer at initial sighting
- Estimated closest distance to observer
- Behavior/activity (flying, perching, soaring, hunting, and foraging), height above ground, and behavior if the bird approached the turbine within $\leq$50 m of the turbine or WRA structures
- Type and operational status of the closest turbine to the observation. For all observations, flight height (to the nearest meter) was recorded when the bird (or group of birds) was first observed and when/if they entered within 50 m of a turbine
- Avoidance behavior (e.g., flaring, other avoidance behavior, perching)
- Comments or unusual observations (recorded in the comment section of the data form).

6.4 Carcass Searches

The objective of the carcass searches was to document bird fatalities. At each of the permanent sites, one carcass search was conducted quarterly. Circular plots with a radius of 50 m centered at each sample turbine site were systematically searched. The intensity of each search was habitat dependent and typically took from 30 minutes to 2 hours. For example, searching short grassland was quicker than searching thick shrubby areas.

Data collected during each carcass search included: a unique carcass number, site, date, observer, species, sex and age when possible, time, condition (e.g. intact, scavenged, feather spot), cause of death (when possible), description of injury(ies), identification of and distance to nearby structures, distance to closest turbine, classification of closest turbine (i.e., mid-row and end-row), and distance to plot center. Comments describing the characteristics of the carcass indicating the cause of death or other pertinent information were also recorded. All carcasses discovered were 1) photographed as found, 2) plotted on a detailed map of the study area showing the location of the wind turbines and associated facilities such as power lines and towers, and 3) collected for species verification. Bird carcasses found by personnel at times other than the scheduled search (incidental find) were noted and photographed but were not removed from the plots.

6.5 Observer Detection Efficiency Study

Circular plots 100 m in diameter were identified with pinflags placed at the north, east, south, and west edges. An individual, not conducting searches as a part of the trial, placed small and large native bird carcasses and carcass parts at randomly selected locations within the plot. All placements were documented and then compared with the observer's findings to determine the proportion of small and large carcasses or carcass parts detected by each observer.

6.6 Scavenging Bias Study

Brown chicken and chick carcasses (64 of each for each scavenging trial) were used to simulate large and small bird carcasses for scavenging rate comparisons near turbines and at different distances from turbines. Two independent scavenging bias trials were conducted using 215 carcasses. The scavenging bias trials were conducted April 1997 and December 1997. Up to 32 chicken and chick carcasses (16 each) were placed in each geographic location. In each location, eight chickens and eight chicks were placed at NT sites, and eight of each were placed at away-from-turbine locations greater than 0.1 km away from the nearest turbines. Because we used carcasses that were not representative of the bird species that were observed as fatalities, this information was primarily used to describe relative differences in scavenging by study area, near and away from turbines, and habitat.

7.0 Statistical Analysis Methods

7.1 Bird Use

Bird activity was described by the calculation of utilization rates. We defined utilization rate as the number of observations of birds per number of utilization counts (surveys). Only birds

visually observed within 200 m of the site center were considered in the calculation of mean utilization rates. Observations of birds only heard and not seen were not used in the calculation of mean utilization rates because turbine and wind noise often mask bird calls. This ensured that turbine or wind noise would not bias bird use estimates in developed WRAs compared to undeveloped areas.

7.2 Observed Bird Fatality Rates

Bird fatality rate was defined as the number of unique bird carcasses found per search per plot (50-m radius of focal turbine):

$$bird\ fatality\ rate = number\ of\ fatalities \Big/ number\ of\ searches\ .$$

Since searches are conducted on a quarterly basis, the fatality rate used in the comparative analyses represents the observed number of fatalities per 3-month period per sample site. This fatality rate could be multiplied by 4 to come up with an observed annual fatality rate per search plot unadjusted for scavenging and search efficiency biases, with each search plot typically containing one or more turbines. An annual per-turbine fatality rate was calculated by adjusting the annual fatality rate per search plot to account for the effective area of the wind project that was searched (12% of the total search area within 50 m of turbine strings).

7.3 Bird Risk Index

We defined an index to bird risk index as the fatality rate divided by the utilization rate. For example, considering only birds observed within 200 m of the site center, the overall bird risk index for the San Gorgonio Pass WRA is:

$$bird\ risk = \frac{fatality\ rate}{utilization\ rate}$$

Bird utilization rates (use) and bird fatality can increase proportionately without changing bird risk index. However, an increase (or decrease) in fatality with no change in use causes an increase (or decrease) in risk index. Similarly, an increase (or decrease) in use with no change in fatality causes a corresponding decrease (or increase) in risk index. Bird risk index can therefore be used to compare differences for variables of interest (i.e., geographic location, avian group, turbine size, and turbine type) while accounting for observed differences in use and fatality rates associated with individual values of each variable. This index, a relative number that can range from zero to a large number, is used to compare levels of other factors such as turbine type and should not be construed as an absolute measure of the risk index. The numerator represents a fatality rate (number of fatalities/3-month period/site). The denominator represents the number of birds observed per 5-minute period. To equate the risk index to a more direct measure of the likelihood of collision per bird observation near wind turbines, the index must be divided by the number of 5-minute periods within the 3-month search interval. For example, a risk index of 1.0 from the equation above can loosely be interpreted in the following way: one fatality is estimated to occur in a 3-month period for every 10,800 bird observations (90 days in 3-month interval times 120 5-minute daylight periods per day) within 200 m of the turbine during that 3-month

period. Detection biases associated with bird observations and detection and scavenging biases for fatalities would affect the risk index measurement.

7.4 Comparison Factors and Analyses

The primary analysis variables considered in comparing use, fatality rates, and the risk index are listed in Table 3. For each metric and variable of interest, 95% confidence intervals were calculated. The null hypothesis of "no difference" was tested at two-tailed α-level of 0.10 by investigating the overlap of the confidence intervals. Given the high variability in field data of this sort, we discuss statistically significant differences and trends in the data that were supported by consistent patterns across several comparisons.

Other factors, which we did not attempt to model, may be important. Cause of the differences was not inferred from the statistical analyses because of the observational nature of the study and the possibility of confounding factors. Professional judgment and trends in the data were the primary methods we used to interpret pattern and to make inferences regarding the results.

7.5 Scavenging Bias Trials

Scavenging rates by season and habitat were described by calculations of the proportion of birds removed after 8 and 10 days and the estimated mean time until removal. Given the limited nature of these data (i.e., few trials and limited species of trial carcass), data were only used to describe the characteristics of 1) scavenging rates, and 2) general comparisons of rates of factors (i.e., season, vegetation, between study areas, and between the San Gorgonio and Tehachapi studies).

7.6 Observer Detection Bias Trials

The observer detection probability was estimated by:

$$p = \frac{\#\,\text{of carcasses detected}}{\#\,\text{of carcasses placed}}.$$

Given the limited nature of these data (i.e., few trials), data were only used to describe the relative efficiency of the searches and general comparisons of detection rates and the influence of factors such as season and vegetation.

8.0 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were used during all stages of the project, including field training, data collection, field form completeness, data entry, data analysis, and report preparation. Field forms were created and lists of variables documented and defined for each research study. A detailed protocol (standard operating procedure) was prepared for Bird Utilization Counts, Carcass Searches, Scavenging Bias Trials, and Observer Detection Trials. These protocols assisted in maintaining a high level of precision and consistency in data collection.

Field personnel were trained in all field collection methods. A computerized database was created to store and retrieve field data. Personnel experienced in data entry using a pre-defined

format to make subsequent data analysis more efficient entered data from field forms into electronic data files. Printouts of the entered data were compared with the completed and previously checked field forms to verify the accuracy of the data entries. All data entry errors were corrected.

At the end of the study, the complete database was sent to statistical personnel for additional QA/QC and data analysis. Anomalies or inconsistencies were resolved with field staff and changes were made where necessary with the proper documentation. Results of data analysis were compared for accuracy during all stages against hand calculations and other alternate methods of calculation.

9.0 Results

9.1 General Avian Use, Frequency Occurrence, and Species Composition

9.1.1 Phase I

A total of 3,313 5-minute bird utilization counts and 830 carcass searches (carcass search areas included one to numerous turbines) were completed in San Gorgonio Pass WRA during Phase I studies from 3 March 1997 to 29 May 1998. During the utilization counts, 84 unique species were documented in 2,194 sightings of 17,861 individuals (Table 4 and Appendix A).

9.1.1.1 Near-Turbine Sites

For all geographic locations combined, 25 species were observed during spring (1 March to 15 April), 33 species were observed during summer (16 April to 30 September), 31 species were observed during fall (1 October to 15 December), and 29 species were observed during winter (16 December to 28/29 February) (Table 5).

Different patterns in numbers of species observed were found depending on geographic location and season. The *Medium* elevation area had consistently low numbers of species across all seasons (range of 6 to 8). The *Water* area had fewer numbers of species observed during spring (11) compared with summer (19), fall (21), and winter (18). The *Low* elevation area had greater numbers of species observed during summer (12) compared with spring (8), fall (7), and winter (9). The *High* elevation area had fewer numbers of species observed during fall (7) compared with spring (13), summer (14), and winter (13) (Table 5).

Avian use (mean number of individuals per survey) across all geographic locations was highest during winter (5.39 individuals/survey) followed by fall (3.40), spring (1.94), and summer (0.54). The highest use occurred at the *Water* areas during winter (13.01), and the lowest use was recorded at the *Medium* elevation areas during summer (0.14). The *Water* areas had consistently higher use while the *Medium* and *High* elevation areas had consistently lower use for most seasons (Table 5 or 6).

Avian richness (mean number of species per survey) was low overall across all geographic locations and was lowest in the summer (0.17 species/survey). Fall, spring, and winter had greater richness compared with summer, although they were not very different from one another (0.32, 0.38, and 0.44 respectively). The highest estimate of avian richness occurred at the *Water* areas during winter (1.06), and the lowest estimate occurred at the *Low* elevation areas during summer (0.09). Avian richness was greater in general at the *Water* areas except during spring

when the *High* elevation areas were slightly higher (0.49 species/survey for the *Water* areas compared to 0.56 for the *High* elevation area) (Table 5).

9.1.1.2 Away-from-Turbine Sites

AFT sites had consistently higher number of species observed than did NT sites, except for fall when both had similar number of species (31 NT sites and 29 AFT sites). For all geographic locations combined, 35 species were observed during spring (1 March to 15 April), 39 species were observed during summer (16 April to 30 September), 29 species were observed during fall (1 October to 15 December), and 39 species were observed during winter (16 December to 28/29 February) (Table 5).

Different patterns in numbers of species observed depended on geographic location and season. These patterns were also different from those observed at NT sites. The *Medium* elevation area had consistently moderate numbers of species observed across all seasons (range from 9 to 11). The *Water* area had greater numbers of species observed during winter (25) compared with summer (19), fall (20), and spring (18). The *Low* elevation area had far fewer numbers of species observed during fall (3) compared with spring (13), summer (10), and winter (10). The *High* elevation area had few numbers of species observed during fall (5) compared with moderate numbers during spring (11) and winter (8) with the greatest number of species observed during summer (18) (Table 5).

Avian use patterns also differed at AFT sites compared with NT sites. Avian use (mean number of individuals per survey) across all geographic locations at AFT sites was highest during fall (19.43 individuals/survey), followed by winter (10.43), spring (4.67), and summer (4.18). The highest use occurred at the *Water* area during fall (61.94), and the lowest use was recorded at the *Medium* elevation area during summer (0.55). Similar to NT sites, the *Water* area AFT sites had consistently higher use while the AFT sites in the *Medium* and *High* elevation areas had consistently lower use for all seasons (Table 5 or 6).

Avian richness (mean number of species per survey) was also low overall for AFT sites; however, every category (geographic location by season) was higher than that observed for NT sites. The highest estimates of avian richness across all geographic locations were observed during winter (1.06 species/survey) and fall (1.04). Summer has the lowest avian richness among the four seasons (0.55). The highest estimate of avian richness occurred at the *Water* area during winter (2.35), and the lowest estimate occurred at the *Low* elevation area during summer (0.22). This same pattern of avian richness was also observed at NT sites. Avian richness was greater overall at the *Water* area (Table 5).

9.1.2 Phase II

A total of 2,222 5-minute bird utilization counts and 600 carcass searches were completed in San Gorgonio Pass WRA during Phase II studies from 18 August 1999 to 11 August 2000. During the utilization counts, 59 unique species were documented in 914 sightings of 3,764 individuals (Table 4 and Appendix A).

9.1.2.1 Near-Turbine Sites

The number of species observed was similar at NT sites for Phase I and Phase II surveys during spring and summer. During fall and winter however, only half as many species were observed during Phase II surveys compared with Phase I. For all Phase II geographic locations combined,

26 species were observed during spring, 30 species were observed during summer, 17 species were observed during fall, and 14 species were observed during winter (Table 5).

The number of species observed at the *Low* elevation area was lower for all seasons during Phase II surveys compared with Phase I (Table 5). At the *Water* area, the number of species observed during Phase II was substantially higher during spring and summer and lower during fall and winter compared with Phase I. At the *Water* area, the greatest number of species was observed during summer (28), followed by spring (24), fall (15), and winter (12). At the *Low* elevation area, numbers of species were low throughout the year with the greatest number of species observed during summer (9), followed by spring and fall (6) and winter (5).

Avian use also differed between Phase I and Phase II surveys at NT sites. Phase II use estimates were higher during spring, similar during summer, and substantially lower during fall and winter compared with Phase I estimates (Table 5). Avian use during Phase II across all geographic locations was highest during spring (2.90 individuals/survey), followed by summer (0.50), winter (0.41), and fall (0.21). The highest use occurred at the *Water* area during spring (5.17), and the lowest use was recorded at the *Low* elevation area during summer and fall (0.09). As observed during Phase I studies, the *Water* area had consistently higher use while the *Low* elevation area had consistently lower use for all seasons during Phase II (Table 5 or 6).

Avian richness was low overall during Phase II and similar to Phase I during spring and summer. Phase II estimates of avian richness during fall and winter were less than half of the Phase I estimates. Avian richness across all geographic locations during Phase II was lowest in the fall (0.13 species/survey). Summer and winter had greater richness, though compared with spring, were not very different from the fall (0.18, 0.17, and 0.40 respectively). Phase II estimates of avian richness at the *Water* area were higher during spring and lower during summer, fall, and winter compared with Phase I. At the *Low* elevation area, Phase II estimates of avian richness were lower during spring, fall, and winter and similar during summer compared with Phase I. The highest estimate of avian richness during Phase II occurred at the *Water* area during spring (0.82), and the lowest estimate occurred at *Low* elevation areas during summer and fall (0.07). As observed during Phase I studies, avian richness was greater at the *Water* area than at the *Low* elevation area for all seasons during Phase II (Table 5).

9.2 Avian Use by Bird Group

9.2.1 Phase I: Near-Turbine Sites

Although patterns varied among geographic locations, waterbirds (species observed in each group are provided in Appendix A) had consistently higher mean abundance (mean number of individuals observed per 5-minute utilization survey) than other groups across the spring, summer, and fall seasons. Passerines outnumbered waterbirds during winter at the *Water* area. Waterbirds were least abundant during summer. Both raptors and other birds were at very low numbers throughout the year. Corvid abundance was highest during spring and lowest during summer and fall. Passerine abundance was highest during winter, followed by fall, spring, and summer (Table 6).

Except for waterbirds and passerines at the *Water* and *Low* areas, mean abundance was low overall for all geographic locations. Waterbirds had the highest mean abundance recorded at the *Water* area during fall (8.28 individuals/survey). Waterbirds were not observed at any *Medium* and *High* elevation areas. Raptors were not observed at any *Medium* and *High* elevation areas

during fall. Other birds were not observed at any *Water* areas during the spring, *Low* elevation areas during the fall, *Medium* elevation areas during the spring and summer, and *High* elevation areas during fall or winter. Otherwise, other birds observed at the *Low* elevation area during spring and summer and raptors at the *Low* elevation area during the spring had the lowest mean abundance (< 0.01 individuals/survey) (Table 6).

9.2.2 Phase I: Away-from-Turbine Sites

Although patterns varied among geographic locations, waterbirds had consistently higher mean abundance than other groups across all seasons. Waterbirds were far more abundant during fall and had greater abundance during all seasons at AFT sites compared with NT sites. Both raptors and other birds were at very low numbers throughout the year; however, numbers were higher in most cases at AFT sites compared to NT sites. Both corvid and passerine abundance were highest during winter and lowest during summer with passerines consistently higher than corvids. Corvids were more abundant during winter at AFT sites; however, they had similar levels of abundance between away-from-turbine and NT sites during other seasons. During fall and winter, passerines were lower in abundance at AFT sites than NT sites. The opposite pattern was observed during spring and summer (Table 6).

Except for waterbirds and passerines at the *Water* and *Low* areas, mean abundance was low for all geographic locations. Waterbirds had the highest mean abundance recorded at the *Water* area during fall (60.35 individuals/survey). Waterbirds were not observed at any *Medium* elevation areas during the spring, summer, or fall. They were also not observed at any *High* elevation areas. Raptors were not observed during the spring, summer, and winter at the *Water* areas, during the summer and fall at the *Low* elevation areas, and during the spring and fall at either the *Medium* or *High* elevation areas. Corvids were not observed at the *Low* elevation areas during the fall. Other birds were not observed at all in the fall. Additionally, other birds were not observed during spring at the *Water* areas, during winter at the *Low* and *High* elevation areas, and during summer at *Medium* elevation areas. Other birds observed at the *Low* elevation area, corvids observed at the *Medium* and *High* elevation areas, and raptors observed at the *High* elevation area during summer had the lowest mean abundance (0.01 individuals/survey) (Table 6).

9.2.3 Phase II: Near-Turbine Sites

Patterns of abundance by season differed between Phase I and Phase II surveys. During Phase II surveys, abundance estimates for waterbirds and corvids were higher for spring only. Phase II abundance estimates for raptors and passerines during all seasons, and waterbirds and corvids during summer, fall, and winter, were primarily lower for Phase II than for Phase I. Other birds were equally abundant during Phase I and Phase II surveys. Waterbirds (species observed in each group are provided in Appendix A) had consistently higher mean abundance than other groups across the spring and summer seasons during Phase II. Corvids and passerines outnumbered waterbirds during fall and winter, though this was primarily due to the absence of waterbirds at the *Low* elevation area during summer, fall, and winter. Waterbirds were most abundant during spring, followed by summer, and fall and winter. Raptors and other birds were at very low numbers throughout the year. Corvid abundance was highest during spring, followed by winter, summer, and fall. Passerines were twice as abundant during winter as during the spring, summer, and fall (Table 6).

The *Water* area abundance estimates were higher during Phase II than Phase I for waterbirds during spring, corvids during spring and summer, and passerines during summer. All other Phase

II abundance estimates at the *Water* and *Low* areas were lower than Phase I estimates. Except for waterbirds at the *Water* and *Low* areas during spring, mean abundance was low for all avian groups and all geographic locations during Phase II surveys. Waterbirds had the highest mean abundance recorded at the *Water* area during spring (4.39 individuals/survey). Raptors were not observed at any *Water* areas during spring and the *Low* elevation areas during winter. Other birds were not observed at the *Water* area during spring and fall and at the *Low* elevation area during spring and winter. Other birds observed at the *Low* elevation area during fall and raptors observed at the *Low* elevation area during spring and summer had the lowest mean abundance (< 0.01 individuals/survey - Table 6).

9.3 Avian Use by Species

9.3.1 Phase I: Near-Turbine Sites

The most abundant avian species, based on mean number per 5-minute utilization survey during the spring and summer, was unidentified gull, with American coot and house finch the most abundant species during the fall and winter, respectively (Table 7). At the *Water* area, the most abundant species varied by season with killdeer in spring, unidentified gull in summer, American coot in fall, and house finch in winter. At the *Low* elevation area, house finch was the most abundant species during fall and winter, while unidentified gull was the most abundant species during spring, and double-crested cormorant was the most abundant species during summer. At the *Medium* elevation area, the most abundant species was white-throated swift during spring, horned lark during summer, white-crowned sparrow during fall, and house finch during winter. At the *High* elevation area, the most abundant species was European starling during spring, common raven during summer, yellow-rumped warbler during fall, and western meadowlark during winter.

The most frequently occurring avian species throughout the year was common raven, except for winter when it followed house finch. Common raven was followed by European starling in spring, loggerhead shrike in summer, and American coot in fall (Table 8). At the *Water* area, the common raven was the most frequently occurring species for the spring and summer and the second most frequent behind American coot and house finch in the fall and winter, respectively. Common raven was followed by European starling in spring and Brewer's blackbird in summer. At the *Low* elevation area, the common raven was the most frequently occurring species throughout the year, except in the winter when it followed house finch. Common raven was followed by unidentified gull during the spring, loggerhead shrike in the summer, and American kestrel in the fall. At the *Medium* elevation area, European starling was the most frequently occurring species in spring and summer, with common raven the most frequently occurring species during fall and house finch in winter. At the *High* elevation area, common raven was the most frequently occurring species in summer and fall, with European starling the most frequently occurring species during spring and rock wren in winter.

American kestrel was the most commonly observed raptor species (Table 4), comprising 35% of the observations, followed by red-tailed hawk (33%). Other raptor species observed included golden eagle (13 detections), prairie and peregrine falcon (4), and northern harrier and unidentified buteo (1).

9.3.2 Phase I: Away-from-Turbine Sites

The most abundant avian species, based on mean number per 5-minute utilization survey during the spring, summer, and winter, was unidentified gull, with American coot the most abundant

species during the fall (Table 7). At the *Water* area, the most abundant species was unidentified gull for summer and winter, with California gull in spring and American coot in fall. At the *Low* elevation area, unidentified gull was the most abundant species during spring and fall, while double-crested cormorant was the most abundant species during summer and ring-billed gull was the most abundant species during winter. At the *Medium* elevation area, the most abundant species varied by season with Le Conte's thrasher in spring, barn swallow in summer, western meadowlark in fall, and unidentified gull during winter. At the *High* elevation area, the most abundant species was the unidentified sparrow during spring and fall, mourning dove during summer, and common raven during winter.

The most frequently occurring avian species was the common raven in spring and winter, Brewer's blackbird in summer, and American coot in fall (Table 8). At the *Water* area, the American coot was the most frequently occurring species for the fall and winter, with common raven and Brewer's blackbird in the spring and summer, respectively. At the *Low* elevation area, the most frequently occurring species varied throughout the year, with common raven in spring, unidentified gull in summer, white-crowned sparrow in fall, and house finch in winter. At the *Medium* elevation area, the unidentified sparrow was the most frequently occurring species in spring, burrowing owl the most frequently occurring species during summer, rock wren in fall, and common raven in winter. At the *High* elevation area, the common raven was the most frequently occurring species in spring and winter, with mourning dove the most frequently occurring species during summer and rock wren in fall.

The red-tailed hawk was the most commonly observed raptor species (Table 4), comprising 40% of the observations, followed by burrowing owl (17%). Other raptor species observed included American kestrel (4 detections), prairie falcon (3), northern harrier and bald eagle (2), osprey and golden eagle (1).

9.3.3 Phase II: Near-Turbine Sites

The most abundant avian species overall, based on mean number per 5-minute utilization survey, was common raven during the summer and fall, unidentified gull during the spring, and Brewer's blackbird during the winter (Table 7). At the *Water* area, the most abundant species varied throughout the year: unidentified gull in spring, American coot in summer, house finch in fall, and Brewer's blackbird during the winter. At the *Low* elevation area, common raven was the most abundant species during summer, fall, and winter, while the unidentified gull was the most abundant species during spring.

The most frequently occurring avian species throughout the year was common raven, followed by loggerhead shrike in summer and fall, unidentified gull in spring, and Say's phoebe in winter (Table 8). At the *Water* elevation area, common raven was the most frequently occurring species throughout the year, followed by unidentified gull during spring, killdeer during summer, American kestrel in the fall, and unidentified sparrow in the winter. At the *Low* elevation area, the common raven was again the most frequently occurring species throughout the year, followed by loggerhead shrike during the summer and fall, unidentified gull during the spring, and Say's phoebe in the winter.

American kestrel was the most commonly observed raptor species (Table 4), comprising more than 43% of the observations, followed by prairie falcon (39%). Other raptor species observed included red-tailed hawk (2 detections), osprey (1), and common barn owl (1).

9.4 Avian Flight Height Characteristics

Flight height characteristics were calculated by taxonomic groups and geographic locations, combining Phase I and Phase II for the *Low* and *Water* areas (Table 9). The mean flight height of bird groups for the San Gorgonio WRA was 21.32 m. Overall, flight heights were highest for raptors (40.95 m), followed by waterbirds (35.59 m) and corvids (21.53 m). For the *High* and *Low* elevation areas, mean flight heights were highest for waterbirds, followed by raptors and corvids. For the *Medium* elevation area, mean flight heights were highest for raptors, followed by corvids. For the *Water* area, mean flight heights were highest for raptors, followed by waterbirds and other birds. For all AFT sites combined, mean flight heights were highest for raptors, followed by corvids and waterbirds. The highest mean flight height was observed at the *High* elevation area (28.51 m), followed by the *Low* elevation area (25.60 m), the *Water* area (21.43 m), the *Medium* elevation area (18.31 m), and AFT sites (16.22 m). Although we see from Table 9 that the mean flight height for raptors overall was 41 m and 33 m for AFT sites, the distribution (%) by height categories was very similar.

9.5 Avian Perching Behavior

Considering all birds except raptors, most observations of perched individuals were on vegetation (24.5%) or the ground (23.2%, Table 10). Power lines (poles, conductors, and lines) were the most common structure used as a perch (12.6%), followed closely by slt (11.9%). The other structure type that was represented with at least 5% of the perched bird observations was the stt (7.5%). No birds were observed perching on LTT.

A total of 44 perching events were documented for raptors (Table 10). Power lines (poles, conductors, and lines, 52.3%) and meteorogical towers (wires and towers, 15.9%) comprised more than 68% of the perched raptor observations. Slt and stt comprised nearly 14% of the observations, while no raptors were observed perching on LTT.

9.6 Avian Fatality Counts and Composition

9.6.1 Phase I: Overall

Sixty-one unknown or turbine-related bird fatalities representing 19 unique species were identified during Phase I in the San Gorgonio Pass WRA (Table 11). A wounded immature, female golden eagle was found by a Zond Mesa employee and taken to Cochella Wild Bird Center, where it was euthanized. In addition, 2 bat fatalities representing two species were found. A Mexican free-tailed bat (*Tadarida brasiliensis*) was found during a carcass search at a low elevation, NT site, and a hoary bat (*Lasiurus cinereus*) was found outside the study area.

Thirty-two (52.5%) of the fatalities were found at NT sites, 7 (11.5%) were found at AFT sites, and the remaining 22 (36.1%) were not associated with study sites, though they were found within the study area.

Twenty of the 61 unknown or turbine-related fatalities (32.8%) were waterbirds (Table 12). Waterbird species with the most fatalities were American Coot (11) and mallard (3). Other waterbird fatalities included 1 each of snow goose, sora, and unidentified grebe, teal, duck, and egret. Eight of the fatalities (13.1%) were raptors. Raptor species with the most fatalities included common barn owl (3) and red-tailed hawk (2). Other raptor fatalities included 1 each of

golden eagle, great horned owl, and burrowing owl. Only one corvid species, the common raven (3), suffered fatalities, representing only 4.9% of the total. Only 4 of the fatalities (6.6%) were passerines. Passerine fatalities consisted of European starling (2) and white-throated swift and western meadowlark (1). Other birds comprised 24.6% of the fatalities. Other bird species with fatalities included rock dove (12) and mourning dove (3).

Sixteen of the 61 fatalities (26.2%) were feather spots, 24 (39.3%) consisted of feathers and/or bones, 13 (21.3%) were intact, and 8 (13.1%) were dismembered. Thirty-nine of the 61 bird fatalities (63.9%) were found during scheduled carcass searches. The remaining fatalities were found by observers while conducting other study activities or by power company employees (Appendix B). Only fatalities found during scheduled carcass searches were used to estimate fatality rates.

Turbines were the closest structure that could have caused fatality for 33 of the 61 fatalities (54.1%). Turbines were the first or second closest structure in 52 fatalities (85.2%). Dead birds were found from 2 to 2000 m (mean = 217.4 m) away from the closest turbine. When the closest structure was a turbine, dead birds were found from 2 to 450 m (mean = 36.5 m) away from the turbine. When the closest structure was not a turbine and the second closest structure was a turbine (n = 17), dead birds were found from 4 to 790 m (mean = 171.5 m) away from the turbine. Twelve (19.7%) of the 61 fatalities were found less than or equal to 10 m from a turbine, 14 (23.0%) from 10 m ≤ 20 m, 7 (11.5%) from 20 m ≤ 30 m, 7 (11.5%) from 30 m ≤ 40 m, 2 (3.3%) from 40 m ≤ 50 m, and 18 (29.5%) ≥ 50 m from a turbine. Twenty-six fatalities (42.6%) were associated with structures other than turbines as the two closest structures. Other structures located closest to (< 100 m) dead birds were other human-made structures (8), distribution lines (3), fences (3), main roads traveled greater than 56 kph (2), and meteorological towers (1).

Cause of death could not be determined for 48 (78.7%) of the 61 fatalities. Thirteen (21.3%) of the fatalities resulted from collisions with turbines. Two additional fatalities were not included in the above totals during Phase I at the San Gorgonio Pass WRA. Cause of death was determined to be non-turbine related. A greater roadrunner was killed due to a collision with a vehicle, and a mallard was probably poached.

9.6.2 Phase I: Near-Turbine Sites

Nine of the 32 unknown or turbine-related fatalities (28.1%) found at NT sites were waterbirds (Tables 11 and 12). The waterbird species with the most fatalities at NT sites was American Coot (5). Other waterbird fatalities included 1 each of mallard, sora, unidentified grebe, and egret. Two of the fatalities (6.3%) were raptors, including 1 each of red-tailed hawk and burrowing owl. Only one corvid species suffered a fatality: a single common raven representing only 3.1% of the total. Only 3 of the fatalities (9.4%) were passerines. Passerine fatalities consisted of 1 each of European starling, white-throated swift, and western meadowlark. Other birds comprised 31.3% of the fatalities. Other bird species with fatalities included rock dove (9) and mourning dove (1).

Turbines were the closest structure that could have caused fatality for 25 of the 32 fatalities (78.1%) found at NT sites. Turbines were the first or second closest structure in 31 fatalities (96.9%). Dead birds were found from 5 to 49 m (mean = 20.5 m) away from the closest turbine at NT sites. When the closest structure was not a turbine and the second closest structure was a turbine (n = 6), dead birds were found from 10 to 46 m (mean = 20.0 m) away from the turbine. The horizontal distribution of dead birds surrounding the closest turbine regardless of other

structures is depicted in the first frame of Figure 3. Eight (25.0%) of the 32 fatalities were found less than or equal to 10 m from a turbine, 10 (31.3%) from 10 m ≤ 20 m, 7 (21.9%) from 20 m ≤ 30 m, 4 (12.5%) from 30 m ≤ 40 m, and 2 (6.3%) from 40 m ≤ 50 m from a turbine. No fatalities were associated with structures except at the two closest turbines at the NT site. Other structures located closest to dead birds, when the second closest structure was a turbine, included other human-made structures (4), main roads traveled greater than 56 kph (1), and meteorological towers (1).

9.6.3 Phase I: Away-from-Turbine Sites

Seven fatalities were found at AFT sites during carcass searches compared with 29 at NT sites (Table 12).

Five of the 7 unknown or turbine-related fatalities (71.4%) found at AFT sites were waterbirds (Table 11): American Coots (3), 1 mallard, and 1 unidentified teal. No raptor, corvid, or passerine fatalities were found at AFT sites. A single rock dove was found making the other birds category 14.3% of the fatalities. A single unidentified bird was also found.

Turbines were the first or second closest structure in 4 fatalities (57.1%). Dead birds were found from 400 to 2000 m (mean = 907.9 m) away from the closest turbine at AFT sites. When the closest structure was a turbine, the dead bird was found at 450 m (n = 1) away from the turbine. When the closest structure was not a turbine and the second closest structure was a turbine (n = 3), dead birds were found from 400 to 790 m (mean = 563.3 m) away from the turbine. The horizontal distribution of dead birds surrounding the closest turbine regardless of other structures is depicted in the second frame of Figure 3. At the AFT sites, two fatalities were associated with non-turbines as the two closest structures. Other structures located closest to dead birds included main roads traveled greater than 56 kph (1) and fences (1).

9.6.4 Phase II: Overall

Thirty-one unknown or turbine-related bird fatalities representing 12 unique species were identified during Phase II in the San Gorgonio Pass WRA (Table 12). Seven feather spots were found. A fatality could not be confirmed in these cases. The total number of fatalities was similar to that found during Phase I surveys of *Water* and *Low* areas (27). It is, however, not directly comparable due to the difference in search effort. A total of 600 searches (10 each for 60 sites) were completed during Phase II surveys, compared with only 381 searches (3 to 5 each for 79 *Water* and *Low* areas) completed during Phase I surveys.

Nine of the 31 unknown or turbine-related fatalities (29.0%) were waterbirds (Table 11). Waterbird species with the most fatalities were unidentified gull (4) and mallard (2). Other waterbird fatalities included 1 each of cinnamon teal, unidentified duck, and American coot. Four of the fatalities (12.9%) were raptors. Raptor species with fatalities included 1 each of red-tailed hawk, American kestrel, great horned owl, and unidentified owl. Only one corvid species suffered fatalities: common raven (2), representing 6.5% of the total. Six of the fatalities (19.5%) were passerines. Passerine fatalities consisted of 1 each of black phoebe, Western meadowlark, Brewer's blackbird, and 3 unidentified passerines. Other birds comprised 16.1% of the fatalities. Other bird species with fatalities included rock dove (5).

Ten of the 31 fatalities (32.3%) were feather spots, 13 (41.9%) consisted of feathers and/or bones, 4 (12.9%) were intact, and 4 (12.9%) were dismembered. More feather spots and fewer intact carcasses were found during Phase II studies than during Phase I. Twenty-four of the 31

Phase II bird fatalities (77.4%) were found during scheduled carcass searches. This was larger than the percentage of Phase I bird fatalities found during scheduled carcass searches. The remaining fatalities were found by observers while conducting other study activities or by power company employees (Appendix B). Only fatalities found during scheduled carcass searches were used to estimate fatality rates.

Turbines were the closest structure that could have caused fatality for 24 of the 31 fatalities (77.4%). Turbines were the first or second closest structure in 30 fatalities (96.8%). When the closest structure was a turbine, dead birds were found from 7 to 66 m (mean = 31.5 m) away from the turbine. When the closest structure was not a turbine and the second closest structure was a turbine (n = 6), dead birds were found from 9 to 56 m (mean = 35.8 m) away from the turbine. Two (6.5%) of the 31 unknown or turbine related fatalities were found less than or equal to 10 m from a turbine, 4 (12.9%) from 10 m ≤ 20 m, 10 (32.3%) from 20 m ≤ 30 m, 7 (22.6%) from 30 m ≤ 40 m, 4 (12.9%) from 40 m ≤ 50 m, and 3 (9.7%) ≥ 50 m from a turbine. Only one fatality (3.2%) was associated with structures other than turbines as the two closest structures. Other structures located closest to (< 20 m) dead birds were meteorological towers (1) and main roads traveled greater than 56 kph (1).

Cause of death could not be determined for 15 (48.4%) of the 31 fatalities. Sixteen (51.6%) fatalities resulted from collisions with turbines. A common raven nest at turbine 5-7 (*Water* area) was the site of additional fatalities not directly attributed to wind turbines. Two immature ravens were found dead due to starvation, exposure, and/or internal injuries during late May 2000. A third immature raven was taken to a rehabilitation center and later released. The adult male from the nest was found electrocuted in mid-June 2000.

None of the 7 fatalities whose age could be determined were immature birds. Of the adult fatalities, 6 (85.7%) collided with turbines and 1 (14.3%) had an undetermined cause of death.

9.6.5 Phase II: Near-Turbine Sites

Nine of the 26 unknown or turbine-related fatalities (34.6%) at NT sites during Phase II surveys were waterbirds (Table 11). Waterbird species with the most fatalities were unidentified gull (4) and mallard (2). Other waterbird fatalities included 1 each of cinnamon teal, unidentified duck, and American coot. Two of the fatalities (7.7%) at NT sites were raptors. Raptor species with fatalities included 1 each of great horned owl and unidentified owl. Only one corvid species suffered fatalities: common raven (2), representing 7.7% of the total. Four of the fatalities (15.4%) were passerines. Passerine fatalities at NT sites consisted of 1 western meadowlark and 3 unidentified passerines. Other birds comprised 19.2% of the fatalities. Other bird species with fatalities at NT sites included rock dove (5).

Turbines were the closest structure that could have caused fatality for 21 of the 26 unknown or turbine-related fatalities (80.8%) found at NT sites. Turbines were the first or second closest structure in all 26 fatalities. Dead birds were found from 7 to 50 m (mean = 28.4 m) away from the closest turbine at NT sites. When the closest structure was a turbine, dead birds were found from 7 to 48 m (mean = 27.6 m) away from the turbine. When the closest structure was not a turbine and the second closest structure was a turbine (n = 5), dead birds were found from 9 to 50 m (mean = 31.8 m) away from the turbine. The mean distances of dead birds from turbines were all larger during Phase II studies compared with Phase I. The horizontal distribution of dead birds surrounding the closest turbine regardless of other structures is depicted in the third frame of Figure 3. The distribution found during Phase II studies is different from that found during

Phase I studies. Overall, dead birds were found farther away from turbines during Phase II studies. Two (7.7%) of the 26 fatalities at NT sites were found less than or equal to 10 m from a turbine, 4 (15.4%) from 10 m ≤ 20 m, 10 (38.5%) from 20 m ≤ 30 m, 6 (23.1%) from 30 m ≤ 40 m, and 4 (15.4%) from 40 m ≤ 50 m from a turbine. At the NT sites, no fatalities were associated with non-turbines as the two closest structures. Other structures located closest to dead birds when the second closest structure was a turbine included distribution lines (3) and fences (2).

9.7 Standardized Bird Utilization, Fatality Rates, and Risk index Comparisons

In this section, comparisons of bird utilization rates, fatality rates, and risk index were made among the primary analysis factors. Bird utilization rates were compared for general analysis categories such as seasons, taxonomic groups, and geographic locations. Fatality rates and the risk indices were compared for all variables except season because searches were performed quarterly and the actual season the fatality occurred cannot always be determined. This is especially true for feather spots and non-fresh carcasses.

9.7.1 Seasons: Utilization

Mean utilization rates and 95% confidence intervals by taxonomic groups were calculated for each season (Table 13).

9.7.1.1 Phase I: Near-Turbine Sites

Higher use was observed during the winter (5.39) and fall (3.40) compared to the spring (1.94) and summer (0.54). Use was highest for waterbirds and passerines. Use was very low for corvids, raptors, and other birds (Table 13). Some differences existed in the observed proportions of use by groups between seasons. Winter use was significantly ($p < 0.10$) higher than spring, and summer use was significantly ($p < 0.10$) lower than the use for all other seasons. Fall use was not significantly different from spring or winter.

9.7.1.2 Phase I: Away-from-Turbine Sites

Higher use was observed during the fall (19.43) and winter (10.43), primarily due to large flocks of waterbirds, compared to spring (4.67) and summer (4.18). Higher use was observed for AFT sites for every season compared to the NT sites. Use was highest for waterbirds, followed by passerines, corvids, other birds, and raptors. Some differences existed in the observed proportions of use by groups between seasons. Fall use was significantly ($p < 0.10$) higher than spring and summer use but was not significantly different from winter use. Spring ($p < 0$), summer, and fall use did not differ significantly.

9.7.1.3 Phase II: Near-Turbine Sites

Higher use was observed during the spring (2.90) compared to summer (0.50), winter (0.41), and fall (0.21). Phase II spring use was higher than for Phase I, while winter and fall were lower, and summer was similar. Use was highest for waterbirds, followed by passerines, corvids, other birds, and raptors. Some differences existed in the observed proportions of use by groups between seasons. Spring use was significantly ($p < 0.10$) higher than all other seasons. Fall use was significantly ($p < 0.10$) lower than summer and spring use but was not significantly different from winter.

9.7.2 Taxonomic Groups: Bird Utilization

Mean utilization rates by taxonomic groups were calculated and presented in Table 13.

9.7.2.1 Phase I: Near-Turbine Sites

The mean utilization rate by all birds was 2.23 birds/survey. Use was highest for waterbirds (1.09 birds/survey), followed by passerines (1.00), corvids (0.11), raptors (0.02), and other birds (0.01). Use by raptors and other birds was not significantly different from each other, but were significantly lower ($p < 0.10$) than waterbirds, passerines, and corvids. Corvids had significantly ($p < 0.10$) higher use than raptors and other birds and significantly ($p < 0.10$) lower use than waterbirds and passerines. Use by waterbirds and passerines was significantly ($p < 0.10$) higher than use by any other avian group; however, they were not significantly different from each other.

9.7.2.2 Phase I: Away-from-Turbine Sites

The mean utilization rate by all birds was 7.70 birds/survey, which was more than three times higher than the NT sites. Overall, use was highest for waterbirds (6.28 birds/survey), followed by passerines (1.15), corvids, other birds (0.12), and raptors (0.02). Waterbirds, passerines, and other birds had higher use for AFT sites compared to the NT sites, whereas corvids and raptors were very similar. Use by raptors was lower (although not statistically significant) than other birds and was significantly ($p < 0.10$) lower than waterbirds, passerines, and corvids. Corvids had significantly ($p < 0.10$) higher use than raptors and significantly ($p < 0.10$) lower use than waterbirds and passerines. Use by waterbirds was significantly ($p < 0.10$) higher than use by any other avian group. Use by passerines was significantly ($p < 0.10$) lower than waterbirds' use and was significantly ($p < 0.10$) higher than use by corvids, other birds, and raptors. Other birds had significantly ($p < 0.10$) lower use than waterbirds and passerines but were not significantly different from corvids and raptors.

9.7.2.3 Phase II: Near-Turbine Sites

The mean utilization rate by all birds was 0.78 birds/survey, which was more than three times lower than the Phase I use. Overall, use was highest for waterbirds (0.49 birds/survey), followed by passerines (0.14), corvids (0.12), and other birds and raptors (0.01). Waterbirds and passerines had lower use for Phase II compared to the Phase I, whereas corvids, raptors, and other birds were very similar. Use by raptors and other birds was significantly ($p < 0.10$) lower than waterbirds, passerines, and corvids, but they were not significantly different from each other. Corvids and passerines had significantly ($p < 0.10$) higher use than raptors and other birds and significantly ($p < 0.10$) lower use than waterbirds; however, they were not significantly different from each other. Use by waterbirds was significantly ($p < 0.10$) higher than use by any other avian group.

9.7.3 Taxonomic Groups: Fatality

Fatality by taxonomic groups is presented in Table 14.

9.7.3.1 Phase I: Near-Turbine Sites

Total bird fatality was 0.044 carcasses/survey. Fatality was highest for waterbirds (0.014 carcasses/survey), followed by other birds (0.011), passerines (0.004), raptors (0.003), and corvids (0.001). There were no significant differences in fatality between taxonomic groups.

9.7.3.2 Phase I: Away-from-Turbine Sites

Total bird fatality was 0.035 carcasses/survey, which was lower than the NT sites. The only fatalities observed were waterbirds (0.025 carcasses/survey) and other birds (0.005). There were no significant differences in fatality between the two taxonomic groups.

9.7.3.3 Phase II: Near-Turbine Sites

Total bird fatality was 0.040 carcasses/survey, which was slightly lower than in Phase I. Fatality was highest for waterbirds (0.013 carcasses/survey), followed by other birds (0.008), passerines (0.007), and raptors and corvids (0.003). There were no significant differences in fatality between taxonomic groups.

9.7.4 Taxonomic Groups: Risk Index

The average risk index by taxonomic groups was calculated and presented in Table 15.

9.7.4.1 Phase I: Near-Turbine Sites

Total bird risk index was 0.019. Risk index was highest for other birds (0.918 carcasses/bird use unit), followed by raptors (0.167), corvids (0.013), waterbirds (0.012), and passerines (0.004) (Table 15). There were no significant differences in risk index between taxonomic groups.

9.7.4.2 Phase I: Away-from-Turbine Sites

Total bird risk index was 0.005, which was lower than the NT sites. The only avian groups with any risk index were other birds (0.043 carcasses/bird use unit) and waterbirds (0.004) (Table 15). There were no significant differences in risk index between the two taxonomic groups.

9.7.4.3 Phase II: Near-Turbine Sites

Total bird risk index was 0.052, which was higher than Phase I. Risk index was highest for other birds (0.881 carcasses/bird use unit), followed by raptors (0.412), passerines (0.047), corvids (0.028), and waterbirds (0.027) (Table 15). There were no significant differences in risk index between taxonomic groups.

9.7.5 Geographic Location: Utilization

Mean utilization rates by taxonomic groups were calculated for each geographic location (Table 13).

9.7.5.1 Phase I: Near-Turbine Sites

Higher use was observed within the *Water* (6.18 birds/survey) and *Low* (2.30) areas, compared to the *High* (0.57) and *Medium* (0.42) elevation areas. Use was highest for waterbirds (1.09), followed by passerines (1.00), corvids (0.11), raptors (0.02), and other birds (0.01) (Table 13). Some differences existed in the observed proportions of use by groups within different geographic locations. Use at the *Water* area was significantly ($p < 0.10$) higher than all other geographic locations. The *Low* elevation area use was significantly ($p < 0.10$) higher than the *Medium* and *High* elevation areas and significantly ($p < 0.10$) lower than the *Water* area. The *Medium* and *High* elevation areas were significantly ($p < 0.10$) lower than the *Water* and *Low* areas; however, they were not significantly different from each other.

Raptors showed similar use at all geographic locations with the highest use at the *Water* area (0.04 birds/survey) and the lowest use at the *Low* elevation area (0.01). The highest use for corvids was observed at the *Water* area (0.16). Significantly ($p < 0.10$) lower use was observed at the *Medium* elevation area (0.05). No other significant differences were observed among geographic locations for corvids. Passerines use was highest in the *Water* area (1.81). Significantly ($p < 0.10$) lower use was observed at the *High* (0.45) and *Medium* (0.34) elevation areas. The *Medium* elevation area was also significantly ($p < 0.10$) lower than the *Low* elevation area for passerines. The *Low* and *Water* areas were not significantly different from each other for

passerines. There were no significant differences in use among the geographic locations for other birds. Waterbirds were only observed at the *Water* (4.16) and *Low* (0.92) areas, which were significantly ($p < 0.10$) different from each other.

9.7.5.2 Phase I: Away-from-Turbine Sites

Higher use was observed within the *Water* (25.70 birds/survey) area, compared to the *Low* (2.90), *High* (1.35), and *Medium* (1.03) elevation areas. *Water* area had more than four times the use than the NT sites. The other geographic locations were also all higher for AFT sites compared to NT sites. Use was highest for waterbirds (6.28), followed by passerines (1.15), corvids and other birds (0.12), and raptors (0.02) (Table 13). Some differences existed in the observed proportions of use by groups within different geographic locations. Use at the *Water* area was significantly ($p < 0.10$) higher than all other geographic locations. No other significant differences were observed among the geographic locations.

9.7.5.3 Phase II: Near-Turbine Sites

Higher use was observed within the *Water* area (1.57 birds/survey) compared to the *Low* elevation area (0.32). Both geographic locations in Phase II were lower than their counterparts in Phase I. Use was highest for waterbirds (0.49), followed by passerines (0.14), corvids (0.12), and raptors and other birds (0.01) (Table 13). Use at the *Water* area was significantly ($p < 0.10$) higher than the *Low* elevation area.

Raptors showed similar use at the two locations with the highest use at the *Water* area (0.02) and the lowest at the *Low* elevation area (<0.01). The highest use for corvids was observed at the *Water* area (0.20), which was significantly higher ($p < 0.10$) than at the *Low* elevation area (0.07). Again, passerine use was highest in the *Water* area (0.31). Significantly ($p < 0.10$) lower use was observed at the *Low* elevation area (0.04). There were no significant differences in use between the geographic locations for other birds. Again, the *Water* area (1.01) was significantly higher ($p < 0.10$) than the *Low* elevation area (0.19) for waterbirds.

9.7.6 Geographic Location: Fatality

Mean fatality by taxonomic groups was calculated for each geographic location (Table 14).

9.7.6.1 Phase I: Near-Turbine Sites

Low elevation area had the highest bird fatality (0.075 carcasses/survey), followed by *Water* area (0.045), and *Medium* elevation area (0.030). No fatalities were observed at the *High* elevation area (Table 14). There were no significant differences between any of the geographic locations.

Very low fatality was observed at all of the geographic locations. For *Water* area, fatalities were only observed for waterbirds (0.027). *Low* elevation area had the largest variation in fatalities rates, but no significant differences existed between the taxonomic groups. Other birds (0.023) and waterbirds (0.020) had the highest observed fatality compared to raptors and passerines (0.007) and corvids (0.004). For *Medium* elevation area, fatality was the same for waterbirds, passerines, and other birds (0.007), and no fatalities were observed for raptors and corvids.

Fatalities were only observed at the *Low* elevation area for raptors and corvids (0.007 carcasses/survey and 0.004, respectively). Passerines showed the same fatality between *Low* and *Medium* elevation areas (0.007). There was no significant difference in fatality between *Low* (0.023) and *Medium* (0.007) elevation areas for other birds. Waterbirds had the highest fatality

rate in the water area (0.027) compared to *Low* (0.020) and *Medium* (0.007) elevation areas but were not significantly ($p > 0.10$) different.

9.7.6.2 Phase I: Away-from-Turbine Sites

Water area had the highest bird fatality (0.080 carcasses/survey), followed by *Low* (0.040) and *Medium* (0.020) elevation areas. No fatalities were observed at the *High* elevation area (Table 14). The *Low* and *Medium* elevation areas for AFT sites had lower fatality than the NT sites, but the *Water* area had a higher fatality. There were no significant differences between the geographic locations.

A very low fatality rate was observed at all the geographic locations. Fatalities were only observed at *Water* (0.080 carcasses/survey) and *Low* (0.020) areas for waterbirds and at *Medium* elevation area (0.020) for other birds.

9.7.6.3 Phase II: Near-Turbine Sites

Water area had the highest bird fatality (0.068 carcasses/survey), followed by *Low* elevation area (0.024) (Table 14). There were no significant differences between the geographic locations. The *Water* area had higher fatality for Phase II than Phase I, while *Low* elevation area had lower fatality for Phase II than Phase I.

Fatality was highest for waterbirds (0.032 carcasses/survey), followed by other birds (0.014) and corvids and passerines (0.005). No raptor fatalities were observed in the *Water* area. *Low* elevation area had a very low fatality for all avian groups. Passerines (0.008) had the "highest" observed fatality compared to raptors and others (0.005) and waterbirds and corvids (0.003, Table 14).

Fatalities were only observed at the *Low* elevation area for raptors (0.005 carcasses/survey). Corvids had the highest fatality at the *Water* area (0.005), compared to the *Low* elevation area (0.003). Passerines had the opposite pattern of corvids with *Low* elevation area (0.008) followed by *Water* area (0.005). Fatality was highest at *Water* area (0.032), followed by *Low* elevation area (0.003) for waterbirds, but the difference was not significant. There was no significant difference in fatality between *Water* (0.014) and *Low* (0.005) areas for other birds.

9.7.7 Geographic Location: Risk Index

The average risk index by taxonomic groups was calculated for each geographic location (Table 15).

9.7.7.1 Phase I: Near-Turbine Sites

Medium elevation area had the highest bird risk index (0.073 carcasses/bird), followed by *Low* elevation area (0.028) and *Water* area (0.007) (Table 15). Patterns of the risk index for individual groups of birds varied by geographic location. For *Water* area, waterbirds had the only risk index (0.006 carcasses/bird unit). The most variation occurred at the *Low* elevation area. Risk index was highest for other birds (1.667), followed by raptors (0.632), corvids (0.027), waterbirds (0.018), and passerines (0.005). None of the observed risk index estimates by avian groups were significantly different from one another. For *Medium* elevation area, risk index was highest for other birds (2.000), followed by passerines (0.023), but not significantly. No fatalities were observed at *High* elevation area resulting in a risk index of 0 for all avian groups.

Raptors only had a risk index at *Low* elevation area (0.632 carcasses/bird). The *Low* elevation area was the only geographic location with any risk index for corvids (0.027). Passerines showed no significant differences in risk index between *Medium* elevation area (0.023) and *Low* elevation area (0.005). *Low* elevation area (0.018) had the highest risk index for waterbirds compared to *Water* area (0.006), but the difference was not significant. The highest risk index observed for other birds was at *Medium* elevation area (2.000) compared to the *Low* elevation area (1.667). There were no significant differences in risk index by geographic location for other birds.

9.7.7.2 Phase I: Away-from-Turbine Sites

Medium elevation area had the highest bird risk index (0.019 carcasses/bird), followed by *Low* elevation area (0.014) and *Water* area (0.003) (Table 15). AFT sites had lower risk indices for all geographic locations compared to the NT sites. For *Water* area, waterbirds had the only risk index (0.003). Again, waterbirds had the only risk index for *Low* elevation area (0.010). For *Medium* elevation area, the only risk index was for other birds (0.500). No fatalities were observed at *High* elevation area. There were no significant differences in risk index between avian groups or geographic locations.

9.7.7.3 Phase II: Near-Turbine Sites

Low elevation area had the highest bird risk index (0.074 carcasses/bird), followed by *Water* area (0.044) (Table 15). Both geographic locations had higher risk indices for Phase II than for Phase I. Patterns of risk index for individual groups of birds varied by geographic location. For *Water* area, other birds had the highest risk index (1.110), followed by waterbirds (0.031), corvids (0.023), and passerines (0.014). For *Low* elevation area, risk index was highest for raptors (1.488), followed by other birds (0.673), passerines (0.192), corvids (0.036), and waterbirds (0.014). None of the observed risk index estimates by taxonomic groups was significantly different from another.

Raptors only had a risk index at the *Low* elevation area (1.488 carcasses/bird). Corvids had the highest risk index at *Low* elevation area (0.036) compared to *Water* area (0.023), but the difference was not significant. Passerines showed no significant differences in risk index between *Low* elevation area (0.192) and *Water* area (0.014). *Water* area (0.031) was the highest risk index for waterbirds compared to *Low* elevation area (0.014), but the difference was not significant. The highest risk index observed for other birds was at *Water* area (1.110) compared to *Low* elevation area (0.673). There were no significant differences in risk index by location for other birds.

9.7.8 Turbine Size: Utilization

Mean use, fatality, and risk index for large (≥26-m rotor diameter) and small (<26-m rotor diameter) turbines were standardized only to a per-turbine basis. Fatality and risk index were expected to be higher for larger turbines because of their larger rotor diameter.

Mean utilization rates by taxonomic groups were calculated for each turbine size and geographic location (Table 16).

9.7.8.1 Phase I: Near-Turbine Sites

Low and *High* elevation areas were the only geographic locations with both large and small turbines, containing large and small tubular and small lattice structures (Table 2). *Water* and *Medium* areas contained only small lattice and tubular structures. Small turbines had higher use

(2.430 birds/survey) compared to large turbines (1.779) (Table 16). Use was highest for both *Low* (3.021) and *High* (0.612) elevation areas for the small turbines compared to *Low* (1.955) and *High* (0.606) elevation areas for the large turbines (Table 16).

9.7.8.2 Phase II: Near-Turbine Sites

Both *Water* and *Low* areas contained large and small tubular structures. Large turbines had higher use (1.056 birds/survey) compared to small turbines (0.629) (Table 16). Use was highest for *Water* (1.998) and *Low* (0.446) areas for the large turbines compared to *Water* (1.134) and *Low* (0.259) for the small turbines (Table 16). These results will be the same as the Turbine Type section below, given only tubular structures exist at Phase II.

9.7.9 Turbine Size: Fatality

Mean fatality by taxonomic groups was calculated for each turbine size and geographic location (Table 17).

9.7.9.1 Phase I: Near-Turbine Sites

Large turbines had higher bird fatality rates (0.087/search) than small turbines (0.035), although the difference was not statistically significant ($p > 0.10$, Table 17). Within all taxonomic groups, except corvids for which no fatalities were observed at the large turbines, the fatality rate at large turbines was higher than at small turbines, although none of the differences were statistically significant. The influence of more than a single turbine in a plot could have affected the results of this study.

Comparisons of bird fatality rates of the turbines in *Low* elevation area show slightly higher fatality rates at larger turbines compared to smaller turbines for all avian groups, except corvids for which no fatalities were observed at the large turbines (Table 17). None of the differences was statistically significant ($p > 0.10$). No fatalities were observed at the *High* elevation area. Rotor swept area of the larger turbines in this comparison are two to three times larger than the rotor swept area of the smaller turbines.

9.7.9.2 Phase II: Near-Turbine Sites

Large turbines had a slightly higher bird fatality rate (0.046/search) than small turbines (0.042), although the difference was not statistically significant ($p > 0.10$, Table 17). The fatality rate at large turbines was only higher than at small turbines for waterbirds, was lower for passerines and other birds, and was the same for raptors and corvids. None of the differences was statistically significant. The influence of more than a single turbine in a plot could have affected the results of this study.

Comparisons of fatality rates at *Water* area show that at larger turbines (0.082), fatality rates were higher compared to smaller turbines (0.055), and no distinct pattern existed between the fatality rates for the avian groups (Table 17). The differences between the avian groups were not statistically significant. Fatality rates at *Low* elevation area were higher for small turbines (0.033) compared to large turbines (0.024). Comparisons of fatality rates for the avian groups show that when fatalities were observed for both turbine types, the fatality rate was higher for the smaller turbines but not statistically significant ($p > 0.10$, Table 17). Rotor swept area of the larger turbines in this comparison are two to three times larger than the rotor swept area of the smaller turbines. These results will be the same as the Turbine Type section below, given only tubular structures exist at Phase II.

9.7.10 Turbine Size: Risk Index

The average risk index by taxonomic groups was calculated for each turbine size and geographic location (Table 18).

9.7.10.1 Phase I: Near-Turbine Sites

Larger turbines had a higher risk index (0.049) than smaller turbines (0.015), although the difference was not statistically significant ($p > 0.10$, Table 18). The raptor risk index was higher for large turbines (0.800 versus 0.093) but not statistically significant. Within the *Low* elevation area, which contains both large and small turbines, larger turbines (0.051) had a larger risk than smaller turbines (0.020) and for avian groups with a risk index at both turbine sizes. None of the differences was statistically significant.

9.7.10.2 Phase II: Near-Turbine Sites

Smaller turbines had a higher risk index (0.067) than larger turbines (0.044), although the difference was not statistically significant ($p > 0.10$, Table 18). The raptor risk index was slightly higher for small turbines (0.464 versus 0.411) but not significantly different.

For *Water* area, smaller turbines had a slightly higher risk index (0.048) than larger turbines (0.041), which was also true for all avian groups, except other birds (Table 18). Within *Low* elevation area, smaller turbines (0.129) had a larger risk index than larger turbines (0.053) and for passerines and other birds. Raptors had a higher risk index at the large turbines (3.700) compared to the small turbines (1.244). No significant differences existed between risk index for either geographic location ($p > 0.10$, Table 18). These results will be the same as the Turbine Type section below, given only tubular structures exist at Phase II.

9.7.11 Turbine Types: Utilization

Mean utilization rates by taxonomic groups were calculated for each geographic location and turbine style (Table 19).

9.7.11.1 Phase I: Near-Turbine Sites

Low and *High* elevation areas contained LTT, stt, and slt, while *Water* and *Medium* areas contained only slt and stt (Table 2). Higher use occurred at the stt (3.804 birds/survey) compared to LTT (1.779) and slt (0.765) (Table 19). Overall use was statistically higher at the stt than at the slt ($p < 0.10$, Table 19). LTT were not significantly different than either stt or slt. Use was highest for stt for all geographic locations, except *High* elevation area where stt had the lowest use. The only significant difference that existed between turbine types occurred at *High* elevation area, where the slt (0.755) were significantly higher than the stt (0.238) ($p < 0.10$, Table 19).

9.7.11.2 Phase II: Near-Turbine Sites

Both *Water* and *Low* areas only contained LTT and stt (Table 2); therefore the results are the same as the Turbine Size section above. Higher overall use occurred at the LTT (1.056 birds/survey) compared to stt (0.629) (Table 19). The difference was not statistically different ($p > 0.10$, Table 19). Use was highest for LTT for both geographic locations. No significant differences existed between turbine types at the geographic locations ($p > 0.10$, Table 19).

9.7.12 Turbine Types: Fatality

Mean fatality for each taxonomic group was calculated for each turbine type and geographic location (Table 20).

9.7.12.1 Phase I: Near-Turbine Sites

Fatality rates were highest for LTT (0.087/search), followed by stt (0.042) and slt (0.027), although confidence intervals for all estimates overlapped one another, indicating no statistically significant differences (Table 20). A similar pattern existed for raptors, with the highest fatality rate occurring with LTT (0.009), followed only by stt (0.003) (slt had no observed raptor fatalities). None of the differences was statistically significant ($p > 0.10$, Table 20).

No fatalities were observed at the *High* elevation area. For the other geographic location with LTT, *Low* elevation area, the fatality rates mimicked the overall results with LTT having the highest rate (0.100/search), followed by stt (0.075) and slt (0.033). For *Water* and *Medium* areas, the higher fatality rates were at the slt (0.086 and 0.033, respectively), followed by stt (0.027, for both areas). No differences between the geographic locations or turbine types were statistically significant ($p > 0.10$). Fatalities rates among avian groups showed no consistent pattern among geographic locations and turbine types.

9.7.12.2 Phase II: Near-Turbine Sites

Fatality rates were only slightly higher for LTT (0.046/search) compared to stt (0.042) (Table 20). A similar pattern existed for raptors, with the same fatality rate occurring at LTT and stt (0.004). None of the differences was statistically significant ($p > 0.10$, Table 20).

For *Water* area, the higher fatality rate occurred at LTT (0.082/search), followed by stt (0.055). For *Low* elevation area, the higher fatality rate was at the stt (0.033) compared to LTT (0.024). No differences between the geographic locations or turbine types were statistically significant ($p > 0.10$). Similar to Phase I, fatality rates among avian groups showed no consistent pattern among geographic locations and turbine types.

9.7.13 Turbine Types: Risk Index

9.7.13.1 Phase I: Near-Turbine Sites

Overall, the average risk index was highest for LTT (0.049), followed by slt (0.035) and stt (0.011), although confidence intervals for all estimates overlapped one another, indicating no statistically significant differences (Table 21). Raptor risk index was highest at LTT (0.800) compared to stt (0.196), with no raptor fatalities and subsequently 0 for an estimate of risk index at the slt (Table 21).

No fatalities were observed at *High* elevation area, resulting in 0 for all estimated risk indices. Within *Low* elevation area, mean overall risk index was highest for the LTT (0.051), followed by slt (0.048) and stt (0.018). Mean raptor risk index was highest for the stt (1.091) compared to estimates for LTT (0.800). For *Water* and *Medium* areas, the average risk index results followed the same pattern as the fatalities rates with slt (0.050 and 0.109, respectively) having the highest risk index over stt (0.003 and 0.055, respectively, Table 21). No significant differences existed between the average risk indices for the geographic locations and turbine types.

9.7.13.2 Phase II: Near-Turbine Sites

Overall, the average risk index was highest for stt (0.067), followed by LTT (0.044), although confidence intervals for the estimates overlapped one another, indicating no statistically significant differences (Table 21). Raptor risk index was slightly higher at stt (0.464) compared to LTT (0.411) (Table 21).

For *Water* area, the average risk index was slightly higher for stt (0.048) compared to LTT (0.041). Within *Low* elevation area, the average overall risk index was again highest for the stt (0.129) followed by LTT (0.053). The average raptor risk index was highest for the LTT (3.700) compared to estimates for stt (1.244) but was not significantly different ($p > 0.10$, Table 21). The average passerine risk index followed the same pattern as *Low* elevation area with stt (0.247) having the highest risk index compared to LTT (0.185, Table 21). No significant differences existed between the average risk indices for the geographic locations and turbine types.

9.8 Observer Detection Rates

Two observer efficiency experiments were conducted: September 22, 1997 and March 31, 1998. A total of 396 native birds or bird parts were placed in the field for observers to either detect or not detect, and then detection rates of placed birds/parts were determined (Table 22). During the first experiment, detection rates of small carcasses was lower than detection rates of large birds/parts, and detection rates in small shrub habitat were lower than detection rates in both large shrub and open habitats. Detection rates of small birds in small shrub habitat were significantly lower ($p < 0.10$) than detection rates of large carcasses in both large shrub and open habitat. Similar trends existed during the second study. Small birds/parts in small shrub habitat were significantly less detectable than large birds within open habitats.

Overall, observers detected 64% of the carcasses/parts placed in the field. Large birds/parts were detected 84% of the time in open habitat, 73% in large shrub habitat, and 55% in small shrub habitat. Small carcasses/parts were detected 60% of the time in open habitat, 64% in large shrub habitat, and 53% in small shrub habitat. Overall, small birds/parts were significantly less detectable than large birds in open habitats ($p < 0.10$) but not in the other two habitats. Large birds/parts were significantly more detectable in open habitat than small shrub habitat. There were no significant differences in detectability between the other two habitats for either small or large birds/parts.

9.9 Scavenging Rates

Two scavenging experiments were conducted, one in April 1997 and one in December 1997. A total of 215 carcasses were used to estimate scavenging rates (Table 23). Primary analysis variables compared include placement (within 100 m of turbines, between 100 and 400 m from turbines, and greater than 400 m from turbines), season (two dates), study area, carcass size (small and large), and carcass color (cryptic vs. non-cryptic). Overall, 90% of the carcasses were removed 8 days after placement, and 96% at day 10. The estimated proportion of fatalities removed by day 8 varied little by the primary analysis variables. The mean time to removal estimate was 3.92 days (95% confidence interval (3.56, 4.29).

9.9.1 Proximity to Turbines

The mean removal time for carcasses near turbines was similar to those far from turbines (4.13 and 3.97).

9.9.2 Geographic Location

The mean removal time was lowest in the *Water* areas (2.59 days), with very similar estimates for the *Low*, *Medium,* and *High* elevation areas (4.26, 4.05, and 4.29). The mean in the *Water* area was significantly lower than *High* and *Medium* elevation areas ($p < 0.10$).

9.9.3 Season

Mean removal time was significantly lower during the April trial (3.21) compared to the December trial (4.31, $p<0.10$).

9.9.4 Size of Carcass

Mean removal time was lower for small carcasses compared to large carcasses but not significantly different ($p > 0.10$). It should be noted that all small carcasses were white or yellow, while all large carcasses were brown.

9.9.5 Color

Mean removal time was higher for cryptic-colored carcasses (4.08 days) compared with non-cryptic-colored carcasses (3.62 days), although this difference was not statistically significant ($p > 0.10$).

10.0 Discussion/Conclusions

This study was not specifically designed to provide standardized estimates of avian fatalities. The wide interval between searches (90 days) led to a high level of uncertainty in the fatality estimates. The unknown impact of scavenging on the fatality estimates could greatly impact them. With these obvious caveats in mind, the unadjusted estimate of raptor fatalities for the wind resource area is 0.006 per turbine per year. The average nameplate output of the turbines in our sample was 155 kW during Phase I and approximately 800 kW during Phase II, yielding an estimate of approximately 0.03 raptor fatalities per MW per year unadjusted for searcher efficiency and scavenging bias. These estimated fatality rates are much lower than the unadjusted estimates from the Altamont Pass WRA (Smallwood and Thelander 2004) and Tehachapi Pass (Anderson *et al.* 2004).

The lack of random assignment of treatments to experimental units may have caused some variables to be confounded. For example, there were no lattice structures in the Phase II geographic locations, possibly confounding the effect of turbine type with geographic location. Differences in overall fatality rates or risk index between tubular towers and lattice towers may be due to differences in geographic location and not differences due to turbine type.

Scavengers, predators, and other removal sources (e.g., oiled carcass sinking in water, carcasses plowed into field) may remove carcasses between the time the casualty occurs and the time the next search is conducted. Estimating scavenging rates is vital to providing good fatality rates (Erickson *et al.* 2000). It is less vital in a study like this when comparing indices among levels of several factors. We did need to assume similar average scavenging rates among the levels of the factors studied. The estimated scavenging rates were higher than those recorded at several other wind projects (Morrison 2002). At the newly constructed Vansycle windplant, located primarily in wheat fields, small carcasses lasted on average 15.0 days, and large carcasses lasted on average greater than the search interval of 28 days (Erickson *et al.* 2000). At the Buffalo Ridge windplant, small carcasses persisted on average 4.7 days, whereas small birds at Foote Creek Rim persisted 12.2 days. Some other scavenging studies have observed high rates of scavenging, such as those estimated at San Gorgonio. Wobeser and Wobeser (1992) reported that nearly 80% (79.2) of the chicks placed in a mixed grazed pasture were removed within 24 hours of being placed. In France, Pain (1991) estimated duck carcasses lasted an average of 1.5 days in open habitats, whereas those concealed by vegetation or those in water lasted between 3.3 and 7.6 days. In one orchard, scavengers removed all 25 of the placed carcasses within 24 hours, with lower rates in the other orchards studied.

It is likely that disappearance rates also vary by species or avian group. For example, it is speculated that raptor carcasses last longer than other large bird carcasses such as gamebirds and waterfowl, although limited empirical data exist to test this hypothesis. Although not tested experimentally, chickens are also likely scavenged at higher rates than raptors.

Observed fatality rates during the Phase I and Phase II components of this study were very low. Due to the low fatality rates, strong patterns in comparison results of fatality and the risk index among levels of factors such as geographic location and type of turbine were not very apparent.

Some fatalities observed during carcass searches at San Gorgonio and other wind projects may not have been caused by the wind facility. Given the large interval between searches on the sites,

many of the carcasses were old and desiccated, which makes it difficult to assign cause of death. We used a conservative approach in which we included all observed fatalities unless cause could be determined to not be wind-facility related.

Bird use was estimated to be similar within 200 m of turbines compared to AFT sites, suggesting no measurable displacement impact at this project.

Rock doves were the most common fatality observed during the study and contributed to the "other bird" category being most at risk. Raptor fatality was very low, but our risk index suggested they still were more at risk than other groups, such as corvids and waterbirds. This was consistent with studies at the Altamont (Thelander *et al.* 2003) and Tehachapi (Anderson *et al.* 2004).

In any future studies at San Gorgonio, we recommend additional scavenging trials be conducted, using bird species that are more representative of the species/groups targeted for monitoring. We also recommend that searches be conducted more frequently and include rows of turbines. Initial scavenging studies should be used to direct how often a plot is to be searched.

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Table 1. Vegetation types documented during Phase I and Phase II studies at San Gorgonio Pass WRA based on vegetation observed within 50 m of the sample site center

Vegetation Structure	Dominant Group/Species	
	Phase I	Phase II
Grass		
	Burned Annual Grassland	Mixed Annuals
	California Annual Grassland	
Subshrub		
	Brittlebush	Crinkled Mats
	California Dalea	Rabbit Brush
	Cheese Bush	Sandpaper Plant
	Rabbit Brush	Scalebroom
	Russian Thistle	White Bur Sage
	Saltbush (Atriplex spp.)	
	Scale Broom	
	White Bur Sage	
	Other	
Large Shrub		
	Creosote Bush	Creosote Bush
		Desert Willow
Wooded		
	Tamarisk	Tamarisk

Table 2. Description of turbines within the Phase I and Phase II studies at San Gorgonio Pass WRA and the turbines selected for the study

MODEL	Tower Type	Tower Height (m)	# blades	Rotor Height (m) max	Rotor Height (m) min	Rotor Length(m)	RSA[a] m	# in WRA	# in sample[b]
Phase I									
***Water* area**									
Entertech 40	slt	24.4	3	31.1	17.7	6.7	141.03	85	7
Micon 108	stt	24.4	3	33.9	14.9	9.5	283.53	107	3
Micon 65	stt	24.4	3	32	16.8	7.6	181.46	136	12
***Low* elevation area**									
Entertech 40	slt	24.4	3	31.1	17.7	6.7	141.03	143	12
Micon 108	stt	24.4	3	33.9	14.9	9.5	283.53	353	22
Micon 65	stt	24.4	3	32	16.8	7.6	181.46	104	3
Micon M-1500	LTT		3			21.7	1479.34	7	7
Nedwind	LTT	38.5	2	58.1	18.1	20	1256.64	20	13
***Medium* elevation area**									
Bonus 120	stt	24.4	3	33.4	15.4	9	254.47	119	1
Bonus 65	stt	24.4	3	31.9	16.9	7.5	176.71	65	3
Micon 108	stt	24.4	3	34.1	14.6	9.7	295.59	61	2
Micon 65	stt	24.4	3	32.6	16.1	8.3	216.42	97	5
Nordtank 65	stt	24.4	3	32.6	16.1	8.3	216.42	83	3
Vestas 15	slt	24.4	3	32	16.7	7.7	186.26	65	4
Vestas 17	slt	24.4	3	32.9	15.9	8.5	226.98	164	8
Wincon 110	stt	24.4	3	35.2	13.6	10.8	366.44	85	1
***High* elevation area**									
Danwin 160	stt	24.4	3	36	12.8	11.6	422.73	115	8
Vestas 15A	slt	24.4	3	32	16.7	7.7	186.26	385	20
Vestas 15B	slt	42.7	3	50.3	35	7.7	186.26	77	1
Vestas V-27	LTT	42.7	3	56.2	29.2	13.5	572.55	41	3
							Subtotal	2312	138
Phase II									
***Water* area**									
Micon 108 and 65	stt								11
Micon M-1500	LTT								11
***Low* elevation area**									
Micon 108 and 65	stt								15
Micon M-1500	LTT								17
Nedwind	L2TT	38.5	2	58.1	18.1	20	1256.64	20	6
							Subtotal		60
							Total		198

[a] Rotor swept area
[b] All sample sites included multiple turbines

Table 3. Sample sizes for each factor used in comparison of fatality rates, use, and collision risk

Measure/Category	Overall		Phase I		Phase II	
	n	%	n	%	n	%
Phases	238		178		60	
Proximity to Turbine						
Near	198	83.2	138	77.5	60	100.0
Away	40	16.8	40	22.5	0	0
Turbine Type						
L2TT	6	3.0	0	0.0	6	10.0
LTT	27	13.6	23	16.7	28	46.7
slt	52	26.3	52	37.7	0	0
stt	102	51.5	63	45.7	26	43.3
Turbine Size						
Large	57	28.8	23	16.7	34	9.3
Small	141	71.2	115	83.3	26	90.7

Table 4. Number of groups and individuals of avian groups observed during bird utilization surveys during Phase I and Phase II studies at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II

	Phase I: NT Site		Phase I: AFT Site		Phase II	
Species	# Groups	# Indivs.	# Groups	# Indivs.	# Groups	# Indivs.
Waterbirds						
Western Grebe	0	0	4	7	1	1
Unidentified Grebe	0	0	0	0	1	1
Double-Crested Cormorant	26	357	52	930	25	288
Red-Breasted Merganser	0	0	0	0	2	3
Brown Pelican	0	0	2	2	0	0
Common Merganser	0	0	5	27	0	0
Mallard	30	92	21	68	52	164
Gadwall	2	20	2	8	3	14
American Green-Winged Teal	0	0	2	150	2	4
Cinnamon Teal	3	14	0	0	4	7
Northern Shoveler	1	1	2	8	0	0
Northern Pintail	0	0	4	12	0	0
Redhead	0	0	15	439	10	80
Canvasback	0	0	2	16	1	2
Greater Scaup	0	0	0	0	1	1
Unidentified Scaup	0	0	0	0	1	1
Ring-Necked Duck	1	1	7	28	7	52
Bufflehead	3	6	4	10	3	6
Ruddy Duck	6	38	21	290	6	12
Unidentified Duck	16	1130	8	606	4	22
Canada Goose	1	27	0	0	0	0
Unknown Light Goose	0	0	0	0	1	1
Black Brant	2	2	0	0	2	27
Great Blue Heron	11	13	4	5	43	50
Great Egret	24	35	24	52	30	55
Snowy Egret	0	0	0	0	2	2
Black-Crowned Night Heron	1	1	0	0	0	0
Tri-Colored Heron	0	0	0	0	4	4
American Coot	54	1183	64	2053	30	257
American Avocet	0	0	0	0	1	1
Black-Necked Stilt	0	0	0	0	3	5
Least Sandpiper	0	0	0	0	9	22
Western Sandpiper	0	0	0	0	3	48
Unidentified Sandpiper	1	6	1	14	10	53
Greater Yellowlegs	2	4	2	2	5	9
Lesser Yellowlegs	0	0	0	0	1	1
Killdeer	9	97	7	11	40	84

Table 4 (continued)

	Phase I: NT Site		Phase I: AFT Site		Phase II	
Species	# Groups	# Indivs.	# Groups	# Indivs.	# Groups	# Indivs.
Eared Grebe	3	3	6	13	1	1
Glaucous-Wing gull	0	0	0	0	1	1
California Gull			4	164	11	24
Unidentified Gull	114	2643	63	1703	63	1577
Ring-Billed Gull	9	99	38	469	0	0
Pied-Billed Grebe	3	8	4	8	3	3
Bonaparte's Gull	2	2	0	0	0	0
Caspian Tern	14	57	24	75	7	23
Common Loon	0	0	8	9	1	6
Unknown Tern	0	0	0	0	1	2
Unidentified Waterbird	0	0	0	0	6	15
Subtotal	338	5839	400	7179	401	2929
Raptors						
Northern Harrier	1	1	2	2	0	0
Red-Tailed Hawk	25	26	12	12	2	2
Unidentified Buteo	1	1	0	0	0	0
Golden Eagle	10	13	1	1	0	0
Bald Eagle	0	0	2	2	0	0
Prairie Falcon	4	4	2	3	9	9
Peregrine Falcon	4	4	0	0	0	0
American Kestrel	27	28	4	4	10	10
Osprey	0	0	1	1	1	1
Common Barn Owl	0	0	0	0	1	1
Burrowing Owl	0	0	5	5	0	0
Unidentified Raptor	3	3	0	0	0	0
Subtotal	75	80	29	30	23	23
Corvids						
Scrub Jay	1	1	0	0	0	0
Common Raven	328	489	123	196	301	440
American Crow	0	0	0	0	2	3
Subtotal	329	490	123	196	303	443
Passerines						
White-Throated Swift	5	44	10	61	0	0
Anna's Hummingbird	0	0	2	3	0	0
Broad-Tailed Hummingbird	0	0	0	0	1	1
Unidentified Hummingbird	4	4	7	7	0	0
Western Kingbird	0	0	3	3	1	1
Say's Phoebe	0	0	2	3	10	10
Black Phoebe	0	0	1	1	6	6
Unidentified Flycatcher	0	0	0	0	3	3

Table 4 (continued)

Species	Phase I: NT Site # Groups	Phase I: NT Site # Indivs.	Phase I: AFT Site # Groups	Phase I: AFT Site # Indivs.	Phase II # Groups	Phase II # Indivs.
Horned Lark	6	12	25	43	3	6
European Starling	81	134	3	10	2	3
Brown-Headed Cowbird	0	0	0	0	10	24
Red-Winged Blackbird	5	35	1	1	11	14
Western Meadowlark	18	25	9	24	0	0
Brewer's Blackbird	18	36	34	70	24	130
House Finch	103	1946	24	277	5	12
American Goldfinch	0	0	0	0	1	3
Lesser Goldfinch	1	12	1	1	0	0
Lawrence's Goldfinch	3	5	1	1	0	0
Savannah Sparrow	4	13	2	2	4	5
Lark Sparrow	1	1	2	3	0	0
White-Crowned Sparrow	21	82	20	46	0	0
Black-Throated Sparrow	4	11	7	8	0	0
Sage Sparrow	0	0	2	2	0	0
Rufous-Crowned Sparrow	0	0	1	1	0	0
Unidentified Sparrow	16	24	38	60	14	26
Abert's Towhee	0	0	6	6	0	0
Western Tanager	0	0	0	0	1	1
Cliff Swallow	2	16	2	10	0	0
Barn Swallow	0	0	6	34	0	0
Violet-Green Swallow	0	0	1	1	2	3
Northern Rough-Winged Swallow	0	0	2	10	0	0
Unidentified Swallow	0	0	6	9	5	12
Phainopepla	1	1	1	1	0	0
Loggerhead Shrike	29	30	12	15	26	27
Yellow Warbler	0	0	2	4	0	0
Yellow-Rumped Warbler	12	43	1	5	4	4
Black-Throated Gray Warbler	2	2	0	0	0	0
Wilson's Warbler	0	0	3	3	0	0
Unidentified Warbler	0	0	0	0	1	2
Sage Thrasher	0	0	3	3	0	0
Northern Mockingbird	3	3	1	1	0	0
California Thrasher	1	1	0	0	0	0
Le Conte's Thrasher	2	2	4	9	0	0
Cactus Wren	4	5	0	0	0	0
Rock Wren	28	29	26	32	0	0
Bewick's Wren	2	2	3	4	0	0
Black-Tailed Gnatcatcher	0	0	1	2	0	0
Mountain Bluebird	0	0	1	1	0	0
Unidentified Passerine	91	236	70	175	26	34
Subtotal	467	2754	346	952	160	327

Table 4 (continued)

Species		Phase I: NT Site # Groups	Phase I: NT Site # Indivs.	Phase I: AFT Site # Groups	Phase I: AFT Site # Indivs.	Phase II # Groups	Phase II # Indivs.
Others							
Rock Dove		8	79	0	0	7	10
Mourning Dove		10	11	19	72	1	5
Gambel's Quail		1	1	4	21	0	0
Greater Roadrunner		5	5	1	1	8	8
Unidentified Bird		22	132	17	19	11	19
	Subtotal	46	228	41	113	27	42
Total		1255	9391	939	8470	914	3764

Table 5. Avian abundance and richness by season during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations within 200 m of site center

Season / Metric	Study Area				
	Overall	*Water*	*Low*	*Medium*	*High*
Phase I – NT Sites					
Spring					
No. Species	25	11	8	8	13
Mean No. / Survey[a]	1.94	3.45	2.40	1.02	0.85
Mean No. Species / Survey	0.38	0.49	0.27	0.32	0.56
Summer					
No. Species	33	19	12	8	14
Mean No. / Survey[a]	0.54	2.24	0.20	0.14	0.28
Mean No. Species / Survey	0.17	0.45	0.09	0.10	0.18
Fall					
No. Species	31	21	7	8	7
Mean No. / Survey[a]	3.40	10.58	2.84	0.38	0.61
Mean No. Species / Survey	0.32	0.85	0.13	0.19	0.26
Winter					
No. Species	29	18	9	6	13
Mean No. / Survey[a]	5.39	13.01	7.18	0.38	0.81
Mean No. Species / Survey	0.44	1.06	0.39	0.26	0.25
Phase I - AFT Sites					
Spring					
No. Species	35	18	13	10	11
Mean No. / Survey[a]	4.67	11.31	5.77	0.89	1.68
Mean No. Species / Survey	0.88	1.44	0.70	0.57	0.92
Summer					
No. Species	39	19	10	9	18
Mean No. / Survey[a]	4.18	13.56	1.54	0.55	1.35
Mean No. Species / Survey	0.55	1.16	0.22	0.32	0.52
Fall					
No. Species	29	20	3	9	5
Mean No. / Survey[a]	19.43	61.94	1.91	1.59	0.62
Mean No. Species / Survey	1.04	2.24	0.41	0.72	0.42
Winter					
No. Species	39	25	10	11	8
Mean No. / Survey[a]	10.43	34.55	3.48	1.79	1.48
Mean No. Species / Survey	1.06	2.35	0.60	0.63	0.63

Table 5 (continued)

Phase II – NT Sites					
Season	Study Area				
	Overall	*Water*	*Low*	*Medium*	*High*
Spring					
No. Species	26	24	6		
Mean No. / Survey[a]	2.90	5.17	1.59		
Mean No. Species / Survey	0.40	0.82	0.17		
Summer					
No. Species	30	28	9		
Mean No. / Survey[a]	0.50	1.23	0.09		
Mean No. Species / Survey	0.18	0.36	0.07		
Fall					
No. Species	17	15	6		
Mean No. / Survey[a]	0.21	0.43	0.09		
Mean No. Species / Survey	0.13	0.24	0.07		
Winter					
No. Species	14	12	5		
Mean No. / Survey[a]	0.41	0.85	0.14		
Mean No. Species / Survey	0.17	0.31	0.08		

[a] Mean No. / Survey defined as the mean number of individuals observed per 5-minute utilization survey

Table 6. Mean abundance, percent composition, and percent frequency of occurrence of avian groups observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations within 200 m of site center

Phase I – NT Sites												
Geographic Locations / Taxonomic Group	Mean Abundance				% Composition				% Freq. of Occurrence			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Overall												
Waterbirds	1.26	0.35	1.81	2.02	64.97	65.38	53.32	37.40	4.54	3.32	4.10	5.98
Raptors	0.02	0.02	0.01	0.02	0.92	3.18	0.38	0.44	1.58	1.43	1.28	2.19
Corvids	0.20	0.06	0.09	0.13	10.39	11.87	2.64	2.44	10.26	4.21	6.15	7.97
Passerines	0.45	0.09	1.47	3.20	23.01	17.39	43.14	59.28	17.16	5.02	11.79	22.31
Other	0.01	0.01	0.01	0.02	0.41	1.17	0.38	0.44	0.79	0.54	0.77	1.00
Unidentified	0.01	0.01	0.01	0	0.31	1.00	0.15	0	0.59	0.54	0.51	0
Total	1.94	0.54	3.40	5.39	100	100	100	100				
Water area												
Waterbirds	2.72	1.89	8.28	6.43	78.76	84.16	78.25	49.39	17.33	17.22	16.25	25.61
Raptors	0.07	0.03	0.03	0.04	1.93	1.24	0.24	0.28	5.33	2.78	2.50	3.66
Corvids	0.19	0.13	0.10	0.23	5.41	5.94	0.95	1.78	12.00	10.00	8.75	13.41
Passerines	0.48	0.19	2.11	6.30	13.90	8.42	19.98	48.45	13.33	6.67	18.75	39.02
Other	0	0.01	0.05	0.01	0	0.25	0.47	0.09	0	0.56	2.50	1.22
Unidentified	0	0	0.01	0	0	0	0.12	0	0	0	1.25	0
Total	3.45	2.24	10.58	13.01	100	100	100	100				
Low elevation area												
Waterbirds	1.99	0.10	0.32	2.31	82.82	48.11	11.34	32.16	4.59	1.13	2.14	4.29
Raptors	0.00	0.01	0.02	0.02	0.19	2.83	0.76	0.33	0.46	0.56	2.14	1.90
Corvids	0.31	0.06	0.06	0.18	12.79	29.25	2.02	2.52	13.76	3.57	4.29	10.48
Passerines	0.09	0.04	2.44	4.62	3.82	17.92	85.89	64.32	6.88	3.20	4.29	20.48
Other	0.00	0.00	0	0.05	0.19	0.94	0	0.66	0.46	0.19	0	1.43
Unidentified	0.00	0.00	0	0	0.19	0.94	0	0	0.46	0.19	0	0
Total	2.40	0.20	2.84	7.18	100	100	100	100				

Table 6 (continued)

Geographic Locations / Taxonomic Group	Mean Abundance				% Composition				% Freq. of Occurrence			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Medium elevation area												
Waterbirds	0	0	0	0	0	0	0	0	0	0	0	0
Raptors	0.02	0.03	0	0.03	2.00	25.00	0	8.82	2.04	2.84	0	3.33
Corvids	0.11	0.01	0.03	0.07	11.00	8.33	9.09	17.65	5.10	1.14	3.41	4.44
Passerines	0.88	0.09	0.32	0.27	86.00	62.50	84.85	70.59	21.43	5.11	13.64	15.56
Other	0	0	0.01	0.01	0	0	3.03	2.94	0	0	1.14	1.11
Unidentified	0.01	0.01	0.01	0	1	4.17	3.03	0	1.02	0.57	1.14	0
Total	1.02	0.14	0.38	0.38	100	100	100	100				
High elevation area												
Waterbirds	0	0	0	0	0	0	0	0	0	0	0	0
Raptors	0.01	0.02	0	0.01	1.01	7.81	0	1.03	0.86	1.32	0	0.83
Corvids	0.09	0.06	0.20	0.03	10.10	21.88	32.00	3.09	6.90	3.51	9.76	2.50
Passerines	0.72	0.16	0.41	0.78	84.85	56.25	68.00	95.88	35.34	7.89	15.85	19.17
Other	0.03	0.02	0	0	3.03	7.81	0	0	2.59	1.75	0	0
Unidentified	0.01	0.02	0	0	1.01	6.25	0	0	0.86	1.75	0	0
Total	0.85	0.28	0.61	0.81	100	100	100	100				

Table 6 (continued)

Phase I - AFT Sites

Geographic Locations/ Taxonomic Group	Mean Abundance				% Composition				% Freq. of Occurrence			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Overall												
Waterbirds	3.24	3.46	18.27	7.27	69.45	82.63	94.04	69.72	14.63	12.15	22.81	17.72
Raptors	0.02	0.01	0.03	0.03	0.39	0.26	0.14	0.24	1.22	1.10	1.75	1.90
Corvids	0.18	0.05	0.11	0.23	3.79	1.19	0.54	2.25	11.59	3.31	7.02	8.86
Passerines	1.15	0.44	1.03	2.86	24.67	10.57	5.28	27.43	38.41	20.72	31.58	35.44
Other	0.07	0.21	0	0.03	1.44	5.09	0	0.30	4.27	2.76	0	2.53
Unidentified	0.01	0.01	0	0.01	0.26	0.26	0	0.06	1.22	1.10	0	0.63
Total	4.67	4.18	19.43	10.43	100	100	100	100				
Water area												
Waterbirds	8.94	12.84	60.35	26.63	79.12	94.72	97.44	77.06	52.78	42.05	67.65	62.50
Raptors	0	0	0.09	0	0	0	0.14	0	0	0	5.88	0
Corvids	0.28	0.13	0.26	0.25	2.46	0.92	0.43	0.72	16.67	9.09	14.71	10.00
Passerines	2.08	0.51	1.24	7.55	18.43	3.77	1.99	21.85	36.11	27.27	26.47	32.50
Other	0	0.08	0	0.1	0	0.59	0	0.29	0	1.14	0	7.50
Unidentified	0	0	0	0.03	0	0	0	0.07	0	0	0	2.50
Total	11.31	13.56	61.94	34.55	100	100	100	100				
Low elevation area												
Waterbirds	4.77	1.29	1.41	1.48	82.68	83.45	73.81	42.45	11.36	7.45	13.64	5.00
Raptors	0.07	0	0	0.03	1.18	0	0	0.72	4.55	0	0	2.50
Corvids	0.14	0.05	0	0.05	2.36	3.45	0	1.44	9.09	2.13	0	2.50
Passerines	0.75	0.19	0.50	1.93	12.99	12.41	26.19	55.40	31.82	10.64	27.27	37.50
Other	0.02	0.01	0	0	0.39	0.69	0	0	2.27	1.06	0	0
Unidentified	0.02	0	0	0	0.39	0	0	0	2.27	0	0	0
Total	5.77	1.54	1.91	3.48	100	100	100	100				

Table 6 (continued)

Geographic Locations/ Taxonomic Group	Mean Abundance				% Composition				% Freq. of Occurrence			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Medium elevation area												
Waterbirds	0	0	0	0.66	0	0	0	36.76	0	0	0	2.63
Raptors	0	0.04	0	0.05	0	6.52	0	2.94	0	3.57	0	2.63
Corvids	0.04	0.01	0.06	0.32	4.88	2.17	3.92	17.65	4.35	1.19	6.25	15.79
Passerines	0.70	0.46	1.53	0.74	78.05	84.78	96.08	41.18	34.78	20.24	43.75	31.58
Other	0.15	0	0	0.03	17.07	0	0	1.47	8.70	0	0	2.63
Unidentified	0	0.04	0	0	0	6.52	0	0	0	3.57	0	0
Total	0.89	0.55	1.59	1.79	100	100	100	100				
High elevation area												
Waterbirds	0	0	0	0	0	0	0	0	0	0	0	0
Raptors	0	0.01	0	0.03	0	0.77	0	1.69	0	1.04	0	2.50
Corvids	0.29	0.01	0.04	0.33	17.19	0.77	6.25	22.03	18.42	1.04	3.85	7.50
Passerines	1.29	0.60	0.58	1.13	76.56	44.62	93.75	76.27	52.63	25.00	26.92	40.00
Other	0.08	0.72	0	0	4.69	53.08	0	0	5.26	8.33	0	0
Unidentified	0.03	0.01	0	0	1.56	0.77	0	0	2.63	1.04	0	0
Total	1.68	1.35	0.62	1.48	100	100	100	100				

Table 6 (continued)

Phase II – NT Sites

Geographic Locations/ Taxonomic Group	Mean Abundance				% Composition				% Freq. of Occurrence			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Overall												
Waterbirds	2.45	0.28	0.03	0.03	84.41	55.60	15.29	7.46	11.84	2.78	1.01	1.61
Raptors	0.00	0.00	0.02	0.01	0.11	0.98	7.06	2.99	0.31	0.40	1.26	1.01
Corvids	0.34	0.08	0.05	0.10	11.61	16.11	22.35	25.87	13.71	4.96	3.28	5.85
Passerines	0.11	0.12	0.12	0.23	3.76	22.99	54.12	57.71	5.30	4.76	6.31	4.84
Other	0	0.02	0.00	0.01	0	3.34	1.18	1.49	0	0.89	0.25	0.60
Unidentified	0.00	0.00	0	0.02	0.11	0.98	0	4.48	0.31	0.10	0	1.01
Total	2.90	0.50	0.21	0.41	100	100	100	100				
Water area												
Waterbirds	4.39	0.77	0.09	0.08	84.96	62.61	20.97	9.49	25.64	7.61	2.76	4.32
Raptors	0	0.01	0.03	0.03	0	0.66	6.45	3.80	0	0.54	2.07	2.70
Corvids	0.51	0.17	0.06	0.15	9.92	13.94	12.90	17.72	19.66	9.51	4.14	7.03
Passerines	0.26	0.25	0.26	0.53	4.96	20.13	59.68	62.03	11.11	7.34	12.41	8.65
Other	0	0.02	0	0.02	0	1.55	0	1.90	0	0.82	0	1.62
Unidentified	0.01	0.01	0	0.04	0.17	1.11	0	5.06	0.85	0.27	0	2.16
Total	5.17	1.23	0.43	0.85	100	100	100	100				
Low elevation area												
Waterbirds	1.33	0	0	0	83.38	0	0	0	3.92	0	0	0
Raptors	0.00	0.00	0.01	0	0.31	3.51	8.70	0	0.49	0.31	0.80	0
Corvids	0.24	0.03	0.04	0.08	14.77	33.33	47.83	55.81	10.29	2.34	2.79	5.14
Passerines	0.02	0.04	0.04	0.06	1.54	45.61	39.13	41.86	1.96	3.28	2.79	2.57
Other	0	0.02	0.00	0	0	17.54	4.35	0	0	0.94	0.40	0
Unidentified	0	0	0	0.00	0	0	0	2.33	0	0	0	0.32
Total	1.59	0.09	0.09	0.14	100	100	100	100				

Mean abundance = mean number of individuals observed per 5-minute utilization survey; percent composition = percent of all observations comprised of species i; percent frequency of occurrence = percent of all surveys where species i was recorded.

Table 7. Five most abundant avian species (based on mean number per 5-minute utilization survey) observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations within 200 m of site center

	Phase I – NT Sites							
Geographic Locations	Season							
	Spring		Summer		Fall		Winter	
	Species	Use	Species	Use	Species	Use	Species	Use
Overall								
	Unidentified Gull	0.97	Unidentified Gull	0.20	American Coot	1.45	House Finch	2.60
	Common Raven	0.20	Common Raven	0.06	House Finch	1.20	Unidentified Gull	1.12
	European Starling	0.18	Double-Crested Cormorant	0.06	Unidentified Gull	0.13	American Coot	0.67
	Killdeer	0.17	Caspian Tern	0.04	Ruddy Duck	0.09	Common Raven	0.13
	Unidentified Duck	0.08	Mallard	0.02	Common Raven	0.09	White-Crowned Sparrow	0.09
Water area								
	Killdeer	1.15	Unidentified Gull	1.16	American Coot	7.08	House Finch	4.73
	Unidentified Gull	0.77	Caspian Tern	0.22	House Finch	1.63	American Coot	4.09
	Unidentified Duck	0.55	Mallard	0.14	Ruddy Duck	0.45	Unidentified Gull	1.33
	European Starling	0.24	Common Raven	0.13	Mallard	0.26	Ring-Billed Gull	0.46
	Cliff Swallow	0.21	Double-Crested Cormorant	0.13	Yellow-Rumped Warbler	0.15	White-Crowned Sparrow	0.38
Low elevation area								
	Unidentified Gull	1.99	Double-Crested Cormorant	0.08	House Finch	2.41	House Finch	4.30
	Common Raven	0.31	Common Raven	0.06	Unidentified Gull	0.32	Unidentified Gull	2.15
	European Starling	0.06	Unidentified Gull	0.02	Common Raven	0.06	Common Raven	0.18
	Loggerhead Shrike	0.01	Loggerhead Shrike	0.02	American Kestrel	0.02	Double-Crested Cormorant	0.16
	American Kestrel	0.00	European Starling	0.01	Loggerhead Shrike	0.01	European Starling	0.05
	Northern Mockingbird	0.00						
	Rock Dove	0.00						
	Unidentified Hummingbird	0.00						

Table 7 (continued)

Geographic Locations	Season							
	Spring		Summer		Fall		Winter	
	Species	Use	Species	Use	Species	Use	Species	Use
Medium elevation area								
	White-Throated Swift	0.31	Horned Lark	0.03	White-Crowned Sparrow	0.20	House Finch	0.13
	European Starling	0.27	Red-Tailed Hawk	0.02	Common Raven	0.03	Common Raven	0.07
	Common Raven	0.11	European Starling	0.02	Loggerhead Shrike	0.03	Red-Tailed Hawk	0.03
	White-Crowned Sparrow	0.09	American Kestrel	0.01	Bewick's Wren	0.02	European Starling	0.02
	House Finch	0.04	Common Raven	0.01	Black-Throated Gray Warbler	0.02	Rock Dove	0.01
			Le Conte's Thrasher	0.01	Black-Throated Sparrow	0.02	Unidentified Sparrow	0.01
							White-Crowned Sparrow	0.01
High elevation area								
	European Starling	0.32	Common Raven	0.06	Yellow-Rumped Warbler	0.24	Western Meadowlark	0.13
	Common Raven	0.09	European Starling	0.06	Common Raven	0.20	White-Crowned Sparrow	0.11
	Unidentified Sparrow	0.06	Mourning Dove	0.02	Rock Wren	0.07	Lesser Goldfinch	0.10
	White-Crowned Sparrow	0.06	Golden Eagle	0.01	Unidentified Sparrow	0.02	White-Throated Swift	0.08
	Western Meadowlark	0.06	Loggerhead Shrike	0.01	California Thrasher	0.01	Lawrence's Goldfinch	0.04
			Rock Wren	0.01	House Finch	0.01		
					Western Meadowlark	0.01		

Table 7 (continued)

Geographic Locations	**Phase I** - AFT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	Use	Species	Use	Species	Use	Species	Use
Overall								
	Unidentified Gull	1.41	Unidentified Gull	1.73	American Coot	13.70	Unidentified Gull	2.93
	California Gull	1.00	Double-Crested Cormorant	1.08	American Green-Winged Teal	1.32	House Finch	1.64
	American Coot	0.33	Redhead	0.30	Ruddy Duck	1.15	American Coot	1.63
	Common Raven	0.18	Mourning Dove	0.17	Unidentified Gull	0.70	Ring-Billed Gull	1.37
	Unidentified Sparrow	0.17	Brewer's Blackbird	0.10	Ring-Billed Gull	0.57	Ruddy Duck	0.46
Water area								
	California Gull	4.56	Unidentified Gull	6.58	American Coot	45.94	Unidentified Gull	10.95
	Unidentified Gull	1.53	Double-Crested Cormorant	3.67	American Green-Winged Teal	4.41	American Coot	6.45
	American Coot	1.50	Redhead	1.25	Ruddy Duck	3.85	House Finch	5.65
	Barn Swallow	0.67	Brewer's Blackbird	0.43	Ring-Billed Gull	1.79	Ring-Billed Gull	3.93
	Brewer's Blackbird	0.47	Caspian Tern	0.36	Unidentified Gull	1.56	Ruddy Duck	1.80
Low elevation area								
	Unidentified Gull	4.02	Double-Crested Cormorant	0.72	Unidentified Gull	1.23	Ring-Billed Gull	1.48
	Caspian Tern	0.48	Unidentified Gull	0.52	White-Crowned Sparrow	0.23	House Finch	0.58
	White-Throated Swift	0.30	Common Raven	0.05	Ring-Billed Gull	0.18	White-Crowned Sparrow	0.28
	Double-Crested Cormorant	0.27	Caspian Tern	0.04	Say's Phoebe	0.09	Unidentified Sparrow	0.10
	Common Raven	0.14	European Starling	0.04			Common Raven	0.05
			Loggerhead Shrike	0.04			Lark Sparrow	0.05

Table 7 (continued)

Geographic Locations	Season							
	Spring		Summer		Fall		Winter	
	Species	Use	Species	Use	Species	Use	Species	Use
Medium elevation area								
	Le Conte's Thrasher	0.15	Barn Swallow	0.08	Western Meadowlark	0.47	Unidentified Gull	0.66
	Unidentified Sparrow	0.13	Horned Lark	0.08	House Finch	0.19	Common Raven	0.32
	Gambel's Quail	0.11	Unidentified Sparrow	0.08	Rock Wren	0.16	House Finch	0.24
	White-Crowned Sparrow	0.11	Burrowing Owl	0.04	Unidentified Sparrow	0.13	Horned Lark	0.13
	Black-Throated Sparrow	0.04	Western Kingbird	0.04	Horned Lark	0.09	European Starling	0.08
	Common Raven	0.04						
	Horned Lark	0.04						
	Mourning Dove	0.04						
High elevation area								
	Unidentified Sparrow	0.47	Mourning Dove	0.55	Unidentified Sparrow	0.12	Common Raven	0.33
	Common Raven	0.29	Gambel's Quail	0.16	Loggerhead Shrike	0.08	White-Crowned Sparrow	0.10
	Horned Lark	0.21	Horned Lark	0.11	Rock Wren	0.08	Bewick's Wren	0.08
	White-Crowned Sparrow	0.16	Rock Wren	0.09	Abert's Towhee	0.04	Rock Wren	0.08
	Mourning Dove	0.08	Unidentified Sparrow	0.07	Black-Throated Sparrow	0.04	Anna's Hummingbird	0.05
	Rock Wren	0.08			Common Raven	0.04		
	White-Throated Swift	0.08						

Table 7 (continued)

Geographic Locations	**Phase II** – NT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	Use	Species	Use	Species	Use	Species	Use
Overall								
	Unidentified Gull	2.07	Common Raven	0.08	Common Raven	0.05	Brewer's Blackbird	0.13
	Common Raven	0.34	American Coot	0.06	House Finch	0.03	Common Raven	0.10
	California Gull	0.06	Brewer's Blackbird	0.05	Killdeer	0.02	Unidentified Sparrow	0.04
	Redhead	0.06	Unidentified Sandpiper	0.05	Loggerhead Shrike	0.02	Unidentified Swallow	0.02
	Mallard	0.05	Mallard	0.05	American Kestrel	0.01	Mallard	0.02
							Say's Phoebe	0.02
Water area								
	Unidentified Gull	3.41	American Coot	0.17	House Finch	0.07	Brewer's Blackbird	0.35
	Common Raven	0.51	Common Raven	0.17	Common Raven	0.06	Common Raven	0.15
	Redhead	0.17	Brewer's Blackbird	0.15	Killdeer	0.05	Unidentified Sparrow	0.10
	Mallard	0.14	Unidentified Sandpiper	0.13	American Goldfinch	0.02	Mallard	0.04
	California Gull	0.13	Mallard	0.13	American Kestrel	0.02	Say's Phoebe	0.03
					Loggerhead Shrike	0.02		
					Unidentified Sparrow	0.02		
Low elevation area								
	Unidentified Gull	1.30	Common Raven	0.03	Common Raven	0.04	Common Raven	0.08
	Common Raven	0.24	Loggerhead Shrike	0.02	Loggerhead Shrike	0.02	Unidentified Swallow	0.04
	California Gull	0.02	Rock Dove	0.01	American Kestrel	0.00	Say's Phoebe	0.01
	Loggerhead Shrike	0.01	European Starling	0.00	Common Barn Owl	0.00	Loggerhead Shrike	0.01
	Savannah Sparrow	0.01	Greater Roadrunner	0.00	Say's Phoebe	0.00	Unidentified Sparrow	0.00
					Rock Dove	0.00		
					Unidentified Flycatcher	0.00		

Table 8. Five most frequently occurring avian species during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations within 200 m of site center

Geographic Locations	**Phase I** – NT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	%	Species	%	Species	%	Species	%
Overall								
	Common Raven	10.26	Common Raven	4.21	Common Raven	6.15	House Finch	9.56
	European Starling	8.48	Loggerhead Shrike	1.25	American Coot	2.31	Common Raven	7.77
	Unidentified Gull	2.96	Unidentified Gull	1.08	House Finch	2.31	Unidentified Gull	2.59
	Western Meadowlark	1.58	European Starling	0.99	Yellow-Rumped Warbler	1.54	European Starling	1.79
	Rock Wren	1.18	Brewer's Blackbird	0.81	Great Egret	1.28	White-Crowned Sparrow	1.79
	Unidentified Sparrow	1.18			Loggerhead Shrike	1.28		
					Rock Wren	1.28		
					Ruddy Duck	1.28		
					Unidentified Gull	1.28		
Water elevation area								
	Common Raven	12.00	Common Raven	10.00	American Coot	11.25	House Finch	19.51
	European Starling	8.00	Brewer's Blackbird	4.44	Common Raven	8.75	Common Raven	13.41
	Unidentified Gull	6.67	Double-Crested Cormorant	3.89	House Finch	7.50	American Coot	8.54
	Unidentified Duck	4.00	Mallard	3.89	Great Egret	6.25	Ring-Billed Gull	7.32
	American Coot	2.67	American Coot	3.33	Ruddy Duck	6.25	White-Crowned Sparrow	7.32
	American Kestrel	2.67	Unidentified Gull	3.33				
	Brewer's Blackbird	2.67						
	Cliff Swallow	2.67						
	Killdeer	2.67						
	Ring-Billed Gull	2.67						
Low elevation area								
	Common Raven	13.76	Common Raven	3.57	Common Raven	4.29	House Finch	12.38
	Unidentified Gull	4.59	Loggerhead Shrike	2.07	American Kestrel	2.14	Common Raven	10.48
	European Starling	3.67	Unidentified Gull	1.13	Unidentified Gull	2.14	Unidentified Gull	3.81
	Loggerhead Shrike	1.38	European Starling	0.56	House Finch	1.43	European Starling	2.38
	American Kestrel	0.46	American Kestrel	0.19	Loggerhead Shrike	1.43	American Kestrel	1.90
	Northern Mockingbird	0.46	Brewer's Blackbird	0.19				
	Rock Dove	0.46	Double-Crested Cormorant	0.19				

Table 8 (continued)

Geographic Locations	**Phase I** – NT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	%	Species	%	Species	%	Species	%
Low elevation area (continued)								
	Unidentified Hummingbird	0.46	Mourning Dove	0.19				
			Prairie Falcon	0.19				
			Red-Tailed Hawk	0.19				
			Unidentified Hummingbird	0.19				
			White-Throated Swift	0.19				
Medium elevation area								
	European Starling	12.24	European Starling	1.70	Common Raven	3.41	House Finch	5.56
	Common Raven	5.10	Red-Tailed Hawk	1.70	Loggerhead Shrike	3.41	Common Raven	4.44
	House Finch	2.04	American Kestrel	1.14	White-Crowned Sparrow	3.41	Red-Tailed Hawk	3.33
	Red-Tailed Hawk	2.04	Common Raven	1.14	Bewick's Wren	2.27	European Starling	1.11
	White-Crowned Sparrow	2.04	Le Conte's Thrasher	1.14	Black-Throated Gray Warbler	2.27	Rock Dove	1.11
							Unidentified Sparrow	1.11
							White-Crowned Sparrow	1.11
High elevation area								
	European Starling	14.66	Common Raven	3.51	Common Raven	9.76	Rock Wren	3.33
	Common Raven	6.90	European Starling	1.32	Rock Wren	6.10	Western Meadowlark	2.50
	Western Meadowlark	6.03	Mourning Dove	1.32	Yellow-Rumped Warbler	2.44	Common Raven	1.67
	Rock Wren	5.17	Rock Wren	1.32	California Thrasher	1.22	Lawrence's Goldfinch	1.67
	Unidentified Sparrow	4.31	Loggerhead Shrike	0.88	House Finch	1.22	White-Crowned Sparrow	1.67
			Red-Tailed Hawk	0.88	Unidentified Sparrow	1.22	White-Throated Swift	1.67
			Unidentified Hummingbird	0.88	Western Meadowlark	1.22		
			Unidentified Sparrow	0.88				

Table 8 (continued)

Geographic Locations	**Phase I** - AFT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	%	Species	%	Species	%	Species	%
Overall								
	Common Raven	11.59	Brewer's Blackbird	5.25	American Coot	14.91	Common Raven	8.86
	Unidentified Sparrow	9.15	Double-Crested Cormorant	4.14	Ring-Billed Gull	10.53	House Finch	8.86
	Unidentified Gull	5.49	Unidentified Gull	3.59	Common Raven	7.02	American Coot	6.96
	Horned Lark	4.27	Common Raven	3.31	Great Egret	5.26	Unidentified Gull	6.96
	White-Crowned Sparrow	4.27	Caspian Tern	3.04	Ruddy Duck	5.26	Ring-Billed Gull	4.43
					Unidentified Sparrow	5.26	Ruddy Duck	4.43
Water area								
	Common Raven	16.67	Brewer's Blackbird	21.59	American Coot	50.00	American Coot	27.50
	American Coot	16.67	Double-Crested Cormorant	15.91	Ring-Billed Gull	29.41	Unidentified Gull	25.00
	Mallard	16.67	Caspian Tern	11.36	Great Egret	17.65	Ruddy Duck	17.50
	Unidentified Gull	13.89	American Coot	10.23	Ruddy Duck	17.65	Caspian Tern	15.00
	Brewer's Blackbird	8.33	Common Raven	9.09	Common Raven	14.71	Mallard	12.50
	Great Egret	8.33	Unidentified Gull	9.09			Ring-Billed Gull	12.50
Low elevation area								
	Common Raven	9.09	Unidentified Gull	5.32	White-Crowned Sparrow	9.09	House Finch	15.00
	Unidentified Gull	9.09	Loggerhead Shrike	4.26	Ring-Billed Gull	9.09	Ring-Billed Gull	5.00
	Sage Thrasher	6.82	Common Raven	2.13	Say's Phoebe	4.55	Anna's Hummingbird	2.50
	Horned Lark	4.55	Unidentified Hummingbird	2.13	Unidentified Gull	4.55	Common Raven	2.50
	Red-Tailed Hawk	4.55	Caspian Tern	1.06			Lark Sparrow	2.50
	Unidentified Sparrow	4.55	Double-Crested Cormorant	1.06			Northern Harrier	2.50
	Unidentified Swallow	4.55	European Starling	1.06			Rock Wren	2.50
	White-Crowned Sparrow	4.55	Horned Lark	1.06			Say's Phoebe	2.50
	White-Throated Swift	4.55	Mourning Dove	1.06			Unidentified Sparrow	2.50
			White-Throated Swift	1.06			Western Meadowlark	2.50

Table 8 (continued)

Geographic Locations	**Phase I** - AFT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	%	Species	%	Species	%	Species	%
Medium elevation area								
	Unidentified Sparrow	8.70	Burrowing Owl	3.57	Rock Wren	9.38	Common Raven	15.79
	Le Conte's Thrasher	6.52	Unidentified Sparrow	3.57	Unidentified Sparrow	9.38	House Finch	10.53
	Black-Throated Sparrow	4.35	Western Kingbird	3.57	Brewer's Blackbird	6.25	American Kestrel	2.63
	Common Raven	4.35	Horned Lark	2.38	Common Raven	6.25	European Starling	2.63
	Gambel's Quail	4.35	Loggerhead Shrike	2.38	House Finch	6.25	Horned Lark	2.63
	Horned Lark	4.35					Mountain Bluebird	2.63
	Mourning Dove	4.35					Mourning Dove	2.63
	White-Crowned Sparrow	4.35					Red-Tailed Hawk	2.63
							Rock Wren	2.63
							Unidentified Gull	2.63
							Unidentified Sparrow	2.63
High elevation area								
	Common Raven	18.42	Mourning Dove	7.29	Rock Wren	7.69	Common Raven	7.50
	Unidentified Sparrow	18.42	Horned Lark	5.21	Unidentified Sparrow	7.69	Rock Wren	7.50
	Horned Lark	7.89	Rock Wren	5.21	Abert's Towhee	3.85	White-Crowned Sparrow	7.50
	Rock Wren	7.89	Abert's Towhee	4.17	Black-Throated Sparrow	3.85	Bewick's Wren	5.00
	White-Crowned Sparrow	7.89	Loggerhead Shrike	4.17	Common Raven	3.85	Anna's Hummingbird	2.50
					Loggerhead Shrike	3.85	House Finch	2.50
							Prairie Falcon	2.50
							Sage Sparrow	2.50
							Unidentified Sparrow	2.50

Table 8 (continued)

Geographic Locations	**Phase II** – NT Sites							
	Season							
	Spring		Summer		Fall		Winter	
	Species	%	Species	%	Species	%	Species	%
Overall								
	Common Raven	13.71	Common Raven	4.86	Common Raven	3.28	Common Raven	5.85
	Unidentified Gull	5.61	Loggerhead Shrike	1.49	Loggerhead Shrike	1.52	Say's Phoebe	1.61
	California Gull	2.80	Killdeer	1.39	American Kestrel	1.01	Unidentified Sparrow	1.61
	Mallard	2.80	Brewer's Blackbird	1.19	Killdeer	0.76	Brewer's Blackbird	0.81
	Killdeer	1.56	Mallard	1.19	House Finch	0.51	Mallard	0.81
					Say's Phoebe	0.51		
					Unidentified Sparrow	0.51		
Water area								
	Common Raven	19.66	Common Raven	9.24	Common Raven	4.14	Common Raven	7.03
	Unidentified Gull	10.26	Killdeer	3.80	American Kestrel	2.07	Unidentified Sparrow	3.78
	Mallard	7.69	Brewer's Blackbird	3.26	Killdeer	2.07	Say's Phoebe	2.70
	California Gull	5.98	Mallard	3.26	Loggerhead Shrike	2.07	Brewer's Blackbird	2.16
	Killdeer	4.27	American Coot	2.45	House Finch	1.38	Mallard	2.16
					Unidentified Sparrow	1.38		
Low elevation area								
	Common Raven	10.29	Common Raven	2.34	Common Raven	2.79	Common Raven	5.14
	Unidentified Gull	2.94	Loggerhead Shrike	2.03	Loggerhead Shrike	1.20	Say's Phoebe	0.96
	California Gull	0.98	Greater Roadrunner	0.47	American Kestrel	0.40	Loggerhead Shrike	0.64
	Loggerhead Shrike	0.98	Rock Dove	0.47	Common Barn Owl	0.40	Unidentified Swallow	0.64
	Prairie Falcon	0.49	European Starling	0.31	Unidentified Flycatcher	0.40	Unidentified Sparrow	0.32
	Savannah Sparrow	0.49			Rock Dove	0.40		
	Unidentified Swallow	0.49			Say's Phoebe	0.40		

Table 9. Flight height characteristics by avian group observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II

Geographic Locations Group	# Flocks Flying	# Birds Flying	Mean Flight Height (m)	% flying	% in Height (m) Categories			
					< 10	10 – 35	36 – 60	> 60
Overall								
Waterbirds	518	7610	35.59	47.7	18.8	34.2	21.7	25.3
Raptors	121	127	40.95	95.5	14.2	51.2	17.3	17.3
Corvids	693	1041	21.53	92.2	31.5	52.1	11.2	5.2
Passerines	815	3524	9.73	87.4	60.6	36.9	2.4	0.0
Other	45	139	9.69	65.3	74.1	25.9	0.0	0.0
Unidentified	39	157	23.00	92.4	16.6	9.6	47.1	26.8
Total	2231	12598	21.32	58.3	32.1	36.2	15.5	16.2
***High* elevation area**								
Waterbirds	2	36	425.00	100.0	0.0	0.0	0.0	100.0
Raptors	14	16	96.07	100.0	0.0	25.0	25.0	50.0
Corvids	45	64	45.42	98.5	6.3	65.6	20.3	7.8
Passerines	112	198	7.88	72.3	61.1	38.9	0.0	0.0
Other	6	7	3.67	70.0	85.7	14.3	0.0	0.0
Unidentified	7	7	22.86	100.0	57.1	28.6	0.0	14.3
Total	186	328	28.51	80.4	41.2	38.4	5.2	15.2
***Medium* elevation area**								
Waterbirds	0	0	0.00	0.0	N/A	N/A	N/A	N/A
Raptors	16	17	32.31	100.0	5.9	52.9	29.4	11.8
Corvids	44	68	21.61	98.6	20.6	61.8	14.7	2.9
Passerines	67	152	13.16	86.9	45.4	32.9	21.7	0.0
Other	2	2	13.50	66.7	50.0	50.0	0.0	0.0
Unidentified	3	3	13.33	75.0	66.7	33.3	0.0	0.0
Total	132	242	18.31	90.3	36.0	42.6	19.8	1.7
***Low* elevation area**								
Waterbirds	70	1829	82.53	100.0	0.5	6.6	45.6	47.3
Raptors	33	33	25.88	100.0	21.2	63.6	6.1	9.1
Corvids	242	355	20.03	91.7	31.5	51.5	10.4	6.5
Passerines	160	1368	10.48	86.0	52.3	47.7	0.1	0.0
Other	13	85	13.85	96.6	76.5	23.5	0.0	0.0
Unidentified	10	14	18.30	100.0	14.3	64.3	21.4	0.0
Total	528	3684	25.60	93.5	24.7	27.3	23.8	24.2

Table 9 (continued)

Geographic Locations Group	# Flocks Flying	# Birds Flying	Mean Flight Height (m)	% flying	% in Height (m) Categories			
					< 10	10 – 35	36 – 60	> 60
***Water* area**								
Waterbirds	262	2678	31.47	38.8	21.4	38.6	18.3	21.6
Raptors	34	36	42.59	97.3	19.4	52.8	11.1	16.7
Corvids	251	372	17.59	90.3	30.9	57.5	7.3	4.3
Passerines	177	919	8.45	88.3	54.8	42.8	2.4	0.0
Other	7	13	19.14	72.2	7.7	92.3	0.0	0.0
Unidentified	11	125	14.73	99.2	9.6	2.4	56.0	32.0
Total	742	4143	21.43	48.5	29.3	40.5	14.8	15.5
Away from Turbine								
Waterbirds	184	3067	19.38	42.7	27.7	47.1	10.8	14.4
Raptors	24	25	32.96	83.3	12.0	48.0	28.0	12.0
Corvids	111	182	23.96	92.9	45.6	33.5	16.5	4.4
Passerines	299	887	10.00	93.2	82.1	14.4	3.4	0.1
Other	17	32	4.29	34.0	93.8	6.3	0.0	0.0
Unidentified	8	8	44.00	42.1	75.0	0.0	12.5	12.5
Total	643	4201	16.22	49.6	40.5	39.2	9.5	10.8

Table 10. Characteristics of perching locations for Phase I only

	All Birds		Raptors	
Perch Type	n	%	n	%
small lattice turbine	57	11.9	4	9.1
small tubular turbine	36	7.5	2	4.5
large tubular turbine	0	0.0	0	0.0
meteorological tower (wire or tower)	17	3.6	7	15.9
powerline/pole/conductor	60	12.6	23	52.3
fence	9	1.9	0	0.0
ground	111	23.2	5	11.4
vegetation	117	24.5	3	6.8
water	9	1.9	0	0.0
shoreline	43	9.0	0	0.0
other	19	4.0	0	0.0
Subtotal	478	100.0	44	100.0

Table 11. Number of avian fatalities observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II

Phase I

Geographic Locations/ Group	Overall[1]		NT Sites		AFT Sites	
	Total	Carcass Search	Total	Carcass Search	Total	Carcass Search
Overall[1]						
Waterbirds	20	14	9	9	5	5
Raptors	8	2	2	2	0	0
Corvids	3	1	1	1	0	0
Passerines	4	3	3	3	0	0
Other	15	8	10	7	1	1
Unidentified	11	8	7	7	1	1
Total	61	36	32	29	7	7
Water area						
Waterbirds	7	7	3	3	4	4
Raptors	0	0	0	0	0	0
Corvids	0	0	0	0	0	0
Passerines	0	0	0	0	0	0
Other	0	0	0	0	0	0
Unidentified	2	2	2	2	0	0
Total	9	9	5	5	4	4
Low elevation area						
Waterbirds	6	6	5	5	1	1
Raptors	2	2	2	2	0	0
Corvids	1	1	1	1	0	0
Passerines	2	2	2	2	0	0
Other	8	6	8	6	0	0
Unidentified	5	5	4	4	1	1
Total	24	22	22	20	2	2
Medium elevation area						
Waterbirds	1	1	1	1	0	0
Raptors	0	0	0	0	0	0
Corvids	0	0	0	0	0	0
Passerines	1	1	1	1	0	0
Other	2	2	1	1	1	1
Unidentified	1	1	1	1	0	0
Total	5	5	4	4	1	1

Table 11 (continued)

Geographic Locations/ Group	Overall[1]		NT Sites		AFT Sites	
	Total	Carcass Search	Total	Carcass Search	Total	Carcass Search
High elevation area						
Waterbirds	0	0	0	0	0	0
Raptors	0	0	0	0	0	0
Corvids	0	0	0	0	0	0
Passerines	0	0	0	0	0	0
Other	1	0	1	0	0	0
Unidentified	0	0	0	0	0	0
Total	1	0	1	0	0	0

Table 11 (continued)

Phase II						
Geographic Locations/ Group	Overall[1]		NT Sites		AFT Sites	
	Total	Carcass Search	Total	Carcass Search	Total	Carcass Search
Overall[1]						
Waterbirds	9	8	9	8		
Raptors	4	2	2	2		
Corvids	2	2	2	2		
Passerines	6	4	4	4		
Other	5	5	5	5		
Unidentified	5	3	4	3		
Total	31	24	26	24		
Water area						
Waterbirds	7	7	7	7		
Raptors	0	0	0	0		
Corvids	1	1	1	1		
Passerines	1	1	1	1		
Other	3	3	3	3		
Unidentified	4	3	4	3		
Total	16	15	16	15		
Low elevation area						
Waterbirds	2	1	2	1		
Raptors	2	2	2	2		
Corvids	1	1	1	1		
Passerines	3	3	3	3		
Other	2	2	2	2		
Unidentified	0	0	0	0		
Total	10	9	10	9		

[1] includes fatalities found in areas not associated with study sites

Table 12. Composition of avian fatalities observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II

Phase I						
Avian Group/Species	Overall[1]		NT Sites		AFT Sites	
	Number	Percent	Number	Percent	Number	Percent
Waterbirds						
Unidentified Grebe	1	1.6	1	3.1	0	0.0
Mallard	3	4.9	1	3.1	1	14.3
Unidentified Teal	1	1.6	0	0.0	1	14.3
Unidentified Duck	1	1.6	0	0.0	0	0.0
Snow Goose	1	1.6	0	0.0	0	0.0
Unidentified Egret	1	1.6	1	3.1	0	0.0
Sora	1	1.6	1	3.1	0	0.0
American Coot	11	18.0	5	15.6	3	42.9
Raptors						
Red-Tailed Hawk	2	3.3	1	3.1	0	0.0
Golden Eagle	1	1.6	0	0.0	0	0.0
Common Barn Owl	3	4.9	0	0.0	0	0.0
Great Horned Owl	1	1.6	0	0.0	0	0.0
Burrowing Owl	1	1.6	1	3.1	0	0.0
Corvids						
Common Raven	3	4.9	1	3.1	0	0.0
Passerines						
White-Throated Swift	1	1.6	1	3.1	0	0.0
European Starling	2	3.3	1	3.1	0	0.0
Western Meadowlark	1	1.6	1	3.1	0	0.0
Other						
Mourning Dove	3	4.9	1	3.1	0	0.0
Rock Dove	12	19.7	9	28.1	1	14.3
Unidentified						
Unidentified Bird	11	18.0	7	21.9	1	14.3
Total	61	100.0 %	32	100.0 %	7	100.0 %

Table 12 (continued)

Avian Group/Species	Phase II					
	Overall[1]		NT Sites		AFT Sites	
	Number	Percent	Number	Percent	Number	Percent
Waterbirds						
Unidentified Gull	4	12.9	4	15.4		
Mallard	2	6.5	2	7.7		
Cinnamon Teal	1	3.2	1	3.8		
Unidentified Duck	1	3.2	1	3.8		
American Coot	1	3.2	1	3.8		
Raptors						
Red-Tailed Hawk	1	3.2	0	0.0		
American Kestrel	1	3.2	0	0.0		
Great Horned Owl	1	3.2	1	3.8		
Unidentified Owl	1	3.2	1	3.8		
Corvids						
Common Raven	2	6.5	2	7.7		
Passerines						
Unidentified Passerine	3	9.7	3	11.5		
Black Phoebe	1	3.2	0	0.0		
Western Meadowlark	1	3.2	1	3.8		
Brewer's Blackbird	1	3.2	0	0.0		
Other						
Rock Dove	5	16.1	5	19.2		
Unidentified						
Unidentified Bird	5	16.1	4	15.4		
Total	31	100.0 %	26	100.0 %		

[1] includes fatalities found in areas not associated with study sites .

Table 13. Mean use observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations within 200 m of site center. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

	Phase I – NT Sites														
Geographic Locations	Season														
	Overall			Spring			Summer			Fall			Winter		
	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl
Overall															
Waterbirds	1.09	0.70	1.49	1.26	0.41	2.11	0.35	0	0.72	1.81	0.53	3.10	2.02	0.78	3.25
Raptors	0.02	0.01	0.02	0.02	0.00	0.03	0.02	0.01	0.03	0.01	0.00	0.02	0.02	0.01	0.04
Corvids	0.11	0.09	0.13	0.20	0.13	0.27	0.06	0.04	0.08	0.09	0.04	0.14	0.13	0.09	0.18
Passerines	1.00	0.66	1.33	0.45	0.29	0.60	0.09	0.06	0.12	1.47	0.19	2.74	3.20	1.86	4.53
Other	0.01	0.00	0.02	0.01	0.00	0.02	0.01	0.00	0.01	0.01	0	0.03	0.02	0	0.05
Unidentified	0.00	0.00	0.01	0.01	0	0.01	0.01	0.00	0.01	0.01	0	0.01	0.00	N/A	N/A
Total	2.23	1.71	2.76	1.94	1.07	2.80	0.54	0.16	0.91	3.40	1.60	5.20	5.39	3.55	7.23
Water area															
Waterbirds	4.16	2.45	5.87	2.72	0.68	4.76	1.89	0	4.11	8.28	2.17	14.38	6.43	2.80	10.06
Raptors	0.04	0.02	0.06	0.07	0	0.14	0.03	0.00	0.05	0.03	0	0.06	0.04	0	0.08
Corvids	0.16	0.11	0.21	0.19	0.04	0.33	0.13	0.07	0.20	0.10	0.02	0.18	0.23	0.08	0.38
Passerines	1.81	0.95	2.68	0.48	0.11	0.85	0.19	0.07	0.31	2.11	0.24	3.99	6.30	2.42	10.19
Other	0.01	0	0.03	0.00	N/A	N/A	0.01	0	0.02	0.05	0	0.13	0.01	0	0.04
Unidentified	0.00	0	0.01	0.00	N/A	N/A	0.00	N/A	N/A	0.01	0	0.04	0.00	N/A	N/A
Total	6.18	4.22	8.14	3.45	1.40	5.51	2.24	0	4.50	10.58	4.26	16.89	13.01	7.45	18.57
Low elevation area															
Waterbirds	0.92	0.30	1.54	1.99	0.15	3.84	0.10	0	0.25	0.32	0	0.76	2.31	0	4.89
Raptors	0.01	0.00	0.02	0.00	0	0.01	0.01	0	0.01	0.02	0	0.05	0.02	0	0.05
Corvids	0.13	0.09	0.17	0.31	0.16	0.45	0.06	0.03	0.09	0.06	0.01	0.11	0.18	0.10	0.26
Passerines	1.23	0.54	1.92	0.09	0.04	0.14	0.04	0.02	0.05	2.44	0	5.83	4.62	1.83	7.41
Other	0.01	0	0.02	0.00	0	0.01	0.00	0	0.01	0.00	N/A	N/A	0.05	0	0.11
Unidentified	0.00	0	0.00	0.00	0	0.01	0.00	0	0.01	0.00	N/A	N/A	0.00	N/A	N/A
Total	2.30	1.38	3.23	2.40	0.54	4.27	0.20	0.04	0.36	2.84	0	6.25	7.18	3.43	10.93

Table 13 (continued)

Medium elevation area															
Waterbirds	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A
Raptors	0.02	0.01	0.04	0.02	0	0.05	0.03	0.00	0.07	0.00	N/A	N/A	0.03	0	0.07
Corvids	0.05	0.02	0.08	0.11	0	0.23	0.01	0	0.03	0.03	0	0.07	0.07	0	0.14
Passerines	0.34	0.18	0.50	0.88	0.21	1.54	0.09	0.01	0.16	0.32	0.07	0.56	0.27	0.11	0.42
Other	0.00	0	0.01	0.00	N/A	N/A	0.00	N/A	N/A	0.01	0	0.03	0.01	0	0.03
Unidentified	0.01	0	0.01	0.01	0	0.03	0.01	0	0.02	0.01	0	0.03	0.00	N/A	N/A
Total	0.42	0.26	0.59	1.02	0.34	1.70	0.14	0.04	0.23	0.38	0.13	0.62	0.38	0.20	0.56
High elevation area															
Waterbirds	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A
Raptors	0.01	0	0.03	0.01	0	0.03	0.02	0	0.05	0.00	N/A	N/A	0.01	0	0.02
Corvids	0.08	0.04	0.12	0.09	0.02	0.15	0.06	0.01	0.11	0.20	0	0.40	0.03	0	0.05
Passerines	0.45	0.32	0.58	0.72	0.49	0.95	0.16	0.07	0.25	0.41	0.02	0.81	0.78	0.34	1.21
Other	0.01	0.00	0.03	0.03	0	0.06	0.02	0	0.04	0.00	N/A	N/A	0.00	N/A	N/A
Unidentified	0.01	0.00	0.02	0.01	0	0.03	0.02	0.00	0.03	0.00	N/A	N/A	0.00	N/A	N/A
Total	0.57	0.43	0.70	0.85	0.60	1.11	0.28	0.17	0.39	0.61	0.18	1.04	0.81	0.38	1.24

Table 13 (continued)

Geographic Locations	**Phase I** – AFT Sites														
	Season														
	Overall			Spring			Summer			Fall			Winter		
	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl
Overall															
Waterbirds	6.28	4.40	8.17	3.24	0.86	5.63	3.46	1.43	5.48	18.27	8.73	27.81	7.27	3.51	11.03
Raptors	0.02	0.01	0.03	0.02	0	0.05	0.01	0.00	0.02	0.03	0	0.07	0.03	0	0.06
Corvids	0.12	0.08	0.16	0.18	0.09	0.26	0.05	0.02	0.08	0.11	0.03	0.18	0.23	0.09	0.38
Passerines	1.15	0.71	1.59	1.15	0.69	1.62	0.44	0.33	0.55	1.03	0.57	1.48	2.86	0.73	5.00
Other	0.12	0	0.26	0.07	0.01	0.12	0.21	0	0.52	0.00	N/A	N/A	0.03	0	0.06
Unidentified	0.01	0.00	0.02	0.01	0	0.03	0.01	0.00	0.02	0.00	N/A	N/A	0.01	0	0.02
Total	7.70	5.77	9.63	4.67	2.26	7.08	4.18	2.14	6.22	19.43	9.91	28.95	10.43	6.19	14.67
Water area															
Waterbirds	23.08	16.13	30.02	8.94	1.16	16.73	12.84	4.90	20.78	60.35	32.38	88.32	26.63	13.41	39.84
Raptors	0.02	0	0.04	0.00	N/A	N/A	0.00	N/A	N/A	0.09	0	0.22	0.00	N/A	N/A
Corvids	0.20	0.11	0.29	0.28	0.04	0.52	0.13	0.04	0.21	0.26	0.02	0.51	0.25	0	0.55
Passerines	2.34	0.62	4.07	2.08	0.12	4.04	0.51	0.30	0.72	1.24	0.13	2.35	7.55	0	15.95
Other	0.06	0	0.13	0.00	N/A	N/A	0.08	0	0.24	0.00	N/A	N/A	0.10	0	0.22
Unidentified	0.01	0	0.02	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.03	0	0.08
Total	25.70	18.66	32.73	11.31	3.47	19.14	13.56	5.65	21.46	61.94	34.17	89.71	34.55	20.17	48.93
Low elevation area															
Waterbirds	2.11	0.46	3.75	4.77	0	11.05	1.29	0	2.89	1.41	0	3.96	1.48	0	4.03
Raptors	0.02	0	0.04	0.07	0	0.17	0.00	N/A	N/A	0.00	N/A	N/A	0.03	0	0.08
Corvids	0.07	0.01	0.12	0.14	0	0.28	0.05	0	0.14	0.00	N/A	N/A	0.05	0	0.15
Passerines	0.70	0.41	0.98	0.75	0.28	1.22	0.19	0.06	0.32	0.50	0.05	0.95	1.93	0.70	3.15
Other	0.01	0	0.02	0.02	0	0.07	0.01	0	0.03	0.00	N/A	N/A	0.00	N/A	N/A
Unidentified	0.01	0	0.01	0.02	0	0.07	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A
Total	2.90	1.24	4.56	5.77	0	12.03	1.54	0	3.15	1.91	0	4.45	3.48	0.69	6.26

Table 13 (continued)

Medium elevation area															
Waterbirds	0.13	0	0.37	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.66	0	1.99
Raptors	0.03	0	0.05	0.00	N/A	N/A	0.04	0	0.08	0.00	N/A	N/A	0.05	0	0.16
Corvids	0.09	0.03	0.14	0.04	0	0.10	0.01	0	0.04	0.06	0	0.15	0.32	0.03	0.60
Passerines	0.74	0.50	0.98	0.70	0.34	1.05	0.46	0.19	0.74	1.53	0.48	2.58	0.74	0.26	1.22
Other	0.04	0.00	0.08	0.15	0	0.32	0.00	N/A	N/A	0.00	N/A	N/A	0.03	0	0.08
Unidentified	0.02	0	0.03	0.00	N/A	N/A	0.04	0	0.08	0.00	N/A	N/A	0.00	N/A	N/A
Total	1.03	0.66	1.40	0.89	0.43	1.36	0.55	0.27	0.82	1.59	0.55	2.64	1.79	0.22	3.36
High elevation area															
Waterbirds	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A
Raptors	0.01	0	0.02	0.00	N/A	N/A	0.01	0	0.03	0.00	N/A	N/A	0.03	0	0.08
Corvids	0.13	0.03	0.23	0.29	0.04	0.54	0.01	0	0.03	0.04	0	0.12	0.33	0	0.76
Passerines	0.84	0.61	1.06	1.29	0.73	1.85	0.60	0.35	0.85	0.58	0.12	1.04	1.13	0.39	1.86
Other	0.36	0	0.91	0.08	0	0.20	0.72	0	1.88	0.00	N/A	N/A	0.00	N/A	N/A
Unidentified	0.01	0	0.02	0.03	0	0.08	0.01	0	0.03	0.00	N/A	N/A	0.00	N/A	N/A
Total	1.35	0.75	1.94	1.68	1.03	2.34	1.35	0.18	2.53	0.62	0.16	1.07	1.48	0.63	2.32

Table 13 (continued)

Geographic Locations	**Phase II** – NT Sites														
	Season														
	Overall			Spring			Summer			Fall			Winter		
	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl	mean	lcl	ucl
Overall															
Waterbirds	0.49	0.27	0.72	2.45	0.99	3.90	0.28	0.11	0.45	0.03	0	0.07	0.03	0.00	0.06
Raptors	0.01	0.00	0.01	0.00	0	0.01	0.00	0	0.01	0.02	0.00	0.03	0.01	0.00	0.02
Corvids	0.12	0.09	0.14	0.34	0.22	0.45	0.08	0.06	0.11	0.05	0.02	0.08	0.10	0.06	0.15
Passerines	0.14	0.09	0.19	0.11	0.05	0.17	0.12	0.06	0.18	0.12	0.06	0.17	0.23	0.06	0.41
Other	0.01	0.00	0.02	0.00	N/A	N/A	0.02	0.00	0.03	0.00	0	0.01	0.01	0	0.01
Unidentified	0.01	0.00	0.01	0.00	0	0.01	0.00	0	0.01	0.00	N/A	N/A	0.02	0.00	0.04
Total	0.78	0.54	1.01	2.90	1.43	4.37	0.50	0.31	0.70	0.21	0.13	0.29	0.41	0.21	0.60
Water area															
Waterbirds	1.01	0.49	1.53	4.39	1.12	7.67	0.77	0.31	1.23	0.09	0	0.18	0.08	0.01	0.15
Raptors	0.02	0.01	0.03	0.00	N/A	N/A	0.01	0	0.02	0.03	0	0.06	0.03	0.00	0.06
Corvids	0.20	0.14	0.25	0.51	0.26	0.76	0.17	0.11	0.23	0.06	0.01	0.10	0.15	0.04	0.27
Passerines	0.31	0.18	0.44	0.26	0.09	0.42	0.25	0.09	0.41	0.26	0.12	0.39	0.53	0.08	0.98
Other	0.01	0	0.03	0.00	N/A	N/A	0.02	0	0.05	0.00	N/A	N/A	0.02	0	0.03
Unidentified	0.02	0.00	0.03	0.01	0	0.03	0.01	0	0.04	0.00	N/A	N/A	0.04	0	0.09
Total	1.57	1.02	2.11	5.17	1.87	8.47	1.23	0.71	1.75	0.43	0.23	0.62	0.85	0.36	1.35
Low elevation area															
Waterbirds	0.19	0.00	0.38	1.33	0.01	2.65	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A
Raptors	0.00	0.00	0.01	0.00	0	0.01	0.00	0	0.01	0.01	0	0.02	0.00	N/A	N/A
Corvids	0.07	0.05	0.09	0.24	0.12	0.35	0.03	0.01	0.05	0.04	0.00	0.08	0.08	0.04	0.12
Passerines	0.04	0.02	0.06	0.02	0	0.05	0.04	0.02	0.06	0.04	0.01	0.06	0.06	0	0.12
Other	0.01	0.00	0.01	0.00	N/A	N/A	0.02	0.00	0.03	0.00	0	0.01	0.00	N/A	N/A
Unidentified	0.00	0	0.00	0.00	N/A	N/A	0.00	N/A	N/A	0.00	N/A	N/A	0.00	0	0.01
Total	0.32	0.12	0.51	1.59	0.27	2.92	0.09	0.06	0.12	0.09	0.04	0.15	0.14	0.07	0.21

Table 14. Mean fatality observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I – NT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.014	0.004	0.024
	Raptors	0.003	0	0.007
	Corvids	0.001	0	0.004
	Passerines	0.004	0	0.009
	Other	0.011	0.003	0.019
	Unidentified	0.010	0.003	0.018
	Total	0.044	0.026	0.062
Water area				
	Waterbirds	0.027	0	0.069
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.018	0	0.044
	Total	0.045	0	0.092
Low elevation area				
	Waterbirds	0.020	0.002	0.038
	Raptors	0.007	0	0.017
	Corvids	0.004	0	0.011
	Passerines	0.007	0	0.017
	Other	0.023	0.005	0.042
	Unidentified	0.014	0.000	0.028
	Total	0.075	0.039	0.110
Medium elevation area				
	Waterbirds	0.007	0	0.023
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.007	0	0.023
	Other	0.007	0	0.023
	Unidentified	0.007	0	0.023
	Total	0.030	0	0.066
High elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 14 (continued)

		Phase I – AFT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.025	0.004	0.046
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.005	0	0.015
	Unidentified	0.005	0	0.015
	Total	0.035	0.010	0.060
Water area				
	Waterbirds	0.080	0.006	0.154
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.080	0.006	0.154
Low elevation area				
	Waterbirds	0.020	0	0.065
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.020	0	0.065
	Total	0.040	0	0.100
Medium elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.020	0	0.065
	Unidentified	0.000	N/A	N/A
	Total	0.020	0	0.065
High elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 14 (continued)

		Phase II – NT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.013	0.003	0.023
	Raptors	0.003	0	0.008
	Corvids	0.003	0	0.008
	Passerines	0.007	0.000	0.013
	Other	0.008	0.001	0.016
	Unidentified	0.005	0	0.011
	Total	0.040	0.021	0.059
Water area				
	Waterbirds	0.032	0.007	0.057
	Raptors	0.000	N/A	N/A
	Corvids	0.005	0	0.014
	Passerines	0.005	0	0.014
	Other	0.014	0	0.029
	Unidentified	0.014	0	0.029
	Total	0.068	0.029	0.108
Low elevation area				
	Waterbirds	0.003	0	0.008
	Raptors	0.005	0	0.013
	Corvids	0.003	0	0.008
	Passerines	0.008	0	0.017
	Other	0.005	0	0.013
	Unidentified	0.000	N/A	N/A
	Total	0.024	0.006	0.041

Table 15. Mean risk observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations of use within 200 m of site center and fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I – NT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.012	0.000	0.025
	Raptors	0.167	0	0.406
	Corvids	0.013	0	0.039
	Passerines	0.004	0	0.009
	Other	0.918	0	1.871
	Unidentified	2.287	0.156	4.418
	Total	0.019	0.008	0.030
Water area				
	Waterbirds	0.006	0	0.017
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	8.000	0	27.051
	Total	0.007	0	0.016
Low elevation area				
	Waterbirds	0.018	0	0.042
	Raptors	0.632	0	1.609
	Corvids	0.027	0	0.080
	Passerines	0.005	0	0.013
	Other	1.667	0	4.287
	Unidentified	8.000	0	21.376
	Total	0.028	0.007	0.050
Medium elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.023	0	0.070
	Other	2.000	0	7.544
	Unidentified	1.333	0	4.322
	Total	0.073	0	0.167
High elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 15 (continued)

		Phase I – AFT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.004	0.000	0.008
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.043	0	0.142
	Unidentified	0.571	0	1.801
	Total	0.005	0.000	0.009
Water area				
	Waterbirds	0.003	0.000	0.007
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.003	0.000	0.006
Low elevation area				
	Waterbirds	0.010	0	0.033
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	4.000	0	15.087
	Total	0.014	0	0.038
Medium elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.500	0	1.605
	Unidentified	0.000	N/A	N/A
	Total	0.019	0	0.058
High elevation area				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 15 (continued)

		Phase II – NT Sites		
Geographic Locations/Group		**mean**	**lcl**	**ucl**
Overall				
	Waterbirds	0.027	0.002	0.052
	Raptors	0.412	0	1.024
	Corvids	0.028	0	0.068
	Passerines	0.047	0	0.099
	Other	0.881	0	1.970
	Unidentified	0.740	0	1.783
	Total	0.052	0.019	0.084
Water area				
	Waterbirds	0.031	0.000	0.063
	Raptors	0.000	N/A	N/A
	Corvids	0.023	0	0.069
	Passerines	0.014	0	0.044
	Other	1.110	0	2.780
	Unidentified	0.793	0	1.892
	Total	0.044	0.011	0.076
Low elevation area				
	Waterbirds	0.014	0	0.043
	Raptors	1.488	0	3.866
	Corvids	0.036	0	0.109
	Passerines	0.192	0	0.417
	Other	0.673	0	2.010
	Unidentified	0.000	N/A	N/A
	Total	0.074	0.005	0.144

Table 16. Mean use observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.239	0	0.508
	Raptors	0.011	0	0.024
	Corvids	0.070	0.030	0.110
	Passerines	1.457	0	3.059
	Other	0.000	N/A	N/A
	Unidentified	0.002	0	0.007
	Total	1.779	0.194	3.364
Overall/Small				
	Waterbirds	1.305	0.382	2.228
	Raptors	0.019	0.011	0.026
	Corvids	0.117	0.088	0.147
	Passerines	0.970	0.391	1.548
	Other	0.015	0.004	0.025
	Unidentified	0.005	0.002	0.008
	Total	2.430	1.306	3.554
Water area/Large				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A
Water area/Small				
	Waterbirds	4.214	0.306	8.122
	Raptors	0.036	0.017	0.055
	Corvids	0.162	0.101	0.223
	Passerines	1.887	0.708	3.067
	Other	0.016	0	0.033
	Unidentified	0.002	0	0.007
	Total	6.318	2.117	10.518
Low elevation area/Large				
	Waterbirds	0.275	0	0.585
	Raptors	0.013	0	0.027
	Corvids	0.075	0.030	0.120
	Passerines	1.593	0	3.448
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	1.955	0.126	3.784

Table 16 (continued)

	Phase I		
Geographic Locations/Turbine Size/Group	**mean**	**lcl**	**ucl**
Low elevation area/Small			
Waterbirds	1.550	0	3.247
Raptors	0.010	0.000	0.020
Corvids	0.161	0.094	0.229
Passerines	1.275	0	2.956
Other	0.022	0	0.052
Unidentified	0.003	0	0.007
Total	3.021	0.688	5.355
Medium elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
Medium elevation area/Small			
Waterbirds	0.000	N/A	N/A
Raptors	0.020	0	0.042
Corvids	0.052	0.013	0.091
Passerines	0.323	0.124	0.521
Other	0.004	0	0.011
Unidentified	0.006	0	0.012
Total	0.404	0.173	0.636
High elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.033	0	0.177
Passerines	0.556	0	1.773
Other	0.000	N/A	N/A
Unidentified	0.017	0	0.088
Total	0.606	0	1.912
High elevation area/Small			
Waterbirds	0.000	N/A	N/A
Raptors	0.014	0.001	0.028
Corvids	0.088	0.036	0.140
Passerines	0.487	0.274	0.699
Other	0.015	0.002	0.028
Unidentified	0.009	0.000	0.018
Total	0.612	0.405	0.820

Table 16 (continued)

		Phase II		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.788	0.207	1.368
	Raptors	0.009	0.002	0.016
	Corvids	0.112	0.058	0.166
	Passerines	0.135	0.028	0.242
	Other	0.004	0	0.009
	Unidentified	0.009	0	0.020
	Total	1.056	0.372	1.739
Overall/Small				
	Waterbirds	0.289	0.056	0.522
	Raptors	0.008	0.000	0.016
	Corvids	0.137	0.094	0.180
	Passerines	0.172	0.032	0.313
	Other	0.017	0	0.036
	Unidentified	0.006	0	0.013
	Total	0.629	0.285	0.974
Water area/Large				
	Waterbirds	1.464	0.097	2.831
	Raptors	0.020	0.003	0.036
	Corvids	0.189	0.064	0.314
	Passerines	0.295	0.028	0.562
	Other	0.007	0	0.019
	Unidentified	0.022	0	0.052
	Total	1.998	0.396	3.599
Water area/Small				
	Waterbirds	0.557	0.031	1.084
	Raptors	0.012	0	0.031
	Corvids	0.201	0.134	0.268
	Passerines	0.334	0	0.668
	Other	0.017	0	0.044
	Unidentified	0.012	0	0.029
	Total	1.134	0.392	1.876
Low elevation area/Large				
	Waterbirds	0.350	0	0.774
	Raptors	0.002	0	0.005
	Corvids	0.062	0.030	0.094
	Passerines	0.032	0.011	0.053
	Other	0.002	0	0.005
	Unidentified	0.000	N/A	N/A
	Total	0.446	0.020	0.873
Low elevation area/Small				
	Waterbirds	0.092	0	0.222
	Raptors	0.005	0	0.012
	Corvids	0.090	0.043	0.137
	Passerines	0.054	0.017	0.091
	Other	0.016	0	0.047
	Unidentified	0.002	0	0.006
	Total	0.259	0.099	0.420

Table 17. Mean fatality observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.026	0	0.056
	Raptors	0.009	0	0.027
	Corvids	0.000	N/A	N/A
	Passerines	0.017	0	0.042
	Other	0.026	0	0.056
	Unidentified	0.009	0	0.027
	Total	0.087	0.036	0.138
Overall/Small				
	Waterbirds	0.012	0.001	0.022
	Raptors	0.002	0	0.005
	Corvids	0.002	0	0.005
	Passerines	0.002	0	0.005
	Other	0.008	0.000	0.016
	Unidentified	0.010	0.002	0.019
	Total	0.035	0.016	0.054
Water area/Large				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A
Water area/Small				
	Waterbirds	0.027	0	0.069
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.018	0	0.044
	Total	0.045	0	0.092
Low elevation area/Large				
	Waterbirds	0.030	0	0.064
	Raptors	0.010	0	0.031
	Corvids	0.000	N/A	N/A
	Passerines	0.020	0	0.049
	Other	0.030	0	0.064
	Unidentified	0.010	0	0.031
	Total	0.100	0.043	0.157

Table 17 (continued)

	Phase I		
Geographic Locations/Turbine Size/Group	**mean**	**lcl**	**ucl**
Low elevation area/Small			
Waterbirds	0.014	0	0.035
Raptors	0.005	0	0.016
Corvids	0.005	0	0.016
Passerines	0.000	N/A	N/A
Other	0.020	0	0.043
Unidentified	0.016	0	0.035
Total	0.061	0.015	0.108
Medium elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
Medium elevation area/Small			
Waterbirds	0.007	0	0.023
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.007	0	0.023
Other	0.007	0	0.023
Unidentified	0.007	0	0.023
Total	0.030	0	0.066
High elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/Small			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 17 (continued)

		Phase II		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.021	0.002	0.041
	Raptors	0.004	0	0.011
	Corvids	0.004	0	0.011
	Passerines	0.004	0	0.011
	Other	0.004	0	0.011
	Unidentified	0.011	0	0.023
	Total	0.046	0.014	0.079
Overall/Small				
	Waterbirds	0.008	0	0.019
	Raptors	0.004	0	0.012
	Corvids	0.004	0	0.012
	Passerines	0.012	0	0.025
	Other	0.015	0.001	0.030
	Unidentified	0.000	N/A	N/A
	Total	0.042	0.016	0.068
Water area/Large				
	Waterbirds	0.045	0	0.092
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.009	0	0.029
	Unidentified	0.027	0	0.059
	Total	0.082	0.009	0.154
Water area/Small				
	Waterbirds	0.018	0	0.045
	Raptors	0.000	N/A	N/A
	Corvids	0.009	0	0.029
	Passerines	0.009	0	0.029
	Other	0.018	0	0.045
	Unidentified	0.000	N/A	N/A
	Total	0.055	0.008	0.101
Low elevation area/Large				
	Waterbirds	0.006	0	0.018
	Raptors	0.006	0	0.018
	Corvids	0.006	0	0.018
	Passerines	0.006	0	0.018
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.024	0	0.052
Low elevation area/Small				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.007	0	0.021
	Corvids	0.000	N/A	N/A
	Passerines	0.013	0	0.033
	Other	0.013	0	0.033
	Unidentified	0.000	N/A	N/A
	Total	0.033	0	0.068

Table 18. Mean risk observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations of use within 200 m of site center and fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.109	0	0.274
	Raptors	0.800	0	2.609
	Corvids	0.000	N/A	N/A
	Passerines	0.012	0	0.032
	Other	0.000	N/A	N/A
	Unidentified	4.000	0	15.087
	Total	0.049	0.000	0.098
Overall/Small				
	Waterbirds	0.009	0	0.019
	Raptors	0.093	0	0.280
	Corvids	0.015	0	0.044
	Passerines	0.002	0	0.005
	Other	0.559	0	1.247
	Unidentified	2.135	0.012	4.258
	Total	0.015	0.004	0.025
Water area/Large				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A
Water area/Small				
	Waterbirds	0.006	0	0.017
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	8.000	0	27.051
	Total	0.007	0	0.016
Low elevation area/Large				
	Waterbirds	0.109	0	0.273
	Raptors	0.800	0	2.606
	Corvids	0.000	N/A	N/A
	Passerines	0.013	0	0.034
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.051	0	0.104

Table 18 (continued)

	Phase I		
Geographic Locations/Turbine Size/Group	**mean**	**lcl**	**ucl**
Low elevation area/Small			
Waterbirds	0.009	0	0.026
Raptors	0.522	0	1.656
Corvids	0.034	0	0.101
Passerines	0.000	N/A	N/A
Other	0.917	0	2.539
Unidentified	6.000	0	16.525
Total	0.020	0	0.042
Medium elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
Medium elevation area/Small			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.023	0	0.070
Other	2.000	0	7.544
Unidentified	1.333	0	4.322
Total	0.073	0	0.167
High elevation area/Large			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/Small			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 18 (continued)

		Phase II		
Geographic Locations/Turbine Size/Group		**mean**	**lcl**	**ucl**
Overall/Large				
	Waterbirds	0.027	0	0.057
	Raptors	0.411	0	1.277
	Corvids	0.032	0	0.096
	Passerines	0.026	0	0.082
	Other	0.925	0	3.033
	Unidentified	1.233	0	3.284
	Total	0.044	0.004	0.084
Overall/Small				
	Waterbirds	0.027	0	0.068
	Raptors	0.464	0	1.469
	Corvids	0.028	0	0.084
	Passerines	0.067	0	0.156
	Other	0.925	0	2.274
	Unidentified	0.000	N/A	N/A
	Total	0.067	0.015	0.120
Water area/Large				
	Waterbirds	0.031	0	0.069
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	1.233	0	4.205
	Unidentified	1.233	0	3.170
	Total	0.041	0	0.084
Water area/Small				
	Waterbirds	0.033	0	0.083
	Raptors	0.000	N/A	N/A
	Corvids	0.045	0	0.135
	Passerines	0.027	0	0.086
	Other	1.057	0	3.083
	Unidentified	0.000	N/A	N/A
	Total	0.048	0.003	0.093
Low elevation area/Large				
	Waterbirds	0.017	0	0.055
	Raptors	3.700	0	13.956
	Corvids	0.095	0	0.287
	Passerines	0.185	0	0.566
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.053	0	0.129
Low elevation area/Small				
	Waterbirds	0.000	N/A	N/A
	Raptors	1.244	0	4.010
	Corvids	0.000	N/A	N/A
	Passerines	0.247	0	0.611
	Other	0.822	0	2.626
	Unidentified	0.000	N/A	N/A
	Total	0.129	0	0.269

Table 19. Mean use observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/slt				
	Waterbirds	0.203	0.009	0.398
	Raptors	0.022	0.010	0.033
	Corvids	0.077	0.045	0.110
	Passerines	0.446	0.279	0.613
	Other	0.010	0.001	0.020
	Unidentified	0.006	0.001	0.011
	Total	0.765	0.522	1.009
Overall/LTT				
	Waterbirds	0.239	0	0.508
	Raptors	0.011	0	0.024
	Corvids	0.070	0.030	0.110
	Passerines	1.457	0	3.059
	Other	0.000	N/A	N/A
	Unidentified	0.002	0	0.007
	Total	1.779	0.194	3.364
Overall/stt				
	Waterbirds	2.214	0.550	3.878
	Raptors	0.016	0.006	0.027
	Corvids	0.150	0.104	0.196
	Passerines	1.402	0.354	2.450
	Other	0.018	0.000	0.036
	Unidentified	0.004	0.001	0.007
	Total	3.804	1.803	5.806
Water area/slt				
	Waterbirds	0.840	0	2.088
	Raptors	0.044	0.001	0.086
	Corvids	0.101	0.031	0.172
	Passerines	0.693	0	1.654
	Other	0.023	0	0.078
	Unidentified	0.000	N/A	N/A
	Total	1.700	0.388	3.013
Water area/LTT				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 19 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Water area/stt			
Waterbirds	5.789	0.050	11.528
Raptors	0.033	0.008	0.057
Corvids	0.191	0.107	0.275
Passerines	2.445	0.774	4.115
Other	0.012	0	0.027
Unidentified	0.003	0	0.010
Total	8.472	2.453	14.492
Low elevation area/slt			
Waterbirds	0.392	0	0.979
Raptors	0.017	0	0.045
Corvids	0.058	0.014	0.103
Passerines	0.217	0.109	0.324
Other	0.004	0	0.013
Unidentified	0.008	0	0.021
Total	0.696	0.123	1.269
Low elevation area/LTT			
Waterbirds	0.275	0	0.585
Raptors	0.013	0	0.027
Corvids	0.075	0.030	0.120
Passerines	1.593	0	3.448
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	1.955	0.126	3.784
Low elevation area/stt			
Waterbirds	2.106	0	4.632
Raptors	0.007	0	0.016
Corvids	0.211	0.117	0.305
Passerines	1.783	0	4.303
Other	0.030	0	0.075
Unidentified	0.000	N/A	N/A
Total	4.137	0.706	7.569
Medium elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.017	0	0.037
Corvids	0.035	0	0.087
Passerines	0.254	0	0.525
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.306	0	0.615
Medium elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 19 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Medium elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.023	0	0.061
Corvids	0.066	0.005	0.126
Passerines	0.378	0.066	0.690
Other	0.007	0	0.021
Unidentified	0.010	0	0.021
Total	0.483	0.119	0.848
High elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.020	0.001	0.038
Corvids	0.105	0.033	0.176
Passerines	0.605	0.326	0.884
Other	0.016	0	0.033
Unidentified	0.010	0	0.022
Total	0.755	0.493	1.018
High elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.033	0	0.177
Passerines	0.556	0	1.773
Other	0.000	N/A	N/A
Unidentified	0.017	0	0.088
Total	0.606	-0.701	1.912
High elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.044	0.009	0.079
Passerines	0.175	0.070	0.280
Other	0.013	0	0.032
Unidentified	0.006	0	0.021
Total	0.238	0.118	0.357

Table 19 (continued)

		Phase II		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/LTT				
	Waterbirds	0.788	0.207	1.368
	Raptors	0.009	0.002	0.016
	Corvids	0.112	0.058	0.166
	Passerines	0.135	0.028	0.242
	Other	0.004	0	0.009
	Unidentified	0.009	0	0.020
	Total	1.056	0.372	1.739
Overall/stt				
	Waterbirds	0.289	0.056	0.522
	Raptors	0.008	0.000	0.016
	Corvids	0.137	0.094	0.180
	Passerines	0.172	0.032	0.313
	Other	0.017	0	0.036
	Unidentified	0.006	0	0.013
	Total	0.629	0.285	0.974
Water area/LTT				
	Waterbirds	1.464	0.097	2.831
	Raptors	0.020	0.003	0.036
	Corvids	0.189	0.064	0.314
	Passerines	0.295	0.028	0.562
	Other	0.007	0	0.019
	Unidentified	0.022	0	0.052
	Total	1.998	0.396	3.599
Water area/stt				
	Waterbirds	0.557	0.031	1.084
	Raptors	0.012	0	0.031
	Corvids	0.201	0.134	0.268
	Passerines	0.334	0	0.668
	Other	0.017	0	0.044
	Unidentified	0.012	0	0.029
	Total	1.134	0.392	1.876
Low elevation area/LTT				
	Waterbirds	0.350	0	0.774
	Raptors	0.002	0	0.005
	Corvids	0.062	0.030	0.094
	Passerines	0.032	0.011	0.053
	Other	0.002	0	0.005
	Unidentified	0.000	N/A	N/A
	Total	0.446	0.020	0.873
Low elevation area/stt				
	Waterbirds	0.092	0	0.222
	Raptors	0.005	0	0.012
	Corvids	0.090	0.043	0.137
	Passerines	0.054	0.017	0.091
	Other	0.016	0	0.047
	Unidentified	0.002	0	0.006
	Total	0.259	0.099	0.420

Table 20. Mean fatality observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/slt				
	Waterbirds	0.012	0	0.029
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.004	0	0.012
	Other	0.000	N/A	N/A
	Unidentified	0.012	0	0.025
	Total	0.027	0.005	0.049
Overall/LTT				
	Waterbirds	0.026	0	0.056
	Raptors	0.009	0	0.027
	Corvids	0.000	N/A	N/A
	Passerines	0.017	0	0.042
	Other	0.026	0	0.056
	Unidentified	0.009	0	0.027
	Total	0.087	0.036	0.138
Overall/stt				
	Waterbirds	0.012	0	0.025
	Raptors	0.003	0	0.010
	Corvids	0.003	0	0.010
	Passerines	0.000	N/A	N/A
	Other	0.015	0.000	0.030
	Unidentified	0.010	0	0.020
	Total	0.042	0.012	0.073
Water area/slt				
	Waterbirds	0.057	0	0.197
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.029	0	0.098
	Total	0.086	0	0.231
Water area/LTT				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 20 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Water area/stt			
Waterbirds	0.013	0	0.042
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.013	0	0.042
Total	0.027	0	0.066
Low elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.033	0	0.083
Total	0.033	0	0.083
Low elevation area/LTT			
Waterbirds	0.030	0	0.064
Raptors	0.010	0	0.031
Corvids	0.000	N/A	N/A
Passerines	0.020	0	0.049
Other	0.030	0	0.064
Unidentified	0.010	0	0.031
Total	0.100	0.043	0.157
Low elevation area/stt			
Waterbirds	0.021	0	0.053
Raptors	0.008	0	0.025
Corvids	0.008	0	0.025
Passerines	0.000	N/A	N/A
Other	0.029	0	0.064
Unidentified	0.008	0	0.025
Total	0.075	0.008	0.141
Medium elevation area/slt			
Waterbirds	0.017	0	0.053
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.017	0	0.053
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.033	0	0.083

Table 20 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Medium elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
Medium elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.013	0	0.042
Unidentified	0.013	0	0.042
Total	0.027	0	0.084
High elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 20 (continued)

		Phase II		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/LTT				
	Waterbirds	0.021	0.002	0.041
	Raptors	0.004	0	0.011
	Corvids	0.004	0	0.011
	Passerines	0.004	0	0.011
	Other	0.004	0	0.011
	Unidentified	0.011	0	0.023
	Total	0.046	0.014	0.079
Overall/stt				
	Waterbirds	0.008	0	0.019
	Raptors	0.004	0	0.012
	Corvids	0.004	0	0.012
	Passerines	0.012	0	0.025
	Other	0.015	0.001	0.030
	Unidentified	0.000	N/A	N/A
	Total	0.042	0.016	0.068
Water area/LTT				
	Waterbirds	0.045	0	0.092
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.009	0	0.029
	Unidentified	0.027	0	0.059
	Total	0.082	0.009	0.154
Water area/stt				
	Waterbirds	0.018	0	0.045
	Raptors	0.000	N/A	N/A
	Corvids	0.009	0	0.029
	Passerines	0.009	0	0.029
	Other	0.018	0	0.045
	Unidentified	0.000	N/A	N/A
	Total	0.055	0.008	0.101
Low elevation area/LTT				
	Waterbirds	0.006	0	0.018
	Raptors	0.006	0	0.018
	Corvids	0.006	0	0.018
	Passerines	0.006	0	0.018
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.024	0	0.052
Low elevation area/stt				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.007	0	0.021
	Corvids	0.000	N/A	N/A
	Passerines	0.013	0	0.033
	Other	0.013	0	0.033
	Unidentified	0.000	N/A	N/A
	Total	0.033	0	0.068

Table 21. Mean risk observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II, calculated based on observations of use within 200 m of site center and fatalities found during scheduled carcass searches. lcl = 95% lower confidence limit; ucl = 95% upper confidence limit. lcl values less than zero were set to zero

		Phase I		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/slt				
	Waterbirds	0.057	0	0.155
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.009	0	0.026
	Other	0.000	N/A	N/A
	Unidentified	1.922	0	4.639
	Total	0.035	0.005	0.065
Overall/LTT				
	Waterbirds	0.109	0	0.274
	Raptors	0.800	0	2.609
	Corvids	0.000	N/A	N/A
	Passerines	0.012	0	0.032
	Other	0.000	N/A	N/A
	Unidentified	4.000	0	15.087
	Total	0.049	0.000	0.098
Overall/stt				
	Waterbirds	0.005	0	0.012
	Raptors	0.196	0	0.599
	Corvids	0.021	0	0.063
	Passerines	0.000	N/A	N/A
	Other	0.824	0	1.972
	Unidentified	2.400	0	5.758
	Total	0.011	0.001	0.021
Water area/slt				
	Waterbirds	0.068	0	0.224
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.050	0	0.126
Water area/LTT				
	Waterbirds	0.000	N/A	N/A
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.000	N/A	N/A

Table 21 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Water area/stt			
Waterbirds	0.002	0	0.007
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	4.000	0	15.087
Total	0.003	0	0.008
Low elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	4.000	0	11.475
Total	0.048	0	0.120
Low elevation area/LTT			
Waterbirds	0.109	0	0.273
Raptors	0.800	0	2.606
Corvids	0.000	N/A	N/A
Passerines	0.013	0	0.034
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.051	0	0.104
Low elevation area/stt			
Waterbirds	0.010	0	0.028
Raptors	1.091	0	3.555
Corvids	0.038	0	0.114
Passerines	0.000	N/A	N/A
Other	0.978	0	2.761
Unidentified	0.000	N/A	N/A
Total	0.018	0	0.039
Medium elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.066	0	0.208
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.109	0	0.284
Medium elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 21 (continued)

	Phase I		
Geographic Locations/Turbine Style/Group	**mean**	**lcl**	**ucl**
Medium elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	2.000	0	7.544
Unidentified	1.333	0	4.297
Total	0.055	0	0.170
High elevation area/slt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/LTT			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A
High elevation area/stt			
Waterbirds	0.000	N/A	N/A
Raptors	0.000	N/A	N/A
Corvids	0.000	N/A	N/A
Passerines	0.000	N/A	N/A
Other	0.000	N/A	N/A
Unidentified	0.000	N/A	N/A
Total	0.000	N/A	N/A

Table 21 (continued)

		Phase II		
Geographic Locations/Turbine Style/Group		**mean**	**lcl**	**ucl**
Overall/LTT				
	Waterbirds	0.027	0	0.057
	Raptors	0.411	0	1.277
	Corvids	0.032	0	0.096
	Passerines	0.026	0	0.082
	Other	0.925	0	3.033
	Unidentified	1.233	0	3.284
	Total	0.044	0.004	0.084
Overall/stt				
	Waterbirds	0.027	0	0.068
	Raptors	0.464	0	1.469
	Corvids	0.028	0	0.084
	Passerines	0.067	0	0.156
	Other	0.925	0	2.274
	Unidentified	0.000	N/A	N/A
	Total	0.067	0.015	0.120
Water area/LTT				
	Waterbirds	0.031	0	0.069
	Raptors	0.000	N/A	N/A
	Corvids	0.000	N/A	N/A
	Passerines	0.000	N/A	N/A
	Other	1.233	0	4.205
	Unidentified	1.233	0	3.170
	Total	0.041	0	0.084
Water area/stt				
	Waterbirds	0.033	0	0.083
	Raptors	0.000	N/A	N/A
	Corvids	0.045	0	0.135
	Passerines	0.027	0	0.086
	Other	1.057	0	3.083
	Unidentified	0.000	N/A	N/A
	Total	0.048	0.003	0.093
Low elevation area/LTT				
	Waterbirds	0.017	0	0.055
	Raptors	3.700	0	13.956
	Corvids	0.095	0	0.287
	Passerines	0.185	0	0.566
	Other	0.000	N/A	N/A
	Unidentified	0.000	N/A	N/A
	Total	0.053	0	0.129
Low elevation area/stt				
	Waterbirds	0.000	N/A	N/A
	Raptors	1.244	0	4.010
	Corvids	0.000	N/A	N/A
	Passerines	0.247	0	0.611
	Other	0.822	0	2.626
	Unidentified	0.000	N/A	N/A
	Total	0.129	0	0.269

Table 22. Results of the searcher efficiency trials at San Gorgonio by size of carcass and vegetation type

Size of Carcass/Part	Vegetation Type	Estimated Probability of Detection	Std.Error	N Carcasses/ Parts	95% C.I.LL	95% C.I.UL
Study 1 (September 22, 1997)						
Small	Small Shrub	0.64	0.09	28	0.46	0.82
Small	Large Shrub	0.67	0.10	24	0.47	0.86
Small	Open	0.68	0.10	22	0.48	0.88
Large	Small Shrub	0.71	0.12	14	0.47	0.96
Large	Large Shrub	0.94	0.05	18	0.84	1.05
Large	Open	0.94	0.05	18	0.84	1.05
Study 2 (March 31, 1998)						
Small	Small Shrub	0.46	0.07	48	0.31	0.60
Small	Large Shrub	0.63	0.06	56	0.50	0.75
Small	Open	0.56	0.07	48	0.42	0.71
Large	Small Shrub	0.50	0.08	44	0.35	0.65
Large	Large Shrub	0.64	0.07	44	0.49	0.78
Large	Open	0.78	0.07	32	0.64	0.93
Overall						
Small	Small Shrub	0.53	0.06	76	0.41	0.64
Small	Large Shrub	0.64	0.05	80	0.53	0.74
Small	Open	0.60	0.06	70	0.48	0.72
Large	Small Shrub	0.55	0.07	58	0.42	0.68
Large	Large Shrub	0.73	0.06	62	0.61	0.84
Large	Open	0.84	0.05	50	0.74	0.94
Total	Total	0.64	0.02	396	0.59	0.68

Table 23. Results of the scavenging trials at San Gorgonio by proximity to turbine, geographic location, size of carcass, and coloration

Comparisons	N	Proportion Removed Day 8	Day 10	Mean	SE	95% CI LL	UL
Proximity to Turbine							
Near: <100 m From Turbine	112	0.90	0.96	4.13	0.24	3.65	4.61
Mid: 100-400 m From Turbine	39	0.92	0.97	3.26	0.41	2.43	4.08
Far: > 400 m From Turbine	64	0.88	0.97	3.97	0.37	3.23	4.70
Geographic Location							
High elevation area	59	0.85	0.95	4.29	0.37	3.55	5.03
Medium elevation area	50	0.90	0.94	4.05	0.37	3.30	4.80
Low elevation area	68	0.90	0.99	4.26	0.31	3.63	4.89
Water area	38	0.97	0.97	2.59	0.36	1.86	3.32
Season							
April 1997	76	0.93	0.95	3.21	0.29	2.64	3.78
December 1997	139	0.88	0.97	4.31	0.23	3.85	4.77
Size							
Small	83	0.90	0.93	3.68	0.30	3.08	4.28
Large	132	0.89	0.98	4.08	0.23	3.62	4.54
Coloration							
Non-Cryptic	83	0.90	0.93	3.68	0.30	3.08	4.28
Cryptic	132	0.89	0.98	4.08	0.23	3.62	4.54
Total	215	0.90	0.96	3.92	0.18	3.56	4.29

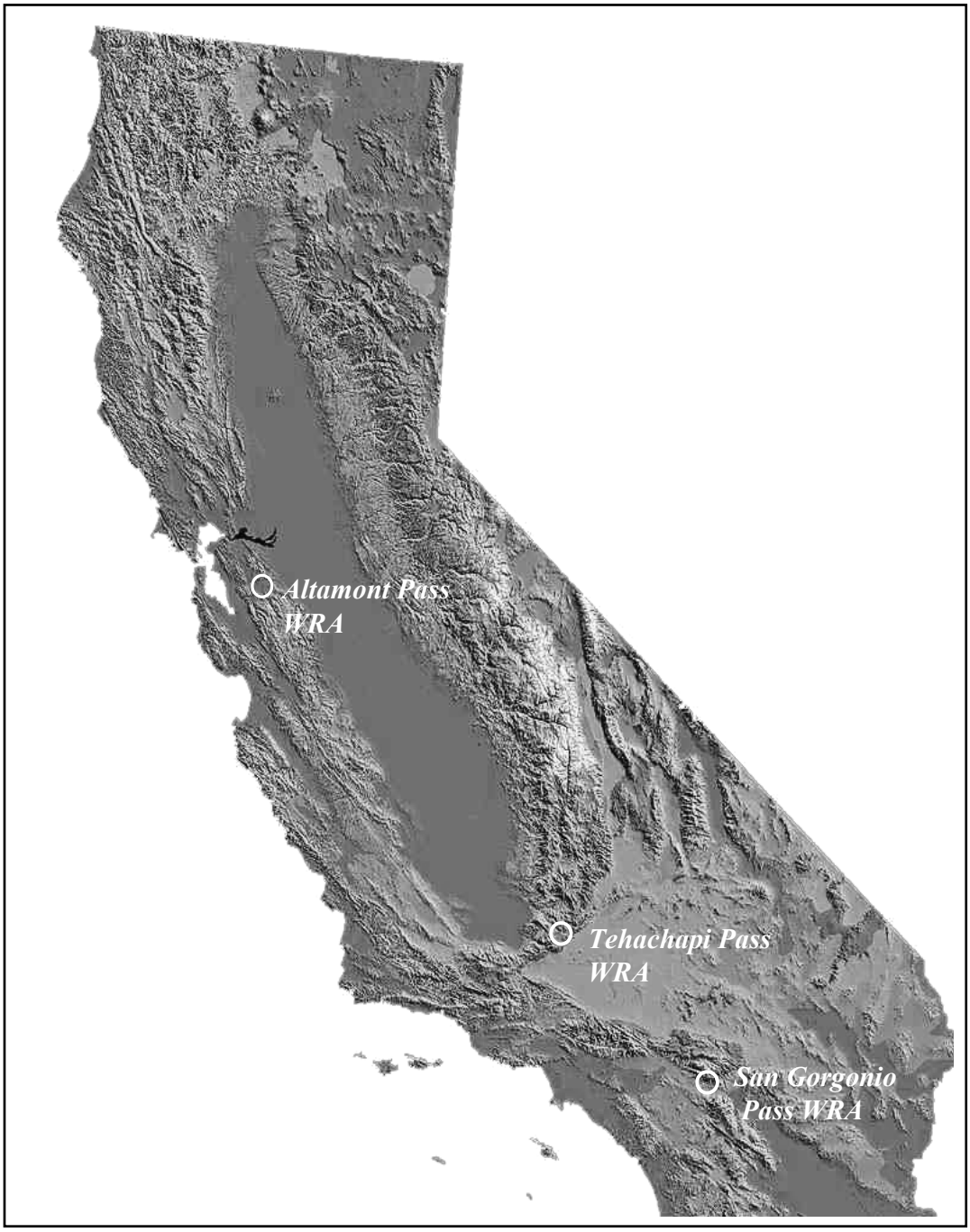

Figure 1. Major developed wind resources areas (WRAs) of California

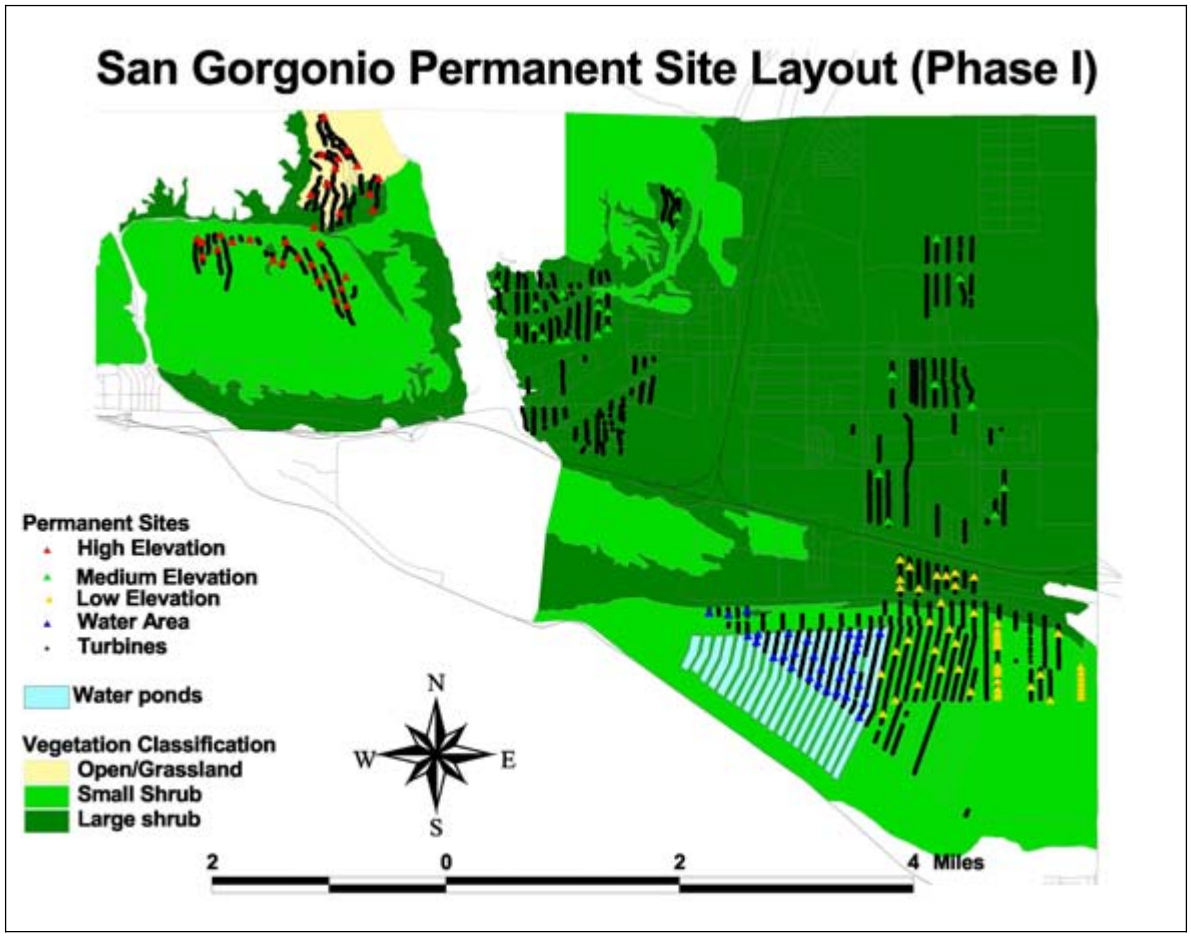

Figure 2. Location of geographic regions and sample site locations at San Gorgonio

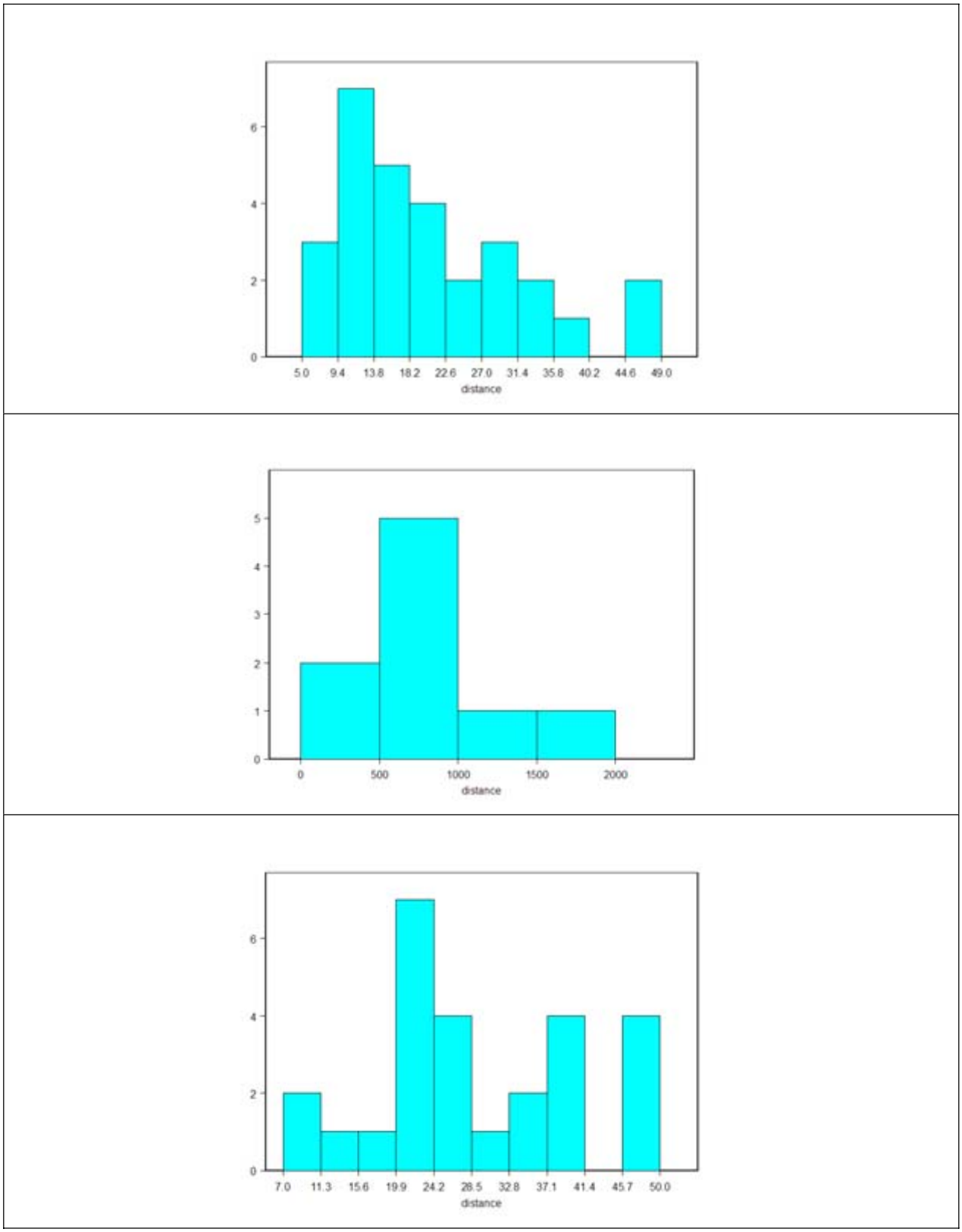

Figure 3. Horizontal distribution of dead birds surrounding the closest turbine observed during Phase I, near and away from turbines, and Phase II studies at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II. Calculated without regard to other structures and whether the turbine is the closest structure

Appendix A. List of birds observed during Phase I and Phase II utilization surveys at San Gorgonio Pass WRA, 3 March 1997 to 29 May 1998 for Phase I and 19 August 1999 to 7 August 2000 for Phase II

Taxonomic Group/ Common Name	Scientific Name	Phase I	Phase II
Waterbirds			
Western Grebe	*Aechmophorus*	I	II
Double-Crested Cormorant	*Phalacrocorax auritus*	I	II
Brown Pelican	*Pelecanus occidentalis*	I	
Common Merganser	*Mergus merganser*	I	
Red-Breasted Merganser	*Mergus serrator*		II
Mallard	*Anas platyrhynchos*	I	II
Gadwall	*Anas strepera*	I	II
American Green-Winged Teal	*Anas crecca*	I	II
Cinnamon Teal	*Anas cyanoptera*	I	II
Northern Shoveler	*Anas clypeata*	I	
Northern Pintail	*Anas acuta*	I	
Redhead	*Aythya americana*	I	II
Canvasback	*Aythya valisineria*	I	II
Greater Scaup	*Aythya marila*		II
Ring-Necked Duck	*Aythya collaris*	I	II
Bufflehead	*Bucephala albeola*	I	II
Ruddy Duck	*Oxyura jamaicensis*	I	II
Unknown Light Goose			II
Canada Goose	*Branta canadensis*	I	
Black Brant	*Branta bernicla*	I	II
Great Blue Heron	*Ardea herodias*	I	II
Great Egret	*Ardea alba*	I	II
Snowy Egret	*Egretta thula*		II
Tri-Colored Heron	*Egretta tricolor*		II
Black-Crowned Night Heron	*Nycticorax nycticorax*	I	
American Coot	*Fulica americana*	I	II
American Avocet	*Recurvirostra americana*		II
Black-Necked Stilt	*Himantopus mexicanus*		II
Least Sandpiper	*Calidris pusilla*		II
Western Sandpiper	*Calidris mauri*		II
Greater Yellowlegs	*Tringa melanoleuca*	I	II
Lesser Yellowlegs	*Tringa flavipes*		II
Killdeer	*Charadrius vociferus*	I	II
Eared Grebe	*Podiceps nigricollis*	I	II
Glaucous-Wing gull	*Larus glaucescens*		II
California Gull	*Larus californicus*	I	II
Ring-Billed Gull	*Larus delawarensis*	I	
Pied-Billed Grebe	*Podilymbus podiceps*	I	II
Bonaparte's Gull	*Larus philadelphia*	I	
Caspian Tern	*Sterna caspia*	I	II
Common Loon	*Gavia immer*	I	II

Appendix A (continued)

Taxonomic Group/ Common Name	Scientific Name	Phase I	Phase II
Raptors			
Northern Harrier	*Circus cyaneus*	I	
Red-Tailed Hawk	*Buteo jamaicensis*	I	II
Golden Eagle	*Aquila chrysaetos*	I	
Bald Eagle	*Haliaeetus leucocephalus*	I	
Prairie Falcon	*Falco mexicanus*	I	II
Peregrine Falcon	*Falco peregrinus*	I	
American Kestrel	*Falco sparverius*	I	II
Osprey	*Pandion haliaetus*	I	II
Common Barn Owl	*Tyto alba*		II
Burrowing Owl	*Athene cunicularia*	I	
Corvids			
Scrub Jay	*Aphelocoma californica*	I	
Common Raven	*Corvus corax*	I	II
American Crow	*Corvus brachyrhynchos*		II
Passerines			
White-Throated Swift	*Aeronautes saxatalis*	I	
Anna's Hummingbird	*Calypte anna*	I	
Broad-Tailed Hummingbird	*Selasphorus platycercus*		II
Western Kingbird	*Tyrannus verticalis*	I	II
Say's Phoebe	*Sayornis saya*	I	II
Black Phoebe	*Sayornis nigricans*	I	II
Horned Lark	*Eremophila alpestris*	I	II
European Starling	*Sturnus vulgaris*	I	II
Brown-Headed cowbird	*Molothrus ater*		II
Red-Winged Blackbird	*Agelaius phoeniceus*	I	II
Western Meadowlark	*Sturnella neglecta*	I	
Brewer's Blackbird	*Euphagus cyanocephalus*	I	II
House Finch	*Carpodacus mexicanus*	I	II
American Goldfinch	*Carduelis tristis*		II
Lesser Goldfinch	*Carduelis psaltria*	I	
Lawrence's Goldfinch	*Carduelis lawrencei*	I	
Savannah Sparrow	*Passerculus sandwichensis*	I	II
Lark Sparrow	*Chondestes grammacus*	I	
White-Crowned Sparrow	*Zonotrichia leucophrys*	I	
Black-Throated Sparrow	*Amphispiza bilineata*	I	
Sage Sparrow	*Amphispiza belli*	I	
Rufous-Crowned Sparrow	*Aimophila ruficeps*	I	
Abert's Towhee	*Pipilo aberti*	I	
Western Tanager	*Piranga ludoviciana*		II

Appendix A (continued)

Taxonomic Group/ Common Name	Scientific Name	Phase I	Phase II
Cliff Swallow	*Petrochelidon pyrrhonota*	I	
Barn Swallow	*Hirundo rustica*	I	
Violet-Green Swallow	*Tachycineta thalassina*	I	II
Northern Rough-Winged	*Stelgidopteryx serripennis*	I	
Phainopepla	*Phainopepla nitens*	I	
Loggerhead Shrike	*Lanius ludovicianus*	I	II
Yellow Warbler	*Dendroica petechia*	I	
Yellow-Rumped Warbler	*Dendroica coronata*	I	II
Black-Throated Gray Warbler	*Dendroica nigrescens*	I	
Wilson's Warbler	*Wilsonia pusilla*	I	
Sage Thrasher	*Oreoscoptes montanus*	I	
Northern Mockingbird	*Mimus polyglottos*	I	
California Thrasher	*Toxostoma redivivum*	I	
Le Conte's Thrasher	*Toxostoma lecontei*	I	
Cactus Wren	*Campylorhynchus brunneicapillus*	I	
Rock Wren	*Salpinctes obsoletus*	I	
Bewick's Wren	*Thryomanes bewickii*	I	
Black-Tailed Gnatcatcher	*Polioptila melanura*	I	
Mountain Bluebird	*Sialia currucoides*	I	
Other Birds			
Rock Dove	*Columba livia*	I	II
Mourning Dove	*Zenaida macroura*	I	II
Gambel's Quail	*Callipepla gambelii*	I	
Greater Roadrunner	*Geococcyx californianus*	I	II

Appendix B. Feathers and fatalities found during Phase I and Phase II studies at San Gorgonio WRA. LLT = large lattice turbine; LTT = large tubular turbine; slt = small lattice turbine; stt = small tubular turbine; L2TT = large 2-blade tubular turbine

Phase I

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Common Raven	*Low*	Near	LN34	Yes	03/18/97	Feather spot and/or bones	37	stt	Only skull. Portion exposed to the sun is bleached. Feathers retained on portion buried in sand.
Mexican Free-Tailed Bat	*Low*	Near	LN26	Yes	03/26/97	Intact	41	Meteorological tower	Dried and covered with ants.
Rock Dove	*Medium*	Away	MA06	Yes	03/28/97	Feather spot	500	Transmission line	Probably an adult killed after site was set up. Most fthrs good cond., not all coll. (4 remiges, few coverts, contour and downy body fthrs).
European Starling	*Medium*	Near	MN02	Yes	04/01/97	Dismembered	19	slt	Body remains, head gone. Flesh dried. May have been scavenged by small mammals and insects.
American Coot	*Water*	Near	WN11	Yes	04/04/97	Feather spot and/or bones	10	stt	Left wing only.
Unidentified Bird	*Water*	Near	WN02	Yes	04/04/97	Feather spot and/or bones	9	slt	Two attached rib bones.
Golden Eagle[2]				No	04/17/97	Intact	3	slt	Injured eagle taken to Cochella Wild Bird Center where it was identified (immature female) and euthanized.
Mourning Dove				No	05/03/97	Intact	52	Elevated transformer box	Back of skull and windpipe exposed, missing flesh & fthrs. Few maggots and red ants. <= couple days old. Body still relatively heavy (water weight).
Unidentified Grebe	*Low*	Near	LN10	Yes	05/14/97	Feather spot and/or bones	29	LTT	3’ X 7’ patch of body feathers remaining intact w/ skin. Some bone.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Mourning Dove	*High*	Near	HN19	No	05/15/97	Feather spot	21	Main road (traveled > 56 kph)	Found 4 or 5 flight feathers (includes retrices) very close together and approx. 20 body feathers. Found within a square meter.
Mallard	*Water*	Away	WA03	Yes	05/19/97	Feather spot and/or bones	750	Main road (traveled > 56 kph)	Spinal column, fused pelvic girdle, skin and svrl coverts att. to 2 consecutive L-primaries, >50 contour and downy fthrs, marrow-filled humerus connected to clavicle and coracoid, partial keel.
Mallard	*Low*	Near	LN25	Yes	05/20/97	Intact	15	L2TT	Chest cavity is fairly clean and dried, but 60% of bird remains. Bird partially covered w/ drifting sand. Prob occurred w/in last 10 days. Ants scavenging.
Unidentified Bird	*Low*	Near	LN41	Yes	05/26/97	Feather spot and/or bones	5	slt	Single stout bone (pneumatic humerus w/ internal struts).
Unidentified Teal	*Low*	Away	LA02	Yes	05/28/97	Feather spot and/or bones	2000		Single right wing, dried out.
Greater Roadrunner				No	06/04/97	Feather spot and/or bones	400	Minor dirt road	Bird lying on road, most likely a road kill. >75% scavenged. Scavenged by ants and maggots.
Mallard	*Water*	Away	WA08	Yes	06/10/97	Dismembered	500	Distribution line	Possibly poached. Still flightless, must have been caught by neck, head missing. Found 2 neck pieces, keel removed, entrails spread around.
Unidentified Bird	*Water*	Near	WN12	Yes	06/18/97	Feather spot and/or bones	11	stt	One wing, another humerus, and 1 leg bone. Bones are short and stout.
Burrowing Owl	*Low*	Near	LN26	Yes	07/08/97	Intact	22	L2TT	Fresh, good condition. Slight smell. Eyes slightly dried. Could feel no broken bones, no obvious signs of injury.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Unidentified Bird	*Medium*	Away	MA09	Yes	07/08/97	Feather spot	500	Transmission line	Caught in creosote bush. Approx. 20 contour and 5 wing feathers.
Mallard				No	07/09/97	Dismembered	17	Distribution line	Very fresh (< 1 day old). Cut cleanly in two. Torso half and tail end 18m apart. Impact may have been with either 5-8 or 5-9.
Rock Dove	*Low*	Near	LN28	Yes	08/01/97	Intact	30	L2TT	Carcass intact, no feather loss.
Rock Dove	*Low*	Near	LN23	Yes	08/25/97	Feather spot and/or bones	35	L2TT	Somewhat fresh, still some sticky blood and flesh on bone. Scavenged by ants.
Red-Tailed Hawk				No	08/29/97	Feather spot and/or bones	156	slt (non-operational)	Skull, leg bones, vertebra, and right wing.
Rock Dove				No	08/30/97	Feather spot and/or bones	155	slt (non-operational)	Approx. 30 fthrs w/ dk brown-white shading (6 primaries, 7 secondaries, other wing fthrs almost all from L-wing, wing bones, coracoid, and clavicle.
Red-Tailed Hawk	*Low*	Near	LN37	Yes	09/01/97	Feather spot and/or bones	14	stt	Old and tattered, may have blown or washed in from elsewhere.
Rock Dove	*Low*	Near	LN03	Yes	09/12/97	Feather spot and/or bones	14	stt	Only wings, both w/o meat and fthrs except for sevl primaries attached at each tip. Probably scavenged; sharp breaks suggest crushing by teeth.
Rock Dove	*Low*	Near	LN13	Yes	09/16/97	Dismembered	27	LTT	Fairly fresh kill, flesh drying out. Feathers intact. Ants scavenging carcass. Tail end sheared off.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Rock Dove	*Low*	Near	LN28	No	09/23/97	Intact	31	L2TT	Looks very fresh, high water content in body. Hole in side of body under left wing. Some intestines protruding from cloaca. Scavenged by ants.
Rock Dove	*Low*	Near	LN28	No	09/23/97	Intact	10	L2TT	Tail feathers damaged, one found next to body, very fresh carcass, eye still moist and clear. Body with high water content.
Unidentified Bird				No	10/07/97	Feather spot and/or bones	700	Transmission line	Large wing only. Fthrs and bone. Scavenged; broken bones and 1 wing. Most likely some sort of waterbird.
Rock Dove	*Low*	Near	LN31	Yes	10/21/97	Feather spot and/or bones	12	stt	Prob. collided w/ 38-7, then was carried and scav. near turbine 38-6 where found. Only wings and feathers, meat chewed off.
Common Barn Owl				No	10/30/97	Dismembered	35	Fence	Wings, tail, head, breast bone missing. Desiccated.
American Coot	*Water*	Near	WN05	Yes	10/31/97	Feather spot	8	slt	Three dark grey/brown consecutive flt fthrs in a clump bound by dried flesh, 5+ tiny fthrs attached to skin at base of clump.
Western Meadowlark	*Low*	Near	LN11	Yes	11/07/97	Feather spot	20	LTT	Feathers scattered in large area, >50 body feathers and ~5 wing feathers, but no primaries or secondaries.
Rock Dove	*Medium*	Near	MN14	Yes	11/11/97	Feather spot and/or bones	18	Other human-made structure	Bones of neck and part of skull, upper bill att. to front of skull w/ intack fthrs. Bones covered w/ dried blood and flesh.
Unidentified Bird	*Low*	Near	LN40	Yes	11/14/97	Feather spot and/or bones	10	Transformer building	One leg bone w/ black-scaled foot and wing bone under nacelle cone in bldg near 17-28. Small bones (mammal) found in same area.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
American Coot				No	11/17/97	Dismembered	40	Distribution line	Lying on main road near pond A RTHA was seen in area <5 min. before, likely had scavenged bird. Coot's breast removed and head is gone. Entrails still inside body cavity. Numerous fthrs, some stuck together w/ blood, scattered about.
American Coot				No	11/19/97	Dismembered	174	stt	Fresh kill; 15% of flesh remains. Body torn apart by possible mammal scavenger. Wings, tail, and many body feathers found.
Unidentified Duck				No	11/19/97	Dismembered	4	Transformer box	On top of transformer box. Head, wings and upper body intact. Flesh dried, possible avian scavenging. Possibly a GWTE.
American Coot				No	12/05/97	Feather spot	900	Transmission line	Many fthrs, collected majority of larger fthrs. Most likely scav. by canine. Fresh because not seen previously.
Mourning Dove				No	12/07/97	Feather spot	1000	Fence	Collected 100+ fthrs. Remains of tissue and a few fthrs on top of post where small bird was eaten by another bird. Most likely scav. by raptor.
European Starling				No	12/08/97	Intact	12	slt	Cut under L-eye, bled through mouth and nose. Fresh kill today, not here yesterday.
Snow Goose				No	12/08/97	Feather spot	900	Transmission line	Many white fthrs; collected majority of larger fthrs. Most likely scav by a canine. Fresh fatality. RTHA seen near spot 2 days ago.
Unidentified Bird				No	12/10/97	Feather spot	900	Transmission Line	Fresh - not seen before. 6 chestnut brn flt and ~10 body fthrs. Prob scav by canine.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Common Raven				No	12/11/97	Intact	17	Distribution line	Body somewhat dried, not fresh, but still in good condition. Prob < 2 wks old. Signs of insect scav. Body intact but a bit contorted.
Unidentified Bird	*Low*	Near	LN22	Yes	12/12/97	Feather spot and/or bones	49	L2TT	Wing bones, radius, ulna, and carpometacarpus connected by dry tissue. Wing w/ primary and secondary shafts only intact. No contour feathers. No meat on wing - old fat.
American Coot	*Water*	Away	WA02	Yes	12/16/97	Feather spot	450	LTT	Approx. 50 blk/dk grey fthrs (9 remiges, others - contour and other body fthrs; one clump of ~10 cont fthrs attached together w/ skin). Mamm scav sign (fthrs chewed at site of att. to body).
White-Throated Swift	*Low*	Near	LN15	Yes	12/22/97	Intact	46	Blockhouse	Carcass fresh, very flexible and in good condition. Prob <2 days old. No obvious injury, possibly slammed into blockhouse by recent strong winds.
American Coot	*Low*	Near	LN53	Yes	12/30/97	Feather spot and/or bones	10	Meteorological tower	Coll ~25 fthrs (3 remiges, ~5 tertiaries, and dk grey/black body fthrs). Possibly eaten by RTHA on nearby MET tower (also found one possible RTHA fthr).
Rock Dove	*Low*	Near	LN53	Yes	12/30/97	Feather spot			Collected at least 10 fthrs (2 retrices, 1 primary, 3 secondaries, grey contours, and 1 white w/ red mottled contour).
American Coot	*Water*	Away	WA08	Yes	12/30/97	Feather spot	400	Distribution line	>75 fthrs (10+ primaries/secondaries, clump of 25+ plumalaceous fthrs-bases attached with dried skin, down, and body fthrs. Scav: fther broken off at attachment site.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Common Barn Owl				No	01/06/98	Feather spot and/or bones	2	stt	Only left rapt leg- bleached and dried. Turbine base surrounded by many small twigs - most likely remains of nest in open nacelle. Leg possibly part of nest or bird using nest.
American Coot	*Water*	Near	WN05	Yes	01/15/98	Feather spot	35	slt	R-wing tip of 3 consecutive primaries and some small coverts att. together. 2 contour/coverts and 1 white fthr. Fair cond. Most likely scav by a canine, wing tip appears chewed off.
American Coot	*Water*	Away	WA05	Yes	01/28/98	Feather spot	790	Main road (traveled > 56 kph)	~50 fthrs, includes 15 remiges w/ <10 AMCO fthrs w/in search area.
Unidentified Bird				No	01/28/98	Feather spot	790	Main road (traveled > 56 kph)	~10 white breast fthrs connected by dried skin, ~20+ loose white fthrs ~3m beyond WA05 search area. Possible SNGO.
Unidentified Egret	*Medium*	Near	MN07	Yes	02/05/98	Feather spot	25	slt	Very clean feathers, it had just rained, so recent fat. 12 remiges and 15 contours. Fthr shafts broken or torn - scav by raptor?
Unidentified Bird	*Medium*	Near	MN14	Yes	02/10/98	Feather spot	10	stt	Found clusters of primaries attached w/ skin. Collected majority of fthrs, but >20 fthrs still in rabbitbrush. Scav = some fthers still have skin attached.
American Coot	*Low*	Near	LN23	Yes	02/18/98	Feather spot and/or bones	26	L2TT	Dk. brown/grey fthers, inc 1 clump of 10 wing fthers bound by flesh and 3 individual flt. fthers. Slightly dried, but prob. < 3 weeks old.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Rock Dove				No	03/10/98	Intact	34	L2TT	Unknown cause of death, found lying on back w/ rt wing sticking up, neck curved back, head hidden, still fresh, not completely stiff, eyes sunk in. Had tar on feet.
Great Horned Owl				No	03/11/98	Dismembered	3	slt	Only found face and 2 clumps of 10-15 bod fthers. Possible mammal or avian scavenger.
Common Raven				No	03/24/98	Feather spot and/or bones	150	Fence	Only wing w/ ~6 primaries and ~2 inch length of bone. Scav - most likely chewed on by feral dog/coyote.
Common Barn Owl				No	04/02/98	Intact	13	stt	Time is not likely > 1week (bit dried but in good cond). Scav by insects. Injury -left wing broken, breast damaged, some flattening (possibly run over after death).
Unidentified Bird	*Low*	Away	LA08	Yes	04/07/98	Feather spot and/or bones	1465	Fence	Approx. 75-100 body fthrs left scattered around. Wind blowing hard, fthrs blowing out of bag. Scavenged possibly by a raptor or raven.
Sora	*Low*	Near	LN38	Yes	04/21/98	Intact	15	Transformer box	Carcass on elevated platform of transformer box, where eaten. Skeleton intact w/ 1 wing missing. Rib cage broken on 1 side. Bones mostly picked clean. Appear <couple days old.
Hoary Bat				No	04/21/98	Intact	3	slt	Very fresh, no drying/rigomortis, possibly died night before. Scav by a few ants.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Unidentified Bird	*Low*	Near	LN31	Yes	05/04/98	Feather spot and/or bones	11	stt	At least 2 weeks, fthrs dried but in good cond. Scav - broken fthrs and bones possibly from scav or impact w/ turbine. L-wing only, dried flesh on bone, most fthrs sheared at lower shaft.

Appendix B (continued)

Phase II									
Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Rock Dove	*Low*	Near	33-2	Yes	08/24/99	Feather spot	7	stt	2 tail feathers connected by skin, 1 more tail feather, 20 body feathers.
Common Raven	*Water*	Near	3-3	Yes	08/26/99	Dismembered	38	stt	CORA found half buried in the sand. Missing feet.
Rock Dove	*Water*	Near	3-3	Yes	08/26/99	Feather spot	22	stt	4 feathers.
Cinnamon Teal	*Low*	Near	49-6	Yes	09/09/99	Intact	46	LTT	Fresh kill, entire bird found intact, with a broken neck. No signs of deterioration or depredation.
Great Horned Owl	*Low*	Near	95-1	Yes	09/10/99	Feather spot	9	Fence	5 remiges, 19 body feathers, 1 tail feather.
Mallard	*Water*	Near	5-10	Yes	09/17/99	Feather spot	21	stt	7 remiges, and 25 body feathers.
Unidentified Bird	*Water*	Near	11-8	Yes	09/17/99	Feather spot	35	LTT	Approximately 15 body feathers in mud, possible waterfowl.
Unidentified Owl	*Low*	Near	33-2	Yes	09/30/99	Feather spot	15	stt	Pygmy or Flammulated? Clump of 8-9 body feathers connected with skin, plus 3 feathers.
Rock Dove	*Water*	Near	11-10	Yes	10/07/99	Feather spot and/or bones	32	LTT	Right wing flight feathers connected by skin, various other RODO feathers collected at site.
Unidentified Gull	*Water*	Near	11-10	Yes	10/07/99	Feather spot and/or bones	20	LTT	Right wing
Rock Dove	*Low*	Near	32-1	Yes	10/07/99	Feather spot	48	stt	Approx. 200 various feathers from all parts of the body, some held together by skin, and 4-5 bones.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Rock Dove	*Water*	Near	8-1	Yes	10/19/99	Feather spot and/or bones	40	stt	Left wing - 4 primaries, 3 secondaries held together by cartilage. 2 body feathers.
Unidentified Passerine	*Low*	Near	54-4	Yes	12/03/99	Intact	27	stt	Vireo or warbler. Basically intact, in a bush. Some decomposition or depredation by insects in body cavity.
Western Meadowlark	*Water*	Near	6-4	Yes	12/09/99	Feather spot	26	stt	Approx. 50 body feathers and right wing primary feather.
American Kestrel				No	12/16/99	Dismembered	56	Distribution line	American kestrel, no head and no tail. Depredation by CORA.
Unidentified Bird	*Water*	Near	11-4	Yes	12/20/99	Feather spot and/or bones	21	LTT	Right wing. Probably from a GULL or DUCK.
Unidentified Bird	*Water*	Near	14-9	Yes	02/07/00	Feather spot and/or bones	28	Distribution line	Connected skin and bones.
American Coot	*Water*	Near	4-7	Yes	02/23/00	Dismembered	50	Distribution line	1 right foot, separated just above tarsometatarsus, missing part of third digit.
Unidentified Gull	*Water*	Near	11-6	No	02/28/00	Feather spot	19	LTT	Approximately 50 body feathers scattered in bushes along the edge of the pond.
Unidentified Gull	*Low*	Near	19-36	Yes	02/29/00	Feather spot	41	stt	12 body feathers caught in bushes, apparently blown from the west.
Unidentified Gull	*Water*	Near	11-10	No	03/02/00	Feather spot and/or bones	15	LTT	142 body feathers collected from bushes. Hundreds of gulls utilizing south end of pond.
Unidentified Bird				No	03/02/00	Feather spot and/or bones	31	stt	GULL or DUCK. 1 right wing, all brown. 4 connected primaries, 2 secondaries, and bones.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Unidentified Bird	*Water*	Near	17-36	No	03/02/00	Feather spot and/or bones	24	stt	3 bones and 9 feathers collected. Bones and feathers probably unrelated.
Unidentified Gull	*Water*	Near	16-39	No	03/02/00	Feather spot	18	stt	Approx. 30 feathers collected throughout the site.
Brewer's Blackbird				No	03/10/00	Feather spot and/or bones	53	Meteorological tower	Scapula, with feathers, skin and bone. Near TWIN-3.
Unidentified Gull	*Water*	Near	14-9	Yes	03/13/00	Feather spot	26	Distribution line	Approx 30 feathers throughout site.
Mallard	*Water*	Near	11-8	Yes	03/30/00	Intact	21	LTT	Carcass partially decomposed, found in water. L and R wings, head, and body cavity.
Unidentified Bird	*Water*	Near	11-10	Yes	03/30/00	Feather spot	19	LTT	Approx. 110 body feathers caught in bushes; many submerged in the water.
Unidentified Duck	*Water*	Near	11-2	Yes	04/20/00	Feather spot and/or bones	23	LTT	DUCK skull, no feathers, no other bones.
Red-Tailed Hawk				No	04/21/00	Feather spot and/or bones			RTHA wing collected near a turbine on the ridge, northwest of the study area.
Black Phoebe				No	05/08/00	Dismembered	66	stt	Fresh kill, missing head. Depredation by CORA.
Unidentified Gull	*Water*	Near	11-10	Yes	05/09/00	Feather spot and/or bones	39	LTT	Bones, feathers, and skin of right foot and body cavity.
Unidentified Passerine	*Low*	Near	95-1	Yes	05/12/00	Feather spot and/or bones	46	Fence	4 flight feathers and 1 feather connected to bone.
Common Raven	*Low*	Near	59-3	Yes	05/19/00	Intact	36	LTT	CORA, entire body. 12 head feathers held together by skin caught in bush 1m from body.
Common Raven				No	05/23/00	Intact	6	stt	Immature, from nest in 5-7. Death by exposure, starvation, and/or internal injuries.

Appendix B (continued)

Species	Geographic Location	Site Type	Site[1]	Found during Fatality Search	Date	Condition	Distance from Closest Turbine (m)	Closest Structure	Comments
Common Raven				No	05/30/00	Intact	109	slt	Imm CORA, probably fell from nest in 5-7. Probably died of exposure or starvation.
Unidentified Passerine	*Low*	Near	31-10	Yes	06/16/00	Feather spot and/or bones	20	stt	Warbler? Right wing - 9 flight feathers attached by skin and bone.
Common Raven				No	06/23/00	Intact	34	Transmission line	Electrocuted 6-22-00 AM. Male adult CORA from nest in 5-7.

[1] Null value for site indicates fatality found outside of permanent sites

[2] Found alive but euthanized due to injuries

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The primary objective of this study at the San Gorgonio Wind Resource Area was to estimate and compare bird utilization, fatality rates, and the risk index among factors including bird taxonomic groups, wind turbine and reference areas, wind turbine sizes and types, and geographic locations. The key questions addressed to meet this objective include: 1) Are there any differences in the level of bird activity, called “utilization rate” or “use”, with the operating wind plant and within the surrounding undeveloped areas (reference area)?; 2) Are there any differences in the rate of bird fatalities (or avian fatality) within the operating wind plant or the surrounding undeveloped areas (reference area)?; 3) Does bird use, fatality rates, or bird risk index vary according to the geographic location, type and size of wind turbine, and/or type of bird within the operating wind plant and surrounding undeveloped areas (reference area)?; and 4) How do raptor fatality rates at San Gorgonio compare to other wind projects with comparable data?

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