Post-Construction Avian Monitoring Study
for the
Shiloh II Wind Power Project
Solano County, California

Year One Report

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Shiloh II Wind Power Project Area is situated on roughly 7,800 acres of agricultural land in the Montezuma Hills, near Rio Vista in Solano County, California. The project consists of 75 wind turbines rated at 2.0 MW each for a total capacity of up to 150 MW. Thirty-three of the turbines are mounted on 68.5 meter towers and forty-two are on 78 meter towers. The rotor diameter is 94 m (308 feet). The height of the rotor when in the 12 o'clock position for turbines with the 68.5 m towers is 115 m (377 feet), and for the 78 m towers is 125 m (410 feet). These turbines are arrayed on similar landscape and habitat as that in which approximately 510 turbines of an older, smaller technology are deployed along with more than 200 turbines of the newer, larger technology.

The Collinsville-Montezuma Hills Wind Resource Area (CMHWRA) consists of approximately 40,300 acres and existing wind plants including Shiloh II, occupy approximately 25,100 acres. The landscape consists of rolling hills with elevations ranging from just above sea level adjacent to the Sacramento River to about 250 - 300 feet (61-91 m). Turbines are placed on the highest ground and do not run through low-lying valleys. Moving from south to north the terrain becomes more uniform with less elevation differential between the ridges and the valleys. On the west is the Suisun Marsh.

The land is private and largely agricultural, mostly rotating crop varieties and grazed pastures. There are isolated wetlands (mostly cattail marsh). Treed areas within the project are limited to the areas close to homes and in a few valleys, consisting of non-native eucalyptus, olive, and some native oaks and junipers.

This report details the first year of an ongoing three year post-construction study of the Shiloh II wind power project, the fourth study of the newer turbine technology in the CMHWRA. The previous three-year study was conducted at the Shiloh I project, from April 10, 2006 to April 11, 2009. Prior to that study, there was a two year study conducted at the adjacent High Winds project from August, 2003 through July, 2005. During the first twelve months (April 27, 2009 to April 24, 2010) of this three-year study, carcass surveys were conducted once per week at 25 of the 75 wind turbines, for a total of 52 rounds. In addition to reporting the results of the study, we provide details regarding the fulfillment of the Solano County Use Permit U-05-25, specifically BIO 9a and Condition 34.

A total of 44 wind turbine related avian incidents were recorded over the first year by searchers during standardized surveys, representing 19 species and 2 unidentified birds (1 of these was a blackbird, and 1 was an unidentifiable grebe). Of the 19 avian species, 2 were raptor species including American Kestrel (n = 1) and Red-tailed Hawk (3), comprising a total of 4 raptor incidents during the first year. The largest numbers of carcasses found were songbirds, comprising 27 incidents (61.4%), and representing 11 species and an unidentifiable blackbird. There were three waterfowl incidents, all Mallards, and 6 waterbird incidents (2 Black Rails, 1 Sora, 1 Dunlin, 1 Long-billed Curlew, and 1 unidentified grebe).

Two California Black Rails, a State Threatened species, were found in year one. No Federally threatened or endangered species were found. There was also one incident of a California Species of Special Concern, the Yellow Warbler.

Thirty-two (32) bat carcasses of three species were found: Hoary Bat (8); Mexican Free-tailed Bat (21); and Western Red Bat (3).

The greatest number of bird incidents occurred during the month of January of 2009, with a total of 7 (17% of the total) incidents in that month alone, 5 (71%) of them passerine species. Two raptor incidents found during year one (~50% of that year's total) were found in November during the fall migration, while the other two raptor incidents were found in July. Waterfowl and water bird incidents were sporadically distributed throughout the year, with 75% of incidents found in spring and summer. Three out of 4 of all "other" bird incidents (~75%) were recorded in winter (January to February).

The great majority of bat incidents occurred during the fall migration months, with 29 out of 32 bat carcasses recorded between September and November of 2009, representing ~91% of bats found during the one year study period.

The data suggested that the distribution of bat incidents was somewhat disproportionately greater at searched sites northwest ("west") of Emigh Road versus southeast ("east"). These two regions (west and east) differ in both topography and crop types. The western areas consist of grazed pasture and fallow, and are generally flatter than the area to the east. The east consists of steeper hills, and is used primarily for agriculture (wheat/crops), although the section also contains areas of grazed fallow and pasture. Spatial distribution of avian incidents in these two regions showed no difference from what would be expected based on tower distribution; however numbers of incidents were low at the end of the first year of this study.

With respect to individual turbines, there was one out of 25 searched towers (for birds) where fatalities deviated significantly from the average. By chance, 1.25 of 25 statistical tests should have shown significance for each category. Therefore we conclude that, individually and with respect to general location (west vs. east), there is no evidence to conclude that any turbines had fatalities that deviated significantly from the average and thus, per permit condition 40 (b) merit consideration for relocation. There were no such outlier turbines for bat incidents.

Fatalities of night migrating birds and bat fatalities were not disproportionately greater at turbines with flashing red FAA lights as opposed to turbines without such lights. Thus, red flashing FAA lights do not attract night migrants or bats.

Avian carcasses tended to be located somewhat evenly over a wider range of distances from wind turbine bases than bat carcasses, which were located closer to the towers. Eighty-four percent of bat carcasses were found within 60 meters of towers as compared to 52% for birds. The average distance to the tower for bat incidents was 35m, while the average distance to tower base for bird incidents was 56m.

Analysis of incidents by species groups and tower height (68.5 meters versus 78 meters) showed no difference from what would be expected based on distribution of towers of each height surveyed. With the exception of bats, all species groups (all avian) either did not have large enough numbers to detect trends, or were almost identical to what would be expected based on a random distribution. Over five times as many bats were found at 68.5 meters towers than at 78 meter towers. This result will be examined for further evidence in the next year of this study.

The vegetative cover of the wind farm consists entirely of agricultural land, roughly sorted into two types of cover, pasture and crop land. The percentage of incidents was highest in pasture, followed by fallow, wheat, and till, as would be expected based on the percentage of ground cover. Comparing vegetative cover to species group showed that bats have a higher than expected mortality in fallow land, and a lower than expected number in tilled soil. A comparison of species group to vegetative cover height indicates that there may be a visibility factor involved, with over 43% of the incidents occurring in short vegetation, and 45% in medium vegetation, and only about one eighth in tall vegetation.

The number of wind turbine related incidents found per total installed megawatt capacity per year, and per turbine per year was calculated for each species grouping. The greatest unadjusted rate of fatality occurred in bats (1.28 incidents/turbine/year, 0.64 incidents/Mw/year) followed by passerines (1.08 incidents/turbine/year, 0.54 incidents/Mw/year) and water birds (0.24 incidents/turbine/year, 0.12 incidents/Mw/year).

Comparison of unadjusted fatality rates within each species group between Shiloh II and the two neighboring project areas, Shiloh I and High Winds, showed the greatest passerine fatality rate at the Shiloh I site. The lowest raptor fatality rate was recorded at Shiloh II, where there were less than 25% of the raptor incidents of Shiloh I, and about 30% of the raptor incidents of High Winds. Only two species of raptors were recorded at the Shiloh II site compared to five species at each of the other two sites. Though conclusions are preliminary at this time due to low raptor incident numbers at Shiloh II after one year of data collection, Red-tailed Hawk fatality rates appear roughly similar between the three sites. American Kestrel numbers however were much greater at Shiloh I and High Winds than at Shiloh II, with 7.5 to 8.5 more kestrels recorded at Shiloh I and High Winds, respectively, than at Shiloh II.

There were approximately 2.3 more unadjusted passerine incidents per tower per year at Shiloh I than at Shiloh II, and 7.2 more than at High Winds. Raw data showed the greatest fatality rate of bats at Shiloh II, where there were 1.2 times more bat incidents per turbine/year than at Shiloh I, and 1.6 times more than at High Winds. This difference between sites was accountable to a single species, the Mexican Free-tailed Bat. Waterfowl and water bird incidents per turbine per year were greater at Shiloh II, with 2.6 times more birds/turbine/year than at Shiloh I, and 6 times as many as at High Winds. One notable species, the California Black Rail (a California threatened species) was only recorded at Shiloh II. Preliminary results appear to show a cluster of water bird and waterfowl in the D grouping of towers which coincide with the presence of two stock ponds and wetlands.

Differences in search protocol may be partly responsible for the greater observances of unadjusted incidents per turbines searched and the per MW capacity of each turbine. There were fewer turbines searched (25 turbines) at Shiloh II compared to an average of 49.4 at Shiloh I, and 86.3 at the High Winds site in the first year of study. However, the turbines at the Shiloh I and II project sites were searched more frequently, every seven days, compared with the 14 day search interval between turbine searches at the High Winds project site. Further, the search radius at each tower in the High Winds project was 75m from the base of the tower, compared to 105m at the Shiloh I and II projects. Thus, the area searched per tower (34636m^2) at each of the two Shiloh projects was 2 times the amount searched per tower at High Winds (17671m^2). In addition, a more detailed search was conducted between the base of each tower and the 30m radius, with every 5m interval searched within this region. Since bats tended to be located more proximal to the bases of towers than birds, this may account for some of the difference between sites in bat fatality rate.

The numbers of fatalities recorded at the site to this point of the report are unadjusted. It is recognized that the number of carcasses found under the towers is lower than the total number of birds and bats likely to have been killed. There are at least two factors that need to be accounted for. The first is the possibility that the searchers will miss carcasses. A second possibility is that the carcasses are removed prior to the time the searchers arrive on location after the collision event occurred.

After adjusting for scavenging, searcher efficiency and the ratio of the number of towers searched to the number of operational towers, the estimated annual number of avian and bat fatalities at Shiloh II were as follows:

- Bird incidents: 1.51 bird incidents/MW (3.03 incidents/tower)
- Bat incidents: 2.72 bat incidents/MW (5.44 incidents/tower)

At the end of each year of this study, we will alternate to search the next series of 25 turbines maintaining the same seven day interval cycle. Over the course of the 36 month study all turbines will have been searched for the same duration and at the same interval between searches of each turbine.

The numbers of fatalities found at Shiloh II do not suggest biologically significant impacts to birds or bats. Two incidents of Black Rail (State Threatened Species) and one incident of Yellow Warbler (California Species of Concern) were noted. The next year of this study will provide additional data on the fatality levels for these two species. With respect to the remaining birds, it is important to remember that the numbers of fatalities, both estimated and actual carcasses found represent extremely small proportions of the North American and regional populations of these animals, suggesting that the impact to these species' populations will not cause declines that could potentially threatened the populations of these species. Even species for which larger numbers of carcasses were found, North American populations are in the tens to hundreds of millions of individuals, so it is highly unlikely that the fatalities at the Project site will result in declines of any species. In addition, several of the species that were found dead at Shiloh II are harvested in the thousands to tens of thousands (and more than a million birds for Mourning Doves), reinforcing our argument that the fatalities are not biologically significant.

1.0 INTRODUCTION

The Collinsville-Montezuma Hills Wind Resource Area (CMHWRA) consists of approximately 40,300 acres of area and existing wind plants including Shiloh II, occupy approximately 25,100 acres. The current Shiloh II project site encompasses approximately 7,800 acres of agricultural land in the Montezuma Hills. The project site is within the Collinsville Montezuma Hills Wind Resource Area (CMHWRA) and is adjacent to the upper sections of the 90 turbine High Winds, LLC project which became operational in 2003 as well as the northern section of the 100 turbine Shiloh I project. The wind turbines installed in the High Winds project are the Vestas V80 model capable of generating 1.8 megawatts. The Shiloh I project consists of 100 General Electric 1.5 MW wind turbines. The Shiloh II project consists of 75 Repower 2 MW turbines capable of producing 150 megawatts. The hub height of thirty-three (33) turbines is 68.5 meters and the rotor diameter is 94 meters (308 feet). A total height for these turbines would be approximately 115 meters (377 feet) above ground level (AGL) when the tip of the blade is in the 12 o'clock position. When the tip of the blade is in the 6 o'clock position, it is 21 meters (70 feet) AGL. Forty-two (42) of the turbines are mounted on 78 meter towers. The hub height is 256 feet, using the same diameter, the total height would be approximately 125 meters (410 feet) above ground level (AGL) when the rotors are in the 12 o'clock position and when the tip of the blade is in the 6 o'clock position, it is 31 meters (102 feet) AGL.

The landscape consists of rolling hills with elevations ranging between near sea level adjacent to the Sacramento River to about 250 - 300 feet (61-91 m) in elevation above sea level. Moving from southeast to northwest, the terrain becomes more uniform with less elevation differential between the ridges and the valleys. Turbines are placed on the highest ground and do not run through low-lying valleys. The northern boundary of the WRA for the present is California State Highway 12. The southern boundary is the Sacramento River Deep Water Ship Channel, which is about 3 miles to the south and east of the southernmost location where turbines are located. Most turbines are more than 4 miles from this waterway. On the west is the Suisun Marsh. The Suisun Marsh is a minimum of 2 miles from where the nearest turbine is located, with most turbines being located more than 2 miles from these wetlands.

The project is dissected by several roads, including: Little Honker Bay Road, Birds Landing Road, Olsen Road, Currie Road, Anderson Road, Emigh Road and Montezuma Hills Road. These roads are bounded by narrow weedy (mostly grasses) strips and a few homesteads complete with houses, yards, barns, driveways, and other structures necessary for farming. The land is privately owned and is largely agricultural. Where turbines and project roads are located the land use is rotating agricultural crops and grazed pastures. Crops include: wheat, barley, hay, and fallow fields. A multi-year rotation is the norm with crop, fallow, grazing and tilling, alternating being the regime used most often. There are some isolated wetlands (mostly cattail marsh).

Treed areas within the project are limited to the areas close to homes (occupied and abandoned) and in a few valleys. No trees were removed to construct the project. Many of the trees are non-native eucalyptus, olive, and other species, although some native oaks and junipers are present near homes. These treed habitats provide havens and nesting substrate for birds that do not use farmland and other birds that forage in agricultural fields.

2.0 METHODS

2.1 Clean Sweep Surveys

Prior to the start of the carcass surveys, a "clean sweep" was conducted at all newly installed and operational wind turbine towers to remove all carcasses and remains of carcasses from the survey area. Clean sweeps were conducted using the same protocol as used in the standardized carcass surveys (see below). The thoroughness of the sweep was adopted to increase the likelihood that all carcasses found during the subsequent surveys would be associated with incidents that occurred during the course of the systematic surveys, and remove the possibility that scavengers or wind could relocate remains between towers. The clean sweep for the 25 towers surveyed during the first year was executed on April 21, 22, and 23 of 2009. A clean sweep was conducted at Tower C2 on August 7, 2009, a tower added to the study to replace a tower (C1) which was unable to be surveyed due to the application of bio-solids. Standardized surveys of the 25 towers started four days following the clean sweeps, on April 27, 2006, and at C2 on August 14, 2009.

2.2 Standardized Surveys

During the first year of this on-going three-year project, carcass surveys were conducted approximately once per week at the same twenty-five wind turbine towers between April 27, 2009 and April 24, 2010, for a total of approximately 52 total rounds (Figure 1). There are 75 wind turbine towers within the Shiloh II wind project area. During the three-year survey, a different set of 25 towers will be surveyed to determine if there are any fatality "hotspots". Tower selection occurred in a systematic fashion. The first turbine in the A string was selected. The next two turbines in the string were eliminated, and the fourth turbine was selected. This procedure was repeated for the entire 75 towers. Thus, every 3rd turbine was selected. In subsequent years, the same procedure is being used. However, the selection process was offset by one turbine, i.e., the second turbine in the 'A' string was selected, the next two turbines were skipped, and the 5th turbine in the string was selected, etc. In the final year, the same procedure will start with the selection of the 3rd turbine in the 'A' string. Some sites which underwent biosolid application were eliminated from the selection process due to health concerns for the search technicians.

There are towers of two different heights in the project area: 68.5 meter and 78 meter towers. In the entire study region of 75 turbine towers, there are 42 -78 meter towers and 33 – 68.5 meter towers. Of these, an average of eleven 68.5m towers were surveyed per round (of 25 tower surveys), and fourteen 78m towers surveyed per round.

The first year of the survey consisted of searchers walking in concentric circles around the base of each tower, at distances of 5 meters apart between 5m and 30m, 10 meters apart between 30m and 100m, and also around the base of each tower (Figure 2).

While walking around each ring, the searcher using the unaided eye, alternately scans an area that extends for 5m in either side of his track, yielding a total of 105 meters scanned. The surveyors use range finders to initially establish and periodically check the distance of each circular route from the tower. Data recorded at the beginning of the surveys includes meteorological data (cloud cover, temperature, and wind velocity) and ground cover information (crop type and height). In addition, the start and finish times are recorded for each tower searched (see Appendix A). In order to avoid having the towers continually surveyed during the same time of day, each round started 3 towers beyond where the previous survey was started.

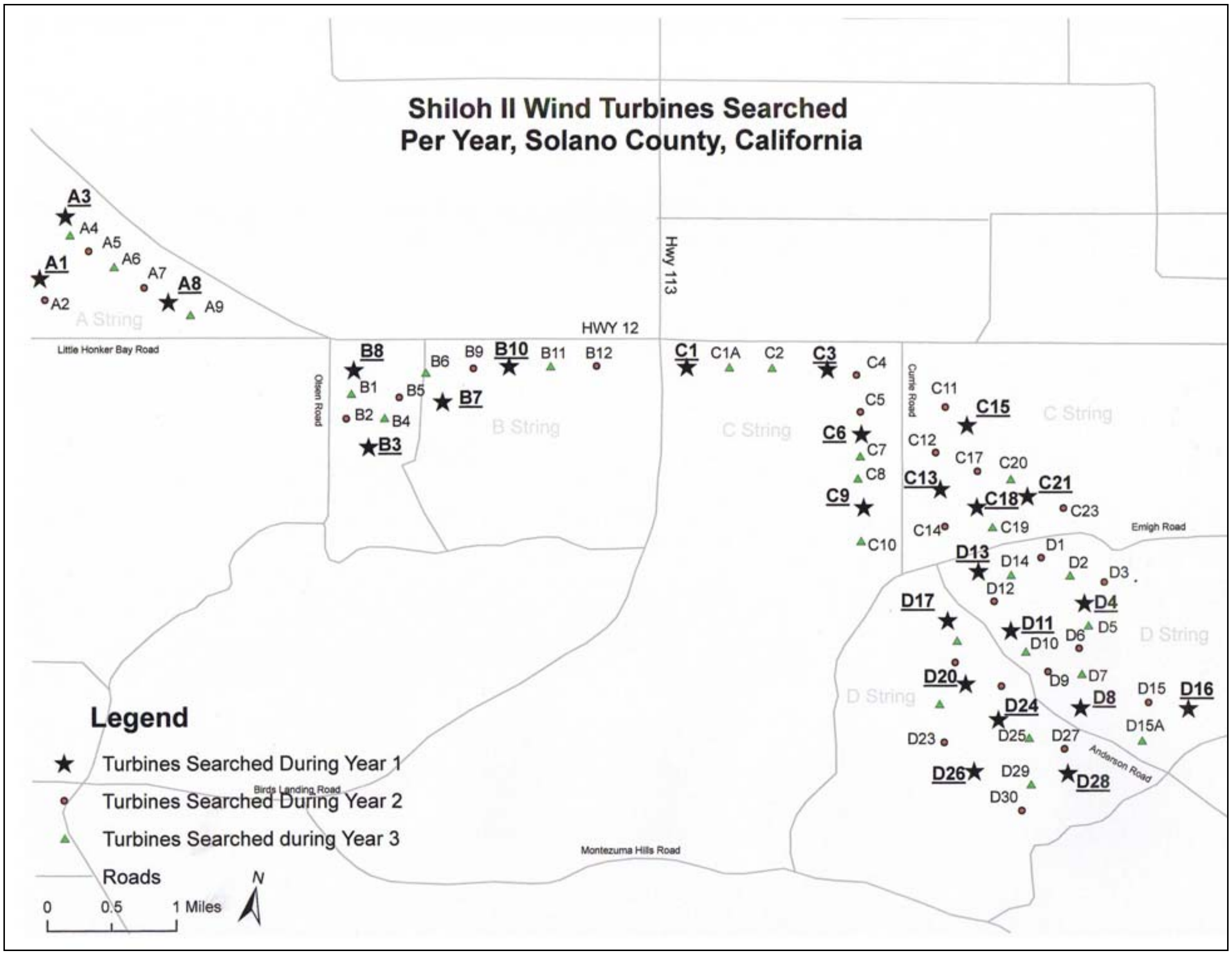


Figure 1. Locations of 75 wind turbine towers of the Shiloh II Wind Power Project.

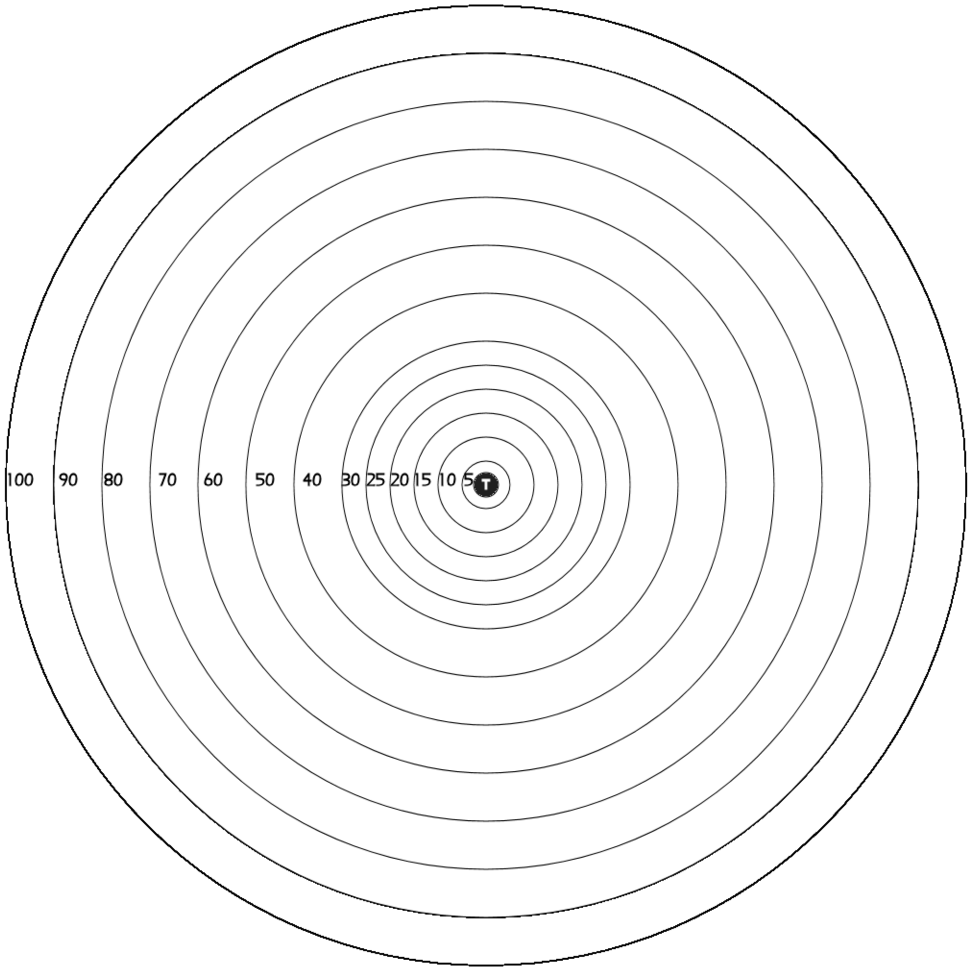


Figure 2. Search pattern for wind turbine tower carcass survey (distance in meters).

When a carcass or injured bird or bat is found, the searchers perform a thorough investigation and documentation of the incident using the protocols listed in the Wildlife Response and Reporting System (WRRS). An incident report number is assigned and an incident report form filled out for each find (Appendix B). A GPS is used to determine geographic coordinates, and a range finder and compass are used to determine distance and bearing from the tower. The carcass is photographed in the position in which it is found (in situ) using a digital camera. After identifying the animal by species (including age and sex when possible), an examination is performed to determine the nature and extent of any injuries, and whether any scavenging or insect infestation has occurred. The time since death is estimated and recorded. In case of dismemberment, the surveyors search the vicinity to locate all body parts. Loose feathers are only considered fatalities if enough feathers are found to represent a dead bird. All loose feathers are collected in order to avoid identifying the feathers as an additional kill during the next survey of the tower. The carcass is then placed in a plastic bag labeled with date, species, tower number, and incident report number, and taken to a freezer to be stored in accordance with the FWS permit requirements. When carcasses are found at times and locations outside of one of the standardized surveys conducted as part of this study, such as during avian surveys or while driving between sites, the carcass is processed as above but it is classified as an “incidental” find.

When an injured animal is found, the searchers record the same data collected for a carcass (noting however, that it is an injury and not a fatality). The searchers then capture and restrain the animal in a manner to avoid either further injury to the animal or injury to the survey crew. Once the animal is secured it is transported to a wildlife rehabilitator or veterinarian. The hospital accession number and the final disposition of the animal are recorded on the report form.

Only in those cases where the injury to the animal can be linked to a specific tower is a tower number recorded as the location in the report. When no corroborating information that the injury is linked to a tower is available, the animal is simply recorded as having been found “ON SITE”. For instance, if a bird is found injured with a broken wing but is still mobile, it would not be associated with a specific wind turbine tower because it could have moved.

2.3 Searcher Efficiency and Scavenger Removal

It is recognized that the number of carcasses found under the towers is lower than the total number of birds and bats likely to have been killed. There are at least three factors that need to be accounted for. The first is the possibility that the searchers will miss carcasses due to the amount of ground cover or the size and coloration of the species making it difficult to spot them. A second possibility is that the carcasses are removed prior to the time the searchers arrive on location after the collision event occurred. Finally, the estimate of incidents must be adjusted by the ratio of the number of towers searched to the number of operational towers in the wind project area. Applying these correction factors to the actual number of carcasses found during standardized surveys reduces underestimation of mortality due to these factors. Four seasonal scavenger removal and searcher efficiency studies were conducted in 2009 and 2010 to estimate the proportion of carcasses missed by the searchers and the proportion removed by scavengers within 7-day search cycles.

We made the following adjustments to extrapolate the mortality counts to estimated mortality for the entire Shiloh II Project Area (the Project). We adjusted the number of incidents found (*C*), previously corrected for Scavenger efficiency (*Sc*), Search efficiency (*Se*) and Proportion of towers searched to the total of 75 operational towers in the Project (*Ps*).

a) Proportion of test carcasses left by scavengers within the search period (*Sc*).
   Scavenger efficiency (*Sc*) was measured in Sep-09, Jan-10, April-10 and March-10, by placing 9 small bird carcasses (European Starling size), 11 medium-large bird carcasses (Rock Pigeon – Turkey Vulture size), and 17 bat carcasses, on searched areas in the Shiloh II Project. We monitored carcasses daily for two weeks, for evidence of scavenging. The status of each carcass was reported as intact, scavenged or completely removed, and the extent of scavenging was described. The probability of a collision event is equally distributed over all days of the search cycle (7 days). Thus, the overall duration between carcass fall and discovery is approximately half the actual search cycle (3.5 days). For example, if a carcass was discovered at a 7-day search site, it had an equal probability of having hit the tower on each of the previous 7 nights. The average time between impact and discovery is (1 + 2 + 3 + 4 + 5 + 6)/6 = 3.5 days (rounded to 4 days). Thus, the scavenge rate was calculated for the number of test carcasses that remained visible (body of carcass removed/severely scavenged) after 4 days. We designed and executed scavenge tests to

encompass all vegetation types and heights, so as to accurately replicate actual search conditions on the ground. Tests were also performed across different seasons, and occurred at most of the searched towers. Finally, carcasses were located at random distances and directions from the individual tower bases to further encompass all likely locations where searchers were likely to encounter actual collision fatalities.

b) Proportion of carcasses not missed by observers in the search efficiency trials (*Se*). Search efficiency trials were conducted for each observer by having an independent technician place carcasses (total 9 small birds, 10 medium-large birds, and 15 bats) under towers in the Project, without the knowledge of the searcher. The search efficiency trials were a subset of the scavenge trials, involving the use of the same carcasses. The searchers recorded all carcasses that they discovered during standardized surveys, including carcasses planted by the independent wildlife technician. Planted evidence of collisions was later removed from the database and a mean search efficiency rate (*Se*) was calculated. Searchers remained unaware of *Se* test carcasses if they did not find them during the initial search. There was a possibility of a carcass being found in a subsequent search, if it had not been scavenged before then. Prior experience at other wind projects showed that a proportion of carcasses found had obviously been on the ground for more than one search cycle (i.e. had been missed in the initial search, only to be found in the next search). Our new methodology allowed for this possibility. For example, if searchers found 5 out of 10 carcasses during the first search round, and then only 2 out of the remaining 5 carcasses during the subsequent search round, *Se* would be (5+2)/10 = 0.70.

c) Proportion of towers searched to the total of 75 operational towers in the windfarm (*Ps*). *Ps* for the 25 7-day sites was 25:75.

Thus, $\hat{C} = \dfrac{C}{Sc \times Se \times Ps}$

Where $\hat{C}$ = Adjusted total number of kills estimated in the project area.

The variance of the number of kills found was first calculated per tower using standard methods. Then, we calculated the variance due to the correction factors *Sc* and Se, using the variance of a product formula (Goodman, 1960). The variance of the product of Sc, Se, and Ps is:

$$\mathrm{Var}(\hat{C}) = \left(\frac{1}{P}\right)^2 \times \hat{C}^2 \times \left[\frac{\mathrm{var\ C}}{\mathrm{C}^2} + \frac{\mathrm{var}(Sc \times Se)}{(Sc \times Se)^2}\right]$$

2.4 Prey Observations

Potential prey species for raptors, such as rodents, rabbits, other larger mammals, reptiles and amphibians, were recorded when seen. These observations were generally made during standardized wind turbine carcass surveys. Data collected for each observation included species name, the number of individuals seen, their approximate location, and the survey tower number.

2.5 Vegetative Cover

Ground cover data was recorded at the beginning of the standardized surveys. Data recorded included vegetation/crop type and height. Vegetation types included: crop (wheat, hay, oat, rye, safflower) fallow, pasture and tilled soil. Vegetation height was classified as short (<6"), medium (6"-12"), or tall (>12").

3.0 RESULTS

3.1 Clean Sweep Surveys

For the first year of this three-year survey, a total of 1 round of 25 clean sweep surveys were conducted April 21st through the 23rd of 2009, totaling 25 tower surveys (25 tower searches being the standard unit of tower searches per round) which comprised 1/3 of the project area's 75 wind turbine towers. The application of "bio-solids" surrounding C1 prevented surveys after June 15th, 2009. Carcasses found included: 1 Horned Lark, 1 Warbling Vireo, and 2 Hoary Bats. At the single tower added in August of 2009 (C2), no carcasses were found. One Red-tailed Hawk was found incidentally (not during clean sweep surveys), during construction before surveys had commenced.

3.2 Standardized Surveys

3.2.1 Summary of Search Effort

A total of 52 complete rounds of standardized searches were conducted between April 27, 2009 and April 24, 2010 (Table 1) on 192 days (53% of the days of the 12 month period), for a total of 1293 complete individual turbine searches. Tower C1 could not be surveyed beyond June 15, 2009 (the date of the last survey at this tower) due to the application of bio-solids/manure. Bio-solids refer to sewage treatment plant solid waste used as a fertilizer. The surrounding area of C1 and the adjacent tower were not deemed to be safe to survey until 60 days post-application. Surveys at Tower C2 commenced on August 14th. The details of the rounds and dates towers were surveyed is shown in Table 1. The average number of wind turbine towers surveyed during the first year of this project was 24.9. For the purposes of our analyses and discussion, we have rounded this number up to 25 wind turbine towers. The average number of days between successive searches for each tower was 7.0 days (Standard Deviation = 1.69).

Table 1. Summary of rounds of fatality searches during year one of Shiloh II carcass surveys at wind turbine towers: clean sweeps and standardized surveys.

Year	Round No.	Dates Surveyed
Clean Sweep of 25 Wind Turbine Towers		
2009	Clean Sweep	April 21, 22, 23
Carcass Surveys of 25 Wind Turbine Towers		
2009	Round 1	April 27, 28, 29, 30, May 1
	Round 2	May 4, 5, 6, 7, 8
	Round 3	May 11, 12, 13, 14, 15
	Round 4	May 18, 19, 20
	Round 5	May 26, 27, 29, 30
	Round 6	June 1, 2, 3, 5, 6
	Round 7	June 9, 10, 11
	Round 8*	June 15, 16, 17, 18 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 9*	June 22, 23, 24 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 10*	June 30, July 1, 2 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 11*	July 6, 7, 8 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 12*	July 13, 14, 16 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 13*	July 20, 21, 22 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 14*	July 27, 28, 29, 30 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 15*	August 3, 4, 7 *(24 towers surveyed June 15 to August 13, 2009)*
Clean Sweep of 1 Wind Turbine Tower (C2)		
2009	Clean Sweep	August 7
Carcass Surveys of 25 Wind Turbine Towers		
2009	Round 16*	August 11, 12, 13, 14 *(24 towers surveyed June 15 to August 13, 2009)*
	Round 17	August 18, 20, 21
	Round 18	August 26, 27, 28
	Round 19	August 31, September 2, 4
	Round 20	September 7, 8, 9, 10, 12
	Round 21	September 14, 16, 18
	Round 22	September 23, 24, 25
	Round 23	September 28, 30, October 1, 2
	Round 24	October 5, 7, 9
	Round 25	October 12, 15, 16, 17
	Round 26	October 19, 21, 23
	Round 27	October 26, 28, 30
	Round 28	November 3, 4, 5, 6
	Round 29	November 11, 12, 13, 14
	Round 30	November 16, 17, 19
	Round 31	November 23, 25, 27
	Round 32	November 30, December 2, 4
	Round 33	December 7, 8, 9, 10
	Round 34	December 14, 17, 18, 19
	Round 35	December 21, 22, 23, 24

Year	Round No.	Dates Surveyed
	Round 36	December 28, 29, 30
2010	Round 37	January 4, 5, 7, 8
	Round 38	January 11, 13, 14, 15
	Round 39	January 19, 20, 21, 22, 23
	Round 40	January 26, 28, 29
2010	Round 41	February 2, 3, 4, 5
	Round 42	February 9, 10, 11, 12
	Round 43	February 16, 18, 19
	Round 44	February 22, 23, 24, 25
	Round 45	March 1, 3, 4, 6
	Round 46	March 8, 10, 11, 12, 13
	Round 47	March 15, 16, 17, 19
	Round 48	March 22, 23, 24, 25
	Round 49	March 29, 30, 31, April 1
	Round 50	April 6, 7, 8
	Round 51	April 14, 15, 16
	Round 52	April 19, 21, 22, 23, 24

Survey Summary		YEAR ONE
Standardized Surveys	Total # Field Days	192
	Total # of Rounds	52
	Average # of Towers Surveyed / Round	24.9
	Total # of Individual Surveys	1293
	Total # Searcher-Hours in Field	1428.8
	Average # Searcher-Hours / Survey	1.1
	Average # Searcher-Minutes / Survey	66.3
Clean Sweep Surveys	Total # Field Days	4
	Total # of Towers Surveyed	26
	Total # of Individual Surveys	26
	Total # Searcher-Hours in Field	29.7
	Average # Searcher-Hours per Survey	1.19
	Average # Searcher-Minutes per Survey	71.4

* Due to the application of bio-solids/manure at tower C1, no surveys were conducted at C1 or adjacent tower C2, between June 15 and August 13, 2009, at which point it was determined safe to begin surveying the area surrounding C2. Therefore 24 towers were searched between these dates.

3.2.2 Incident Species Composition and Unadjusted Fatality Rates

During the first year of this study, a grand total of 80 incidents were recorded. Of 80 wind turbine related incidents, 76 incidents were found during standardized surveys. An additional 4 were found in between surveys, or “incidentally” and classified as “incidental” finds (Table 2; Appendix D and E).

Table 2. Unadjusted number of incidents per species during year one of surveys per total installed megawatt capacity* per year, and per turbine per year, at the Shiloh II Project Area, April 2009 – April 2010, found during standardized surveys.

Species Name	Total	# Incidents per Mw/Year	# Incidents per Turbine/Year	Incidental**
***Birds* (n=44)**				
American Kestrel	1	0.020	0.040	1
Black Rail***	2	0.040	0.080	
Brewer's Blackbird	2	0.040	0.080	
Dunlin	1	0.020	0.040	
European Starling	2	0.040	0.080	
Horned Lark	3	0.060	0.120	
Long-billed Curlew	1	0.020	0.040	
Mallard	3	0.060	0.120	1
Mourning Dove	3	0.060	0.120	
Red-tailed Hawk	3	0.060	0.120	
Red-winged Blackbird	5	0.100	0.200	
Rock Pigeon	1	0.020	0.040	
Sora	1	0.020	0.040	
Tree Swallow	1	0.020	0.040	
Varied Thrush	1	0.020	0.040	
Western Flycatcher	1	0.020	0.040	
Western Meadowlark	8	0.160	0.320	1
Western Tanager	1	0.020	0.040	
Wilson’s Warbler	1	0.020	0.040	
Yellow Warbler****	1	0.020	0.040	
Unidentified Grebe species	1	0.020	0.040	
Unidentified Blackbird species	1	0.020	0.040	
Subtotal Bird Species	*44*	*0.880*	*1.760*	
***Bats* (n=32)**				
Hoary Bat	8	0.160	0.320	
Mexican Free-tailed Bat	21	0.420	0.840	1
Western Red Bat	3	0.060	0.120	
Subtotal Bat Species	*32*	*0.640*	*1.280*	
Total	**76**	**1.520**	**3.040**	**4**

* A total installed megawatt capacity of 50.0 MW was calculated by multiplying individual turbine MW of 2.0 by the number of wind turbine towers surveyed per round (25)
** Number of individuals found incidentally and not during standardized surveys. NOT included in the Total for that species
*** Denotes California State Threatened Species
**** Denotes California Species of Special Concern (CSC)

A total of 44 wind turbine-related avian incidents were recorded by searchers during standardized surveys, representing 19 species and 2 unidentified birds (1 of these was a blackbird, and 1 was an unidentifiable grebe; Table 2). Of the 19 avian species, 2 were raptor species including American Kestrel (1), and Red-tailed Hawk (3), comprising a total of 4 raptor incidents found during the one year study period. The greatest numbers of carcasses found were songbirds; this group comprised 27 incidents identified to 11 different species plus an unidentified blackbird. There were a total of 3 waterfowl incidents, all Mallards. Water bird species comprised 6 incidents, including 2 Black Rails, 1 Sora, 1 Dunlin, 1 Long-billed Curlew, and 1 unidentified grebe species. Other avian species included 3 Mourning Doves, and 1 Rock Pigeon (Tables 2 and 3), comprising 2 species involved in 4 incidents. Thirty-two (32) bat carcasses were found by searchers, representing 3 different species including Hoary Bat (8), Mexican Free-tailed Bat (21), and Western Red Bat (3). All of the incidents found during the one year study during standardized surveys were fatalities (none were injured birds or bats).

The unadjusted number of wind turbine related incidents found per total installed megawatt capacity per year was calculated to provide a comparable metric between different wind power projects. The individual wind turbine MW of 2.0 was multiplied by the number of wind turbine towers (25) searched during the course of this one year study to yield a total installed megawatt capacity of 50.0 MW for turbines being searched. Another unit for comparison purposes, the number of incidents per turbine tower per year, was also calculated (Table 2). The highest fatality rates occurred in the Mexican Free-tailed Bat and Hoary Bat, followed by Western Meadowlark and Red-winged Blackbird. About 1.8 birds and 1.3 bats per tower per year were found at wind turbine towers during the first year of this project.

The number of wind turbine related incidents found per total installed megawatt capacity per year, and per turbine per year was calculated for each species grouping (Table 3). The greatest unadjusted rate of fatality occurred in bats (1.28 incidents/turbine/year, 0.64 incidents/Mw/year) followed by passerines (1.08 incidents/turbine/year, 0.54 incidents/Mw/year) and water birds (0.24 incidents/turbine/year, 0.12 incidents/Mw/year).

Table 3. Unadjusted number of incidents per species group during year one of surveys per total installed megawatt capacity* per year, and per turbine per year, at the Shiloh II Project Area, April 2009 – April 2010, found during standardized surveys.

Species Group	Total	# Incidents per Mw/Year	# Incidents per Turbine/Year
Bird Species			
Raptor	4	0.080	0.160
Passerine	27	0.540	1.080
Waterfowl	3	0.060	0.120
Water Bird	6	0.120	0.240
Other Bird	4	0.080	0.160
Subtotal Bird Species	**44**	**0.880**	**1.760**
Bat species	**32**	**0.640**	**1.280**
Grand Total	**76**	**1.520**	**3.040**

* A total installed megawatt capacity of 50.0 MW was calculated by multiplying individual turbine MW of 2.0 by the number of wind turbine towers surveyed per round

For purpose of our analyses, "raptors" included all eagles, hawks, kites, falcons, harriers, and owls (predatory birds). Non-protected non-native species including Rock Pigeon and European Starling were included in analyses, fatality maps and data tables.

Two California Black Rails, a State Threatened species, were found in year one. These birds were found at Towers D17 (July 2009) and A3 (August 2009). No Federally threatened or endangered species were found. There was also one incident of a California Species of Special Concern, the Yellow Warbler.

3.2.3 Seasonal Distribution of Incidents

The number of wind turbine associated incidents found during standardized surveys was calculated per month for each species grouping.

The greatest number of bird incidents occurred during the month of January of 2009, with a total of 7 (17% of the total) incidents in that month alone, 5 (71%) of them passerine species (Table 4 and Figure 3). Two raptor incidents found during year one (~50% of that year's total) were found in November during the fall migration, while the other two raptor incidents were found in July. Waterfowl and water bird incidents were sporadically distributed throughout the year, with 75% of incidents found in spring and summer. Three out of 4 of all "other" bird incidents (~75%) were recorded in winter (January to February).

The great majority of bat incidents occurred during the fall migration months, with 29 out of 32 bat carcasses were recorded between September and November of 2009, representing ~91% of bats found during the one year study period.

Table 4. Number of wind turbine related incidents per species grouping per month.*

Estimated Month of Death	Raptor	Passerine	Waterfowl	WaterBird	Other	*Total Birds*	*Bat*	Grand Total
Apr-09							1	1
May-09		3		1		4	1	5
Jun-09		1	1			2		2
Jul-09	2	1		2	1	6		6
Aug-09			1	1		2	1	3
Sep-09		3				3	11	14
Oct-09				1		1	13	14
Nov-09	2	3				5	5	10
Dec-09		2		1		3		3
Jan-10		5			2	7		7
Feb-10		1			1	2		2
Mar-10		3				3		3
Apr-10		3				3		3
Grand Total	**4**	**25**	**2**	**6**	**4**	**41**	**32**	**73**

*Estimated month of death was calculated by subtracting an estimated number of days since death from the report date. These numbers include incidents with known estimated month of death, found during standardized surveys only.

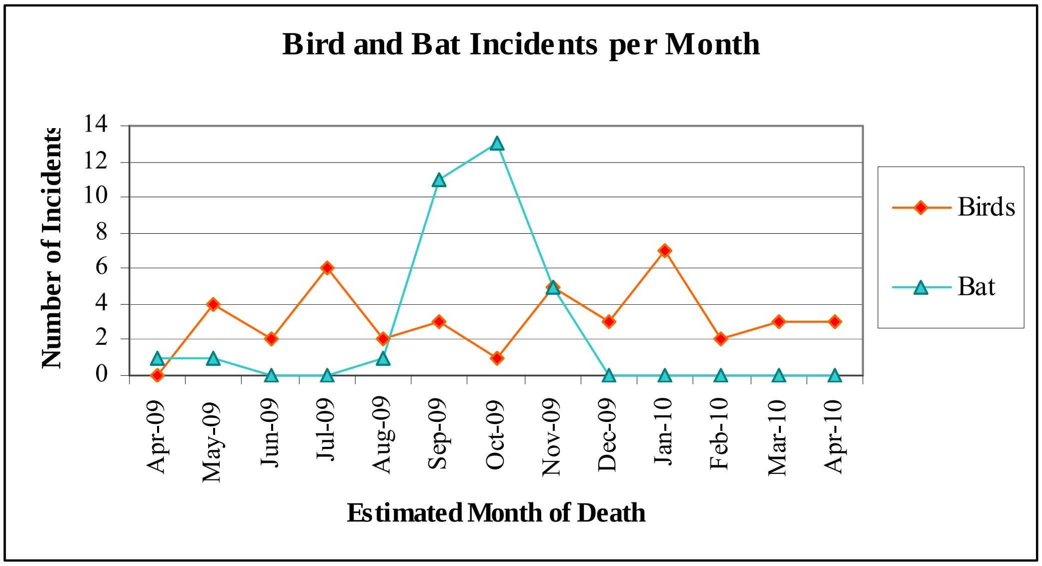


Figure 3. Number of wind turbine related incidents (birds and bats) per month, from April 2009-April 2010.*

*Estimated month of death was calculated by subtracting an estimated number of days since death from the report date. These numbers include incidents with known estimated month of death, found during standardized surveys only.

3.2.4 Age Classes of Raptors

Seventy-five percent of raptor incidents were adults (Table 5). The single American Kestrel incident was an adult, and of 3 Red-tailed Hawk incidents, 2 were adults, 1 was a first year bird.

Table 5. Age classes of raptor wind turbine tower related incidents.

Species	Adult	First Year	Total
American Kestrel	1		1
Red-tailed Hawk	2	1	3
Total	**3**	**1**	**4**

3.2.5 Spatial Distribution of Incidents

To determine if there are a statistically greater number of incidents occurring in one area than another, we divided the wind project area into two areas for spatial distribution analyses. These two areas are defined as follows: 1) north and west of Emigh Road, which encompasses 44 wind turbine towers (rows A, B, and C), hereafter referred to as “the West”; and 2) south of Emigh Road, with 31 wind turbine towers (rows D), referred to as “the East”. During year one of this survey, an average of 15 towers were surveyed in the west during each round, while 10 were surveyed in the east. The western areas consist of grazed pasture and fallow, and are generally flatter than the area to the east. The east consists of steeper hills, and is used primarily for agriculture (wheat/crops), though also contains areas of grazed fallow and pasture.

If the incidents are randomly spread throughout the area, with no difference between the east and the west, the number of incidents would be proportionate to the number of wind turbines surveyed in each of these areas. There were 15 wind turbines surveyed northwest of Emigh Road ("west") and 10 towers surveyed south of Emigh Road ("east"). Therefore the number of incidents would be expected to reflect a 1.5 to 1 ratio (15 to 10) in these two regions if there is no difference between the west and east regions.

3.2.5.1 Raptors

The four raptor incidents found during the first year of this study were distributed widely throughout the project area, with one incident found per turbine string (at towers A8, B3, C3 and D16), and 3 incidents in the west and 1 in the east (Table 6 and Figure 4). Raptor incident numbers were too low at this time however to conduct statistical tests to discern if there were any evident patterns of fatality between regions.

Table 6. Comparison of raptor incident distribution to wind turbine tower distribution.*

	Number			Ratio	
	East (D Towers)	West (A, B & C Towers)	Total	East	West
Number of Turbines	10	15	25	1	1.5
Incidents					
American Kestrel	0	1	1	0	1
Red-tailed Hawk	1	2	3	1	2
Total Raptors	**1**	**3**	**4**	**1**	**3**

*Project area divided into two regions, West and East, with all towers south of Emigh Road comprising the "East" and all those northwest of Emigh Road comprising the "West". Note: Includes data from standardized surveys only

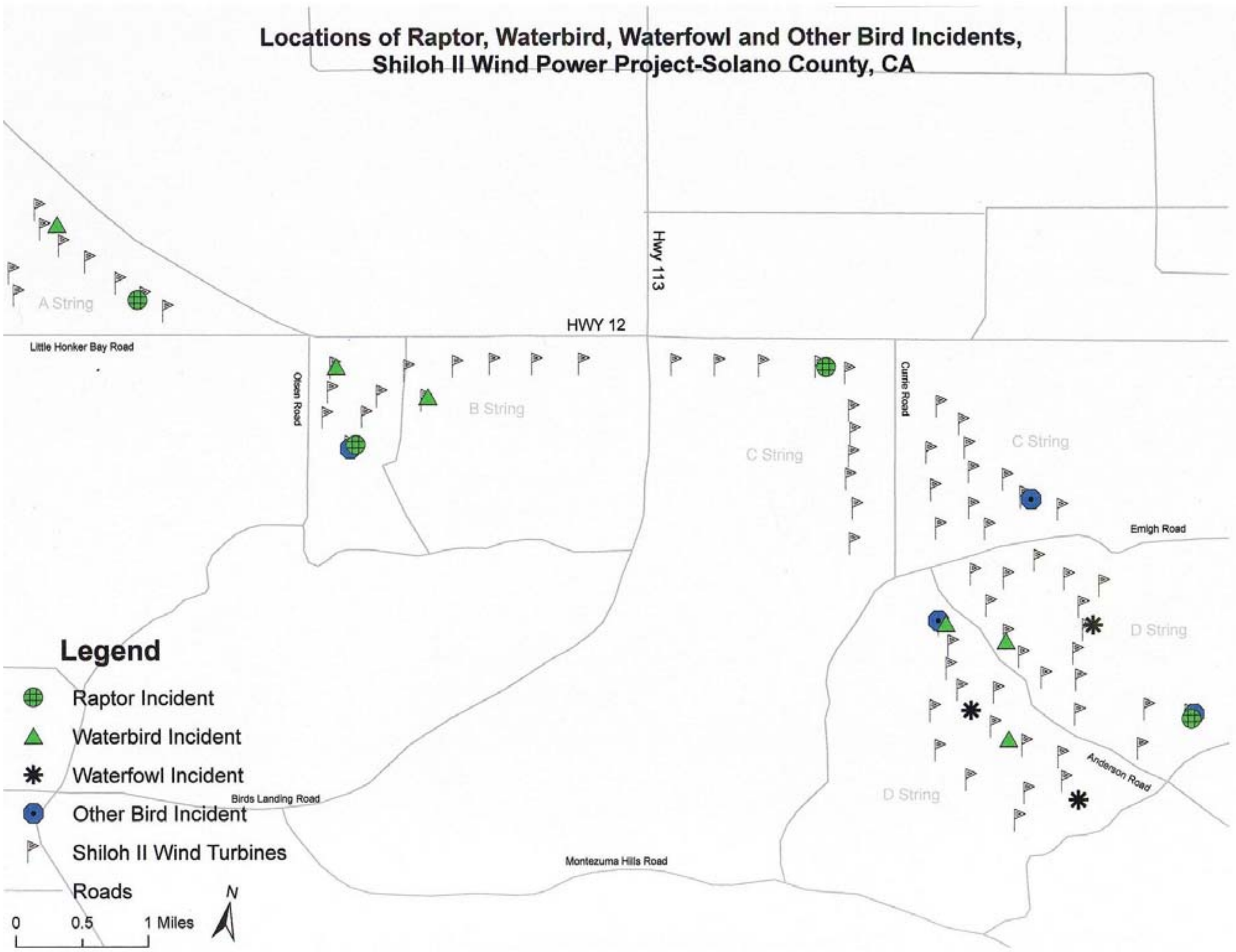


Figure 4. Locations of raptor, water bird, waterfowl and other bird incidents (found during standardized surveys) in the Shiloh II Project Site, April 2009 through April 2010.

3.2.5.2 Non-Raptors

Incidents of non-raptor species appeared to not be evenly distributed throughout the project area (Figures 4 and 5) with slightly less than would be expected in the west based on the number of wind turbines located in that region. Passerine species accounted for the majority of incidents within this subgroup, with 1.5 times greater songbird fatalities in the west than the east (Table 7) as would be expected (Chi-square Test, $\chi^2 = 0.003$, df = 1, p = 0.96). The numbers of incidents of all other non-raptor, non-passerine avian species groups was too low to make any conclusions at this time. Preliminary results appear to show a cluster of water bird and waterfowl in the D grouping of towers (east), with 6 of 9 (67%) of these incidents occurring in this region. There are two stock ponds located in the D grouping of towers. One Southwest of D20 and another larger drainage/wetland area (with bulrushes/sedges) just East of D4/ D5/D6.

Table 7. Comparison of all non-raptor avian incident distribution (by species group) to wind turbine tower distribution.*

	Number			Ratio	
	East	West	Total	East	West
Number of Turbines	10	15	25	1	1.5
Incidents					
Passeriformes (songbird)	11	16	27	1	1.5
Waterfowl	3	0	3	3	0
Water Birds (rail, curlew, grebe)	3	3	6	1	1
Other (dove, rock pigeon)	2	2	4	1	1
Total Non-Raptor Avian Species	**19**	**21**	**40**	**1**	**1.1**

*Project area divided into two regions, West and East, with all towers south of Emigh Road comprising the "East" and all those northwest of Emigh Road comprising the "West". Note: Includes data from standardized surveys only

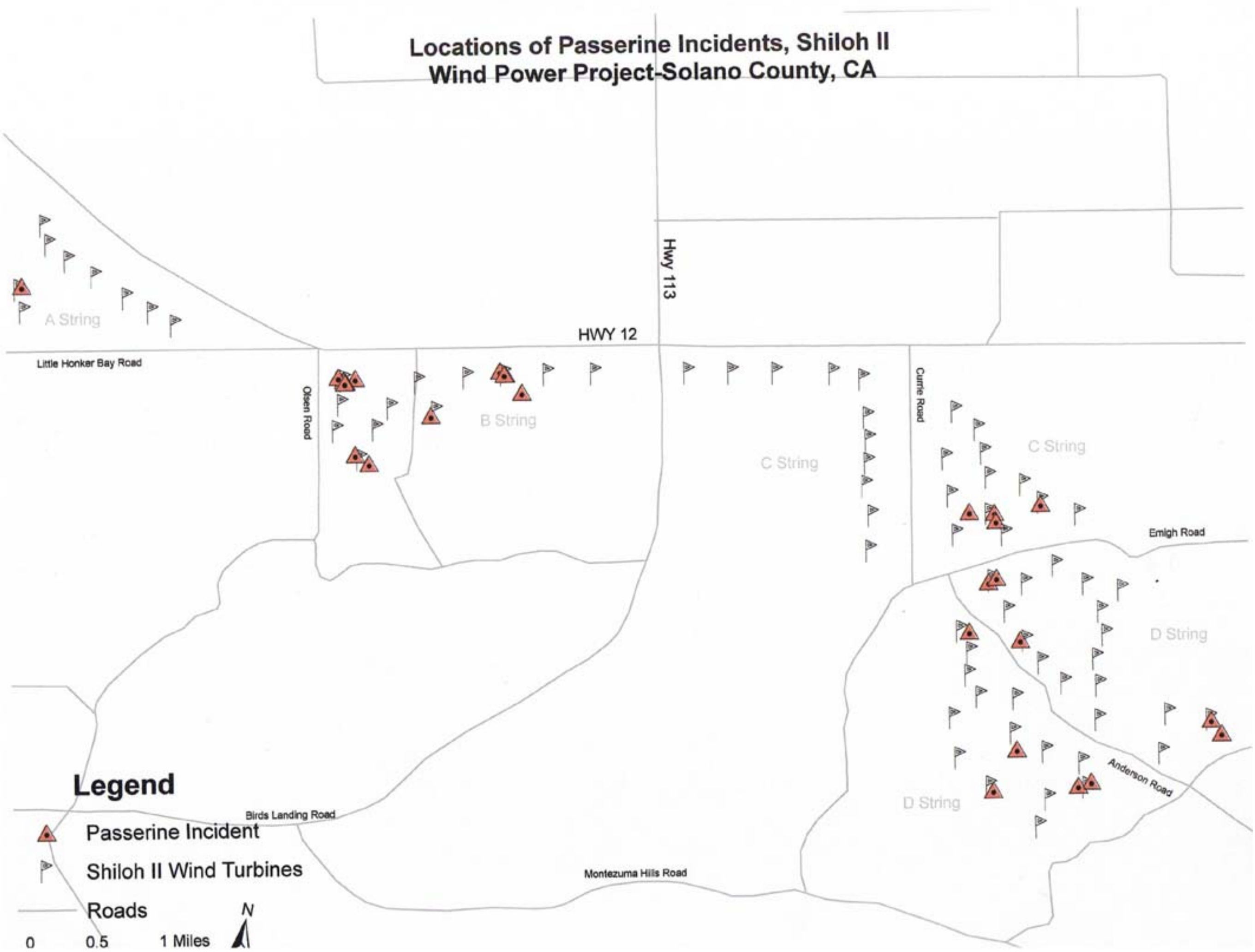


Figure 5. Locations of passerine avian incidents found during standardized surveys in the Shiloh II Project Site, April 2009 through April 2010.

3.2.5.3 Bats

Bat incidents were 2.6 times more numerous in the west than the east (Table 8). Pooling all species together, there was no evidence of a significant difference in fatality distribution (Chi-square test, $\chi^2 = 0.89$, df = 1, p = 0.35). Looking at species individually, the Mexican Free-tailed Bat incidents were concentrated in the west (2.5:1), but showed no evidence of a significant difference in fatality distribution (Chi-square test, Yates' $\chi^2 = 0.25$, df = 1, p = 0.62). The Hoary Bat incidents also showed no evidence of a significant difference in fatality distribution (Chi-square test, Yates' $\chi^2 = 0.08$, df = 1, p = 0.77). The number of incidents of the other bat species (Western Red Bat) was too low to draw conclusions after the first year of study (Table 8). Figure 6 provides a map of the locations of bat incidents (found during standardized surveys) in the Shiloh II Project Site, April 27, 2009 through April 24, 2010.

Table 8. Comparison of bat incident distribution to wind turbine tower distribution.*

	Number			Ratio	
	East	West	Total	East	West
Number of Turbines	10	15	25	1	1.5
Incidents					
Hoary Bat	3	5	8	1	1.7
Mexican Free-tailed Bat	6	15	21	1	2.5
Western Red Bat	0	3	3	0	3
Total Bat Species	**9**	**23**	**32**	**1**	**2.6**

*Project area divided into two regions, West and East, with all towers south of Emigh Road comprising the "East" and all those northwest of Emigh Road comprising the "West". Note: Includes data from standardized surveys only

3.2.6 Location in Turbine String

Previous studies at the Altamont Pass Wind Resource Area indicated that turbines at the ends of turbine strings may have been associated with higher collision fatalities. We examined the number of bird fatalities at each turbine, to determine whether these sites conformed with permit clauses that required relocation of high mortality turbines. We hypothesized that any such turbines unusually high fatalities may be associated with the ends of turbine strings. We plotted the distribution of the number of bird incidents per turbine using JMP ® 7.0.1 statistical software (© 2007 SAS Institute Inc.), to determine the presence of outliers in the data. There was one outlier turbine, B8, (where the number of bird incidents exceeded the boundaries defined as [upper quartile + 1.5*(interquartile range)]. Turbine B8 was at the end of a turbine string.

Similar to birds, we plotted the distribution of the number of bat incidents per turbine using JMP ® 7.0.1 statistical software (© 2007 SAS Institute Inc.), to determine the presence of outliers in the data. There were no outlier turbines.

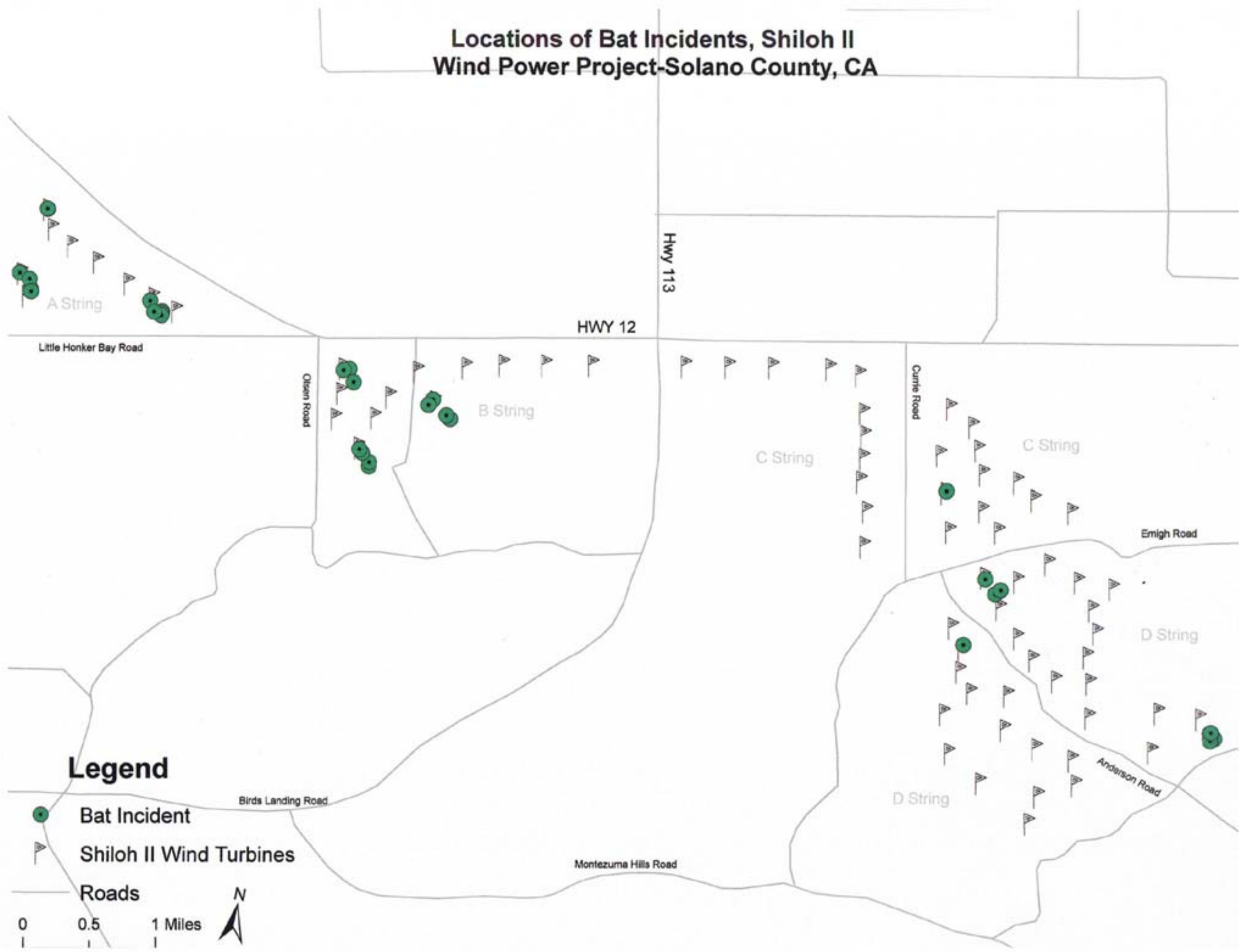


Figure 6. Locations of bat incidents found during standardized surveys in the Shiloh II Project Site, April 2009 through April 2010.

3.2.7 Distance from Turbine Bases

Species were divided into size groupings (Table 9) to determine the general distribution of distances of incidents from wind turbine towers, and also if surveying a 105 meter radius area is an effective method for finding the majority of carcasses.

Table 9. Species size groupings used in analyses.

Category	Description
Small Bird	≤ 8" length (most smaller passerines)
Medium Bird	8" < X ≤ 14" length (kestrels, flickers, starlings, blackbirds, doves)
Large Bird	> 14" length (most raptors, coots, ducks, pheasants)
Bats	All small size

The number of incidents of species (found during standardized surveys only) falling into each size grouping were then tabulated based on distance (range) from the wind turbine tower (Table 10).

Fifty-four percent of all 76 bird and bat incidents were located within 50 meters of a wind turbine, 66% were within 60 meters, 76% were within 70 meters, 87% within 80 meters, 93% within 90 meters, and 99% were within 100 meters (Table 10).

Table 10. Number of incidents per size grouping versus distance from wind turbine tower (Shiloh II).

Distance	# Incidents			Ring Area	Fall Density		
Range	Small & Medium	Large	Bats	(m^2)	Small & Medium	Large	Bats
0-5	2		1	78.6	0.02545	0	0.01273
6-10	1		2	235.7	0.00424	0	0.00848
11-15	2		4	392.9	0.00509	0	0.01018
16-20	1		4	550.0	0.00182	0	0.00727
21-25	2		4	707.1	0.00283	0	0.00566
26-30	2	1	2	864.3	0.00231	0.001157	0.00231
31-40	2		5	2200.0	0.00091	0	0.00227
41-50	2	2	2	2828.6	0.00071	0.000707	0.00071
51-60	3	3	3	3457.1	0.00087	0.000868	0.00087
61-70	4	2	2	4085.7	0.00098	0.00049	0.00049
71-80	7		1	4714.3	0.00148	0	0.00021
81-90	4		1	5342.9	0.00075	0	0.00019
91-100	4			5971.4	0.00067	0	0.00000
101-105			1	3221.4	0.00000	0	0.00031
	36	8	32	34650			

Avian carcasses of all size groups tended to be located somewhat evenly over a larger distance range than bat carcasses, which tended to be located closer to the towers. The average distance to the tower for bat incidents was ~35m, while the average distance to tower base for bird incidents was ~56m.

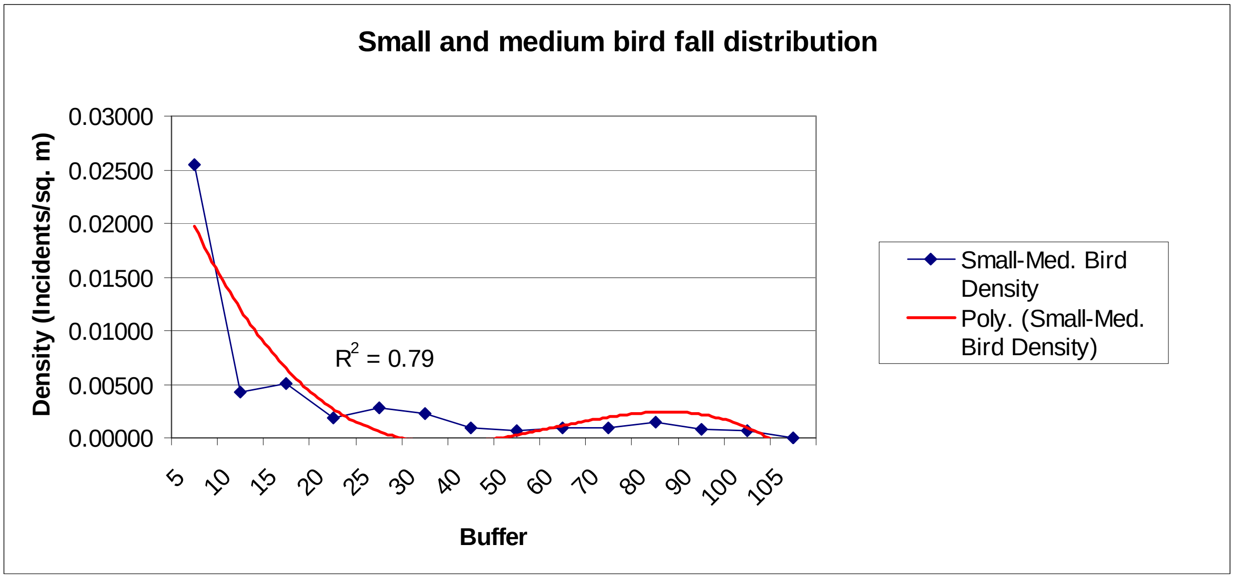
Scavengers may move carcasses, affecting carcass distance analyses. Our previous analysis of the location of birds found at projects using the newest turbine technology (Erickson, et al., 2001, Erickson, et al, 2003), and the Orloff and Flannery (1992) experience searching under older turbine technology supported the judgment that 90% of the carcasses would be located within a circle having a 65 meter radius therefore we expected a 75 meter radius to be sufficient for finding nearly 100% of all carcasses. Eighty percent of the incidents found at Shiloh II were within 75m of the tower base.

The number of incidents of species (found during standardized surveys only) falling into the size groups: Large birds; Small and Medium birds (combined); and, Bats (Table 9) were tabulated based on distance (range) from the base of wind turbines. We divided the number of incidents found within each annulus by the total area of that annulus to arrive at an incident density (Table 12). The reader is cautioned to keep in mind that, for results adjusted for search efficiency and scavenge rate, medium and large birds were pooled, whereas medium and small birds were pooled for the following analysis of distance to turbine base.

These densities were plotted (Figures 7 and 8) along with the best fitting trend line to approximate the distance at which density drops to zero, indicating no more incidents would be found at that distance. The R^2 (goodness-of-fit) value for the trend lines are shown (R^2= 1.0 indicates perfect fit – 100% of variance explained). The R^2 for Small and Medium birds was 0.79 and the R^2 for bat incidents was 0.82.

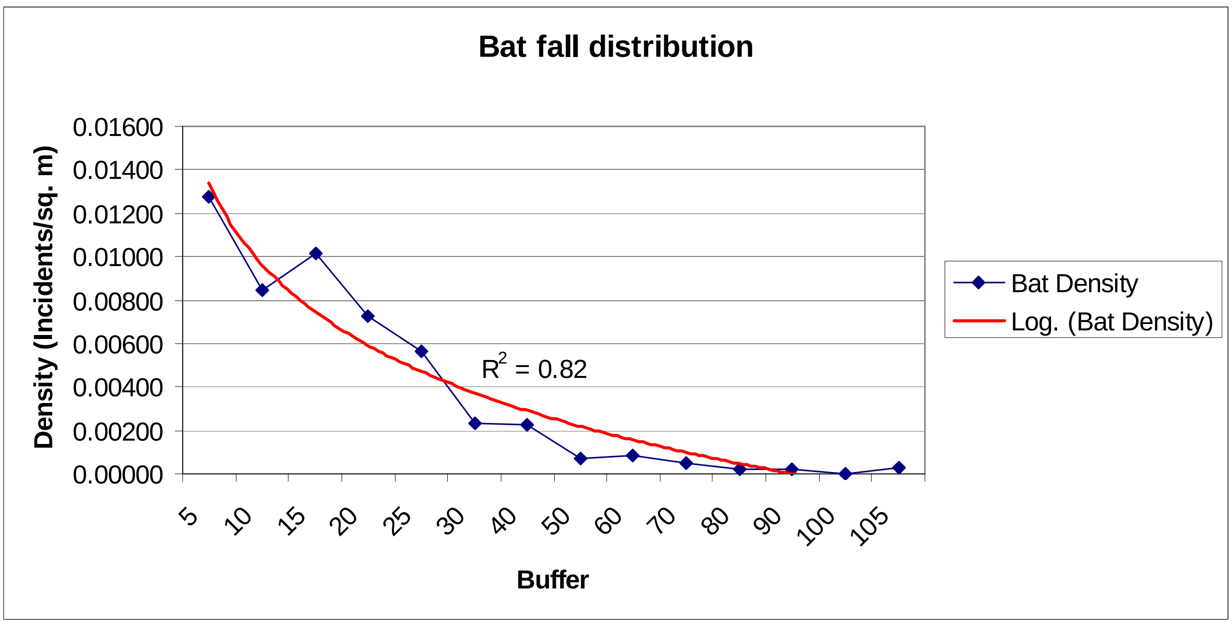
The trend-line derived from that data was in accordance with our expectation that bird incidents approximate zero at a point farther out than bat incidents. Densities of bat incidents were very low (approached zero) after ~55m from the turbine base and bird incidents approached zero at ~50m from the turbine base (Figures 8 and 9). However, bird incident density did not reach zero but remained low out until 105m. The current available data indicate that the current search area of 105m radius was more than adequate to detect most bird and bat collision fatalities. Nevertheless, it is possible that a negligible number of bat fatalities and, perhaps, a very small number of bird fatalities may have been overlooked.

Figure 7. Density of small and medium bird incidents at 7-Day sites in relation to distance from towers.



Note: Polynomial trend line approximates distance at which density crosses zero.

Figure 8. Density of Bat incidents at 7-Day sites in relation to distance from towers.



Note: Polynomial trend line approximates distance at which density crosses zero.

3.3 Tower Height and Incident Distribution

Analysis of incidents by species groups and tower height (68.5 meters versus 78 meters) showed no difference from what would be expected based on distribution of towers of each height surveyed (Table 11). With the exception of bats, all species groups (all avian) either did not have large enough numbers to detect trends, or were almost identical to what would be expected based on a random distribution. Over five times as many bats were found at 68.5 meters towers than at 78 meter towers, a difference which was found to be significant (Chi-square test, χ^2 = 10.30, df = 1, P = 0.0013, **s**).

Table 11. Comparison of incident distribution (by species group) to wind turbine tower height.

	Tower Height			Ratio	
	68.5m	**78m**	**Total**	**68.5m**	**78m**
Number of Turbines surveyed per round	11	14	25	1	1.3
Bird Species					
Raptor	4	0	4	4	0
Passerine	14	13	27	1.1	1
Waterfowl	0	3	3	0	3
Water Bird	3	3	6	1	1
Other Bird	2	2	4	1	1
Subtotal Bird Species	**23**	**21**	**44**	**1**	**1.1**
Bat Species	27	5	32	5.4	1
Subtotal Bat Species	**27**	**5**	**32**	**5.4**	**1**
Grand Total	**50**	**26**	**76**	**1.9**	**1**

3.4 Prey Observations

Potential prey species, such as rodents, rabbits, other larger mammals, reptiles and amphibians, were recorded incidentally when seen (Table 12). Observations recorded during the study period included 3 Black-tailed Jackrabbits, 1 Cottontail, 1 Alligator Lizard, 3 Gopher Snakes, and 3 Racers. Multiple California Ground Squirrel burrows were noted 60 to 100m southeast of D4, however no individuals were observed.

Table 12. Prey observations year 1 at Shiloh II, April 2009 – April 2010.

Tower #	Black-tailed Jackrabbit	Cottontail	Alligator Lizard	Gopher Snake	Racer	Total
B10		1				1
B7	1					1
B8	1			1		2
C3	1					1
C6				1		1
D13			1		3	4
D20				1		1
Total	**3**	**1**	**1**	**3**	**3**	**11**

3.5 Vegetative Cover

The vegetative cover of the wind farm consists largely of agricultural land. Where turbines and project roads are located the land use is rotating agricultural crops and grazed pastures. Crops include: wheat, barley, hay, and fallow fields. A multi-year rotation is the norm with crop, fallow, grazing and tilling, alternating being the regime used most often. There are some isolated wetlands (mostly cattail marsh).

Pasture is land which is permanently used for the grazing of sheep, horses, and cattle. The vegetation consists of mixed grasses along with a lesser amount of Mustard family plants, various thistles, among others, and is generally kept short by the grazing. While the horse pastures are continuously grazed, those areas used exclusively for sheep are only periodically grazed, with the sheep being moved from field to field as the grass becomes too short.

Crop land is land that goes through cycles of cultivation, crop production, fallow and grazing, and back to crop. The crops consist mostly of grass crops – wheat, barley, oats, and hay – with safflower being the other crop. When a grass crop is to be planted, the soil will generally be cultivated in late May or June, while the soil is still moist. The soil will remain in the tilled state throughout the summer with periodic re-tilling to break up the clumps further. In the fall the soil is fertilized, usually with liquid ammonia, although “Bio-solids” (sewage treatment plant solid waste) was used on some fields in the past year. In November or December, just prior to the start of the winter rains, the fields are seeded. Harvesting of the crops usually occurs in July, but is determined by when the seed reaches the right moisture level. By the time the wheat, barley or oats are harvested the soil is usually too dry and hard to disc, so the field will be fallow the following winter. Hay is usually mowed around the end of May, and allowed to dry in the field before baling and gathering. Like the other grass crops, by the time the hay is gathered, it is too late to disc in time to plant the following winter, so the field will be fallow.

In the first year of this survey, pasture represented the dominant ground cover of approximately 48% of the surveyed towers, fallow 24%, wheat 17%, and tilled soil 11%.

Although several towers had more than one kind of cover due to fence lines running through the survey area, for the purposes of this analysis each tower was considered to have a single type of vegetation cover, that which occupied more than 50% of the survey area and surrounded the base of the tower. Vegetation height was classified as short (<6”), medium (6”-12”), or tall (>12”). At less than 6”, vegetation does not obscure the surveyor’s vision, while a height of more than 12” could potentially obscure the view sufficiently that the surveyor could miss some carcasses, including larger birds. Between 6” and 12” there is some possibility of missing small birds and bats, but not the larger birds.

In the first year of the survey, short vegetation accounted for 46% of the surveyed towers, medium for 36%, and tall for 18%. A comparison of the percentage of incidents found on each vegetative cover type appears to indicate a random distribution of incidents, with the percentage of incidents found on each cover type comparable to the percentage of area of each cover type that was observed. The percentage of incidents was highest in pasture, followed by fallow, wheat, and till, as would be expected based on the percentage of ground cover (Table 13).

Table 13. Percentage of surveyed area of each vegetative cover type and the percentage of incidents found on each vegetative cover type.

Ground Cover	% Cover	# Incidents	% Incidents
Pasture	48%	41	54%
Fallow	24%	18	24%
Wheat	17%	13	17%
Till	11%	4	5%
Totals	**100%**	**76**	**100%**

Comparing vegetative cover to species group shows that bats have a higher than expected mortality in fallow land, and a lower than expected number in till (Table 14). One possible explanation for this is the lack of insects over tilled soil in comparison to ground covered with vegetation. Another factor could be that the coloration of the tilled soil is closer to the coloration of the bat carcasses. Spotting the carcasses is more difficult due to the fact that there is little or no contrast between the carcass and the exposed soil upon which it is laying. There were a greater number of passerine incidents in pasture and fewer on fallow than would be expected based on cover. The number of incidents of all other (non-passerine) avian species groupings was too low to make any conclusions at this time. Overall, there was a greater percentage of avian incidents on pasture and lower percentage on fallow than would be explained by the percentage of vegetative cover in the study area, while the percentage of incidents on wheat and till were as expected.

Table 14. Comparison of the number of incidents within each species group to vegetative cover type.

Species group	Pasture	Fallow	Wheat	Till	Total	% by Group
Raptor	1	2	1		4	5%
Passerine	18	3	4	2	27	36%
Waterfowl	1		1	1	3	4%
Water Bird	3	2		1	6	8%
Other bird	2		2		4	5%
Bat	16	11	5		32	42%
Totals	**41**	**18**	**13**	**4**	**76**	**100%**
% of fatalities	54%	24%	17%	5%	100%	
Vegetative Cover	*48%*	*24%*	*17%*	*11%*	*100%*	
Percentage						
Raptor	25%	50%	25%		100%	
Passerine	67%	11%	15%	7%	100%	
Waterfowl	33%		33%	33%	100%	
Water Bird	50%	33%		17%	100%	
Other bird	50%		50%		100%	
% Birds	**57%**	**16%**	**18%**	**9%**	**100%**	
Bat	**50%**	**34%**	**16%**		**100%**	

A comparison of species group to vegetative cover height indicates that there may be a visibility factor involved, with over 43% of the incidents occurring in short vegetation, and 45% in medium vegetation, and only about one eighth in tall vegetation (Table 15).

Table 15. Comparison of species group to vegetative cover height.

	Vegetation Height						
Species Group	**Short**	**Medium**	**Tall**	**Total**	**% Short**	**% Medium**	**% Tall**
Raptor	1	3		**4**	25%	75%	
Passerine	14	7	6	**27**	52%	26%	22%
Waterfowl	1	1	1	**3**	33%	33%	33%
Water Bird	3	2	1	**6**	50%	33%	17%
Other	3	1		**4**	75%	25%	
Bat	11	20	1	**32**	34%	63%	3%
Total	**33**	**34**	**9**	**76**	**43%**	**45%**	**12%**
% Cover	46%	36%	18%	100%	46%	36%	18%
Percentage	**Short**	**Medium**	**Tall**	**Total**			
Raptor	3%	9%	0%	**5%**			
Passerine	42%	21%	67%	**36%**			
Waterfowl	3%	3%	11%	**4%**			
Water Bird	9%	6%	11%	**8%**			
Other	9%	3%	0%	**5%**			
Bat	33%	59%	11%	**42%**			
Total	**100%**	**100%**	**100%**	**100%**			

Comparing the species size groups to cover height further supports the idea that visibility might be an underlying factor influencing why carcasses were found more heavily in short and medium height vegetation than in tall vegetation. The smallest percentage of incidents was found in tall vegetation, with the most noticeable difference being in the bat group (Table 16), with only 3% of bat incidents found in tall vegetation. The majority (63%) of bat incidents were found in vegetation of medium height. Since medium height ground cover would seem to obscure visibility of small carcasses like bats more than that of short cover, a possible explanation for this could be related to the fact that none of the bat carcasses were found on tilled soil, which comprised 25% of all “short” vegetative cover surveyed. When small and medium sized birds are lumped, 50% of these incidents were found in short vegetation, while 31% and 19% were found in medium to tall vegetation, respectively. Crop height may play an important part in the visibility of carcasses however more data is needed to see a clear correlation.

Table 16. Comparison of incident species size group to vegetative cover height.

Size Group	Short	Medium	Tall	Total	% Short	% Medium	% Tall
Small Bird	9	5	5	**19**	47%	26%	26%
Medium Bird	9	6	2	**17**	53%	35%	12%
Large Bird	4	3	1	**8**	50%	38%	13%
Bat	11	20	1	**32**	34%	63%	3%
Total Incidents	**33**	**34**	**9**	**76**	**43%**	**45%**	**12%**
% Cover	46%	36%	18%	100%	46%	36%	18%

3.6 FAA Obstruction Tower Lighting

An examination of the fatality rates of night migrating bird (songbirds, waterbirds) and bat fatalities found during fall (August through November) and spring (mid-February through May) at turbines with flashing red FAA lights versus turbines without such lights did not reveal a significant difference (Table 17). There was also almost no difference between the fatality rates of incidents of night migrant species and non-night migrant species at lit towers versus those that were not lit. Of the 9 night migrating bird incidents (5 songbirds and 4 waterfowl and water birds), 67% were found dead at turbines equipped with flashing red lights as opposed to 33% being found at turbines that did not have FAA lights. These percentages are slightly different than the percentages of towers with and without FAA lights (48% had FAA lights and 52% did not have lights). A chi-square test revealed no deviation from expected numbers of night migrant fatalities at lit turbines as opposed to unlit turbines (Chi-square test, $\chi^2 = 0.33$, df = 1, P = 0.57, ns). If the red flashing lights attracted birds to turbines, a disproportionately greater number of these fatalities would have been found at turbines with lights, which was not the case.

A similar examination of the numbers of bat fatalities at turbines with FAA lights versus turbines without such lights showed that, of all wind turbine related bat fatalities which occurred during fall or spring migrations, 72% were found at turbines with FAA lights and 28% were found at turbines without such lights. These proportions do not deviate from those expected if bats collided with towers randomly (Chi-square test, $\chi^2 = 3.38$, df = 1, P = 0.06, ns). While the p value approaches 0.05, the preponderance of evidence at comparable wind farms shows no link between tower lighting and bat fatalities.

Table 17. The number of incidents of night migrating birds and bats, and non-migrating birds, found during fall (August - November) and spring (mid-February - May) migrations during the first year of standardized surveys, at towers with and without FAA red-flashing lights.

	NO LIGHT		RED BLINKING LIGHT		Total
	#	%	#	%	#
Wind Turbines Surveyed*	**13**	**52%**	**12**	**48%**	**25***
Night Migrant Incidents					
Bats	9	28%	23	72%	32
Passerine	2	40%	3	60%	5
Waterbird/Waterfowl	1	25%	3	75%	4
Night Migrant Subtotal	**12**	**29%**	**29**	**71%**	**41**
Non-Night Migrant Incidents	3	23%	10	77%	13
Non-Night Migrant Subtotal	**3**	**23%**	**10**	**77%**	**13**
Total # Incidents	**15**	**28%**	**39**	**72%**	**54**

* The number of wind turbines searched during the first year of this study with and without lights was calculated based on the proportion of rounds conducted at each tower type (lit or not).

3.6 Searcher Efficiency and Scavenger Removal

A scavenger removal and searcher efficiency study, conducted at different times of year over the study year period has estimated the proportion of incidents missed by the searchers and the proportion removed by scavengers within the 7 day search cycle. Accounting for scavenging and searcher efficiency, an adjusted estimate of the total number of kills at the wind farm was calculated. The number of incidents/tower and incidents/megawatt (MW) were calculated using the estimated number of avian and bat incidents found during the first year of this study. These rates are readily comparable between wind farms of different sizes (different numbers of turbines and different generational capacities per turbine).

3.6.1 Adjusting Fatality Estimates

This section presents data for the first year of the study.

Table 18 shows the results of the scavenger study as described in the Methods. The proportion of birds not scavenged (*Sc*) within 4 days was used to adjust the number of incidents that were discovered by our searchers, in each size class (small, medium-large and bats).

Table 18. Shiloh II scavenger removal study data Study Year 1 (April 27, 2009 to April 24, 2010).

Species Size Group	# of Carcasses	# Scavenged	Proportion not scavenged (Sc)
Small Birds	9	2	0.78
Medium-Large Birds	11	3	0.73
Bats	17	5	0.71

Table 19 shows the results of the search efficiency study as described in the Methods for year three, using bird carcasses only. The proportion of birds found (*Se*) was used to adjust the number of incidents that were discovered by our searchers, in each size class (small, medium, and large birds, and bats).

Table 19. Shiloh II searcher efficiency study data Study Year 1 (April 27, 2009 to April 24, 2010).

Species Size Group	# of Carcasses	# Not Found	Prop. Found (Se)
Small Birds	9	3	0.67
Medium-Large Birds	10	1	0.90
Bats	15	10	0.33

Table 20 contains estimates of the number of bird and bat fatalities attributed to collisions with the total number of wind turbines at the Shiloh II Project, in the first year of the project. They reflect corrections for *Sc*, *Se* as determined in tables 18 and 19, as well as *Ps*, the number of birds/bats found during searches and the subsequent estimate adjustment made using the formula described in the Methods.

The total number of bird incidents estimated for the project area for the first year of this study is 227, or 3.03 birds/tower/year (Table 20). Raptors accounted for ~18 raptors out of 227 incidents (~7.9%), 0.24 raptor incidents/tower/year. Passerines were 144 passerines out of 227 incidents (~63.4%), 1.9 passerine incidents/tower/year. Bats accounted for 408 bats/year (5.44 bats/tower/year). Mexican Free-tailed bats (~65.6%) accounted for the majority of the adjusted bat incidents of this study.

Table 20. Estimates for bird and bat collision mortality under 75 turbines of the Shiloh II Project, Year 1 (April 27, 2009 to April 24, 2010), corrected for searcher efficiency, scavenger removal rate and proportion of towers searched.

	Birds			
Correction Factors	**Small**	**Medium Large**	**Bats**	**Total Carcasses**
# Found	21	23	32	76
% Not Scavenged **(Sc)**	78%	73%	71%	
Search Efficiency **(Se)**	67%	90%	33%	
Proportion Searched Turbines **(Ps)**	33.33%	33.33%	33.33%	
Adjusted Total	**122**	**105**	**408**	**635**
95% CI (±)	67	43	306	

By dividing the estimated number (adjusted for searcher efficiency and scavenger losses) of birds/bats by the number of towers searched in each year of this study, a rate of incidents/tower and incidents/megawatt (MW) can be calculated, allowing comparisons between wind farms of different sizes (different numbers of turbines and different generational capacities per turbine).

3.6.2 Species Fatality Estimates

Table 21 shows the estimated number of incidents and fatality rates per species within each size group.

Table 21. Adjusted number of incidents per species per turbine and per total installed megawatt capacity at Shiloh II, found during standardized surveys Study Year 1 (April 27, 2009 to April 24, 2010).

	# Incidents (Year 1)	Estimated # Incidents/Mw/year	Estimated # Incidents/Tower/year		Estimate of mortality (Incidents/year)	Incidental Finds
Species Name						
Birds (Medium - Large)						
American Kestrel	1	0.03	0.06		5	1
Brewer's Blackbird	2	0.06	0.12		9	0
Long-billed Curlew	1	0.03	0.06		5	0
Mallard	3	0.09	0.18		14	1
Mourning Dove	3	0.09	0.18		14	0
Red-tailed Hawk	3	0.09	0.18		14	0
Rock Pigeon	1	0.03	0.06		5	0
Grebe Spp.	1	0.03	0.06		5	0
Western Meadowlark	8	0.24	0.49		37	1
Total Medium - Large	**23**	0.70	1.41	**Total Estd. Med-Large**	**105**	**3**
Birds (Small)						
Black Rail*	2	0.08	0.15		12	0
Dunlin	1	0.04	0.08		6	0
European Starling	2	0.08	0.15		12	0
Horned Lark	3	0.12	0.23		17	0
Red-winged Blackbird	5	0.19	0.39		29	0
Sora Rail	1	0.04	0.08		6	0
Tree Swallow	1	0.04	0.08		6	0
Varied Thrush	1	0.04	0.08		6	0
Western Flycatcher	1	0.04	0.08		6	0
Western Tanager	1	0.04	0.08		6	0
Wilson's Warbler	1	0.00	0.00		0	0
Yellow Warbler**	1	0.04	0.08		6	0
Blackbird Species	1	0.04	0.08		6	**0**
Total Small Birds	**21**	0.81	1.62	**Total Estd. Small**	**122**	**0**
Total Birds	**44**	1.51	3.03	**Total Estd. Birds**	**227**	**3**
Bats						
Hoary Bat	8	0.68	1.36		102	0
Mexican Free-tailed	21	1.79	3.57		268	1
Western Red Bat	3	0.26	0.51		38	0
Total Bats	**32**	2.72	5.44		**408**	**1**
Total (Birds & Bats)	**76**				**635**	**4**

* Denotes State Threatened Species.
** Denotes California Species of Special Concern (CSC).

4.0 DISCUSSION

This report details the first year results of a three-year post-construction study of the Shiloh II wind power project. This is the fourth fatality study of the newer turbine technology installed in the Collinsville Montezuma Hills Wind Resource Area (CMHWRA). The project site is adjacent to the upper sections of the 90 turbine High Winds project and to the northern section of the 100 turbine Shiloh I project. When this three year cycle of post-construction studies is completed Curry & Kerlinger will have twelve years of continuous and comparative documentation of the impacts of wind plant development on three projects within the CMHWRA. Comparable pre-construction and post-construction surveys have been completed over that period of time using data collection protocols that enable us to better understand the impact of wind plant development on a large scale. The first study in this series commenced on August 17, 2000 (High Winds). The Shiloh II project will provide an expanded opportunity to examine and compare the effects of the change in turbine technology on the wildlife and habitat of the CMHWRA.

Due to the similarity of terrain and land use practices throughout the CMHWRA we would expect to find a strong overlap of species composition and abundance among the wind project developed areas of the WRA. If this is so, we would also expect to find comparable post-construction risk to avian species since the new technology deployed in these areas is comparable in turbine configuration (tower hub height, blade length and FAA lighting requirements), operating characteristics and turbine layout (spacing Region specific sources of variation and error should be relatively constant among these different surveys. Thus, the data collected at these projects may be compared (Table 22) in an effort to determine if there are differences in mortality trends between these projects.

Table 22 compares specific attributes of these three adjacent developments within the CMHWRA. When comparing unadjusted number of incidents between the three sites, there were half as many bird incidents per turbine per year recorded at Shiloh II compared to Shiloh I, and over one-and-a-half bird incidents at Shiloh II compared to High Winds. There were slightly more bats killed per turbine/year at Shiloh II than the other two sites.

Table 22. Comparison of Shiloh II, Shiloh I, and High Winds attributes or metrics (unadjusted data) for the first year of each study.

Attribute or Metric	Shiloh II	Shiloh I	High Winds
Number of Turbines	25 (of 75 towers)	49.4 (of 100 towers)	86.3 (of 90 towers)
Nameplate Capacity of Turbines	2.0 MW	1.5 MW	1.8 MW
Total Installed Megawatt Capacity*	50	74.1	155.3
Total Height of Rotor (AGL)	115 m, 125 m	103.5 m, 118.5 m	100 m
Duration of Study (year one of multi-year surveys)	1	1	1
Study Dates	April 2009 – April 2010	April 2006 – April 2007 (year one of three years)	August 2003 – July 2004 (year one of two years)
Search Interval (in days)	7 days	7 days	14 days
Number of Birds Found	44	173	96
Number of Raptors Found	4	30	41
Number of Songbirds Found	27	121	29
Number of Bats Found	32	52	70
Number of Birds Killed Per Turbine Per Year (unadjusted data)	1.76	3.50	1.11
Number of Birds Killed Per Megawatt* Per Year (unadjusted data)	0.88	2.33	0.62
Number of Bats Killed Per Turbine Per Year (unadjusted data)	1.28	1.05	0.81
Number of Bats Killed Per Megawatt* Per Year (unadjusted data)	0.64	0.70	0.45

* Number of incidents per megawatt per year was calculated by dividing the number of incidents (within the species group) by the total installed megawatt capacity (which was calculated by multiplying the average number of wind turbines surveyed throughout the survey period by the individual tower MW), then dividing this number by total number of years surveyed.

We turn to a comparison of the fatalities recorded between the three project sites.

4.1 Recorded Fatalities: Shiloh II – Shiloh I – High Winds One Year Comparison

A total of 44 wind turbine-related avian incidents were recorded by searchers during standardized surveys at the Shiloh II project, representing 19 species and 2 unidentified birds (1 of these was a blackbird, and 1 was an unidentifiable grebe; Table 21). Of the 19 avian species, 2 were raptor species including American Kestrel (1), and Red-tailed Hawk (3), comprising a total of 4 raptor incidents found during the one year study period. The greatest numbers of carcasses found were songbirds; this group comprised 27 incidents identified to 11 different species plus an unidentified blackbird. There were a total of 3 waterfowl incidents, all Mallards. Water bird species comprised 6 incidents, including 2 Black Rails, 1 Sora, 1 Dunlin, 1 Long-billed Curlew, and 1 unidentified grebe species. Other avian species included 3 Mourning

Doves, and 1 Rock Pigeon, comprising 2 species involved in 4 incidents. Thirty-two (32) bat carcasses were found by searchers, representing 3 different species including Hoary Bat (8), Mexican Free-tailed Bat (21), and Western Red Bat (3).

Unadjusted figures between Shiloh II, Shiloh I and High Winds are presented in Table 23. A total of 173 wind turbine related avian incidents were recorded by searchers during standardized surveys at the Shiloh I project area, representing 35 species and 13 unidentified birds (3 of these were sparrows, 1 a swallow, and 9 were not identified to species but classified as passerines). Of the 35 species, 5 were raptor species including American Kestrel (16), Red-tailed Hawk (8), Northern Harrier (2), Golden Eagle (1), and Barn Owl (4). There were a total of 30 turbine related raptor carcasses found during this 12 month period. One raptor carcass, an American Kestrel was found in association with a met tower. The largest number of carcasses found were songbirds, this group comprised 121 (70.0%) incidents identified to 22 different species plus unidentified species. Fifty-two (52) bat carcasses were found by searchers, representing 4 different species including Hoary Bat (24), Mexican Free-tailed Bat (26), Silver-haired Bat (1), and Western Red Bat (1). There were a total of 4 waterfowl incidents, all of them Mallards. Water bird fatalities included 2 American Coots and 1 Virginia Rail. Other avian species included a mixed group of doves, a pheasant, a chukar, and a flicker, comprising 5 species involved in 15 incidents.

Table 23. Unadjusted number of incidents species per turbine per year at Shiloh II (April 2009 - April 2010), Shiloh I (April 2006 - April 2007) and High Winds (August 2003 - July 2004), found during standardized surveys during the first year of each study.

	Shiloh II (25 turbines)		**Shiloh I** (49.4 turbines)		**High Winds** (86.3 turbines)	
Species Name	**# Incidents**	**# Incidents per Tower/Year**	**# Incidents**	**# Incidents per Tower/Year**	**# Incidents**	**# Incidents per Tower/Year**
American Coot			2	0.040	1	0.012
American Goldfinch			1	0.020		
American Kestrel	1	0.040	15	0.304	29	0.336
American Pipit			4	0.081		
Barn Owl			4	0.081		
Black-crowned Night Heron						
Black-Headed Grosbeak			1	0.020		
Black Rail	2	0.080				
Black-throated Gray Warbler			1	0.020		
Brewer's Blackbird	2	0.080	6	0.121	2	0.023
Chukar			1	0.020		
Common Moorhen					1	0.012
Common Yellowthroat					1	0.012
Dark-eyed Junco, slate			1	0.020		
Double-crested Cormorant					1	0.012
Dunlin	1	0.040				
Empidonax species					1	0.012
European Starling	2	0.080	2	0.040	4	0.046
Ferruginous Hawk					1	0.012
Golden Eagle			1	0.020	1	0.012
Golden-crowned Kinglet			1	0.020		
Golden-crowned Sparrow			1	0.020		
Great Horned Owl						
Hammond's Flycatcher			1	0.020		
Hoary Bat	8	0.320	24	0.486	45	0.521

Species Name	Shiloh II (25 turbines) # Incidents	Shiloh II # Incidents per Tower/Year	Shiloh I (49.4 turbines) # Incidents	Shiloh I # Incidents per Tower/Year	High Winds (86.3 turbines) # Incidents	High Winds # Incidents per Tower/Year
Horned Lark	3	0.120	5	0.101	10	0.116
House Finch						
House Sparrow			1	0.020		
Killdeer						
Lincoln's Sparrow					1	0.012
Long-billed Curlew	1	0.040				
MacGillivray's Warbler						
Mallard	3	0.120	4	0.081		
Merlin						
Mexican Free-tailed Bat	21	0.840	26	0.526	22	0.255
Mourning Dove	3	0.120	8	0.162	2	0.023
Northern Flicker			1	0.020	1	0.012
Northern Harrier			2	0.040		
Northern Mockingbird			1	0.020		
Orange-crowned Warbler					1	0.012
Pacific Slope Flycatcher						
Peregrine Falcon						
Red-tailed Hawk	3	0.120	8	0.162	10	0.116
Red-winged Blackbird	5	0.200	27	0.547	2	0.023
Ring-necked Pheasant			1	0.020	2	0.023
Rock Pigeon	1	0.040	4	0.081		
Rough-legged Hawk						
Ruby-crowned Kinglet					2	0.023
Savannah Sparrow			3	0.061		
Silver-haired Bat			1	0.020		
Sora	1	0.040			1	0.012
Townsend's Warbler					2	0.023
Tree Swallow	1	0.040	3	0.061		
Tricolored Blackbird			1	0.020		
Turkey Vulture					1	0.012
Unidentified Duck						
Unidentified Grebe	1	0.040				
Unidentified Bird			9	0.182	6	0.070
Unidentified Blackbird	1	0.040			1	0.012
Unidentified Passerine						
Unidentified Sparrow			3	0.061		
Unidentified Swallow			1	0.020		
Unidentified Warbler					2	0.023
Varied Thrush	1	0.040				
Virginia Rail			1	0.020	1	0.012
Warbling Vireo					1	0.012
Western Flycatcher	1	0.040				
Western Meadowlark	8	0.320	42	0.850	2	0.023
Western Red Bat	3	0.120	1	0.020	3	0.035
Western Tanager	1	0.040				
Western Wood-Pewee					1	0.012
White-crowned Sparrow			2	0.040		
White-tailed Kite					2	0.023
White-throated Swift					2	0.023
Wilson's Warbler	1	0.040	2	0.040		
Yellow Warbler	1	0.040	1	0.020	1	0.012
Yellow-breasted Chat			1	0.020		
Total	**76**	**3.040**	**225**	**4.555**	**166**	**1.924**

At the High Winds project area, a total of 96 avian incidents were recorded by searchers during the first year of standardized surveys, representing 29 species. Of the 29 species, 5 were raptor species including American Kestrel, Red-tailed Hawk, Ferruginous Hawk, White-tailed Kite, Golden Eagle. There were a total of 41 raptor incidents found during the first year study. There were 29 incidents of songbirds identified to 14 different species. There were three species of bats recorded at High Winds, comprising 70 incidents.

Comparison of unadjusted fatality rates between the first year data recorded from each of these three project areas has been simplified below in Table 24 and 25. Table 24 reports the number of raptor incidents per turbine per year for each site. The lowest raptor fatality rate was recorded at Shiloh II, where there were less than 25% the raptor incidents of Shiloh I, and about 30% of the raptor incidents of High Winds. Only two species of raptors were recorded at the Shiloh II site compared to five species at each of the other two sites. Though conclusions are preliminary at this time due to low raptor incident numbers at Shiloh II after one year of data collection, Red-tailed Hawk fatality rates appear roughly similar between the three sites. American Kestrel numbers however were much greater at Shiloh I and High Winds than at Shiloh II, with 7.5 to 8.5 times more kestrels recorded at Shiloh I and High Winds, respectively, than at Shiloh II.

Table 24. Number of raptor incidents species per turbine per year at Shiloh II (April 2009 - April 2010), Shiloh I (April 2006 - April 2007) and High Winds (August 2003 - July 2004), found during standardized surveys during the first year of each study.

	Shiloh II		Shiloh I		High Winds	
Species Name	**# Incidents**	**# Incidents per tower/year**	**# Incidents**	**# Incidents per tower/year**	**# Incidents**	**# Incidents per tower/year**
American Kestrel	1	0.04	15	0.3	29	0.34
Red-tailed Hawk	3	0.12	8	0.16	10	0.12
Golden Eagle			1	0.02	1	0.01
Northern Harrier			2	0.04		
White-tailed Kite					2	0.02
Ferruginous Hawk					1	0.01
Barn Owl			4	0.08		
Total	**4**	**0.16**	**30**	**0.61**	**43**	**0.50**

Comparison of unadjusted fatality rates within each species group between these three project areas (Table 25) shows the greatest passerine fatality rate at the Shiloh I site. There were approximately 2.3 more passerine incidents per tower per year at Shiloh I than at Shiloh II, and 7.2 more than at High Winds. However, raw data showed the greatest fatality rate of bats at Shiloh II, where there were 1.2 times more bat incidents per turbine/year than at Shiloh I, and 1.6 times more than at High Winds. The difference between the sites was due to the greater number of Mexican Free-tailed Bats recorded at Shiloh II. There were about 1.6 times more Mexican Free-tailed Bats recorded per turbine per year at Shiloh II than at Shiloh I, and 3.3 times more of this species at Shiloh II than at High Winds (Table 23). Waterfowl and water bird incidents per turbine per year were greater at Shiloh II, with 2.6 times more birds/turbine/year than at Shiloh I, and 6 times as many as at High Winds. One notable species, the California Black Rail (a

California threatened species) was only recorded at Shiloh II. These two birds were found at two towers which were very distant from each other, Towers D17 (July 2009) and A3 (August 2009).

Table 25. Number of unadjusted incidents per species group per turbine per year at Shiloh II (April 2009 - April 2010), Shiloh I (April 2006 - April 2007) and High Winds (August 2003 - July 2004), found during standardized surveys during the first year of each.

Species Group	Shiloh II	Shiloh I	High Winds
Avian			
Raptor (including owls)	0.16	0.6	0.5
Passerine (incl. unidentified bird spp.)	1.08	2.44	0.34
Waterfowl (ducks)	0.12	0.08	
Water Bird (coots, rails, cormorants)	0.24	0.06	0.06
All Other Bird (doves, flickers, pheasants, vultures)	0.16	0.3	0.12
Bat	1.28	1.05	0.81
Total Incidents/Turbine/Year	**3.04**	**4.53**	**1.83**

Differences in search protocol may be partly responsible for the greater observances of incidents per turbines searched and the per MW capacity of each turbine. There were fewer turbines searched (25 turbines) at Shiloh II compared to an average of 49.4 at Shiloh I, and 86.3 at the High Winds site in the first year of study. However, the turbines at the Shiloh I and II project sites were searched more frequently, every seven days, compared with the 14 day search interval between turbine searches at the High Winds project site. Further, the search radius at each tower in the High Winds project was 75m from the base of the tower, compared to 105m at the Shiloh I and II projects. Thus, the area searched per tower (34636m^2) at each of the two Shiloh projects was 2 times the amount searched per tower at High Winds (17671m^2). In addition, a more detailed search was conducted between the base of each tower and the 30m radius, with ever 5m searched within this region. Since bats tended to be located more proximal to the bases of towers than birds, this may account for some of the difference between sites in bat fatality rate.

If search efficiency and amount of scavenging activity at these three WRAs were assumed to be the same, much of the differences in raw data of bats found at each site could be attributed to these differences in search protocol. However, the larger differences in observed passerine fatalities imply that scavenge and search efficiency rates can only explain part of the difference. The extrapolated (adjusted) data from the first year of the study show low, non significant numbers of bird and bat fatalities. A more valid comparison of results from the three WRAs should await one or more years of additional data.

4.2 Night Migrant Fatalities

As with most other turbine facilities across the United States, the fatality rate of night migrants was low at the Shiloh II facility during the one year of study. The numbers were especially small in comparison with fatality rates of these birds at taller, guyed communication towers in the Midwestern and eastern United States where fatalities involving hundreds or even thousands of birds in a single night have been found dead in a single migration season. Those towers are usually equipped with two types of Federal Aviation Administration (FAA) lighting (steady burning and flashing lights), multiple sets of guy wires, and are almost always in excess of 500 feet (152 m). For example, a study in Michigan demonstrated that fatalities at guyed communication towers in excess of 305 m (1,000 feet) in height revealed that such towers kill 300+ birds per tower per year (calculated from data in Gehring et al. 2009). For guyed towers 450-475 feet in height, the data in Gehring et al. (2009) suggest that fatality rates are about 65-70 birds per tower per year. A vast majority of these birds are night migrants, so most guyed communication towers have been shown to kill orders of magnitude more birds on a per structure basis than wind turbines. Thus, guyed communication towers of the same height or taller kill about 13 or 14 times per structure to more than 60 times more per structure than do the wind turbines at Shiloh.

For both bats and birds, there is no evidence that FAA lighting in the form of SFRLs (simultaneously flashing red lights) attracted birds to towers and that the presence of those lights cause large scale fatality events at wind turbines.

The fact that the Shiloh I and most other western turbines are only 339.5 feet (103.5 m) in height, do not have guy wires, and have only flashing red strobe-like lights may explain the low rate of night migrant fatalities at those turbines. Gehring et al. 2009 has recently demonstrated that flashing red, strobe-like lights (L-864) of the type recommended by FAA and used most often on wind turbines do not appear to attract night migrants like the utilization of the same lights (L-864) in combination with L-810 steady burning red lights. In the Shiloh I project, the L-810 units were modified from steady burning to blinking lights. These results continue to suggest that wind turbines in the western United States do not appear to kill large or significant numbers of night migrants. Determining the exact number of night migrants is difficult, however, as some of the birds involved may have been resident breeders.

4.2 Second Year Adjustments

With the availability of a sufficient supply of indigenous birds with which to conduct searcher efficiency and scavenger removal tests we will be conducting three to four such additional tests during the next twelve months. Test results will be pooled with the first year’s results, if appropriate, to provide more robust calculations.

In addition, the second year of the study, we will switch and search a different set of 25 turbines maintaining the same seven day interval cycle, increasing the scope of the study and reducing the possibility of missing any particular turbines that may have unusually high fatality levels.

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*Not all of the above references are cited specifically in the text. In some cases the references were consulted and information (or lack of information) was noted without citing the specific reference

APPENDIX A. SHILOH II WIND POWER PROJECT AVIAN CARCASS SURVEYS DATA SHEET.

Page ____ of ____

Date__________________________ Observers ____
Notes:____

Loc	Time		Fatalities		Ground Cover/Crop Type (give % cover, ave. height, whether standing or cut crop)						Weather			
Turb#	Start	Finish	#	Brief Notes	Gravel	Tilled	Wheat	Barley	Saff.	Fallow	Temp F	Wind Speed	Dir	% Cloud

APPENDIX B. SHILOH II WILDLIFE INCIDENT REPORT DATA SHEET.

SHILOH II
Wildlife Incident Report

SECTION NO. 1 - DISCOVERY DATA

Report Date: _____________ Recovery Date: _____________ ID#: ____________

Reporting Crew: ____________ Injury / Fatality Complete / Dismembered / Feathers / Bones

SECTION NO. 2 - LOCATION OF FIND

Parts: Bearing and Distance from tower/pole: Structure: _____________

List parts by size: Distance Degrees

Part 1: ____ ________ _______

Part 2: ____ ________ _______

Part 3: ____ ________ _______

Location Remarks: ____

____

SECTION NO. 3 - WILDLIFE IDENTIFICATION

Species: Field marks used:

____________________________ ____

Age: ______ Sex: ______ Band: No ___ Yes ___ Unknown ___ (Leg(s) missing)

SECTION NO. 4 - OBSERVATIONAL DATA

Describe the physical condition of the find at the time of discovery:

____

____

____

Describe Scavenging Activity: ____

Estimated Time Since Death or Injury (days): <1, <4, <7, <14, <30, >30, UNK Photos: ______

Carcass Condition:
____ 1 - Fresh
____ 2 - Decomposing (early stage)
____ 3 - Decomposing (late stage)
____ 4 - Desiccated
____ 5 - N/A

Infestation Activity: ____ Yes ____ No
____ Fly Larvae (maggots)___________________
____ Adult Flies _________________________
____ Beetles_____________________________
____ Ants_______________________________
____ Other_______________________________

Eyes: __N/A __Round, Fluid Filled __Partially Dehydrated __Flat __Sunken __Amorphous/Empty

Other Field Notes: ____

____

APPENDIX C. LIST OF 4 INCIDENTS FOUND DURING CLEAN SWEEP SURVEYS AT SHILOH II, APRIL 21 - 23, 2009.

Report Date	Estimated Month of Death	Species Name	Fatality /Injury	Species Group	Tower	Distance (m)	Degrees (GN)*	Days Since Death
4/22/2009	UNK	Horned Lark	Fatality	Passerine	D28	30	14	UNK
4/22/2009	APR	Warbling Vireo	Fatality	Passerine	C15	39	68	4
4/22/2009	UNK	Hoary Bat	Fatality	Bat	C18	11	234	UNK
4/23/2009	APR	Hoary Bat	Fatality	Bat	D20	21	346	4

* Degrees Geographic North represents degrees from tower to carcass.

APPENDIX D. LIST OF 76 INCIDENTS FOUND DURING STANDARDIZED SURVEYS AT WIND TURBINE TOWERS AT SHILOH II, APRIL 2009- APRIL 2010.

ID #	Report Date	Month of Death	Species	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH2-015-09	7/30/2009	Jul-09	American Kestrel	Fatality	Raptor	C3	74	78	4
SH2-016-09	7/30/2009	Jul-09	Black Rail	Fatality	Waterbird	D17	37	48	7
SH2-017-09	8/21/2009	Aug-09	Black Rail	Fatality	Waterbird	A3	95	44	4
SH2-002-09	5/19/2009	May-09	Blackbird species	Fatality	Passerine	D26	47	104	7
SH2-050-09	11/16/2009	Nov-09	Brewer's Blackbird	Fatality	Passerine	D13	42	218	4
SH2-080-10	4/8/2010	Apr-10	Brewer's Blackbird	Fatality	Passerine	D28	93	254	7
SH2-014-09	7/29/2009	Jul-09	Dunlin	Fatality	Waterbird	B8	25	44	1
SH2-066-10	1/22/2010	Jan-10	European Starling	Fatality	Passerine	B8	12	258	7
SH2-077-10	4/6/2010	Apr-10	European Starling	Fatality	Passerine	B8	26	146	4
SH2-005-09	5/27/2009	May-09	Hoary Bat	Fatality	Bat	B8	55	96	7
SH2-021-09	9/9/2009	Sep-09	Hoary Bat	Fatality	Bat	D16	32	6	4
SH2-026-09	9/24/2009	Sep-09	Hoary Bat	Fatality	Bat	B7	66	65	7
SH2-041-09	10/23/2009	Oct-09	Hoary Bat	Fatality	Bat	D16	61	136	7
SH2-044-09	10/23/2009	Oct-09	Hoary Bat	Fatality	Bat	A8	32	320	7
SH2-047-09	10/30/2009	Oct-09	Hoary Bat	Fatality	Bat	B7	30	326	7
SH2-048-09	11/4/2009	Oct-09	Hoary Bat	Fatality	Bat	D13	89	22	14
SH2-060-09	12/8/2009	Nov-09	Hoary Bat	Fatality	Bat	B3	18	88	30
SH2-008-09	7/8/2009	Jul-09	Horned Lark	Fatality	Passerine	B10	4	342	7
SH2-058-09	12/4/2009	UNK	Horned Lark	Fatality	Passerine	D11	62	270	unk
SH2-075-10	3/10/2010	Mar-10	Horned Lark	Fatality	Passerine	B8	10	114	4
SH2-061-09	12/8/2009	Dec-09	Long-billed Curlew	Fatality	Waterbird	D11	68	169	4
SH2-006-09	6/24/2009	Jun-09	Mallard	Fatality	Waterfowl	D4	28	108	4
SH2-007-09	7/2/2009	UNK	Mallard	Fatality	Waterfowl	D20	55	146	unk
SH2-019-09	9/2/2009	Aug-09	Mallard	Fatality	Waterfowl	D28	50	74	30
SH2-003-09	5/20/2009	Apr-09	Mexican Free-tailed Bat	Fatality	Bat	A8	4	158	30
SH2-023-09	9/14/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	D13	20	74	14
SH2-024-09	9/16/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	A8	33	328	1
SH2-024-09	9/14/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	A1	10	324	7
SH2-027-09	9/24/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	B7	31	6	7
SH2-030-09	9/30/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	D16	102	48	1
SH2-031-09	9/28/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	D16	37	116	14
SH2-032-09	9/28/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	A1	25	319	14
SH2-033-09	9/28/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	A8	16	328	7
SH2-035-09	10/2/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	D13	23	84	1
SH2-35B-09	10/7/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	B3	26	8	1
SH2-35C-09	10/7/2009	Sep-09	Mexican Free-tailed Bat	Fatality	Bat	B8	45	334	14
SH2-036-09	10/12/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	A3	53	306	7
SH2-037-09	10/12/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	A8	15	246	14
SH2-038-09	10/15/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	C13	17	353	4
SH2-040-09	10/21/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	D17	22	64	7
SH2-043-09	10/23/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	A1	22	108	1
SH2-045-09	10/28/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	D16	45	0	14
SH2-049-09	11/11/2009	Oct-09	Mexican Free-tailed Bat	Fatality	Bat	A3	10	38	14
SH2-052-09	11/18/2009	Nov-09	Mexican Free-tailed Bat	Fatality	Bat	B3	73	74	7
SH2-055-09	11/23/2009	Nov-09	Mexican Free-tailed Bat	Fatality	Bat	A3	15	342	4
SH2-013-09	7/27/2009	Jul-09	Mourning Dove	Fatality	Other	D16	62	66	7
SH2-071-10	2/1/2010	Jan-10	Mourning Dove	Fatality	Other	D17	59	294	7
SH2-074-10	2/25/2010	Feb-10	Mourning Dove	Fatality	Other	B3	30	119	4
SH2-009-09	7/21/2009	Jul-09	Red-tailed Hawk	Fatality	Raptor	B3	68	52	7
SH2-051-09	11/18/2009	Nov-09	Red-tailed Hawk	Fatality	Raptor	A8	60	224	1
SH2-054-09	11/23/2009	Nov-09	Red-tailed Hawk	Fatality	Raptor	D16	54	112	4

ID #	Report Date	Month of Death	Species	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH2-001-09	5/11/2009	UNK	Red-winged Blackbird	Fatality	Passerine	C18	23	64	unk
SH2-064-09	12/28/2009	Dec-09	Red-winged Blackbird	Fatality	Passerine	D17	100	122	30
SH2-070-10	1/29/2010	Jan-10	Red-winged Blackbird	Fatality	Passerine	C18	94	114	4
SH2-072-10	2/16/2010	Feb-10	Red-winged Blackbird	Fatality	Passerine	B10	1	174	7
SH2-079-10	4/8/2010	Apr-10	Red-winged Blackbird	Fatality	Passerine	D28	89	354	7
SH2-069-10	1/29/2010	Jan-10	Rock Pigeon	Fatality	Other	C21	78	74	7
SH2-046-09	10/28/2009	Oct-09	Sora Rail	Fatality	Waterbird	D24	63	6	14
SH2-078-10	4/6/2010	Mar-10	Tree Swallow	Fatality	Passerine	A1	53	356	7
SH2-005-09	6/2/2009	May-09	Unidentified Grebe	Fatality	Waterbird	B7	47	0	7
SH2-057-09	12/2/2009	Nov-09	Varied Thrush	Fatality	Passerine	C21	19	194	4
SH2-028-09	9/25/2009	Sep-09	Western Flycatcher	Fatality	Passerine	C13	89	60	7
SH2-005-09	6/10/2009	Jun-09	Western Meadowlark	Fatality	Passerine	B10	70	74	7
SH2-025-09	9/25/2009	Sep-09	Western Meadowlark	Fatality	Passerine	D24	80	246	30
SH2-059-09	12/4/2009	Nov-09	Western Meadowlark	Fatality	Passerine	D13	57	12	7
SH2-063-09	12/18/2009	Dec-09	Western Meadowlark	Fatality	Passerine	D16	74	234	7
SH2-065-10	1/8/2010	Jan-10	Western Meadowlark	Fatality	Passerine	B10	80	334	7
SH2-067-10	1/28/2010	Jan-10	Western Meadowlark	Fatality	Passerine	B3	90	94	4
SH2-068-10	1/28/2010	Jan-10	Western Meadowlark	Fatality	Passerine	B3	90	288	7
SH2-076-10	3/10/2010	Mar-10	Western Meadowlark	Fatality	Passerine	B8	80	264	7
SH2-022-09	9/9/2009	Aug-09	Western Red Bat	Fatality	Bat	B3	15	46	14
SH2-053-09	11/18/2009	Nov-09	Western Red Bat	Fatality	Bat	B8	15	144	14
SH2-056-09	11/30/2009	Nov-09	Western Red Bat	Fatality	Bat	B7	60	184	14
SH2-029-09	9/25/2009	Sep-09	Western Tanager	Fatality	Passerine	D17	77	42	7
SH2-004-09	5/20/2009	May-09	Wilson's Warbler	Fatality	Passerine	B8	39	106	7
SH2-004-09	5/27/2009	May-09	Yellow Warbler	Fatality	Passerine	D16	15	4	7

* Degrees Geographic North represents degrees from tower to carcass.

APPENDIX E. LIST OF 4 INCIDENTS FOUND INCIDENTALLY (NOT DURING STANDARDIZED SURVEYS) AT WIND TURBINE TOWERS AT SHILOH II, APRIL 2009-APRIL 2010.

ID #	Report Date	Estimated Month of Death	Species	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH2-062-09	12/9/2009	(injured)	American Kestrel	Injury	Raptor	B11			(injured)
	7/14/2009	JUL	Mallard	Fatality	Waterfowl	A2	10	324	1
SH2-034-09	10/2/2009	OCT	Mexican Free-tailed bat	Fatality	Bat	D19	42	58	1
SH2-073-10	2/23/2010	FEB	Western Meadowlark	Fatality	Passerine	D13	106	22	4

* Degrees Geographic North represents degrees from tower to carcass.

APPENDIX F. SEARCHED TURBINES AND TOWER HUB HEIGHTS AT SHILOH II, APRIL 2009- APRIL 2010.

Turbine ID	Hub Height(M)	Tower Searched	Turbine ID	Hub Height(M)	Tower Searched
A1	68.5	Yes	**C17**	78	No
A2	68.5	No	**C18**	78	Yes
A3	68.5	Yes	**C19**	78	No
A4	68.5	No	**C20**	78	No
A5	68.5	No	**C21**	78	Yes
A6	68.5	No	**C23**	78	No
A7	68.5	No	**D1**	78	No
A8	68.5	Yes	**D2**	78	No
A9	68.5	No	**D3**	78	No
B1	68.5	No	**D4**	78	Yes
B2	68.5	No	**D5**	78	No
B3	68.5	Yes	**D6**	78	No
B4	68.5	No	**D7**	78	No
B5	68.5	No	**D8**	78	Yes
B6	68.5	No	**D9**	78	No
B7	68.5	Yes	**D10**	78	No
B8	68.5	Yes	**D11**	78	Yes
B9	68.5	No	**D12**	78	No
B10	68.5	Yes	**D13**	78	Yes
B11	68.5	No	**D14**	78	No
B12	68.5	No	**D15**	68.5	No
C1	68.5	Yes	**D15a**	78	No
C1a	68.5	No	**D16**	68.5	Yes
C2	68.5	No	**D17**	78	Yes
C3	68.5	Yes	**D18**	78	No
C4	78	No	**D19**	78	No
C5	68.5	No	**D20**	78	Yes
C6	68.5	Yes	**D21**	78	No
C7	68.5	No	**D22**	68.5	No
C8	68.5	No	**D23**	78	No
C9	78	Yes	**D24**	78	Yes
C10	68.5	No	**D25**	78	No
C11	78	No	**D26**	78	Yes
C12	78	No	**D27**	78	No
C13	78	Yes	**D28**	78	Yes
C14	78	No	**D29**	78	No
C15	78	Yes	**D30**	78	No
C16	78	No			