Post-Construction Avian and Bat Fatality Monitoring at the Rising Tree and Addison Wind Energy Projects Kern County, California

Year 3 Final Report

June 2018 – May 2019

Prepared for:

EDP Renewables North America, LLC

808 Travis, Suite 700
Houston, Texas 77002

Prepared by:

Andrea Chatfield, Troy Rintz, and Andrew Tredennick

Western EcoSystems Technology, Inc.
2725 NW Walnut Boulevard
Corvallis, Oregon 97330

August 15, 2019

WEST Inc.

EXECUTIVE SUMMARY

Rising Tree Wind Farm LLC, Rising Tree Wind Farm II LLC, and Rising Tree Wind Farm III LLC, each wholly owned subsidiaries of EDP Renewables North America LLC (EDPR), own and operate the Rising Tree I, II, and III wind energy projects (Projects or Rising Tree Projects) in Kern County, California. During the development phase, the Projects were known as the Homestead Wind Energy Project and Bent Tree Wind Energy Project, with a portion that was also referred to as the Addison Wind Energy Project. Environmental Impact Reports (EIRs) were developed for the Rising Tree Projects and Addison Wind Energy Project as a part of the California Environmental Quality Act review process. As specified in Mitigation Measures 4.4-22 and 4.4-23 of the EIRs, EDPR is committed to conducting post-construction avian and bat fatality monitoring and raptor nest monitoring at the Projects for at least three years of operation. To that end, Western EcoSystems Technology, Inc. (WEST), was contracted by EDPR to develop and implement a standardized protocol for post-construction monitoring for the purpose of estimating the impacts of facility operation on birds and bats. Data collection and analysis follow the recommendations presented in the US Fish and Wildlife Service Wind Turbine Advisory Committee Guidelines, the California Wind Energy Guidelines, and are based on WEST's experience studying wildlife at wind energy projects throughout California and the US. Two years of post-construction fatality monitoring and raptor nest monitoring have been conducted by WEST at the Projects from September 2015 to September 2016 and from June 2017 to June 2018, the results of which are presented in separate Year 1 and Year 2 reports. This report presents the results of the third year of monitoring (Year 3) conducted at the Projects from June 3, 2018 through May 29, 2019.

The fatality monitoring study detailed in this report consists of four components: 1) standardized carcass surveys of selected turbines, 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers, 3) carcass persistence trials to estimate the length of time that a carcass remained in the field for possible detection, and 4) calculation of adjusted fatality estimates for birds and bats and 5) raptor nest monitoring within the Project.

Consistent with the first two years of monitoring, standardized carcass searches were conducted to systematically search the ground beneath 19 of the Project's 60 turbines (31%) every two weeks throughout the study period. Searches were conducted within square plots measuring 280 meters (918 feet) on a side and centered on each of the sampled turbines. Twenty-two bird fatalities, representing 11 identifiable species, were found during standardized carcass searches or incidentally within the Projects. No bat fatalities were found. The only bird species having more than two identified fatalities was horned lark (three fatalities). Two diurnal raptor fatalities (both red-tailed hawks) and one owl fatality (short-eared owl) were documented during the Year 3 study. No fatalities of state- or federal-listed bird species were encountered; however, short-eared owl is considered a California Species of Special Concern. Bird fatalities were found at 12 of the 19 search plots, and were generally spread throughout the Projects. The search plot with the greatest number of fatalities (four) was at Turbine 26. Bird fatalities were generally spread throughout the

Projects both spatially and temporally, with fatalities occurring less frequently in winter than during the other seasons.

During searcher efficiency trials, 178 carcasses (41 large birds, 102 small birds, and 35 bat surrogates [i.e., mice]) were placed throughout the Projects, resulting in overall searcher efficiency rates of 100% for large birds, 77.4% for small birds, and 81.5% for bats. During carcass persistence trials, 218 carcasses (60 large birds, 90 small birds, and 68 bat surrogates) were placed within the Projects. The top carcass persistence models indicated that the probability of a carcass persisting through the search interval varied across seasons, ranging from 0.06 to 0.51 for large birds, 0.06 to 0.26 for small birds, and 0.08 to 0.43 for bats. Given the average search interval (14 days) and estimates of searcher efficiency and carcass persistence, the probability that a carcass would remain in a search plot and be found by a searcher ranged from 0.06 to 0.51 for large birds, 0.06 to 0.18 for small birds, and 0.06 to 0.35 for bats.

Based on the 3.3-megawatt (MW) capacity of the turbines at the Projects, the estimated fatality rate for all birds was 2.71 birds per MW per year, with an estimated fatality rate of 0.28 diurnal raptors per MW per year. No bat fatalities were found; therefore, the bat fatality rate was assumed to be very low, if not zero, and no bat fatality estimate was calculated.

Raptor nest monitoring was conducted in accordance with MM 4.4-23 of the Projects' EIRs with the goal of demonstrating whether raptor nesting was compatible with operation of the Projects. No raptor nests were documented during nest surveys conducted monthly from February through May, 2019. Two stick nests were identified including one active common raven nest and one unsuccessful common raven nest.

Overall bird and diurnal raptor fatality rates estimated during Year 3 of the study were similar to those estimated during years 1 and 2 of the study, and are also consistent with fatality rates reported at other nearby facilities in the Tehachapi Wind Resource Area. Based on the range of bird and bat fatality levels that have been observed during the 3-year fatality monitoring study, as well as the species composition of fatalities, data collected to date do not suggest that continued operation of the Projects will result in significant impacts to bird or bat populations.

STUDY PARTICIPANTS

Joel Thompson	Consulting Biologist
Andrea Chatfield	Project Manager
Troy Rintz	Research Biologist, GIS Technician
Carmen Boyd	Project Tracking and Data Manager
Mandy Kauffman	Statistician
Andrew Tredennick	Statistician
Katie Wynne	Technical Editor
Ashley Albert	Field Technician
Samantha Hanson	Field Technician
Grace Milanowski	Field Technician
Jennifer Sojka	Field Technician
Christina Van Oosten	Field Technician

REPORT REFERENCE

Chatfield, A., T. Rintz, and A. Tredennick. 2019. Post-Construction Avian and Bat Fatality Monitoring at the Rising Tree and Addison Wind Energy Projects, Kern County, California. Year 3 Final Report: June 2018 – May 2019. Prepared for EDP Renewables North America, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. August 15, 2019.

ACKNOWLEDGEMENTS

A number of individuals were instrumental in the completion of the post-construction studies at the Rising Tree Projects. EDP Renewables provided funding for the monitoring study. From WEST, Samantha Hanson, Grace Milanowski, Jennifer Sojka, and Christina Van Oosten conducted fatality surveys and carcass persistence trials beneath turbines. Ashley Albert conducted searcher efficiency trials.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Rising Tree Wind Farm LLC, Rising Tree Wind Farm II LLC, and Rising Tree Wind Farm III LLC, each wholly owned subsidiaries of EDP Renewables North America LLC (EDPR), own and operate the Rising Tree I, II, and III wind energy projects (Projects or Rising Tree Projects) in Kern County, California. During the development phase, the Projects were known as the Homestead Wind Energy Project (Homestead) and Bent Tree Wind Energy Project (Bent Tree), with a portion also referred to as the Addison Wind Energy Project (Addison). Environmental Impact Reports (EIRs) were developed for the Rising Tree Projects and Addison as a part of the California Environmental Quality Act review process, and as specified in Mitigation Measures (MM) 4.4-22 and 4.4-23 of the EIRs (Kern County Planning and Community Development Department 2013a, 2013b), EDPR is committed to conducting post-construction avian and bat fatality monitoring at the Projects for at least three years of operations.

Although the Projects were referred to by various names (i.e., Homestead, Bent Tree, Addison, and Rising Tree) throughout the development and permitting processes, the Projects are referenced throughout this report as the Projects or Rising Tree Projects. As stated in MM 4.4-22 of the EIRs, the objective of the fatality monitoring study was to demonstrate the level of incidental injury and mortality to populations of avian and bat species in the vicinity of the Projects. To this end, Western EcoSystems Technology, Inc. (WEST), was contracted by EDPR to develop and implement a standardized protocol for post-construction monitoring to estimate the level of bird and bat mortality attributable to collisions with wind turbines at the Projects on an annual basis.

The monitoring protocols were stipulated in the Rising Tree Bird and Bat Conservation Strategy (WEST 2018a) and Eagle Conservation Plan (WEST 2018b), and are based on WEST's experience studying wildlife at wind energy projects in California and throughout the US. Data collection and analysis followed the recommendations presented in the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012) and the California Wind Energy Guidelines (California Energy Commission and California Department of Fish and Game 2007).

The first two years of post-construction fatality monitoring and raptor nest monitoring were conducted at the Projects from September 2015 to September 2016 and from June 2017 to June 2018, the results of which are presented in separate Year 1 and Year 2 reports (Rintz et al. 2016, Chatfield et al. 2018). The following report presents the results of the third year of monitoring (Year 3) conducted at the Projects from June 3, 2018 through May 29, 2019.

STUDY AREA

The Projects are sited on private lands encompassing an area of approximately 1,144 hectares (2,826 acres) in south-central Kern County, California, approximately 4.8 kilometers (km; 3.0 miles [mi]) west of the unincorporated community of Mojave. The Projects comprise 60 Vestas V112 wind turbines, each having a hub height of approximately 84 meters (m; 275 feet [ft]) and a

rotor radius of approximately 56 m (184 ft), for a maximum turbine height of 140 m (459 ft). Each turbine has a capacity of 3.3 megawatts (MW) for a total generating capacity of 198 MW of electricity. The Projects interconnect to the grid at Southern California Edison's Windhub Substation, located approximately 2.4 km (1.5 mi) west of the Projects' southern boundary. The Projects lie near the center of the Tehachapi Wind Resource Area (TWRA), a region of high-density wind energy development in southern Kern County. The Projects are surrounded by existing wind farms in all directions.

The Projects are situated in the western Mojave Desert, on the lower slope of Cameron Ridge and the Horned Toad Hills. Elevations range from approximately 960 to 1,113 m (3,150 to 3,651 ft). Topography within the Projects is varied, with the southern and eastern portions being relatively flat, while the northwestern portion is more topographically diverse and contains a number of ridges oriented northwest-southeast (Figures 1 and 2). Vegetation consists primarily of creosote bush (*Larrea tridentata*) scrub, Mojave mixed scrub, and scattered patches of Joshua tree (*Yucca brevifolia*) woodland. No permanent water exists in the Projects; however, a number of washes with intermittent water flow are present. The Projects are bordered to the south by Oak Creek Road, which runs east to west, and by an underground portion of the Los Angeles Aqueduct that runs along the eastern boundary of the Projects (Figures 1 and 2).

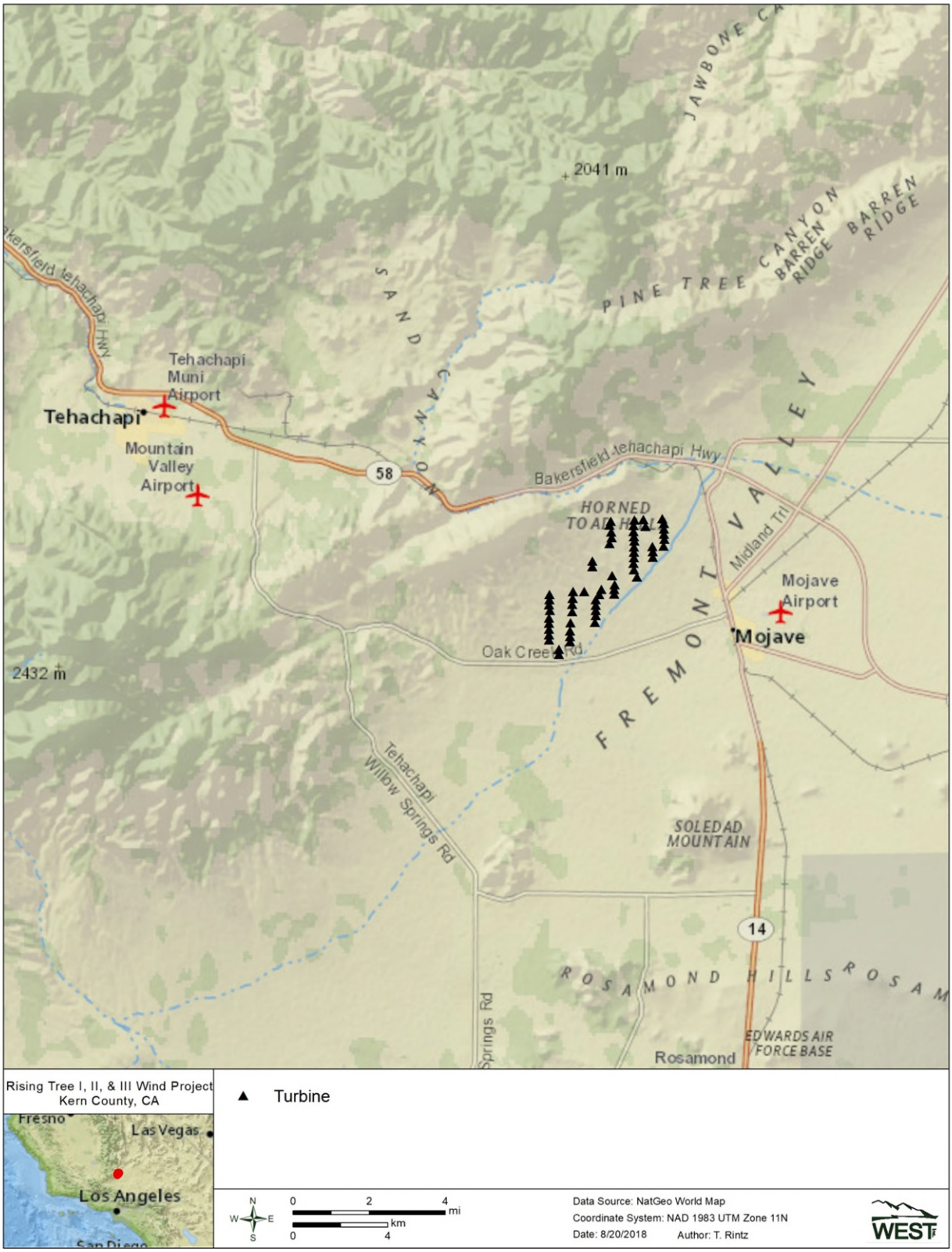

Figure 1. Location of the Rising Tree Wind Projects, Kern County, California.

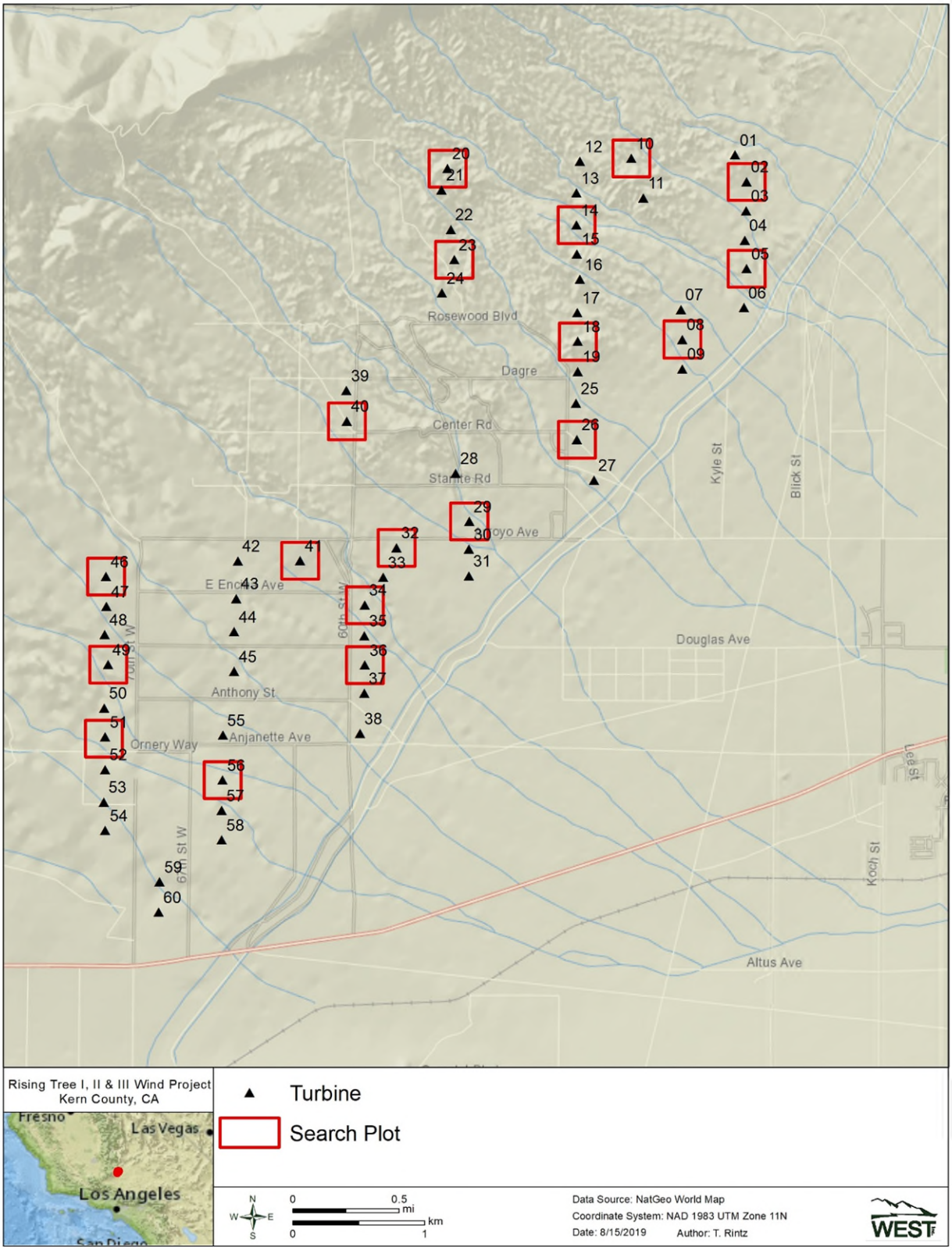

Figure 2. Location of carcass search plots at the Rising Tree Wind Projects, Kern County, California.

METHODS

Avian and Bat Fatality Monitoring

The methods and results presented herein represent the final year of a 3-year avian and bat fatality monitoring study. The primary objective of the study is to estimate the level of bird and bat mortality attributable to collisions with wind turbines at the facility on an annual basis. Additionally, the estimated fatality rates at the Projects are compared to fatality rates estimated for other regional wind energy facilities to determine if mortality at the Projects is lower, similar to, or higher than that observed at other facilities, particularly those within the TWRA. The methods for the fatality study are broken into four primary components: 1) standardized carcass surveys of selected turbines, 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers, 3) carcass persistence trials to estimate the length of time that a carcass remained in the field for possible detection, and 4) calculation of adjusted annual fatality estimates for birds and bats within the Projects.

Standardized Carcass Surveys

Consistent with methods implemented during the first and second year of the fatality monitoring study (Rintz et al. 2016, Chatfield et al. 2018), standardized carcass surveys were conducted to systematically search the ground beneath turbines for avian and bat fatalities. Nineteen of the Project's 60 turbines (31%) were searched during Year 3 of the fatality monitoring study (Figure 2). These were the same 19 turbines searched during first two years of the study (see Rintz et al. 2016, Chatfield et al. 2018). Search plots were originally selected using a constrained random sample, such that the search effort was distributed throughout the Projects and all land cover types and topographies were represented. Searches were conducted within square plots measuring 280 m (918 ft) on a side and centered on each of the sampled turbines (Figure 2). Plots were searched along parallel transects spaced 6-10 m (20-33 ft) apart (depending on visibility), with the orientation of transects based on the orientation of the topography within the plots.

Data recorded for all documented fatalities included: species, sex and age when identifiable, date and time encountered, Global Positioning System (GPS) location, condition of carcass, and any comments that indicated possible cause of death. All fatalities were photographed as found, including detailed close-up photos of the carcass for identification purposes, as well as photos showing location of the carcass in relation to the closest wind turbine or other Project infrastructure, such as overhead power lines.

Incidental fatalities found within search plots, but outside of the standardized search times, were documented in the same manner as those found during scheduled surveys and were included in the overall dataset under the assumption that these fatalities would have been found during the next scheduled survey. Incidental fatalities found outside the formal search area (e.g., near a turbine or other portion of the Projects' infrastructure not included in the study) were also recorded following the above protocol as closely as possible; however, these fatalities were not included in

the overall dataset used for estimating fatality rates. Fatalities found by maintenance personnel and others not conducting the formal searches were similarly documented. Rising Tree does not have a Special Purpose Utility Permit from the USFWS. As a result, study personnel were not permitted to possess carcasses of native migratory birds encountered during searches, and all bird and bat carcasses were documented and left in the field as found. Because of this, care was taken to take detailed photos of the carcasses for purposes of identification and to accurately record the condition and location of carcasses to avoid double-counting fatalities.

Standardized carcass surveys were conducted every two weeks at the Projects from June 3, 2018 through May 29, 2019, with seasons defined as: summer (June 1 – August 27), fall (August 28 – November 15), winter (November 16 – March 11), and spring (March 12– May 31) at each of the sampled turbines.

Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of fatalities found by searchers. Estimates of searcher efficiency were used to adjust the total number of carcasses found for those possibly missed by searchers, correcting for detection bias. Searcher efficiency trials were conducted in the same areas as carcass surveys and searcher efficiency was estimated by the size of carcass and season.

Carcasses used for searcher efficiency trials were non-native/non-protected or commercially available species (e.g., *Coturnix* quail [*Coturnix* spp.], and mallard [*Anas platyrhynchos*]). Due to a lack of bat carcasses available for the study, brown mice (*Mus musculus*) were used as surrogates for bats. All searcher efficiency trial carcasses were placed at random locations within the search plot prior to that day's scheduled carcass survey. Personnel conducting carcass surveys did not know when searcher efficiency trials were being conducted or the location of the trial carcasses. Each trial carcass was discreetly marked with electrical tape so that it could be identified as a study carcass after it was found. The number and location of the trial carcasses found during the carcass survey were recorded. The number of carcasses available for detection during each trial was determined immediately after the trial by the person responsible for distributing the carcasses.

Carcass PersistenceTrials

The objective of carcass persistence trials was to estimate the average length of time a carcass remained in the study area and was potentially detectable. Estimates of carcass persistence were used to adjust the total number of carcasses found for those removed from the study area, correcting for removal bias. Possible means of carcass removal include removal by predation or scavenging, or removal by other less likely means, such as burial by wind-blown sand. Trials were spread throughout the summer, spring and fall, winter persistence data was used from previous years the effects of varying weather and environmental conditions, and scavenger densities. Trial carcasses were of similar composition to those used for searcher efficiency trials as described above.

Turbines, including searched and non-searched turbines, were randomly selected for inclusion in the persistence trials. Trial carcasses were randomly placed at selected turbines within a plot of similar size to the actual search plots. Personnel conducting carcass searches monitored the trial carcasses over a 30-day period, checking the carcasses every day for the first four days of the trial, and then again on days 7, 10, 14, 20, and 30. This schedule varied somewhat depending on weather and coordination with the other survey work. Persistence trial carcasses were discreetly marked (e.g., with dark electrical tape around one or both legs) for recognition by searchers and other personnel, and left at the location until the end of the carcass persistence trial. Any remaining evidence of the carcass was removed at the end of the 30-day trial period.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following each round of bi-weekly carcass surveys, observers were responsible for reviewing the raw data for completeness and accuracy. A Microsoft® SQL Server database was developed to store, organize, and retrieve survey data. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data, and appropriate changes in all steps were made. All data forms, field notebooks, and electronic data files were retained for reference.

Fatality Estimates

Overall fatality estimates were calculated for five bird and bat categories: 1) small birds (i.e., cuckoos, hummingbirds, swifts, woodpeckers, and passerines), 2) large birds (i.e., waterbirds, waterfowl, shorebirds, owls, vultures, upland gamebirds, doves and pigeons, large corvids, large cuckoos, and goatsuckers), 3) diurnal raptors (i.e., kites, accipiters, buteos, eagles, falcons, northern harrier [*Circus hudsonius*], osprey [*Pandion haliaetus*]), 4) all birds, and 5) bats. Estimates of facility-related fatalities were based on:

1) Observed number of carcasses found during standardized searches during the monitoring year for which the cause of death was either unknown or probably facility-related;
2) Persistence rates, expressed as the estimated average probability a trial carcass was expected to remain in the study area and be available for detection by the searchers during persistence trials; and
3) Searcher efficiency, expressed as the proportion of trial carcasses found by searchers during searcher efficiency trials.

Fatality rates were calculated using the Huso estimator (Huso 2011, Huso et al. 2015). The following variables were used in the equations presented below for the Huso estimator:

- c_i total number of carcasses in category *i* (e.g., season)
- n_i number of turbines sampled in category *i*
- *k* number of carcass categories

- l_i time interval between the previous search and discovery for category *i*
- $\hat{\bar{I}}_i$ effective search interval for carcasses in category *i*
- $\hat{r}_i$ average probability of persistence for carcasses in category *i*
- $\hat{p}_i$ probability of detection for carcasses in category *i*
- $\widehat{\pi_i}$ the estimated probability that a carcass in category *i* was both available to be found during a search and was found, as determined by carcass removal and searcher efficiency trials
- $\widehat{f_i}$ per turbine mortality for category *i*
- $\hat{f}$ total per turbine mortality
- $\widehat{m}$ total per turbine mortality

Estimation of Searcher Efficiency Rates

Searcher efficiency rates, $\hat{p}_i$, were estimated as the proportion of trial carcasses found in a search category. Searcher efficiency was assumed to be a binomial process, and was pooled across seasons as appropriate (i.e., if the data indicated no statistical difference).

Estimation of Carcass Persistence

Estimates of carcass persistence were used to adjust carcass counts for removal bias. Carcass persistence can be modeled as a function of a variety of variables including ground visibility, size, season, and the interactions between these variables. The average probability of persistence of a carcass, $\widehat{r_i}$, was estimated from an interval censored carcass persistence model. Exponential, log-logistic, lognormal, and Weibull distributions were fit along with other covariates appropriate for the study. For this study, carcass size class and season were investigated as potential covariates in the model. Models were selecting using the corrected Akaike Information Criteria (AICc; Burnham and Anderson 2002) statistic, with the final model selected being the most parsimonious model within two AICc values of the top model.

Estimation of Adjusted Facility-Related Fatality Rates

The estimated probability that a carcass in category *i* was available and detected was:

$$\widehat{\pi_i} = \widehat{p_i} \cdot \widehat{r_i} \cdot \hat{v}_i$$

where $\hat{v}_i$ = min(1, $\hat{\bar{I}}_i / I_i$). The model assumes that searchers have a single opportunity to find each carcass, even though some carcasses may persist through multiple searches before being detected. Therefore, a carcass was only included in the calculation of adjusted fatality estimates if it had become available since the last search, and no longer. The estimated time since death, recorded in the field and based on carcass condition, was used to evaluate each carcass for inclusion in the final fatality estimate calculations.

The per-turbine fatality rate ($\hat{f}_i$) in category *i*, based on the number of carcasses found in category *i*, is given by

$$\hat{f}_i = \frac{c_i}{\hat{\pi}_i}.$$

The standard errors and 90% confidence intervals on this estimate were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, *p*, $\hat{\pi}$, and *m* were calculated. A total of 1,000 bootstrap samples were used and the standard deviation of the bootstrap estimates was the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower and upper limits of 90% confidence intervals.

Raptor Nest Monitoring

Surveys for nesting raptors were conducted during the 2019 breeding season to determine the presence or absence of raptor nests within the Projects. Following guidance of MM 4.4-23 of the EIRs, ground-based surveys were conducted by vehicle and on foot throughout all areas of suitable raptor nesting habitat within approximately 150 m (500 ft) of Project infrastructure from February 15 through May 5, 2019. For each nest identified, biologists recorded the nest location with a hand-held GPS device; species present at the nest (if any); condition of the nest; presence of eggs or young (if present and visible); nest substrate (e.g., tree, power pole, rock outcrop); and height and aspect of nest. Nest status information was recorded as: 1) unoccupied - a nest with no evidence of recent use, or attendance by adults or young; or 2) occupied - a nest site exhibiting recent refurbishing (greenery, recent egg cup), or attended by one or more adults on or immediately adjacent to the nest structure(s).

RESULTS

Avian and Bat Fatality Monitoring

Twenty-six rounds of searches were conducted during the Year 3 fatality monitoring study, for a total of 494 plot searches. Twenty-two bird fatalities representing at least 13 separate species were found during the study; no bat fatality were found (Table 1). The number, species, location, other characteristics of the bird fatalities, the results of searcher efficiency and carcass persistence trials, and the bird fatality estimates adjusted for searcher efficiency and carcass persistence biases, are discussed below. A full listing of fatalities is presented in Appendix A.

Bird Fatalities

During the Year 3 study period, 22 bird fatalities were found on search plots during scheduled searches (Appendix A, Figure 3). No bird fatalities were found incidentally outside of search plots and none of the fatalities were estimated to have a time since death of more than the 14-day search interval. The Huso estimator assumes that searchers have a single opportunity to find a carcass, and carcasses estimated to be greater than the search interval (14 days) are censored

from the analysis. Because all carcasses were estimated to be less than 14 days old, no fatalities were excluded from the analysis. As a result, all 22 bird fatalities were included in the analysis (Table 1).

The only bird species represented by more than two fatalities was horned lark (*Eremophila alpestris*; three fatalities; Table 1). Two diurnal raptor fatalities (both red-tailed hawk [*Buteo jamaicensis*]) and one owl fatality (short-eared owl [*Asio flammeus*]) were documented during the study period. No fatalities of state- or federal-listed bird species were encountered; however, short-eared owl is considered a California Species of Special Concern (California Department of Fish and Wildlife 2018; Table 1).

Bird fatalities were found at 12 of the 19 search plots (Figures 3 and 4). The greatest number of fatalities was found at Turbine 26 (four fatalities), followed by turbines 8 and 34 (three fatalities each); two or fewer bird fatalities were documented at all other search plots (Figures 3 and 4). Bird fatalities were found throughout the search plots, with the majority (63.6%) found between 60 and 120 m (197 and 393 ft) of the turbines (Table 2). The timing of bird fatalities was generally distributed throughout the year with no obvious season of higher mortality (Figure 5, Appendix A).

Table 1. Total number of bird fatalities and the composition of fatalities discovered at the Rising Tree Wind Projects from June 3, 2018 – May 29, 2019. No bat fatalities were documented during the study period.

Species	Scientific Name	Number of Fatalities	% Comp.*
horned lark	*Eremophila alpestris*	3	13.6
greater roadrunner	*Geococcyx californianus*	2	9.1
house wren	*Troglodytes aedon*	2	9.1
mourning dove	*Zenaida macroura*	2	9.1
red-tailed hawk	*Buteo jamaicensis*	2	9.1
Townsend's warbler	*Setophaga townsendi*	2	9.1
unidentified passerine	-	2	9.1
house finch	*Haemorhous mexicanus*	1	4.5
orange-crowned warbler	*Vermivora celata*	1	4.5
short-eared owl	*Asio flammeus*	1	4.5
unidentified shorebird	-	1	4.5
unidentified waterfowl	-	1	4.5
white-crowned sparrow	*Zonotrichia leucophrys*	1	4.5
western meadowlark	*Sturnella neglecta*	1	4.5
Overall Birds		**22**	**100**

* Sums may not total values shown due to rounding.
% Comp. = percent composition

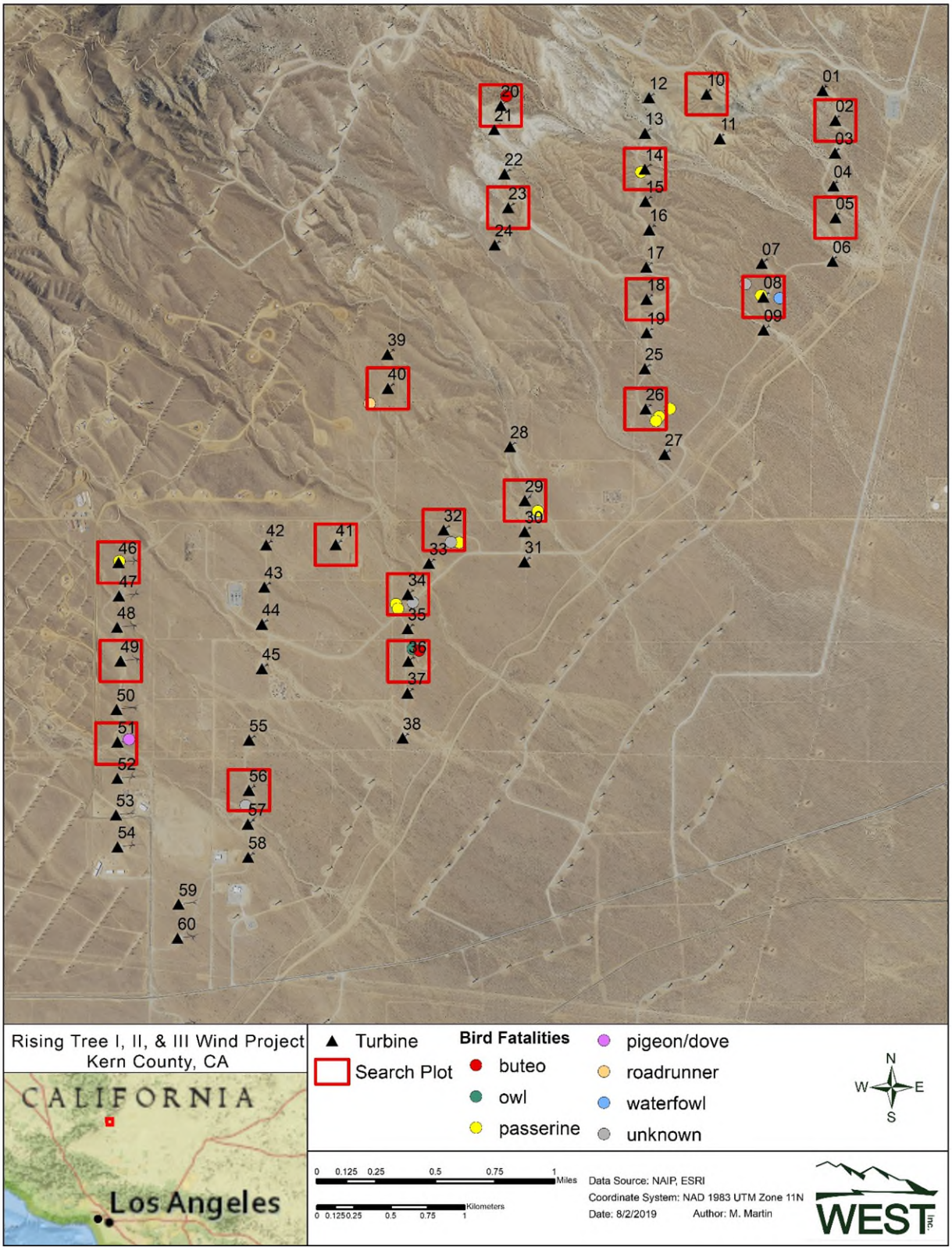

Figure 3. Location of bird fatalities found at the Rising Tree Wind Projects during avian and bat fatality monitoring from June 3, 2018 to May 29, 2019. No bat fatalities were documented.

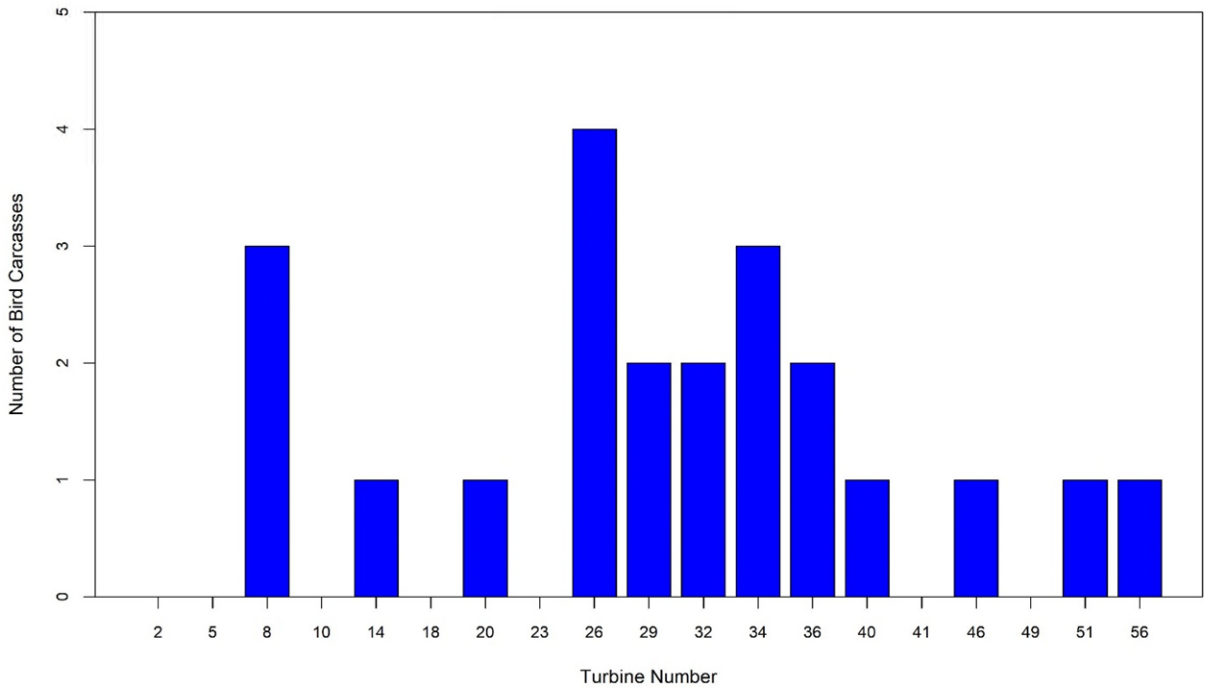

Figure 4. Number of bird fatalities by search plot at the Rising Tree Wind Projects, June 3, 2018 – May 29, 2019.

Table 2. Distribution of distances from turbines for bird fatalities found at the Rising Tree Wind Projects from June 3, 2018 – May 29, 2019.

Distance to Turbine (meters)	Number of Bird Fatalities	% Bird Fatalities
0-20	2	9.1
20-40	1	4.5
40-60	0	0
60-80	3	13.6
80-100	3	13.6
100-120	8	36.4
120-140	2	9.1
140-160	2	9.1
160-180	1	4.5

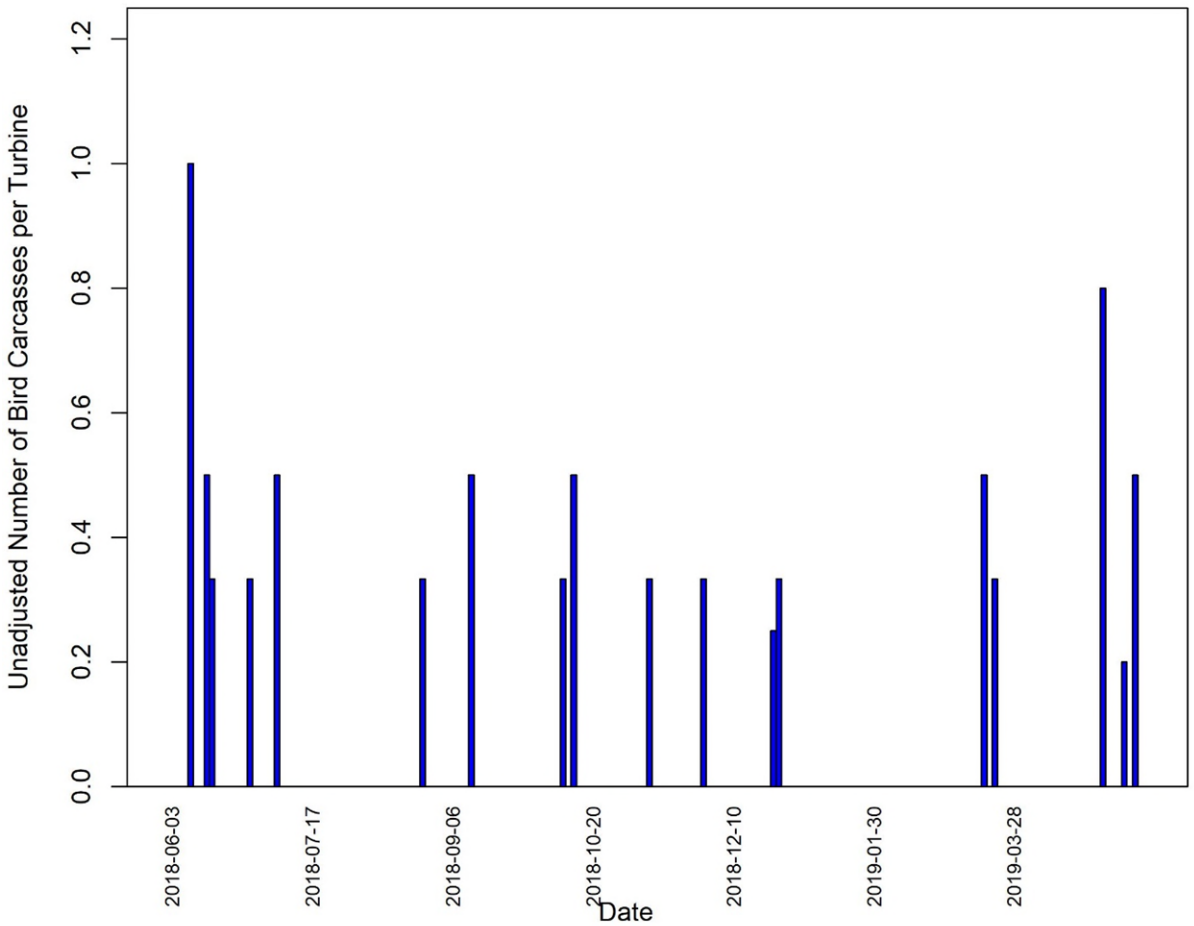

Figure 5. Timing of bird fatalities (i.e., unadjusted number of bird fatalities per turbine) found at the Rising Tree Wind Projects from June 3, 2018 – May 29, 2019.

Searcher Efficiency Trials

A total of 178 trial carcasses (41 large birds, 102 small birds, and 35 mice [bat surrogates]) were placed throughout the Projects on 16 separate dates between July 2018 and May 2019 to estimate searcher efficiency rates (Table 3). Logistic regression modeling was used to assess potential effects of size class and season on searcher efficiency and alternative models were evaluated using AICc. For large birds and bats, the best-fitting model indicated that searcher efficiency was best explained by size class alone (i.e., there was insufficient evidence for seasonal differences in searcher efficiency; Appendix B1). For small birds, the best-fitting model included season as a covariate (Appendix B1) and, therefore, different searcher efficiency rates were used each season to adjust small bird fatality rates. For large birds and bats, the overall searcher efficiency rates used in the analysis were 100% for large birds and 81.5% for bats. For small birds searcher efficiency ranged from 60.0% in spring to 100% in fall (Table 3).

Table 3. Results of searcher efficiency trials conducted from June 2018 to May 2019 at the Rising Tree Wind Projects as a function of season and trial carcass size/type.

Size Class	Season	# Placed	# Available	# Found	% Found
Large Bird	Summer	10	10	10	100
	Fall	8	8	8	100
	Winter	11	11	11	100
	Spring	12	12	12	100
	Overall	**41**	**41**	**41**	**100**
Small Bird	Summer	23	12	10	83.3
	Fall	20	14	14	100
	Winter	24	21	15	71.4
	Spring	35	15	9	60.0
	Overall	**102**	**62**	**48**	**77.4**
Bat*	Summer	13	10	8	80.0
	Fall	12	10	9	90.0
	Spring	10	7	5	71.4
	Overall	**35**	**27**	**22**	**81.5**

*brown mice were used as surrogates for bats.

Carcass PersistenceTrials

A total of 120 trial carcasses (32 large birds, 45 small birds, and 43 mice) were placed within the Projects on seven separate dates between June 2018 and April 2019. Because carcass persistence trials were not conducted in the winter season during the Year 3 study, trial data were supplemented by winter carcass persistence data collected in Years 1 and 2 of the study. This included an additional 98 trial carcasses (28 large birds, 45 small birds, and 25 mice) which were used to model winter carcass persistence. By Day 14 (equal to the search interval), roughly 22% of large birds remained in the search area, while only about 3% of small birds and about 15% of bats remained (Figure 6).

For each size class, combinations of distribution (i.e., Weibull, exponential, loglogistic, and lognormal) and season were fit and AICc values used to determine the best model. Using the Year 3 spring, summer, and fall carcass persistence data, models for large birds, small birds and bats were best fit by the exponential model with a season covariate (Appendix B2). Using the Year 1 and Year 2 winter data, carcass persistence for large birds and small birds was best fit by the loglogistic model (Appendices B2 and B3). For bats, the best fitting model using the winter data was a lognormal distribution; however, the simpler, exponential model was used in the final analysis as it contained fewer parameters and the difference in AICc was only 0.70 indicating that the additional parameter added little to the model fit (Appendix B2). Based on the modeling results, the overall probability that a carcass persisted through the search interval varied across seasons for all size classes. For the final analysis, carcasses persistence ranged from 0.06 to 0.51 for large birds, 0.06 to 0.26 for small birds, and 0.08 to 0.43 for bats (Appendix C).

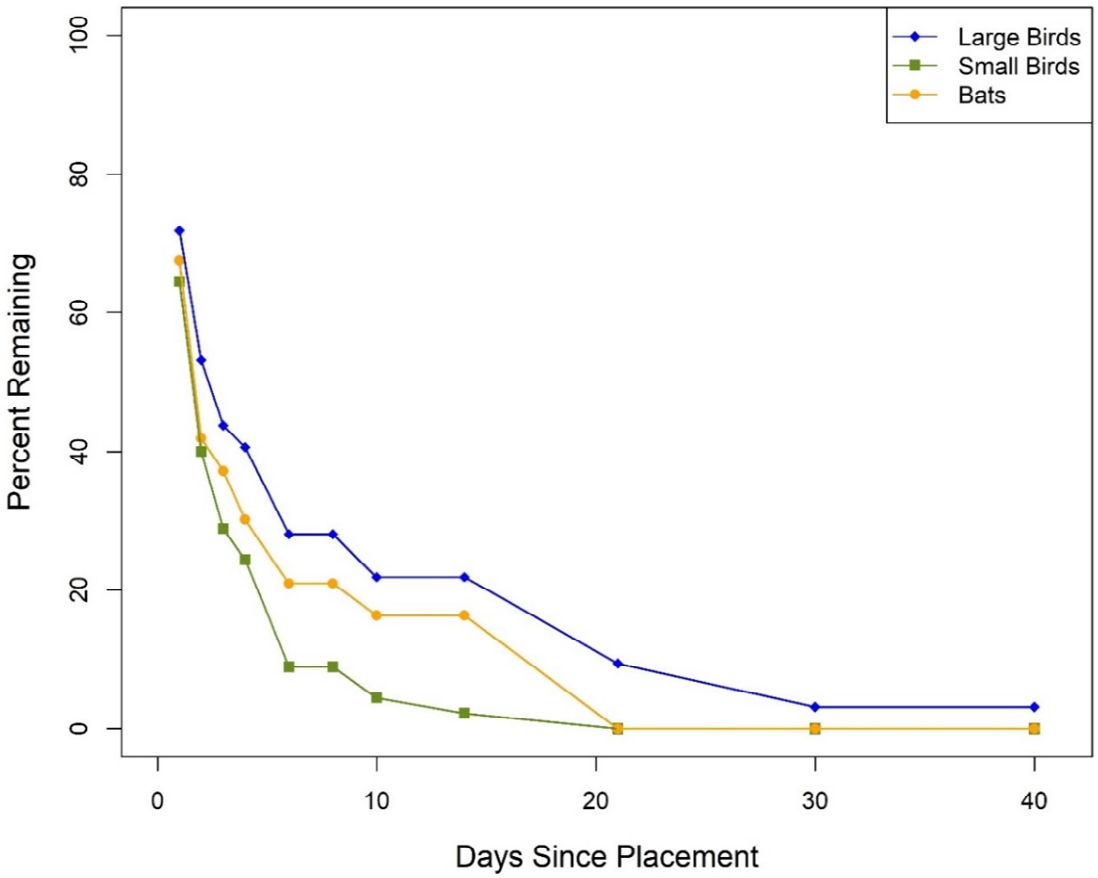

Figure 6. Carcass persistence times at the Rising Tree Wind Projects, June 2018 to May 2019.

Adjusted Fatality Estimates

Seasonal fatality estimates and 90% confidence intervals were calculated on a per-turbine basis for each bird category (Appendix C), and overall Projects-wide fatality estimates and 90% confidence intervals were calculated on a per-turbine and per-MW basis for each bird category (Table 4). Confidence intervals are not provided for estimates when sample size (observed number of fatalities) was less than five fatalities for any particular bird category. No bat fatalities were documented during the study period; therefore, bat fatality rates were assumed to be generally very low and an estimate was not calculated. The fatality estimates were adjusted based on the corrections for carcass persistence and observer detection bias. Because 100% of each search plot was surveyed, no search area correction factor was applied. Given the search interval (14 days) and estimates of searcher efficiency and carcass persistence, the probability that a carcass would remain in a search plot and be found by a searcher ranged from 0.06 in fall to 0.51 in summer for large birds and 0.06 in fall to 0.18 in winter for small birds. For bats, this probability ranged from 0.06 in summer to 0.35 in spring (Appendix C).

Table 4. Adjusted bird fatality estimates and 90% confidence intervals for the Rising Tree Wind Projects from June 3, 2018 – May 29, 2019. No bats were found during the study period; therefore, a fatality rate for bats was not calculated.

Class	Adjusted Mean Fatality Estimate	90% Confidence Interval*
	# fatalities/turbine/year	
Small Birds	6.55	3.38-10.11
Large Birds	2.39	0.34-4.74
Diurnal Raptors	0.91	-
All Birds	8.94	4.79-13.43
	# fatalities/megawatt/year	
Small Birds	1.99	1.03-3.06
Large Birds	0.72	0.10-1.44
Diurnal Raptors	0.28	-
All Birds	2.71	1.45-4.07

*Confidence intervals are not provided for estimates when sample size was less than five fatalities.

Small Birds

The estimated fatality rate for small birds was highest during the fall (2.57 birds per turbine per season) and lowest during the winter (0.28; Appendix C). Combining all seasons, the overall estimated fatality rate for small birds within the Projects was 6.55 small birds per turbine per year, or 1.99 small birds per MW per year (Table 4). This extrapolates to an estimated 393 small bird fatalities per year at the Projects, which would likely be spread among a variety of species (at least seven small bird species were documented among fatalities during the study period; Appendix A). A detailed breakdown of small bird fatality rates and the associated correction factors is presented in Appendix C.

Large Birds

The estimated fatality rate for large birds was also highest during the fall (1.98 birds per turbine per season), but lowest during the spring (0.08; Appendix C). Combining all seasons, the overall estimated fatality rate for large birds within the Projects was 2.39 large birds per turbine per year, or 0.72 large birds per MW per year (Table 4). This extrapolates to an estimated 143 large bird fatalities per year at the Projects, which would likely be spread among a variety of species (at least six species classified as large birds were documented among fatalities during the study period; Appendix A). A detailed breakdown of large bird fatality rates and the associated correction factors is presented in Appendix C.

Diurnal Raptors

The estimated fatality rate for diurnal raptors were highest during the fall (0.83 birds per turbine per season) and lower during the spring (0.08); no diurnal raptor fatalities were found during the winter or summer so fatality rates were not calculated for those seasons (Appendix C). Combining all seasons, the overall estimated fatality rate for diurnal raptors within the Projects was 0.91 diurnal raptors per turbine per year or 0.28 diurnal raptors per MW per year (Table 4). This extrapolates to an estimated 55 diurnal raptor fatalities per year at the Projects, which would likely be spread among several species (the two diurnal raptor fatalities documented during the Year 3 study were both red-tailed hawks; Appendix A). A detailed breakdown of diurnal raptor fatality rates and the associated correction factors is presented in Appendix C.

All Birds

The estimated fatality rate for all birds was highest during the fall (4.55 birds per turbine per season), and lowest during the winter (0.50; Appendix C). Combining all seasons, the overall estimated fatality rate for all birds within the Projects was 8.94 birds per turbine per year, or 2.71 birds per MW per year (Table 4). This equates to an estimated 536 bird fatalities per year at the Projects, which would likely consist of a variety of species (11 bird species were identified during the study period, along with several unidentified species). A detailed breakdown of all bird fatality rates and the associated correction factors is presented in Appendix C.

Bats

There were no bat fatalities documented at the Projects; therefore, no fatality estimates for bats were calculated.

Raptor Nest Monitoring

On January 22, 2019, prior to the 2019 nest surveys, an empty stick nest, occupied by common ravens (*Corvus corax*) the previous year (2018; see Chatfield et al. 2018) was removed in an attempt to prevent this nest from being occupied by ravens in 2019. Prior to removal by Rising Tree, WEST confirmed that the nest was not active. This nest was located between turbines 36 and 37 and was believed to have contributed the greater number of bird fatalities documented in this area during the Year 1 and Year 2 fatality monitoring (Rintz et al. 2016, Chatfield et al. 2018).

Ground-based surveys for raptor nests were conducted within the Projects approximately monthly from February – June 2019. Two occupied raptor nests were found within the Projects during the 2019 monitoring period. Both nest were occupied by common ravens the nest closet to turbine 19 failed and nest close to 20 had chicks in by the end of the study (Table 5, Figure 7). The nests were the same nests documented during nest surveys in 2016 and 2018 (see Rintz et al. 2016 and Chatfield et al. 2018).

Table 5. Raptor nest monitoring results at the Rising Tree Wind Projects, February – June, 2019.

Substrate	Species	Nearest Turbine	Distance to Turbine (meters)	Final Status
Radio tower	Common Raven	20	200	Occupied
Radio tower	Common Raven	19	300	Unsuccessful

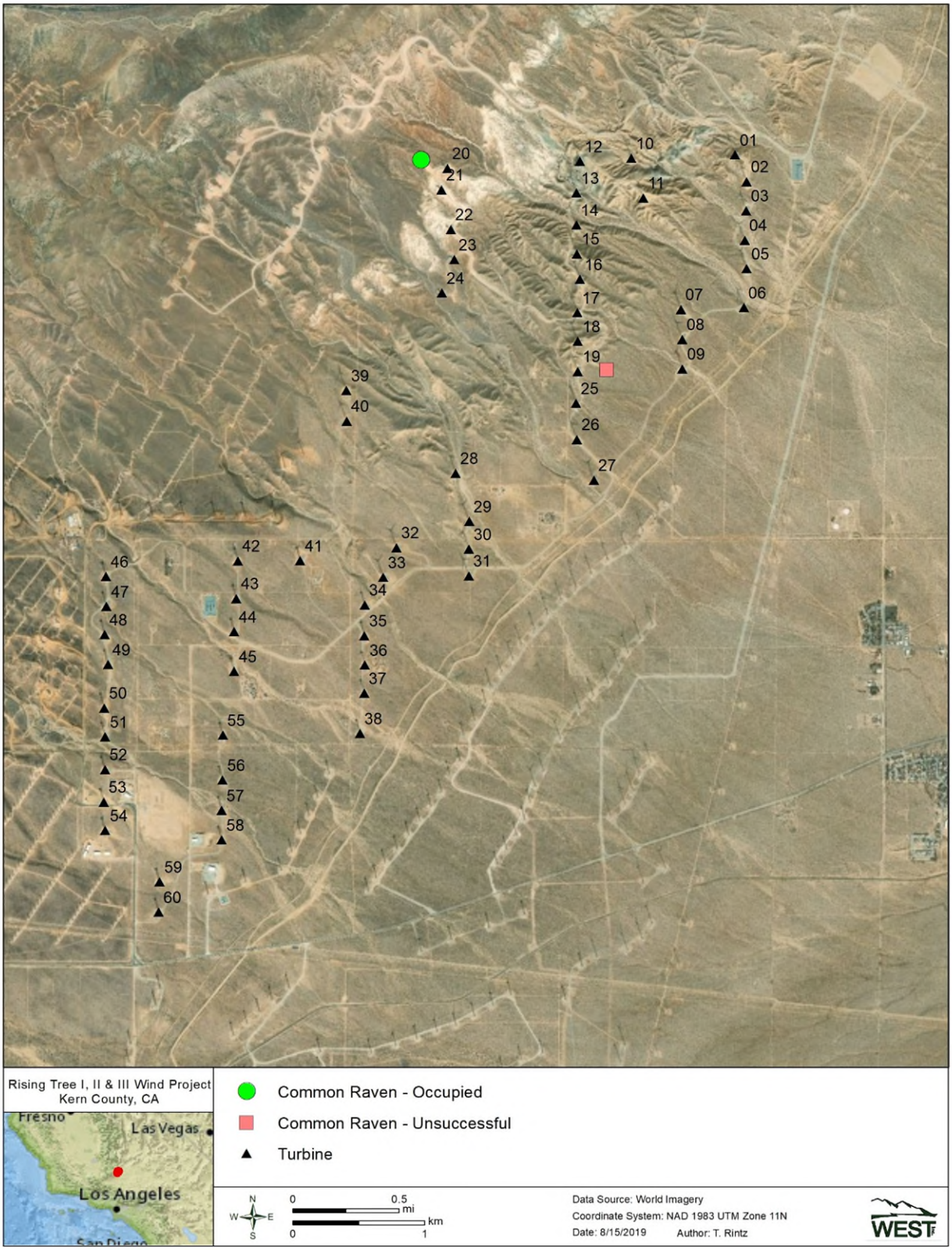

Figure 7. Location of raptor/raven nests identified during raptor nest monitoring at the Rising Tree Wind Projects, February – June, 2019.

DISCUSSION

Avian and Bat Fatality Monitoring

The Huso estimator was used for calculating adjusted fatality estimates and accounted for search interval, searcher efficiency, and carcass persistence. It is hypothesized that scavenging could change through time at a given site and must be accounted for when attempting to estimate fatality rates. This was accounted for by conducting carcass persistence and searcher efficiency trials throughout the year to account for any biases associated with seasonal changes in environmental conditions and scavenger populations.

Potential Biases

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006). The overall design of this study incorporated several assumptions or factors that could affect fatality estimates. First, all bird fatalities found within the standardized search plots were included in the analysis. Second, it was assumed that all carcasses found during the study were due to collision with wind turbines, while true cause of death is unknown for most of the fatalities. It is possible that some of the bird fatalities were caused by predators, and some of the fatalities included in the analysis were potentially due to natural causes (background mortality; see Johnson et al. 2000, Althouse and Meade 2014, Harvey & Associates 2014).

While the above are considered positive biases (i.e., potentially leading to overestimates), there are also some potential negative biases. For example, no adjustments were made for fatalities possibly occurring outside of the square plot boundaries. Plot boundaries were established a minimum distance of 140 m from the turbine, which was equivalent to the maximum turbine height. The search plot distance for this study was selected based on results of other studies (Higgins et al. 1996; Erickson et al. 2004; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007; Young et al. 2003, 2006), in which a distance equal to the approximate height of the turbine appeared to capture a very large percentage of fatalities. Hull and Muir (2010) provide additional support for the study plot size based on their ballistic models, indicating that 99% or more of all bird and bat size classes should fall within a 140-m search plot based on the turbine specifications at the Projects. However, while plot sizes should have captured a large majority of all fatalities, based on the distribution of fatalities as a function of distance from turbines (Table 2, Appendix A), a small percentage of bird fatalities, and potentially a bat, could have fallen outside the search plots and been missed. This factor would lead to an underestimate of fatality rates.

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass persistence trials and whether or not they are representative of naturally occurring carcasses. This may occur if the types of birds used are larger or smaller than the carcasses of fatalities or more or less cryptic in color than the actual fatalities. Mallards, *Coturnix* quail, and brown mice were used to represent the range of bird and bat fatalities that could potentially occur. It is believed that this range captures the range of sizes and other characteristics of actual fatalities

and should be a reasonable representation of scavenging rates as a whole. It is generally not practical or feasible to obtain a sufficiently large sample of native bird and bat species in fresh condition for use in these trials.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates (e.g., Smallwood 2007, Smallwood et al. 2010). Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities were low enough such that scavenging rates for trial carcasses were lower than for turbine related fatalities. The logic is that if the trials are based on too many carcasses on a given day, scavengers are unable to access all trial carcasses, whereas they could access all turbine caused fatalities. If this were the case, and the trial carcass density was much greater than actual turbine related fatality density, the trials would underestimate true scavenging rates. The contrary is also possible, where placing carcasses may draw in more scavengers and carcasses could be removed more quickly than normal.

Bird Fatalities

Passerines were the bird type most commonly found as a fatality, representing 59.1% of avian fatalities. Diurnal raptors and owls composed another 13.6% of observed mortality. Of the 11 identified bird species documented as fatalities during the Year 3 study, only one (short-eared owl, a California Species of Special Concern) is considered sensitive at the state or federal level. Avian fatalities were generally spread throughout the Projects both spatially and temporally, with fatalities occurring less frequently in winter than during the other seasons.

Overall bird fatality rates at wind energy facilities in California have been variable, ranging from 0.17 to 17.44 birds/MW/year (Figure 8, Appendix D). During the third year of fatality monitoring at the Projects, the estimated annual bird fatality rate was 2.71 birds/MW/year, which is consistent with overall bird fatality rates estimated in Year 1 and Year 2 of the study (3.13 and 1.63 fatalities/MW/year, respectively; Rintz et al. 2016, Chatfield et al. 2018; Figure 8). Fatality rates from the 3-year study at the Project are relatively low compared to other wind energy facilities in California with publicly available data (Figure 8, Appendix D). More locally, at the facilities in the immediate vicinity (within 3.0 km [1.9 mi]) of the Projects (i.e., Alta II-V, Alta VIII, Mustang Hills, Pinyon Pines I & II, Alta X, Windstar, Lower West, and Cameron Ridge/Section 15), overall bird fatality rates have ranged from 0.25 to 6.65 birds/MW/year, with an average of 1.57 birds/MW/year (Figure 8, Appendix D). The avian fatality rates from the Rising Tree Projects fall within this range (1.63, 2.71, 3.13 birds/MW/year; Appendix D). Two other facilities in the TWRA, Alta I and Pine Tree, have had somewhat higher overall bird fatality rates (12.05 and 17.44 birds/MW/year, respectively) than other regional facilities (Figure 8, Appendix D). However, both of these facilities are located more than 8.0 km (5.0 mi) from the Rising Tree Projects and have considerably different topographical and vegetative characteristics and, therefore, may not be as appropriate for comparison.

<u>Diurnal Raptors</u>

Diurnal raptor fatality estimates at wind energy facilities in California have ranged from zero to 1.06 birds/MW/year with an average of 0.20 diurnal raptors/MW/year (Figure 9, Appendix D).

Diurnal raptor fatality estimates during Years 1-3 of the monitoring study at the Projects (0.06, 0.14, and 0.28 diurnal raptors/MW/year, respectively) are on the lower end of this range (Figure 9) and more similar to fatality rates documented at the facilities located adjacent to the Projects (i.e., Alta II-V, Alta VIII, Mustang Hills, Pinyon Pines I & II, Alta X, Windstar, Lower West, and Cameron Ridge/Section 15) than to other facilities in the Montezuma Hills Wind Resource Area (e.g., Montezuma, Shiloh, and High Winds; see Figure 9 and Appendix D). Diurnal raptor fatality rates at these adjacent facilities have ranged from zero to 0.18 raptors/MW/year during multiple years of fatality monitoring at each facility (Figure 9, Appendix D). During Year 3 of monitoring at the Projects, diurnal raptor fatalities consisted of two red-tailed hawks. Diurnal raptor fatalities during other years of the study have included a single red-tailed hawk in Year 1 (Rintz et al. 2016) and three red-tailed hawks and an American kestrel (*Falco sparverius*) in Year 2 (Chatfield et al. 2018). While fewer diurnal raptor fatalities were found in Year 3 than the previous year, the Year 3 diurnal raptor fatality rate is twice that estimated for Year 2. This is likely due to very low carcass persistence rates (0.06) observed during the fall bias trials in Year 3 which contributed to higher fatality rates during that season (Appendix C).

Comparatively low diurnal raptor mortality at the Projects and surrounding facilities is consistent with the relatively low diurnal raptor use observed during pre-construction surveys conducted at the Projects and nearby sites in the TWRA (see Johnson et al. 2007, Erickson et al. 2009, Chatfield et al. 2010a, 2011a, 2011b).

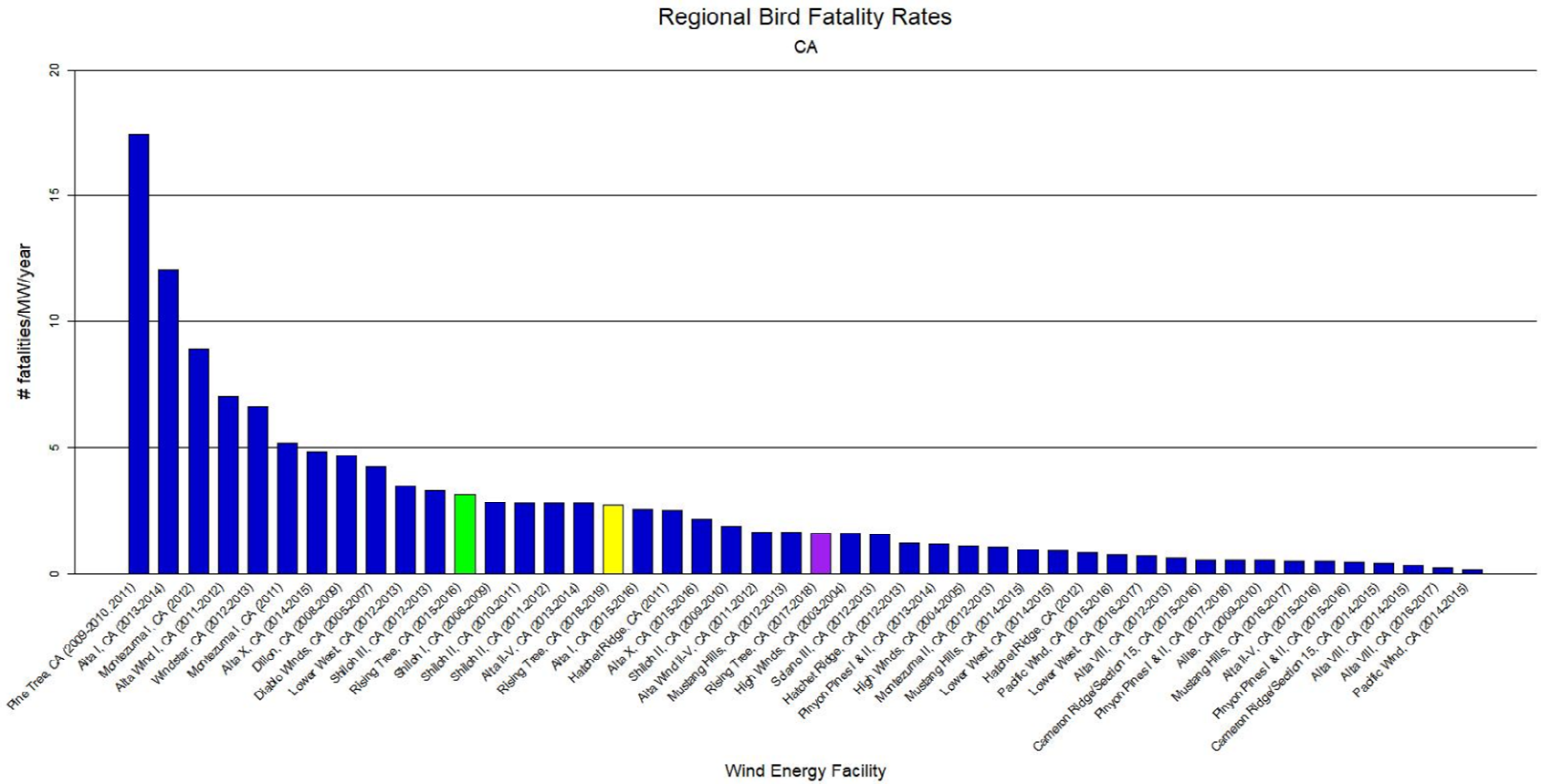

Figure 8. Fatality rates for all birds (number of birds per megawatt [MW] per year) at the Rising Tree Wind Projects compared with publicly available studies at other wind energy facilities in California. Results of the Year 3 (2018-2019) study are shown in yellow and results of the Year 1 (2015-2016) and Year 2 (2017-2018) studies are shown in green and purple, respectively.

Figure 8 (*continued*). Fatality rates for all birds (number of birds per megawatt [MW] per year) at the Rising Tree Wind Projects compared with publicly available studies at other wind energy facilities in California.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference
Rising Tree (2018-2019)	**This study.**		
Rising Tree (2017-2018)	**Chatfield et al. 2018**		
Rising Tree (2015-2016)	**Rintz et al. 2016**		
Pine Tree (2009-2010, 2011)	Bio Resource Consultants 2012	Solano III (2012-2013)	AECOM 2013
Alta I (2013-2014)	Chatfield et al. 2014	Hatchet Ridge (2012-2013)	Tetra Tech 2014
Montezuma I (2012)	ICF International 2013	Pinyon Pines I & II (2013-2014)	Chatfield and Russo 2014
Alta I (2011-2012)	Chatfield et al. 2012	High Winds (2004-2005)	Kerlinger et al. 2006
Windstar (2012-2013)	Levenstein and Bay 2013a	Montezuma II (2012-2013)	Harvey & Associates 2013
Montezuma I (2011)	ICF International 2012	Mustang Hills (2014-2015)	WEST 2016a
Alta X (2014-2015)	Chatfield et al. 2015	Lower West (2014-2015)	Levenstein and DiDonato 2015
Dillon (2008-2009)	Chatfield et al. 2009	Hatchet Ridge (2012)	Tetra Tech 2013
Diablo Winds (2005-2007)	WEST 2006, 2008	Pacific Wind (2015-2016)	WEST 2017a
Lower West (2012-2013)	Levenstein and Bay 2013b	Lower West (2016-2017)	WEST 2017b
Shiloh III (2012-2013)	Kerlinger et al. 2013a	Alta VIII (2012-2013)	Chatfield and Bay 2014
Shiloh I (2008-2009)	Kerlinger et al. 2009	Cameron Ridge/Section 15 (2015-2016)	Rintz and Thompson 2017
Shiloh II (2010-2011)	Kerlinger et al. 2013b	Pinyon Pines I & II (2017-2018)	Rintz and Pham 2018
Shiloh II (2011-2012)	Kerlinger et al. 2013b	Alite (2009-2010)	Chatfield et al. 2010b
Alta II-V (2013-2014)	Chatfield et al. 2014	Mustang Hills (2016-2017)	WEST 2018
Alta I (2015-2016)	Thompson et al. 2016a	Alta II-V (2015-2016)	Thompson et al. 2016a
Hatchet Ridge (2011)	Tetra Tech 2013	Pinyon Pines I & II (2015-2016)	Rintz and Starcevich 2016
Alta X (2015-2016)	Thompson et al. 2016b	Cameron Ridge/Section 15 (2014-2015)	WEST 2016b
Shiloh II (2009-2010)	Kerlinger et al. 2010	Alta VIII (2014-2015)	Western EcoSystems Technology, Inc. (WEST) 2016a
Alta II-V (2011-2012)	Chatfield et al. 2012	Alta VIII (2016-2017)	WEST 2018
Mustang Hills (2012-2013)	Chatfield and Bay 2014	Pacific Wind (2014-2015)	WEST 2016c
High Winds (2003-2004)	Kerlinger et al. 2006		

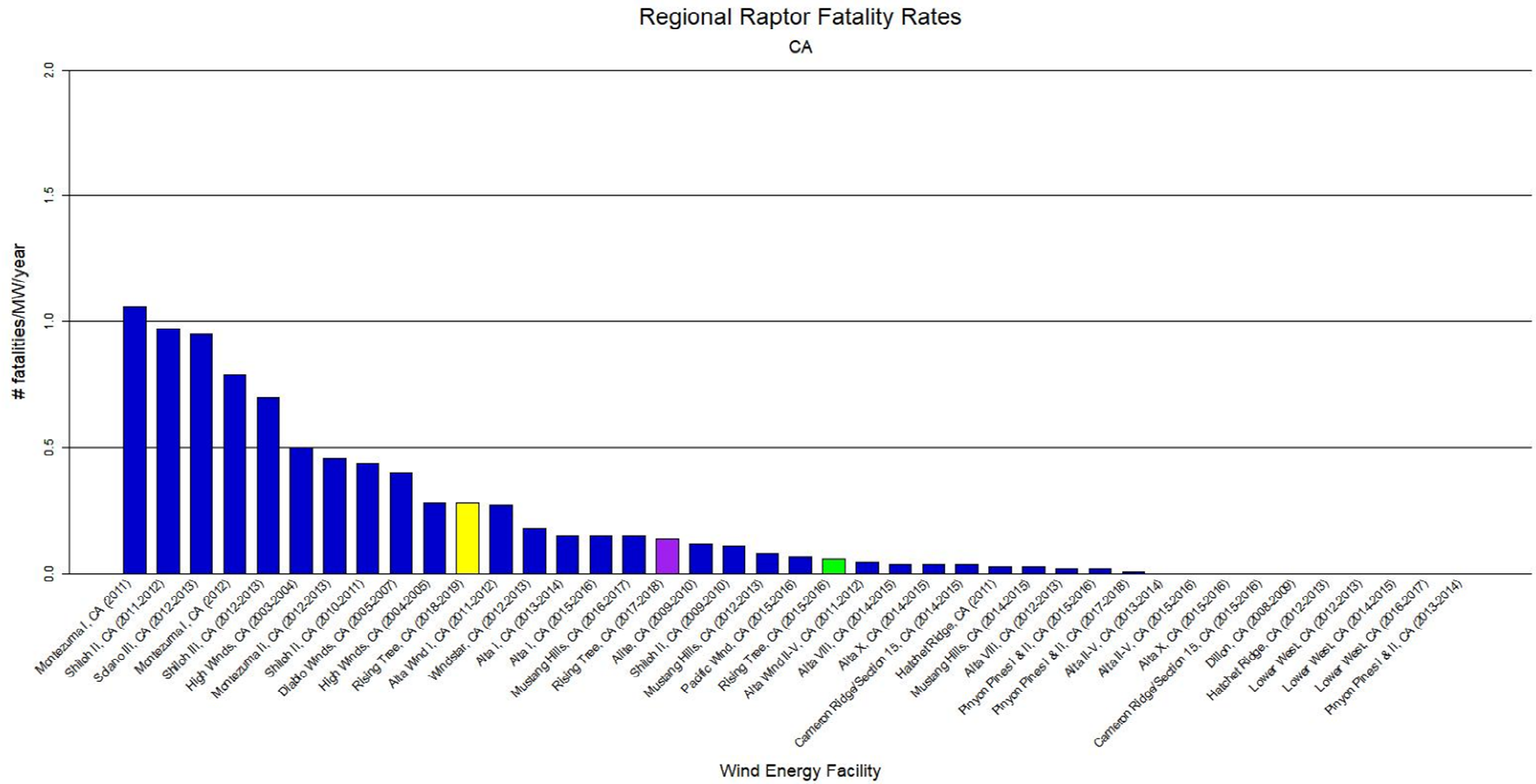

Figure 9. Fatality rates for diurnal raptors (number of diurnal raptors per megawatt [MW] per year) at the Rising Tree Wind Projects compared with publicly available studies at other wind energy facilities in California. Results of the Year 3 (2018-2019) study are shown in yellow and results of the Year 1 (2015-2016) and Year 2 (2017-2018) studies are shown in green and purple, respectively.

Figure 9 (*continued*). Fatality rates for diurnal raptors (number of diurnal raptors per megawatt [MW] per year) at the Rising Tree Wind Projects compared with publicly available studies at other wind energy facilities in California.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference
Rising Tree (2018-2019)	**This study**		
Rising Tree (2017-2018)	**Chatfield et al 2018.**		
Rising Tree (2015-2016)	**Rintz et al. 2016**		
Montezuma I (2011)	ICF International 2012	Alta II-V (2011-2012)	Chatfield et al. 2012
Shiloh II (2011-2012)	Kerlinger et al. 2013b	Alta VIII (2014-2015)	Western EcoSystems Technology, Inc. (WEST) 2016a
Solano III (2012-2013)	AECOM 2013	Alta X (2014-2015)	Chatfield et al. 2015
Montezuma I (2012)	ICF International 2013	Cameron Ridge/Section 15 (2014-2015)	WEST 2016b
Shiloh III (2012-2013)	Kerlinger et al. 2013a	Hatchet Ridge (2011)	Tetra Tech 2013
High Winds (2003-2004)	Kerlinger et al. 2006	Mustang Hills (2014-2015)	WEST 2016a
Montezuma II (2012-2013)	Harvey & Associates 2013	Alta VIII (2012-2013)	Chatfield and Bay 2014
Shiloh II (2010-2011)	Kerlinger et al. 2013b	Pinyon Pines I & II (2015-2016)	Rintz and Starcevich 2016
Diablo Winds (2005-2007)	WEST 2006, 2008	Pinyon Pines I & II (2017-2018)	Rintz and Pham 2018
High Winds (2004-2005)	Kerlinger et al. 2006	Alta II-V (2013-2014)	Chatfield et al. 2014
Alta I (2011-2012)	Chatfield et al. 2012	Alta II-V (2015-2016)	Thompson et al. 2016a
Windstar (2012-2013)	Levenstein and Bay 2013a	Alta X (2015-2016)	Thompson et al. 2016b
Alta I (2013-2014)	Chatfield et al. 2014	Cameron Ridge/Section 15 (2015-2016)	Rintz and Thompson 2017
Alta I (2015-2016)	Thompson et al. 2016a	Dillon (2008-2009)	Chatfield et al. 2009
Mustang Hills (2016-2017)	WEST 2018	Hatchet Ridge (2012)	Tetra Tech 2014
Alite (2009-2010)	Chatfield et al. 2010b	Lower West (2012-2013)	Levenstein and Bay 2013b
Shiloh II (2009-2010)	Kerlinger et al. 2010	Lower West (2014-2015)	Levenstein and DiDonato 2015
Mustang Hills (2012-2013)	Chatfield and Bay 2014	Lower West (2016-2017)	WEST 2017b
Pacific Wind (2015-2016)	WEST 2017a	Pinyon Pines I & II (2013-2014)	Chatfield and Russo 2014

Bat Fatalities

In California, bat fatality rates have ranged from zero to 5.22 bats/MW/year (Appendix D). At facilities adjacent to the Projects, bat fatality rates have been much lower, ranging from zero to 2.17 bats/MW/year (Appendix D). No bat fatalities were found during the 3-year monitoring study at the Projects (see Rintz et al. 2016, Chatfield et al. 2018). While some bat fatalities may have occurred and gone undetected by searchers, the lack of documented fatalities is a clear indication that the actual fatality rate is very low and consistent with other wind energy facilities in the TWRA (Appendix D). The comparatively low bat fatality rate documented at the Projects to date is consistent with the relatively low bat activity levels (0.10 bat passes/detector night) reported during pre-construction acoustic bat surveys conducted at the Projects (see Chatfield et al. 2010c).

CONCLUSIONS AND RECOMMENDATIONS

The results of the 3-year post-construction fatality monitoring study at the Projects add to our understanding of the potential long-term impacts of the facility on birds and bats and to our understanding of the impacts of wind energy on wildlife in general. Overall bird and diurnal raptor fatality rates estimated during Year 3 of the study were similar to those estimated during years 1 and 2 of the study, and are also consistent with fatality rates reported at other nearby facilities in the TWRA. No bat fatalities have been documented during three years of fatality monitoring conducted at the Projects.

As initially stated, the objective of the fatality monitoring study described in MM 4.4-22 of the EIRs was to demonstrate the level of incidental injury and mortality to populations of avian and bat species in the vicinity of the Projects. Based on the range of bird and bat fatality levels that have been observed during the 3-year study, as well as the composition of those fatalities, it appears unlikely that continued operation of the Projects will result in significant impacts to bird or bat populations.

REFERENCES

AECOM. 2013. Annual Monitoring Report: July 2012 - June 2013. Solano Wind Project - Phase 3. Prepared for SMUD - Environmental Management, Sacramento, California. Prepared by AECOM, Sacramento, California. September 2013.

Althouse and Meade, Inc. 2014. Topaz Solar Farms 2013 Fourth Quarter/Second Annual Report for Avian and Bat Protection Plan and Bird Monitoring and Avoidance Plan. Prepared for Topaz Solar Farms LLC, Santa Margarita, California. Prepared by Althouse and Meade, Inc., Paso Robles, California. March 2014.

BioResource Consultants, Inc. (BRC). 2012. Avian Mortality Monitoring Report, Pine Tree Wind Farm, Kern County, California. Prepared for the City of Los Angeles Department of Water and Power. Report prepared by BioResource Consultants, Inc., Ojai, California. March 26, 2012.

Burnham, K. P. and D. R. Anderson. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. Second Edition. Springer, New York, New York.

California Department of Fish and Wildlife (CDFW). 2018. Special Animals List. Periodic publication. CDFW, Natural Diversity Database. November 2018. 67 pp. Available online: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109406&inline

California Energy Commission (CEC) and California Department of Fish and Game (CDFG). 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. Commission Final Report. CEC, Renewables Committee, and Energy Facilities Siting Division, and CDFG, Resources Management and Policy Division. CEC-700-2007-008-CMF.

Chatfield, A. and D. Russo. 2014. Post-Construction Avian and Bat Fatality Monitoring for the Pinyon Pines I & II Wind Energy Project, Kern County, California. Final Report for the First Year of Operation: March 2013 - March 2014. Prepared for MidAmerican Renewables, LLC, Des Moines, Iowa, and Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 28, 2014.

Chatfield, A. and K. Bay. 2014. Post-Construction Studies for the Mustang Hills and Alta VIII Wind Energy Facilities, Kern County, California. Final Report for the First Year of Operation: July 2012 - October 2013. Prepared for EverPower Wind Holdings, Inc. and Brookfield Renewable Energy Group. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. February 28, 2014.

Chatfield, A., D. Riser-Espinoza, and K. Bay. 2014. Bird and Bat Mortality Monitoring at the Alta Wind Energy Center, Phases I - V, Kern County, California. Final Report for the Second Year of Operation: March 4, 2013 – March 6, 2014. Prepared for Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 22, 2014.

Chatfield, A., J. Gruver, K. Bay, M. Bourassa Stahl, and E. Baumgartner. 2010c. Acoustic Bat Study for the Homestead Wind Resource Area, Kern County, California. Final Report: July 2008 – August 2009. Draft technical report prepared for Horizon Wind Energy, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. February, 2010.

Chatfield, A., K. Levenstein, and G. DiDonato. 2015. Post-Construction Avian and Bat Mortality Monitoring, Alta X, Llc, Kern County, California. Final Report for the First Year of Operation: March 2014 - March 2015. Prepared for Alta Wind X, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 10, 2015.

Chatfield, A., M. Sonnenberg, and K. Bay. 2012. Avian and Bat Mortality Monitoring at the Alta-Oak Creek Mojave Project, Kern County, California. Final Report for the First Year of Operation March 22, 2011 – June 15, 2012. Prepared for Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 12, 2012.

Chatfield, A., T. Rintz, and R. Clark. 2018. Post-Construction Avian and Bat Fatality Monitoring at the Rising Tree and Addison Wind Energy Projects, Kern County, California. Year 2 Final Report: June 2017 – June 2018. Prepared for EDP Renewables North America, LLC (EDPR), Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. August 20, 2018. 35 pp. + appendices.

Chatfield, A., W. Erickson, and K. Bay. 2009. Avian and Bat Fatality Study, Dillon Wind-Energy Facility, Riverside County, California. Final Report: March 26, 2008 - March 26, 2009. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 3, 2009.

Chatfield, A., W. P. Erickson, and K. Bay. 2010a. Avian Baseline Studies at the Sun Creek Wind Resource Area, Kern County, California. Final Report: May 2009 - May 2010. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. September 30, 2010. Available online: https://www.kerncounty.com/planning/pdfs/eirs/AltaEast/Appendices/ApD/D3%20Avian%20Baseline%20Studies%202010.pdf

Chatfield, A., W. P. Erickson, and K. Bay. 2010b. Avian and Bat Fatality Study at the Alite Wind-Energy Facility, Kern County, California. Final Report: June 15, 2009 – June 15, 2010. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Chatfield, A., W. P. Erickson, and K. Bay. 2011a. Avian Baseline Studies at the Alta East Wind Resource Area, Kern County, California. Final Report: July 10, 2010 - June 1, 2011. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. July 13, 2011. Appendix D-8. *In:* Bureau of Land Management (BLM). 2013. Alta East Wind Project: Proposed Plan Amendment and Final Environmental Impact Statement. CACA #0052537. US Department of the Interior BLM. February 2013. Available online: http://www.blm.gov/ca/st/en/fo/ridgecrest/alta_east_wind_project.html; 2011 Avian Baseline Report (Appendix D-8) available online at: http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/ridgecrest/alta_east_wind.Par.22191.File.dat/D8%20Avian%20Baseline%20Studies%202011.pdf

Chatfield, A., W. P. Erickson, and K. Bay. 2011b. Baseline Avian Studies for the Rising Tree Wind Resource Area, Kern County, California. Prepared for Rising Tree Wind Farm LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Erickson, W. and A. Chatfield. 2009. Avian Baseline Studies for the Alta-Oak Creek Mojave Wind-Energy Project, Kern County, California. Summary of Results: February 4 - July 11, 2009. Prepared for CH2M HILL. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 15, 2009. Available online at: http://www.co.kern.ca.us/planning/pdfs/eirs/AltaOakCreek/AltaOakCreek_TOC.pdf; Avian Study Results, Appendix C-4, available at: http://www.co.kern.ca.us/planning/pdfs/eirs/AltaOakCreek/AltaOakCreek_C-4.pdf

Erickson, W. P. 2006. Objectives, Uncertainties and Biases in Mortality Studies at Wind Facilities. Paper presented at the NWCC Research Meeting VI, November 2006. San Antonio, Texas.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Annual Report: July 2001 - December 2003. Technical Report Peer-Reviewed by and Submitted to Fpl Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee. Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. December 2004. Available online: http://www.west-inc.com/reports/swp_final_dec04.pdf

ESRI. 2019. World Imagery and Aerial Photos. (World Topo). ArcGIS Resource Center. Environmental Systems Research Institute (ESRI), producers of ArcGIS software. Redlands, California. Information online: http://www.arcgis.com/home/webmap/viewer.html?useExisting=1

Harvey & Associates. 2013. Montezuma II Wind Energy Center: Post Construction Monitoring Report, Year-1. Prepared by NextEra Montezuma II Wind, LLC, Juno Beach, Florida. Prepared by H.T. Harvey & Associates, Los Gatos, California. September 3, 2013.

Harvey & Associates. 2014. Avian and Bat Protection Plan Annual Postconstruction Fatality Report for the California Valley Solar Ranch Project Covering 16 August 2012 to 15 August 2013. Prepared for High Plains Ranch II, LLC, Carlsbad, California. Prepared by H.T. Harvey & Associates.

Higgins, K. F., R. G. Osborn, C. D. Dieter, and R. E. Usgaard. 1996. Monitoring of Seasonal Bird Activity and Mortality at the Buffalo Ridge Wind Resource Area, Minnesota, 1994-1995. Completion Report for the Research Period May 1, 1994 - December 31, 1995. Unpublished report prepared for Kenetech Windpower, Inc. by the South Dakota Cooperative Fish and Wildlife Research Unit, Brookings, South Dakota. 84 pp.

Hull, C. L. and S. Muir. 2010. Search Areas for Monitoring Bird and Bat Carcasses at Wind Farms Using a Monte-Carlo Model. Australasian Journal of Environmental Management 17(2): 77-87.

Huso, M. 2011. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22(3): 318-329. doi: 10.1002/env.1052.

Huso, M., N. Som, and L. Ladd. 2015. Fatality Estimator User's Guide. US Geological Survey (USGS) Data Series 729. Version 1.1. December 2015. Available online: http://pubs.usgs.gov/ds/729/pdf/ds729.pdf

ICF International. 2012. Montezuma Wind Llc (Montezuma I) 2011 Avian and Bat Fatality Monitoring Report. Prepared for NextEra Energy Resources. Prepared by ICF International, Sacramento, California. May 17, 2012.

ICF International. 2013. Montezuma Wind Llc (Montezuma I) 2012 Avian and Bat Fatality Monitoring Report. Prepared for NextEra Energy Resources. Prepared by ICF International, Sacramento, California. May 2013.

Johnson, G. D., M. K. Perlik, W. P. Erickson, and M. D. Strickland. 2004. Bat Activity, Composition and Collision Mortality at a Large Wind Plant in Minnesota. Wildlife Society Bulletin 32(4): 1278-1288.

Johnson, G. D., W. P. Erickson, K. Bay, C. Nations, J. Kerns, E. Riley, and P. Bloom. 2007. Baseline Avian Use and Risk Assessment for the Homestead Wind Energy Project, Kern County, California. 2005 – 2006. Unpublished report prepared for Horizon Wind Energy. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. April 19, 2007.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000. Final Report: Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision Mortality of Local and Migrant Birds at a Large-Scale Wind-Power Development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30(3): 879-887.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of Bats at a Large-Scale Wind Power Development at Buffalo Ridge, Minnesota. American Midland Naturalist 150: 332-342.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory Bird and Bat Monitoring Study at the Crescent Ridge Wind Power Project, Bureau County, Illinois: September 2005 - August 2006. Final draft prepared for Orrick Herrington and Sutcliffe, LLP. May 2007.

Kerlinger, P., R. Curry, A. Hasch, J. Guarnaccia, and D. Riser-Espinoza. 2013a. Post-Construction Bird and Bat Studies at the Shiloh III Wind Project, Llc, Solano County, California. Report on Year 1 Results. Prepared for EDF Renewable Energy (formerly known as enXco). Prepared by Curry and Kerlinger, LLC, McLean, Virginia. August 2013.

Kerlinger, P., R. Curry, A. Hasch, J. Guarnaccia, and D. Riser-Espinoza. 2013b. Post-Construction Bird and Bat Studies at the Shiloh II Wind Project, Llc, Solano County, California. Final Report. Prepared for EDF Renewable Energy (formerly known as enXco). Prepared by Curry and Kerlinger, LLC, McLean, Virginia. December 2012 (Revised June 2013).

Kerlinger, P., R. Curry, L. Culp, A. Hasch, and A. Jain. 2009. Revised Post-Construction Avian Monitoring Study for the Shiloh I Wind Power Project, Solano County, California. Final Report: October 2009. Third Year Report (Revised 2010). Prepared for Iberdrola Renewables, Inc. (IRI). Prepared by Curry and Kerlinger, LLC., McLean, Virginia. Available online: https://www.solanocounty.com/civicax/filebank/blobdload.aspx?blobid=8914

Kerlinger, P., R. Curry, L. Culp, A. Hasch, and A. Jain. 2010. Post-Construction Avian Monitoring Study for the Shiloh II Wind Power Project, Solano County, California. Year One Report. Prepared for enXco Development Inc. Prepared by Curry and Kerlinger, LLC, McLean, Virginia. September 2010. Available online: https://www.solanocounty.com/civicax/filebank/blobdload.aspx?blobid=12118

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilkerson, B. Fischer, and A. Hasch. 2006. Post-Construction Avian and Bat Fatality Monitoring Study for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds LLC, FPL Energy. Prepared by Curry and Kerlinger, LLC, MacLean, Virginia. April 2006. Available online: http://www.co.solano.ca.us/civicax/filebank/blobdload.aspx?blobid=8915

Kern County Planning and Community Development Department (Kern County Department). 2013a. Addison Energy Wind Project. Draft Environmental Impact Report SCH# 2013091022. EDP Renewables North America LLC. Kern County Planning and Community Development Department, Bakersfield, California. November 2013. Available online at: http://pcd.kerndsa.com/planning/environmental-documents/eda/332-addison-energy-wind-project

Kern County Planning and Community Development Department (Kern County Department). 2013b. Rising Tree Wind Energy Project. Draft Environmental Impact Report SCH# 2011071049. EDP Renewables North America LLC. Kern County Planning and Community Development Department, Bakersfield, California. November 2013. Available online at: http://pcd.kerndsa.com/planning/environmental-documents/333-rising-tree-wind-energy-project

Levenstein, K. and G. DiDonato. 2015. Post-Construction Avian and Bat Mortality Study at the Lower West Wind Energy Project, Kern County, California. Final Report for the Third Year of Operation: July 2014 - July 2015. Prepared for Brookfield Renewable Energy Partners, LP. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. October 31, 2013.

Levenstein, K. and K. Bay. 2013a. Post-Construction Avian and Bat Mortality Study at the Windstar Wind Energy Project, Kern County, California. Final Mortality Report: May 2012 - May 2013. Prepared for Brookfield Renewable Energy Partners, LP. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. October 29, 2013.

Levenstein, K. and K. Bay. 2013b. Post-Construction Avian and Bat Mortality Study at the Lower West Wind Energy Project, Kern County, California. Final Report for the First Year of Operation: May 2012 - May 2013. Prepared for Brookfield Renewable Energy Partners, LP. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. October 31, 2013.

Levenstein, K., A. Chatfield, and D. Riser-Espinoza. 2015. Post-Construction Studies for the North Sky River Wind Energy Facility, Kern County, California. Draft Report for the Second Year of Operation: January 2014 - January 2015. Prepared for North Sky River Energy LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. April 10, 2015.

Levenstein, K., E. Baumgartner, and K. Bay. 2014. Post-Construction Studies for the North Sky River Wind Energy Facility, Kern County, California. Final Report for the First Year of Operation: January 2013 - January 2014. Prepared for North Sky River Energy LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. March 31, 2014.

Manly, B. F. J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. 2nd Edition. Chapman and Hall, London.

National Geographic Society (National Geographic). 2018. World Maps. Digital topographic map. PDF topographic map quads. Accessed March 8, 2018. Available online: http://www.natgeomaps.com/trail-maps/pdf-quads

North American Datum (NAD). 1983. NAD83 Geodetic Datum.

Rintz, T. and D. Pham. 2018. Post-Construction Avian and Bat Fatality Monitoring for the Pinyon Pines I & II Wind Energy Project, Kern County, California. Final Report for the Fifth Year of Operation: March 2017 - March 2018. Prepared for MidAmerican Energy Company, Des Moines, Iowa, and Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. June 19, 2018. 63 pp. + appendices.

Rintz, T. and J. Thompson. 2017. Post-Construction Avian and Bat Mortality Monitoring at the Cameron Ridge-Section 15 Wind Farm, Coram California Development, Lp, Kern County, California. Mortality Analysis, Fourth Year of Operation: August 2015 - August 2016. Prepared for Renewable Energy Trust, San Francisco, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. January 12, 2017.

Rintz, T. and L. A. Starcevich. 2016. Post-Construction Avian and Bat Fatality Monitoring for the Pinyon Pines I & II Wind Energy Project, Kern County, California. Final Report for the Third Year of Operation: March 2015 - March 2016. Prepared for Berkshire Hathaway Energy Renewables, LLC, Des Moines, Iowa, and Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. October 17, 2016.

Rintz, T., J. Thompson, and S. Howlin. 2016. Post-Construction Avian and Bat Mortality Monitoring at the Rising Tree and Addison Wind Energy Projects, Kern County, California. Year 1 – Final Report: September 2015 – September 2016. Prepared for EDP Renewables North America, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. November 16, 2016.

Smallwood, K. S. 2007. Estimating Wind Turbine-Caused Bird Mortality. Journal of Wildlife Management 71: 2781-2791.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel Scavenger Removal Trials Increase Wind Turbine-Caused Avian Fatality Estimates. Journal of Wildlife Management 74: 1089-1097. doi: 10.2193/2009-266.

Tetra Tech. 2013. Hatchet Ridge Wind Farm Post-Construction Mortality Monitoring: Year Two Annual Report. Prepared for Hatchet Ridge Wind, LLC. Prepared by Tetra Tech, Portland, Oregon. March 2013. Available online: http://wintuaudubon.org/Documents/HatchetRidgeYear2FinalReport3-13.pdf

Tetra Tech. 2014. Hatchet Ridge Wind Farm Post-Construction Mortality Monitoring: Comprehensive Three Year Report. Prepared by Tetra Tech, Portland, Oregon.

Thompson, J., C. Boyd, and J. Lombardi. 2016b. Post-Construction Avian and Bat Mortality Monitoring at the Alta X Wind Energy Project, Kern County, California. Final Report for the Second Year of Operation: April 2015 - April 2016. Prepared for Alta Wind X, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 22, 2016.

Thompson, J., J. Lombardi, and C. Boyd. 2016a. Bird and Bat Mortality Monitoring at the Alta Wind Energy Center, Phases I - V, Kern County, California. Final Report for the Third Year of Monitoring: March 10, 2015 – March 4, 2016. Prepared for Alta Windpower Development, LLC, Mojave, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 9, 2016.

US Department of Agriculture (USDA). 2019. Imagery Programs - National Agriculture Imagery Program (Naip). USDA, Farm Service Agency (FSA), Aerial Photography Field Office (APFO), Salt Lake City, Utah. Accessed January 2019. Information online: https://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/index

US Fish and Wildlife Service (USFWS). 2012. Land-Based Wind Energy Guidelines. March 23, 2012. 82 pp. Available online: http://www.fws.gov/cno/pdf/Energy/2012_Wind_Energy_Guidelines_final.pdf

US Geological Survey (USGS). 2018. USGS Topographic Maps. Accessed June 2019. Information online: https://nationalmap.gov/ustopo/index.html

USA Topo. 2019. USA Topo Maps. US Geological Survey (USGS) topographical maps for the United States. ArcGIS. Environmental Systems Research Institute (ESRI), producers of ArcGIS software. Redlands, California.

Western EcoSystems Technology, Inc. (WEST). 2006. Diablo Winds Wildlife Monitoring Progress Report, March 2005 - February 2006. Technical report submitted to FPL Energy and Alameda County California. WEST, Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2008. Diablo Winds Wildlife Monitoring Progress Report: March 2005 – February 2007. Prepared by WEST, Cheyenne, Wyoming. August 2008.

Western EcoSystems Technology, Inc. (WEST). 2016a. Post-Construction Studies for the Mustang Hills and Alta VIII Wind Energy Facilities, Kern County, California. Draft Report for the Third Year of Operation: September 2014 - September 2015. Prepared for EverPower Wind Holdings, Inc. and Brookfield Renewable Energy Group. Prepared by WEST, Cheyenne, Wyoming. February 22, 2016.

Western EcoSystems Technology, Inc. (WEST). 2016b. Post-Construction Avian and Bat Mortality Monitoring at the Cameron Ridge-Section 15 Wind Farm, Coram California Development, Lp, Kern County, California. Mortality Analysis, Third Year of Operation: August 2014 - August 2015. Prepared for Renewable Energy Trust, San Francisco, California. Prepared by WEST, Corvallis, Oregon. January 2016.

Western EcoSystems Technology, Inc. (WEST). 2016c. Post-Construction Avian and Bat Fatality Monitoring at the Pacific Wind Energy Facility, Kern County, California. Final Report for the Third Year of Operation: October 2014 - October 2015. Prepared for Pacific Wind, LLC, San Diego, California. Prepared by WEST, Cheyenne, Wyoming. January 27, 2016.

Western EcoSystems Technology, Inc. (WEST). 2016d. Post-Construction Studies for the North Sky River Wind Energy Facility, Kern County, California. Final Report for the Third Year of Operation. January 2015 - January 2016. Prepared for North Sky River Energy LLC, Juno Beach, Florida. Prepared by WEST, Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2017a. Post-Construction Avian and Bat Fatality Monitoring at the Pacific Wind Energy Facility, Kern County, California. Final Report for the Fourth Year of Operation, October 2015 – October 2016. Prepared for Pacific Wind, LLC, San Diego, California. Prepared by WEST, Cheyenne, Wyoming. January 2017.

Western EcoSystems Technology, Inc. (WEST). 2017b. Post-Construction Avian and Bat Mortality Study at the Lower West Wind Energy Project, Kern County, California. Final Report for the Fifth Year of Operation: July 2016 – August 2017. Prepared for Brookfield Renewable Energy Partners, LP. Prepared by WEST, Corvallis, Oregon. December 15, 2017.

Western EcoSystems Technology, Inc. (WEST). 2018. Post-Construction Avian and Bat Mortality Studies for the Mustang Hills and Alta VIII Wind Energy Facilities, Kern County, California. Final Report for the Fifth Year of Operation: September 2016 – September 2017. Prepared for EverPower Wind Holdings, Inc. and Brookfield Renewable Energy Partners, LP. Prepared by WEST, Corvallis, Oregon. January 12, 2018.

Western EcoSystems Technology, Inc. (WEST). 2018a. Rising Tree Wind Energy Project Bird and Bat Conservation Strategy. Preliminary Draft Prepared for Rising Tree Wind Farm LLC, Rising Tree Wind Farm II LLC, and Rising Tree Wind Farm III LLC. Prepared by Western EcoSystems Technology, Inc., Corvallis, Oregon. Revision 3: June 8, 2018.

Western EcoSystems Technology, Inc. (WEST). 2018b. Rising Tree Wind Energy Project Eagle Conservation Plan. Preliminary Draft Prepared for Rising Tree Wind Farm LLC, Rising Tree Wind Farm II LLC, and Rising Tree Wind Farm III LLC. Prepared by Western EcoSystems Technology, Inc., Corvallis, Oregon. Revision 3: May 29, 2018.

Young, D. P., Jr., J. Jeffrey, W. P. Erickson, K. Bay, V. K. Poulton, K. Kronner, R. Gritski, and J. Baker. 2006. Eurus Combine Hills Turbine Ranch. Phase 1 Post Construction Wildlife Monitoring First Annual Report: February 2004 - February 2005. Technical report prepared for Eurus Energy America Corporation, San Diego, California, and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla Washington, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. February 21, 2006. Available online: http://wind.nrel.gov/public/library/young7.pdf

Young, D. P., Jr., W. P. Erickson, R. E. Good, M. D. Strickland, and G. D. Johnson. 2003. Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming, Final Report, November 1998 - June 2002. Prepared for Pacificorp, Inc. Portland, Oregon, SeaWest Windpower Inc. San Diego, California, and Bureau of Land Management, Rawlins District Office, Rawlins, Wyoming. January 10, 2003. Available online: http://west-inc.com/reports/fcr_final_mortality.pdf

Appendix A. Complete List of Fatalities Documented during Post-Construction Avian and Bat Fatality Monitoring at the Rising Tree Wind Projects from June 3, 2018 – May 29, 2019

Appendix A. Complete listing of fatalities found at the Rising Tree Wind Projects, June 3, 2018 – May 29, 2019.

Date	Common Name	Scientific Name	Turbine	Distance from Turbine (meters)	Type of Find	Condition
2018-06-11	unidentified passerine	-	29	122	Carcass search	Feather spot
2018-06-11	mourning dove	*Zenaida macroura*	32	95	Carcass search	Feather spot
2018-06-14	unidentified passerine	-	56	105	Carcass search	Feather spot
2018-06-17	greater roadrunner	*Geococcyx californianus*	8	148	Carcass search	Feather spot
2018-06-27	mourning dove	*Zenaida macroura*	51	77	Carcass search	Feather spot
2018-07-08	house wren	*Troglodytes aedon*	29	110	Carcass search	Intact
2018-08-28	house wren	*Troglodytes aedon*	8	17	Carcass search	Intact
2018-09-17	unidentified shorebird	-	34	63	Carcass search	Feather spot
2018-10-12	unidentified waterfowl	-	8	108	Carcass search	Feather spot
2018-10-15	red-tailed hawk	*Buteo jamaicensis*	36	101	Carcass search	Feather spot
2018-11-12	western meadowlark	*Sternella neglecta*	14	33	Carcass search	Feather spot
2018-11-29	greater roadrunner	*Geococcyx californianus*	40	160	Carcass search	Feather spot
2018-12-21	short-eared owl	*Asio flammeus*	36	86	Carcass search	Feather spot
2018-12-26	horned lark	*Eremophila alpestris*	46	6	Carcass search	Intact
2019-03-15	red-tailed hawk	*Buteo jamaicensis*	20	71	Carcass search	Feather spot
2019-03-20	horned lark	*Eremophila alpestrisd*	34	104	Carcass search	Intact
2019-05-07	white-crowned sparrow	*Zonotrichia leucophrys*	26	98	Carcass search	Dismembered
2019-05-07	Townsend's warbler	*Setophaga townsendi*	26	162	Carcass search	Intact
2019-05-07	orange-crowned warbler	*Vermivora celata*	26	103	Carcass search	Intact
2019-05-07	house finch	*Haemorhous mexicanus*	26	106	Carcass search	Dismembered
2019-05-21	Townsend's warbler	*Setophaga townsendi*	32	133	Carcass search	Dismembered
2019-05-23	horned lark	*Eremophila alpestris*	34	118	Carcass search	Intact

Appendix B. Final Models for Searcher Efficiency and Carcass Persistence Based on Bias Trials Conducted at the Rising Tree Wind Projects from June 2018 – May 2019

Appendix B1. Searcher efficiency logistic regression models for the Rising Tree Wind Projects, June 2018 to May 2019. Selected models are denoted by an asterisk in the ΔAICc column.

Size Class	Covariates	Number of Parameters	Sample Size	AICc	ΔAICc
Large Birds	Intercept Only	1	41	2.1	0.0*
	Response with Season	4	41	9.1	7.0
Small Birds	Response with Season	4	62	64.8	0.0*
	Intercept Only	1	62	68.3	3.5
Bats*	Intercept Only	1	27	28.0	0.0*
	Response with Season	3	27	31.9	3.9

* Brown mice used as surrogates for bats.

AICc = Corrected Akaike Information Criteria

Appendix B2. Carcass persistence models and parameters at the Rising Tree Wind Projects. Selected models are denoted by an asterisk in the ΔAICc column.

Size Class	Data Source	Covariate	Distribution	Number of Parameters	Sample Size	AICc	ΔAICc
Large Birds	Spring, Summer, Fall 2018-2019	survDat with Season	Exponential	3	32	126.5	0.0*
	Spring, Summer, Fall 2018-2019	survDat with Season	Weibull	4	32	127.5	1.0
	Spring, Summer, Fall 2018-2019	survDat with Season	Loglogistic	4	32	127.7	1.2
	Spring, Summer, Fall 2018-2019	survDat with Season	Lognormal	4	32	128.3	1.8
	Spring, Summer, Fall 2018-2019	Intercept Only	Weibull	2	32	132.6	6.1
	Spring, Summer, Fall 2018-2019	Intercept Only	Lognormal	2	32	132.7	6.2
	Spring, Summer, Fall 2018-2019	Intercept Only	Loglogistic	2	32	133.4	6.9
	Spring, Summer, Fall 2018-2019	Intercept Only	Exponential	1	32	138.9	12.4
	Winter 2015-2016; 2017-2018	Intercept Only	Loglogistic	2	28	116.7	0.0*
	Winter 2015-2016; 2017-2018	Intercept Only	Lognormal	2	28	116.7	0.0
	Winter 2015-2016; 2017-2018	Intercept Only	Weibull	2	28	116.9	0.2
	Winter 2015-2016; 2017-2018	Intercept Only	Exponential	1	28	138.4	21.7
Small Birds	Spring, Summer, Fall 2018-2019	survDat with Season	Exponential	3	45	149.9	0.0*
	Spring, Summer, Fall 2018-2019	survDat with Season	Weibull	4	45	152.3	2.4
	Spring, Summer, Fall 2018-2019	survDat with Season	Lognormal	4	45	153.3	3.4
	Spring, Summer, Fall 2018-2019	survDat with Season	Loglogistic	4	45	154.2	4.3

Appendix B2. Carcass persistence models and parameters at the Rising Tree Wind Projects. Selected models are denoted by an asterisk in the ΔAICc column.

Size Class	Data Source	Covariate	Distribution	Number of Parameters	Sample Size	AICc	ΔAICc
Bats*	Spring, Summer, Fall 2018-2019	Intercept Only	Exponential	1	45	155.9	6.1
	Spring, Summer, Fall 2018-2019	Intercept Only	Weibull	2	45	157.1	7.2
	Spring, Summer, Fall 2018-2019	Intercept Only	Lognormal	2	45	157.8	7.9
	Spring, Summer, Fall 2018-2019	Intercept Only	Loglogistic	2	45	159.2	9.3
	Winter 2015-2016; 2017-2018	Intercept Only	Loglogistic	2	45	170.2	0.0*
	Winter 2015-2016; 2017-2018	Intercept Only	Lognormal	2	45	171.6	1.4
	Winter 2015-2016; 2017-2018	Intercept Only	Weibull	2	45	175.3	5.1
	Winter 2015-2016; 2017-2018	Intercept Only	Exponential	1	45	211.2	41.0
	Spring, Summer, Fall 2018-2019	survDat with Season	Exponential	3	43	136.3	0.0*
	Spring, Summer, Fall 2018-2019	survDat with Season	Weibull	4	43	138.7	2.4
	Spring, Summer, Fall 2018-2019	survDat with Season	Lognormal	4	43	144.2	7.9
	Spring, Summer, Fall 2018-2019	survDat with Season	Loglogistic	4	43	146.1	9.8
	Spring, Summer, Fall 2018-2019	Intercept Only	Weibull	2	43	153.4	17.1
	Spring, Summer, Fall 2018-2019	Intercept Only	Lognormal	2	43	154.9	18.6
	Spring, Summer, Fall 2018-2019	Intercept Only	Loglogistic	2	43	156.6	20.3
	Spring, Summer, Fall 2018-2019	Intercept Only	Exponential	1	43	157.3	20.9
	Winter 2015-2016; 2017-2018	Intercept Only	Lognormal	2	25	81.2	0.0
	Winter 2015-2016; 2017-2018	Intercept Only	Weibull	2	25	81.4	0.2
	Winter 2015-2016; 2017-2018	Intercept Only	Loglogistic	2	25	81.5	0.3
	Winter 2015-2016; 2017-2018	Intercept Only	Exponential	1	25	81.9	0.7*

* Brown mice used as surrogates for bats.

AICc = Corrected Akaike Information Criteria

Appendix B3. Carcass persistence top models with covariates, distributions, and model parameters for the Rising Tree Wind Project.

Size	Season	Distribution	Predicted Values	Scale
Large Bird	summer	Exponential	9.0	1.0
	fall	Exponential	0.8	1.0
	spring	Exponential	7.8	1.0
	winter	Loglogistic	3.5	1.7
Small Bird	summer	Exponential	2.4	1.0
	fall	Exponential	0.9	1.0
	spring	Exponential	3.8	1.0
	winter	Loglogistic	1.4	1.1
Bat*	summer	Exponential	1.1	1.0
	fall	Exponential	1.6	1.0
	spring	Exponential	6.9	1.0
	winter	Exponential	2.1	1.0

* Brown mice used as surrogates for bats.

Appendix C. Complete Bird and Bat Fatality Table (Based on Huso Estimator) for the Rising Tree Wind Projects for Studies Conducted from June 3, 2018 – May 29, 2019

Appendix C. Complete bird and bat fatality table (based on Huso estimator) for the Rising Tree Wind Projects for studies conducted from June 3, 2018 – May 29, 2019.

	Winter		Spring		Summer		Fall	
Parameter	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**
Observer Detection Rate								
P (Bat)	0.81	0.68 - 0.93	0.81	0.68 - 0.93	0.81	0.68 - 0.93	0.81	0.68 - 0.93
P (Large Bird)	1	1 - 1	1	1 - 1	1	1 - 1	1	1 - 1
P (Diurnal Raptor)	1	1 - 1	1	1 - 1	1	1 - 1	1	1 - 1
P (Small Bird)	0.71	0.55 - 0.86	0.6	0.38 - 0.8	0.83	0.64 - 1	1	1 - 1
Probability of a Carcass Persisting Through the Search Interval								
Bat	0.15	0.09 - 0.23	0.43	0.32 - 0.51	0.08	0.05 - 0.1	0.11	0.06 - 0.17
Large Bird	0.44	0.31 - 0.57	0.46	0.34 - 0.56	0.51	0.06 - 0.86	0.06	0.03 - 0.08
Diurnal Raptor	0.44	0.31 - 0.57	0.46	0.34 - 0.56	0.51	0.06 - 0.86	0.06	0.03 - 0.08
Small Bird	0.25	0.17 - 0.34	0.26	0.19 - 0.33	0.17	0.09 - 0.26	0.06	0.04 - 0.09
Probability of Available and Detected								
Bat	0.12	0.07 - 0.19	0.35	0.25 - 0.43	0.06	0.04 - 0.09	0.09	0.05 - 0.14
Large Bird	0.44	0.31 - 0.57	0.46	0.34 - 0.56	0.51	0.06 - 0.86	0.06	0.03 - 0.08
Diurnal Raptor	0.44	0.31 - 0.57	0.46	0.34 - 0.56	0.51	0.06 - 0.86	0.06	0.03 - 0.08
Small Bird	0.18	0.11 - 0.26	0.16	0.09 - 0.23	0.14	0.07 - 0.23	0.06	0.04 - 0.09
Unadjusted Number of Fatalities								
Bat	0	-	0	-	0	-	0	-
Large Bird	2	-	1		1	-	2	-
Small Bird	1	-	7	1 - 14	5	2 - 9	3	-
Diurnal Raptor	0	-	1	-	0	-	1	-
Observed Fatality Rates (Fatalities/Turbine/Season)								
Bat	0	-	0	-	0	-	0	-
Large Bird	0.11	-	0.05	-	0.05		0.11	-
Small Bird	0.05	-	0.37	0.05 - 0.74	0.26	0.11 - 0.47	0.16	-
Diurnal Raptor	0	-	0.05	-	0	-	0.05	-
Adjusted Fatality Rates (Fatalities/Turbine/Season)								
Large Bird	0.22	-	0.08	-	0.1	-	1.98	-
Small Bird	0.28	-	1.93	0.18 - 4.1	1.77	0.67 - 3.27	2.57	-
Diurnal Raptor	-	-	0.08	-	-	-	0.83	-
All Bird	0.5	-	2.02	-	1.87	-	4.55	-
Adjusted Fatality Rates (Fatalities/MW/Season)								
Large Bird	0.07	-	0.03	-	0.03	-	0.6	-
Small Bird	0.08	-	0.59	0.05 - 1.24	0.54	0.2 - 0.99	0.78	-
Diurnal Raptor	-	-	0.03	-		-	0.25	-
All Bird	0.15	-	0.61	-	0.57	-	1.38	-

Appendix C. Complete bird and bat fatality table (based on Huso estimator) for the Rising Tree Wind Projects for studies conducted from June 3, 2018 – May 29, 2019.

	Winter		Spring		Summer		Fall	
Parameter	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**	**Estimate**	**90 % CI**

CI = confidence interval, MW = megawatt

Appendix D. Avian and Bat Fatality Rates at Wind Energy Facilities in California

Appendix D. Wind energy facilities in California with fatality data for all bird species, diurnal raptors, and bats. Fatality estimate presented as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bird Fatality Estimate	Raptor Fatality Estimate	Bat Fatality Estimate	Number of Turbines	Total MW
Rising Tree Wind Project, CA (2018-2019)	**2.71**	**0.28**	**-**	**60**	**198**
Rising Tree Wind Project, CA (2017-2018)	**1.63**	**0.14**	**-**	**60**	**198**
Rising Tree Wind Projects, CA (2015-2016)	**3.13**	**0.06**	**-**	**60**	**198**
Pine Tree, CA (2009-2010, 2011)	17.44	-	0	90	135
Alta I, CA (2013-2014)	12.05	0.15	0.36	100	150
Montezuma I, CA (2012)	8.91	0.79	0.84	16	36.8
Alta I, CA (2011-2012)	7.07	0.27	1.28	100	150
Windstar, CA (2012-2013)	6.65	0.18	0	53	106
Montezuma I, CA (2011)	5.19	1.06	1.9	16	36.8
Alta X, CA (2014-2015)*	4.88	0.04	0.42	48	137
Dillon, CA (2008-2009)	4.71	0	2.17	45	45
Diablo Winds, CA (2005-2007)	4.29	0.4	0.82	31	20.5
Lower West, CA (2012-2013)*	3.5	0	2.17	7	14
Shiloh III, CA (2012-2013)	3.3	0.7	0.4	50	102.5
Shiloh I, CA (2006-2009)	2.82	-	-	100	150
Shiloh II, CA (2010-2011)	2.8	0.44	3.8	75	150
Shiloh II, CA (2011-2012)	2.8	0.97	3.4	75	150
Alta II-V, CA (2013-2014)*	2.79	0	0	290	720
Alta I, CA (2015-2016)	2.57	0.15	0.7	100	150
Hatchet Ridge, CA (2011)	2.5	0.03	2.23	44	101
Alta X, CA (2015-2016)	2.17	0	0.8	48	137
Shiloh II, CA (2009-2010)	1.9	0.11	2.6	75	150
Alta Wind II-V, CA (2011-2012)*	1.66	0.05	0.08	290	720
Mustang Hills, CA (2012-2013)*	1.66	0.08	0.1	50	150
High Winds, CA (2003-2004)	1.62	0.5	2.51	90	162
Solano III, CA (2012-2013)	1.6	0.95	0.31	55	128
Hatchet Ridge, CA (2012-2013)	1.22	0	4.2	44	101
Pinyon Pines I & II, CA (2013-2014)*	1.18	0	0.04	100	300
High Winds, CA (2004-2005)	1.1	0.28	1.52	90	162
Montezuma II, CA (2012-2013)	1.08	0.46	0.91	34	78.2
Mustang Hills, CA (2014-2015)*	0.97	0.03	0	50	150
Lower West, CA (2014-2015)*	0.9	0	1.13	7	14
Hatchet Ridge, CA (2012)	0.83	-	5.22	44	101
Pacific Wind, CA (2015-2016)	0.77	0.07	0	70	144
Lower West, CA (2016-2017)*	0.73	0	0	7	14
Alta VIII, CA (2012-2013)*	0.66	0.02	0	50	150

Appendix D. Wind energy facilities in California with fatality data for all bird species, diurnal raptors, and bats. Fatality estimate presented as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bird Fatality Estimate	Raptor Fatality Estimate	Bat Fatality Estimate	Number of Turbines	Total MW
Cameron Ridge/Section 15, CA (2015-2016)*	0.57	0	0.19	34	102
Pinyon Pines I & II, CA (2017-2018)*	0.56	0.01	0	100	300
Alite, CA (2009-2010)	0.55	0.12	0.24	8	24
Mustang Hills, CA (2016-2017)*	0.54	0.15	0.33	50	150
Alta II-V, CA (2015-2016)*	0.51	0	0	290	720
Pinyon Pines I & II, CA (2015-2016)*	0.5	0.02	0.18	100	300
Cameron Ridge/Section 15, CA (2014-2015)*	0.45	0.04	0.15	34	102
Alta VIII, CA (2014-2015)	0.38	0.04	0.17	50	150
Alta VIII, CA (2016-2017)	0.25	0	0	50	150
Pacific Wind, CA (2014-2015)	0.17	0	0.21	70	144

*Denotes facilities located in immediate vicinity (within two miles) of the Rising Tree Projects.

MW = megawatts

Appendix D (*continued*). Wind energy facilities in California with fatality data for all bird species, diurnal raptors, and bats. Fatality estimate presented as number of fatalities per megawatt (MW) per year.

Data from the following sources:

Facility	Reference	Facility	Reference	Facility	Reference
Rising Tree (2018-2019)	**This study**				
Rising Tree (2017-2018)	**Chatfield et al. 2018.**				
Rising Tree (2015-2016)	**Rintz et al. 2016**				
Alite (2009-2010)	Chatfield et al. 2010b	Dillon (2008-2009)	Chatfield et al. 2009	North Sky River (2014-2015)	Levenstein et al. 2015
Alta I (2011-2012)	Chatfield et al. 2012	Hatchet Ridge (2011)	Tetra Tech 2013	North Sky River (2015-2016)	WEST 2016d
Alta I (2013-2014)	Chatfield et al. 2014	Hatchet Ridge (2012)	Tetra Tech 2013	Pacific Wind (2014-2015)	WEST 2016c
Alta I (2015-2016)	Thompson et al. 2016a	High Winds (2003-2004)	Kerlinger et al. 2006	Pacific Wind (2015-2016)	WEST 2017a

Appendix D (*continued*). Wind energy facilities in California with fatality data for all bird species, diurnal raptors, and bats. Fatality estimate presented as number of fatalities per megawatt (MW) per year.

Data from the following sources:

Facility	Reference	Facility	Reference	Facility	Reference
Alta II-V (2011-2012)	Chatfield et al. 2012	High Winds (2004-2005)	Kerlinger et al. 2006	Pine Tree (2009-2010, 2011)	Bio Resource Consultants 2012
Alta II-V (2013-2014)	Chatfield et al. 2014	Lower West (2012-2013)	Levenstein and Bay 2013b	Pinyon Pines I & II (2013-2014)	Chatfield and Russo 2014
Alta II-V (2015-2016)	Thompson et al. 2016a	Lower West (2014-2015)	Levenstein and DiDonato 2015	Pinyon Pines I & II (2015-2016)	Rintz and Starcevich 2016
Alta VIII (2012-2013)	Chatfield and Bay 2014	Lower West (2016-2017)	WEST 2017b	Pinyon Pines I & II (2017-2018)	Rintz and Pham 2018
Alta VIII (2014-2015)	Western EcoSystems Technology, Inc. (WEST) 2016a	Montezuma I (2011)	ICF International 2012	Shiloh I (2006-2009)	Kerlinger et al. 2009
Alta VIII (2016-2017)	WEST 2018	Montezuma I (2012)	ICF International 2013	Shiloh II (2009-2010)	Kerlinger et al. 2010
Alta X (2014-2015)	Chatfield et al. 2015	Montezuma II (2012-2013)	Harvey & Associates 2013	Shiloh II (2010-2011)	Kerlinger et al. 2013b
Alta X (2015-2016)	Thompson et al. 2016b	Mustang Hills (2012-2013)	Chatfield and Bay 2014	Shiloh II (2011-2012)	Kerlinger et al. 2013b
Cameron Ridge/Section 15 (2014-2015)	WEST 2016b	Mustang Hills (2014-2015)	WEST 2016a	Shiloh III (2012-2013)	Kerlinger et al. 2013a
Cameron Ridge/Section 15 (2015-2016)	Rintz and Thompson 2017	Mustang Hills (2016-2017)	WEST 2018	Solano III (2012-2013)	AECOM 2013
Diablo Winds (2005-2007)	WEST 2006, 2008	North Sky River (2013-2014)	Levenstein et al. 2014	Windstar (2012-2013)	Levenstein and Bay 2013a