2008/2009 Annual Report

for the

Buena Vista Avian and Bat Monitoring Project

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1 – INTRODUCTION

This report analyzes results from the first year of the avian and bat mortality monitoring at the Buena Vista Wind Farm (Buena Vista) in the Altamont Pass Wind Resource Area. The monitoring was conducted by Insignia Environmental (Insignia) on behalf of the Contra Costa County Department of Conservation and Development. An estimation of the overall mortality was developed through a combination of trials including direct mortality surveys, searcher efficiency trials, and scavenging trials. In addition to mortality estimates, data was also collected relating to the overall usage of the site and surrounding area by local avian species.

1.0 BACKGROUND

In 2005, Buena Vista, LLC (BV LLC), a subsidiary of Babcock & Brown, obtained a permit from Contra Costa County to repower Buena Vista by removing 179 existing 150- and 160 kilowatt wind turbines and replacing them with 38 new 1-megawatt (MW) turbines constructed by Mitsubishi Power Systems. Construction was initiated in 2005 and the newly repowered wind farm became operational in December 2006.

The wind farm is divided into four separate strings of turbines—A-string, C-string, P-string, and V-string. The A-string is located between the V-string and the C-string, and is comprised of 16 55-meter-tall turbines. The C-string, which is located in the northeastern part of the wind farm, is comprised of 13 turbines. Turbines C1 through C7 are each 60 meters tall and turbines C8 through C13 are each 55 meters tall. The P-string is located in the southeastern part of the wind farm and is comprised of seven turbines. Turbines P1 and P2 are each 55 meters tall and turbines P3 through P7 are each 45 meters tall. The V-string is the shortest string of turbines in the wind farm. Located in the western part of the wind farm, each of the two V-string turbines are 45 meters tall.

1.1 ENVIRONMENTAL SETTING

Buena Vista is located in southeastern Contra Costa County along the eastern side of the Diablo Range within the Altamont Pass Wind Resource Area, which is one of the first wind power-producing areas in the United States. Located near the town of Byron, it is bordered to the west by Vasco Road and to the east by the California Aqueduct. An overview of the area is shown in Figure 1: General Overview Map. The surrounding area is comprised of rolling hills primarily utilized for livestock grazing. Annual grassland dominates the project area with areas of scattered oak trees (*Quercus* spp.), sagebrush-dominated chaparral, and scattered rock outcrops intermixed. The area is home to a robust population of several species of raptors including golden eagle (*Haliaeetus leucocphalus*), red-tailed hawk (*Buteo jamaicensis*), burrowing owl (*Athene cunicularia*), and American kestrel (*Falco sparverius*). A large population of California ground squirrel (*Spermophilus beechyi*) is also present in the project area. The area also acts as an important migratory flyway for many bird species. Many other local wildlife species inhabit the area, including coyote (*Canis latrans*), San Joaquin kit fox (*Vulpes macrotis mutica*), bobcat (*lynx rufus*), California red-legged frog (*Rana draytonii*), California tiger salamander (*Ambystoma californiense*), common raven (*Corvus corax*), turkey vulture (*Cathartes aura*), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), and several

species of bats. The climate at Buena Vista is classified as Mediterranean, with dry, hot summers and cool, wet winters. Representative photographs of the site and surrounding area are shown in Attachment A: Representative Photographs.

1.2 ENVIRONMENTAL IMPACT REPORT (EIR) CONDITIONS

The Buena Vista Wind Energy Project Draft EIR identified Impact 8-7 and Impact 8-9, which stated that the implementation of the Buena Vista Energy Project could lead to significant impacts relating to avian and bat mortality from collision with turbines. To mitigate these impacts, the adopted Mitigation Monitoring Plan (MMP) included Mitigation Measure (MM) 8-7i and MM 8-9a, requiring the implementation of a scientifically defensible 3-year monitoring program, as shown in Table 1: EIR Mitigation Measures. This monitoring program would monitor direct mortality as well as avian use and abundance in the area. In addition to the monitoring program, the MMP also called for the formation of a technical advisory committee (TAC) to provide oversight of the monitoring program and provide recommendations to further reduce avian and bat mortality on the project site.

Table 1: EIR Mitigation Measures

Mitigation Measure	Description
MM 8-7i	A scientifically defensible monitoring program shall be implemented to estimate the avian fatality rate from the new turbines, and important covariates such as prey base and avian use. a) Standardized fatality monitoring and avian use and behavior studies shall be conducted for a minimum of 3 years. b) A TAC shall be formed to oversee the program and to propose additional mitigation and/or additional monitoring depending on the results of the monitoring program. c) Should additional mitigation be necessary, potential measures may include off-site mitigation.
MM 8-9a	A scientifically defensible monitoring program shall be implemented to estimate the bat fatality rates from the new turbines.
MM 8-9b	A TAC should be established, as recommended in the repowering program. This TAC shall evaluate monitoring results, and if the bat mortality is determined to be significant, the TAC could recommend additional focused bat monitoring, or recommend additional mitigation such as contributions for the conservation of bats.

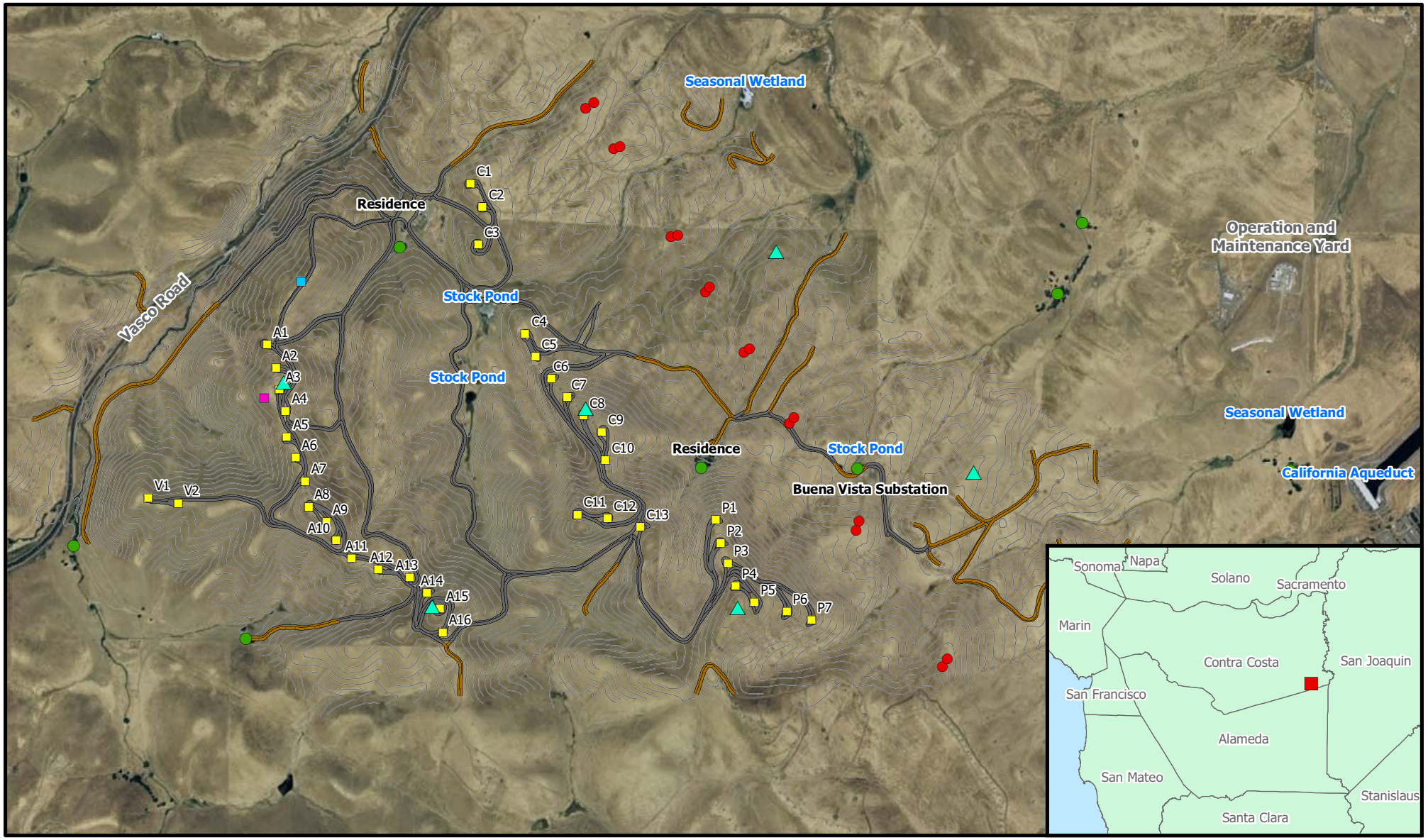

Figure 1: General Overview Map

Buena Vista Avian and Bat Monitoring Project

- Turbine
- Dirt Access Road
- Gravel Access Road
- Contour Line
- Cellular Phone Relay Tower
- Meteorological Tower
- Observation Point
- PG&E Transmission Tower
- Tree Grove

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In order to measure the expected reduction in raptor mortalities due to the repowering effort, the EIR identified four key species to act as indicators for the overall reduction. Estimates of the reduced number of mortalities after repowering were established for the key species, which include:

- Red-tailed hawk
- American kestrel
- Golden eagle
- Burrowing owl

1.3 TECHNICAL ADVISORY COMMITTEE

As stated in MM 8-7i and MM 8-9b, a TAC was formed to provide recommendations and insight into the monitoring study. Responsibilities of the TAC include reviewing and approving the Avian and Bat Monitoring Plan for the Buena Vista Wind Energy Project (monitoring plan) and making changes to the monitoring protocols, if necessary. The TAC is comprised of four members, all from different agencies or organizations including:

- United States (U.S.) Fish and Wildlife Service (USFWS);
- California Department of Fish and Game;
- East Bay Regional Park District; and
- Contra Costa County Department of Conservation and Development

Meetings were held with the TAC, Contra Costa County, and Insignia several times over the first year of monitoring in order to approve the monitoring plan, provide recommendations to the monitoring effort, and provide insight into other relevant studies being conducted at wind farms.

1.4 ATTORNEY GENERAL SETTLEMENT AGREEMENT

On May 10, 2006, BV LLC entered into a settlement agreement with the California State Attorney General regarding the repowering of Buena Vista. Pursuant to the agreement, BV LLC agreed to seasonal turbine shutdowns during the winter season (November 15 through February 28) if findings revealed that the new repowered 1-MW turbines did not result in a 35 percent reduction of mortalities of the four key raptor species from current estimates of 54 mortalities per year, to an average of 35 mortalities per year throughout the 3-year study. In addition, a reduction of 50 percent or more to an average of less than 27 mortalities per year has the potential to influence the repowering of an adjacent wind farm, Tres Vaqueros. The agreement between BV LLC and the California State Attorney General required that surveys be conducted twice per turbine per month, whereas once per month was identified in the monitoring plan included in the EIR. Survey efforts twice per month per turbine began in September 2008.

2 – METHODOLOGY

The avian and bat monitoring study began with the clean sweep surveys in January of 2008. The 2008/2009 Annual Report encompasses survey results from the beginning of February 2008 to February 2009. The protocols for the study were described in the monitoring plan, which has

been included in Attachment B: Avian and Bat Monitoring Plan for the Buena Vista Wind Energy Project. The study involved four major components:

- Avian use and abundance surveys
- Avian and bat mortality monitoring
- Searcher efficiency trials
- Carcass removal trials

2.0 AVIAN USE AND ABUNDANCE SURVEYS

Avian use and abundance surveys were conducted to estimate overall avian usage within and adjacent to Buena Vista. Four observation points were established within the repowered turbine area and two observation points were established outside of the repowered area in order to compare usage inside and outside of the turbine area. The purpose of these trials was to identify avian usage trends related to season, species, and specific areas within the wind farm. Locations of the avian use and abundance trial observation points have been included in Figure 2: Observation Point Map.

Trials were conducted once per month from February 2008 to January 2009, with each observation point surveyed twice per day—once in the morning and once in the afternoon. Surveys of each observation point consisted of a 360-degree scan of the area for 30 minutes to a range of 800 meters from the observation point. Due to the varying topography of the area, not all areas within 800 meters of each observation point were visible to the observer. The locations of all individuals or flocks were noted every 30 seconds on topographic maps. New topographic maps were used for every 30-minute observation session. In addition to locations plotted on maps, data sheets were used to record the specific activities of the individuals—flight characteristics, such as soaring, contour hunting, or flying through; perching locations; and/or flight height above the ground. Perching structures were categorized into one of four groups, as shown in Table 2: Perching Structures.

Table 2: Perching Structures

Category Number	Characteristics	Presence on Site
1	Turbine Devices	Includes the 38 repowered turbines
2	Electrical Distribution Poles	Includes wood distribution poles located through the site
3	Metal/Electrical Towers	Pacific Gas and Electric Company (PG&E) owns and operates a 230-kilovolt transmission line built on steel lattice towers; this line runs between the C-string and Observation Point #1 and between the P-string and Observation Point #2
4	Landscape Features	Includes rock outcrops, fence lines, and other natural vegetation

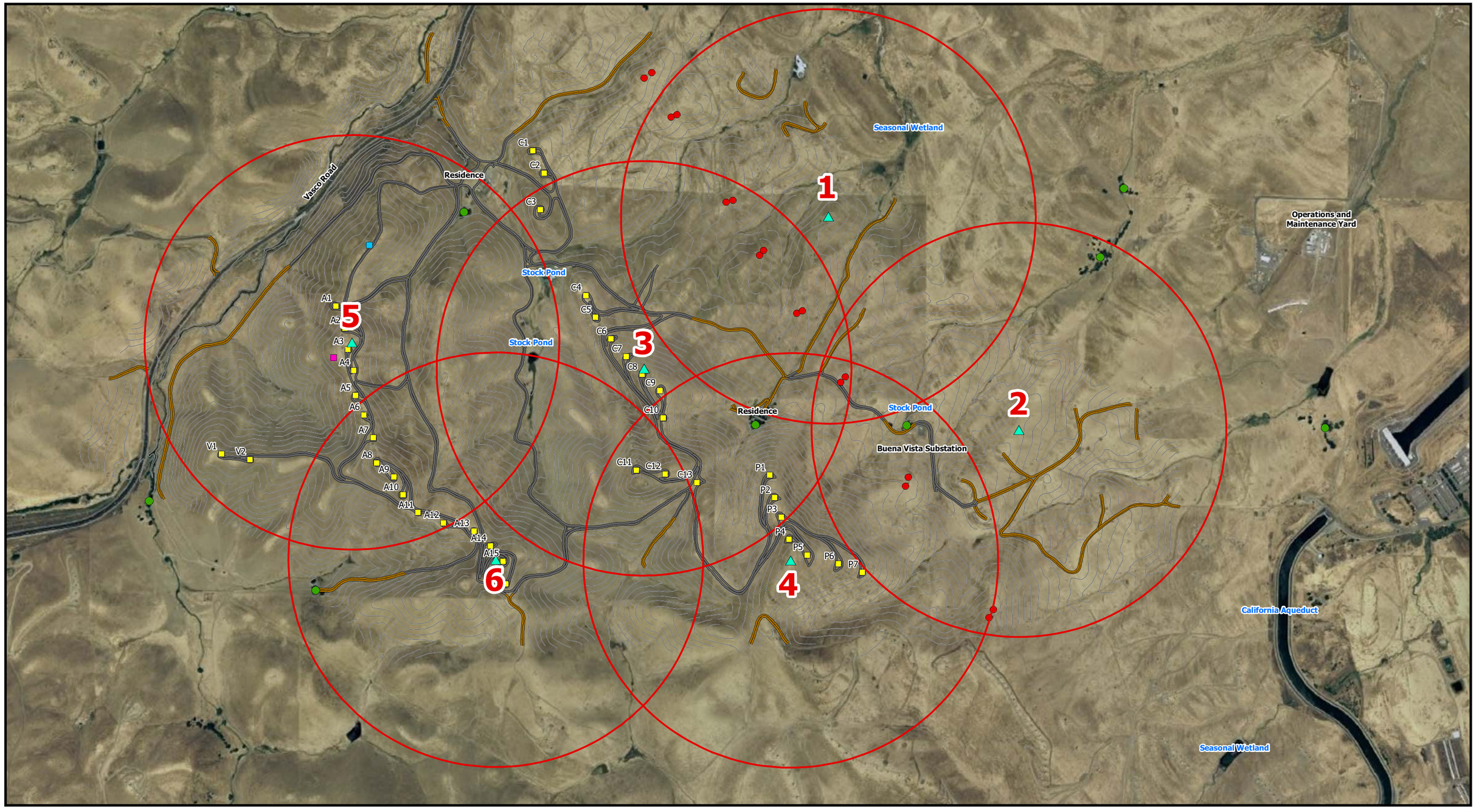

Figure 2: Observation Point Map

Buena Vista Avian and Bat Monitoring Project

- Turbine
- Observation Area
- Cellular Phone Relay Tower
- Meteorological Tower
- Observation Point
- PG&E Transmission Tower
- Tree Grove
- Dirt Access Road
- Gravel Access Road
- Contour Line

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Plotted flight locations were transferred to a geographic information system database after surveys were completed. Surveys were not conducted in conditions where winds exceeded 55 kilometers per hour, as required by the monitoring plan, because these conditions tend to inaccurately represent usage.

2.1 AVIAN AND BAT FATALITY STUDIES

In order to estimate the annual number of avian and bat mortalities on site, the study was comprised of three components:

- Standardized carcass surveys,
- Searcher efficiency trials, and
- Carcass removal trials.

While the standardized carcass surveys aim to identify all carcasses on site, they were only conducted once per turbine per month (later increased to twice per month). To account for the removal of carcasses by scavengers, such as coyotes or ravens, carcass removal trials were designed and implemented to accurately adjust the annual mortality rate for carcasses that are removed prior to discovery during a carcass survey. In addition to scavenging, searcher efficiency can affect the overall mortality rate as well. To account for carcasses missed by the surveyors, searcher efficiency trials were also conducted to obtain an accurate searcher efficiency rate. The searcher efficiency rate, carcass removal rate, and overall number of carcasses discovered were used to calculate the overall adjusted annual mortality rate for the site. These adjusted rates are discussed further in Section 4.3.0 Adjusted Mortality Rate.

2.1.0 Avian and Bat Mortality Monitoring

Prior to the start of avian mortality surveys, clean sweep surveys were conducted over a 6-day period between January 31, 2008 and February 9, 2008 to document and remove any pre-existing mortalities on site. These surveys were conducted using the same survey methodology as standardized carcass surveys.

Avian and bat mortality surveys began in February 2008. These surveys were conducted by surveying transects along concentric rings centered on the turbine. These surveys were conducted every 10 meters from the turbine out to a distance of 75 meters from the turbine. A rangefinder was regularly used during surveys to maintain the appropriate distance of the transect from the turbine. Five meters on either side of each transect were surveyed for avian or bat carcasses. In a given month, approximately half of the turbines were surveyed over 3 consecutive days and the other half were surveyed over a 3-day period the following week.

It should be noted that while the monitoring plan outlines protocols for surveys to be conducted once per turbine per month, the settlement agreement between BV LLC and the California State Attorney General requires each turbine to be surveyed twice per month. Therefore, doubled search efforts began in September 2008. Thus, in a given month, each turbine was surveyed twice—once by each surveyor—generally alternating weeks in which surveys were conducted. Results therefore reflect seven months of single surveys per month and four months of doubled

surveys per month. The impacts of these doubled survey efforts will be discussed in Section 4.3 Estimated Avian and Bat Mortalities.

Upon the discovery of a bird or bat fatality, information regarding the location, species, and condition were recorded. Specific data collected for each carcass is provided in Attachment C: Casualty Information Field Form. Additionally, all carcasses were photographed and their locations were recorded using a Trimble XT sub-meter global positioning system unit. The criteria used to determine a fatality were defined in the monitoring plan. In accordance with the monitoring plan, to be considered a turbine-related fatality, all remains must have been comprised of no less than 5 bones or 10 feathers. In the event that remnants of a bird (i.e., less than 10 feathers of 5 bones) were discovered, the incident was to be recorded but not considered a facility-related fatality. No such incidents occurred during the first year. After all relevant information was recorded, the mortality was collected, placed in a labeled plastic bag, and stored in an on-site freezer until used in a searcher efficiency trial or disposed of. All golden eagle remains were shipped to the National Eagle Repository in Commerce City, Colorado, as directed by the USFWS. All other species were stored and utilized for carcass removal trials or searcher efficiency trials.

Incidental Findings

Mortalities that were discovered outside of the survey area or at a time other than during a regularly scheduled survey were processed using the same methods as a standardized mortality; however, they were identified as an incidental find. These types of mortalities were generally either discovered by the wind farm operator and reported to Insignia, or were discovered during avian use and abundance surveys.

2.1.1 Searcher Efficiency Trials

In order to estimate searcher bias, searcher efficiency trials were conducted to determine the rate at which carcasses were located. The survey year was divided into four seasons, and new trials were conducted during each season in order to include seasonal changes in landscape, weather, and other factors that may affect searcher efficiency. The specific dates of each season are shown in Table 3: Survey Seasons. Trials were conducted on dates when carcass surveys were already scheduled. Carcass surveyors were not made aware of when searcher efficiency trials were to be conducted in order to eliminate bias on dates when trials were conducted.

Table 3: Survey Seasons

Season	Dates
Spring	2/14/08–5/15/08
Summer	5/16/08–8/15/08
Fall	8/16/08–11/15/08
Winter	11/16/08–2/13/09

Four trials were conducted per season. During each season, a total of 20 birds—10 birds of a representative medium or large species and 10 birds of a representative small species—were placed in the field. Rock pigeons (*Columba livia*) were used to represent medium or large bird species, and Japanese quail (*Coturnix japonica*) were used to represent small bird species. These two species were used exclusively during the spring, summer, and fall trials of 2008. During the winter trials in 2008/2009, additional birds were obtained from two local rehabilitation centers—the California Raptor Center and the Lindsay Wildlife Museum—and utilized in the study. In addition to the eight Japanese quail utilized, the trial also included one cedar waxwing (*Bombycilla cedrorum*) and one pine siskin (*Carduelis pinus*), which represented small birds, and four barn owls (*Tyto alba*), three sharp-shinned hawks (*Accipiter striatus*), one red-tailed hawk, one red-shouldered hawk (*Buteo lineatus*), and one Cooper's hawk (*Accipiter cooperii*), which represented medium or large birds.

Birds were placed in the field early in the morning prior to surveyor arrival, and were marked with brown electrical tape on one leg in order to distinguish them from actual mortalities. The locations of the carcasses were determined at random using Microsoft Excel. At the end of the survey day, the surveyor would contact the trial administrator and determine if all birds were recovered. Surveyors were then told where any remaining birds were located so they could be retrieved, though they often were subject to scavenging during that day and were no longer able to be located.

2.1.2 Carcass Removal Trials

Because scavengers can remove carcasses prior to their discovery by the surveyors, carcass removal trials were implemented in order to estimate the length of time a carcass remains in the field. Carcass removal trials were conducted once per season, using 20 birds—10 rock pigeons and 10 Japanese quail[1]. These carcasses were placed across the entire site using random locations determined using Microsoft Excel to generate random bearings and distances from the turbines. Each carcass was marked with green electrical tape on one leg in order to distinguish it from searcher efficiency trial birds and actual turbine mortalities. Upon placement in the field, the carcasses were checked daily for the first 3 days, after which they were checked every other day until day 14. After two weeks, they were checked once per week until the trial birds had been in the field for 60 days. During carcass checks, surveyors classified the carcass as one of four designations shown in Table 4: Carcass Scavenging Classifications.

[1] Rock pigeons and Japanese quail have been shown to have scavenging rates different from those of native birds. Game birds have been shown to have a removal rate higher than that of native small birds. Rock pigeons have been shown to have a removal rate between that of large raptors and medium/small non-raptors.

Table 4: Carcass Scavenging Classifications

Classification	Symbology	Determination
Intact	I	The carcass was undisturbed
Scavenged	S	The carcass had been scavenged[2] but the remains were located in the original drop location
Feather Spot	FS	The carcass was scavenged and removed; greater than 10 feathers or 5 bones remained
Removed	O	The entire carcass was removed; fewer than 10 feathers remained

3 – RESULTS

3.0 AVIAN USE AND ABUNDANCE STUDY

Avian use and abundance surveys found the five most common species in the area to be red-tailed hawk, common raven, golden eagle, turkey vulture, and American kestrel. Red-tailed hawk constituted approximately 27 percent of the observation records, and common raven constituted approximately 24 percent of the observation records. Avian scavengers, including common raven, American crow (*Corvus brachyrhynchos*), and turkey vulture, comprised 35 percent of all observations. Raptors, including red-tailed hawk, golden eagle, American kestrel, ferruginous hawk (*Buteo regalis*), burrowing owl, northern harrier (*Circus cyaneus*), and Swainson's hawk (*Buteo swainsoni*), constituted approximately 53 percent of all records. Other common species observed on site included American coot (*Fulica americana*), California gull (*Larus californicus*), western meadowlark, Brewer's blackbird (*Euphagus cyanocephalus*), horned lark, mourning dove (*Zenaida macroura*), red-winged blackbird (*Agelaius phoeniceus*), Canada goose (*Branta canadensis*), and mallard (*Anas platyrhynchos*). The plotted locations of avian use locations are shown in Figure 3: All Species Usage Map and the locations of the four key species are shown in Figure 4: Key Species Usage Map.

Morning observations yielded a similar number of birds present (57 percent) when compared to birds present during the afternoon observations (43 percent). Winter and spring months presented higher numbers of observations than did the summer and fall months, indicating that the site may be more utilized by avian species during the winter and spring months.

3.1 SEARCHER EFFICIENCY TRIALS

A total of 80 birds were utilized for the study—40 medium/large birds and 40 small birds. Results of the searcher efficiency trials showed an average searcher efficiency rate of 69 percent.

[2] A determination of whether a carcass was scavenged is described in Attachment B: Avian and Bat Monitoring Plan for the Buena Vista Wind Energy Project.

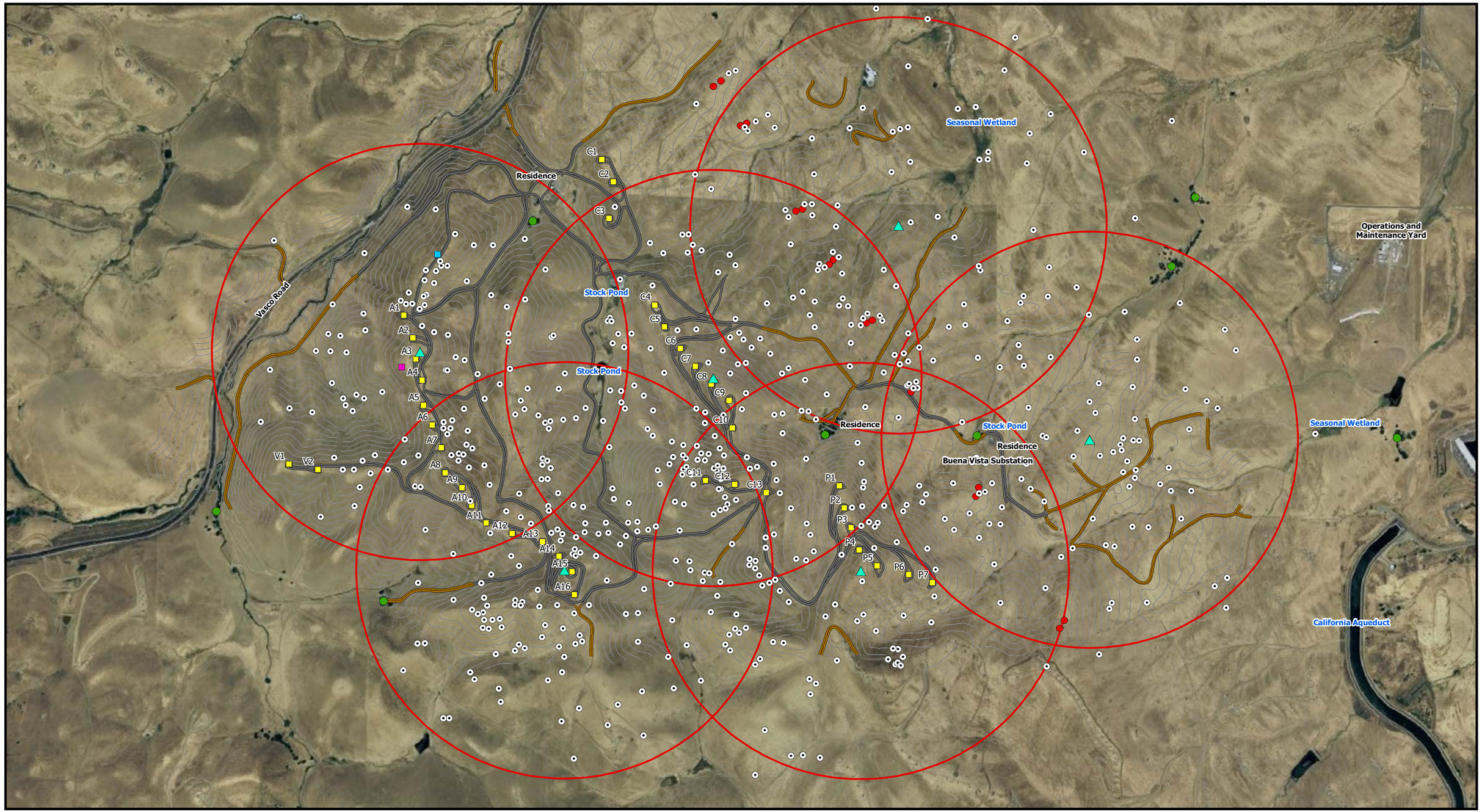

Figure 3: All Species Usage Map

Buena Vista Avian and Bat Monitoring Project

- Turbine
- Record of Avian Use
- Cellular Phone Relay Tower
- Meteorological Tower
- Observation Point
- PG&E Transmission Tower
- Tree Grove
- Observation Area
- Dirt Access Road
- Gravel Access Road
- Contour Line

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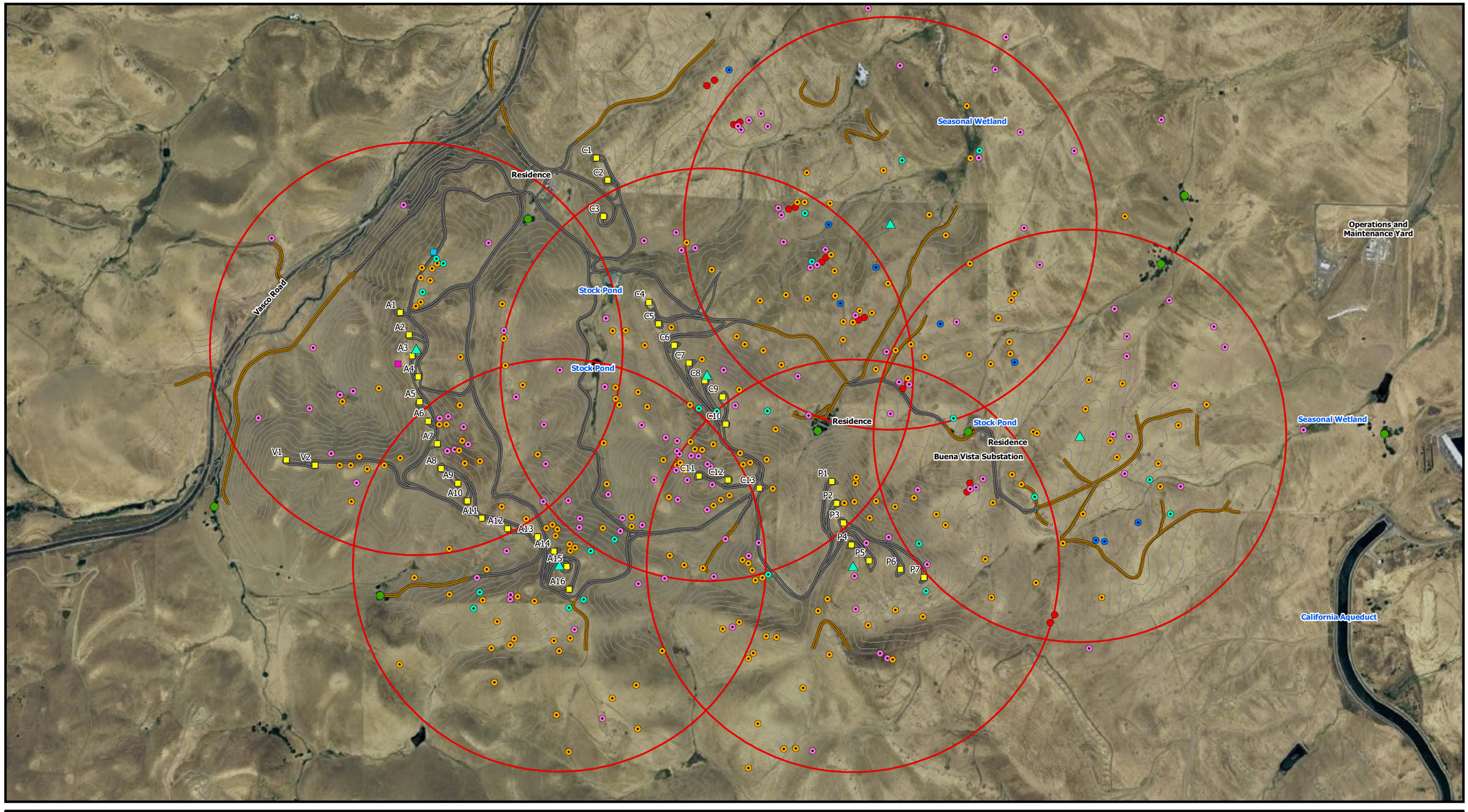

Figure 4: Key Species Usage Map

Buena Vista Avian and Bat Monitoring Project

- Turbine
- American Kestrel
- Burrowing Owl
- Golden Eagle
- Red-Tailed Hawk
- Cellular Phone Relay Tower
- Meteorological Tower
- Observation Point
- PG&E Transmission Tower
- Tree Grove
- Observation Area
- Dirt Access Road
- Gravel Access Road
- Contour Line

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Of the approximately 31 percent of carcasses that were not initially detected, 52 percent were not recovered at the end of the day and may have been scavenged. Seasonal variation and variation related to carcass size in relation to searcher efficiency is shown in Table 5: Searcher Efficiency Rates.

As shown in Table 5: Searcher Efficiency Rates, a greater overall efficiency rate was achieved during the summer and fall months. In addition, a significantly greater efficiency rate was achieved when using large-bodied birds than when using small-bodied birds. During the winter 2008/2009 trial, species composition was changed and a greater variety of species was used to represent the two bird carcass size classes. While only rock pigeon and Japanese quail were used for the spring 2008, summer 2008, and fall 2008 trials, additional species were used in during the winter 2008/2009 trial. Though the overall efficiency rate was lower during the winter 2008/2009 season, four Japanese quail—the only species used for the previous three trials—and four individuals of the mixed species—one barn owl, one sharp-shinned hawk, one pine siskin, and one cedar waxing—were not detected by searchers. Because searchers missed equal numbers of the original species and new species, it can be suggested that they do not have differing detection rates.

Table 5: Searcher Efficiency Rates

Season	Medium/Large Birds[3]	Small Birds[4]	Overall
Spring	90%	40%	65%
Summer	80%	70%	75%
Fall	100%	50%	75%
Winter	80%	40%	60%
Total	**87.5%**	**50%**	**69%**

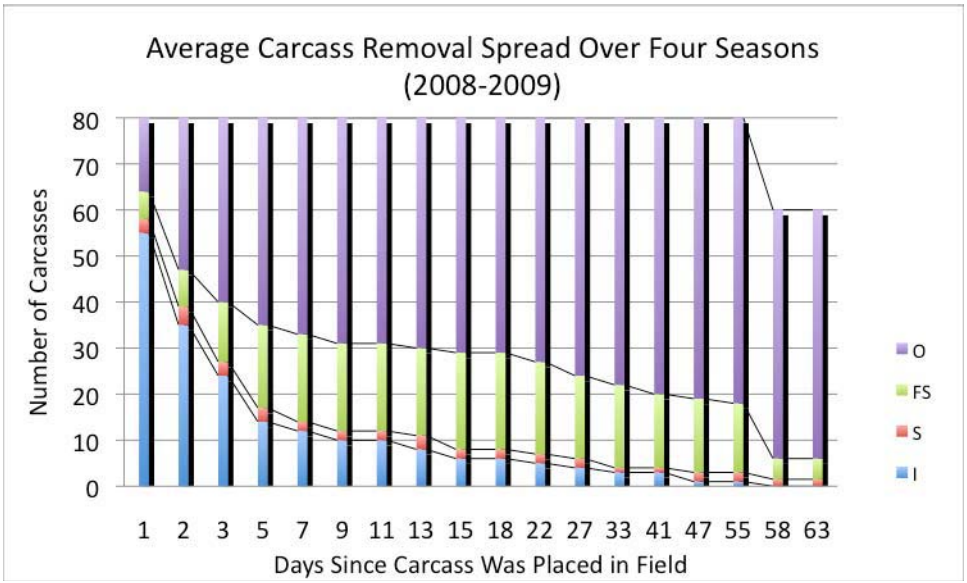
3.2 CARCASS REMOVAL TRIALS

The greatest carcass scavenging rate occurred during the first 72 hours after the carcass was placed in the field, with an average of 75 percent of all carcasses showing some form of scavenging. Scavenging trends differed between seasons with the fastest scavenging rates occurring during the fall and winter trials, as shown in Figure 5: Cumulative Carcass Removal and Figure 6: Carcass Removal by Season. Definitions of the classifications for the carcasses are summarized in Table 4: Carcass Scavenging Classifications. The mean length of time that a carcass was left in the field was approximately 30 days.

[3] Rock doves were used exclusively during the spring, summer, and fall seasons. During the winter season, four barn owls, three sharp-shinned hawks, one Cooper's hawk, one red-tailed hawk, and one red-shouldered hawk were used.

[4] Japanese quail were used exclusively during the spring, summer, and fall seasons. During the winter season, eight Japanese quail, one cedar waxwing, and one pine siskin were used.

Figure 5: Cumulative Carcass Removal



Note: Total values for days 58 and 63 are reduced because the spring 2008 trial ended on day 57. A description of the definitions used is included in Table 4: Carcass Scavenging Classifications.

3.3 AVIAN AND BAT MORTALITY SURVEYS

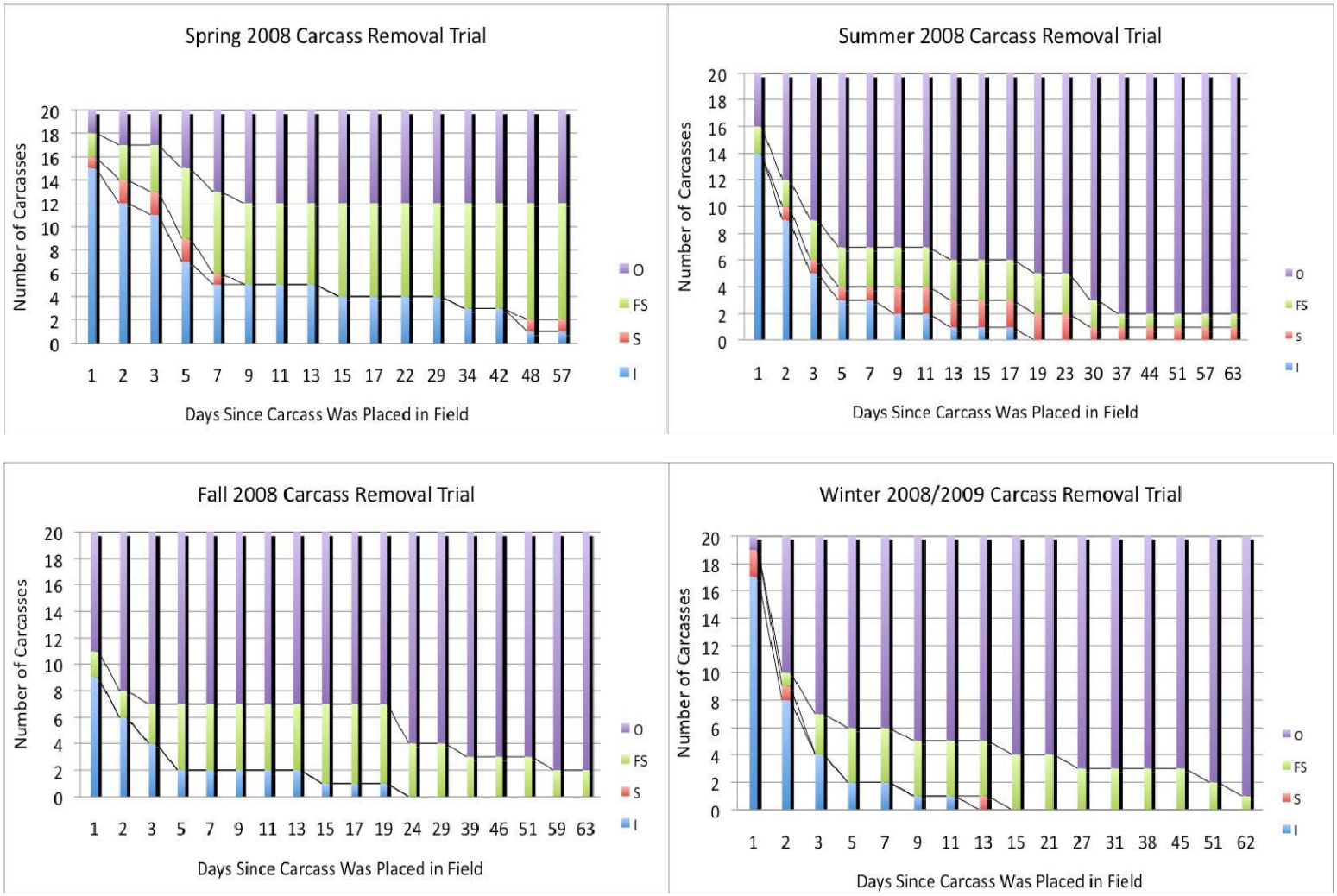
Mortality surveys began in February 2008 after clean sweep surveys had been conducted to remove all pre-existing mortalities from the site. From February 2008 through August 2008, all turbines were surveyed once per month, generally over a 6-day period divided into two 3-consecutive-day periods. After the disclosure of the settlement agreement between the California State Attorney General and BV LLC, surveys were doubled and each turbine was surveyed twice per month. Surveys were then divided into four 3-consective-day periods. The number of searcher efficiency trials and carcass removal trials that were conducted remained unaffected by the agreement.

3.3.0 Bird Mortalities

Clean sweep surveys were conducted over a 6-day period between January 31, 2008 and February 9, 2008. During these surveys, two red-tailed hawks were discovered. After the clean sweep surveys were completed, standardized turbine mortality searches began.

During the first year of mortality surveys, 18 mortalities were recorded on site, including two birds discovered during clean sweep surveys and three incidental birds discovered during avian use and abundance surveys. Of these mortalities, 17 were birds and one was a bat. Of the 17 bird mortalities, nine were raptors and eight were non-raptors. The discovery of carcasses was generally concentrated in the spring and summer months, with 11 of the 16 standardized mortalities recorded from May 2008 to August 2008 (this period was limited to surveying the turbines once per month). Of the nine raptor mortalities that were recorded during the first year, eight individuals were identified to be one of the four key focal species identified in the EIR—four red-tailed hawks, three golden eagles, and one American kestrel. The most commonly

Figure 6: Carcass Removal by Season



Note: A description of the definitions used is included in Table 4: Carcass Scavenging Classifications.

discovered species was red-tailed hawk (with four mortalities discovered, though two were noted during the initial clean sweep surveys). More detailed information regarding each mortality is provided in Table 6: Avian and Bat Mortalities. Locations of all mortalities are shown in Figure 7: 2008 Avian and Bat Mortalities Map. A distribution of mortalities, excluding the clean sweep individuals, is shown in Figure 8: Seasonal Distribution of Carcass Discovery.

3.3.1 Bat Mortalities

Only one bat mortality was recorded during the first year of surveys. The incident involved a hoary bat (*Lasiurus cinereus*) that was discovered in March 2008 along the C-string of turbines.

4 – DISCUSSION AND CONCLUSIONS

4.0 AVIAN USE AND ABUNDANCE STUDY

4.0.0 Spatial Distribution of All Species

Avian use and abundance surveys revealed several areas throughout the wind farm that were more heavily utilized by birds than others. These areas include around Turbines C11, C12, and C13, which are located on the peak of one of the largest hills on site; near each PG&E transmission tower; and along the southern and eastern sides of the westernmost ridgeline on which the A-string is located. These areas are shown in Figure 3: All Species Usage Map. Increased activity near the PG&E transmission towers is a result of perching on the towers, which was commonly noted on site by many species of birds. The remaining two areas—along the A-string and near Turbines C11, C12, and C13—were located where strong updrafts exist. Increased activity is likely the result of prevailing winds entering the site from the south and west, creating constant updrafts. These areas create ideal conditions for contour flying by raptors, vultures, and ravens.

Most likely a result of up-drafting winds, clusters of observations were recorded along steeper ridges running along the sides of the turbine strings, as shown in Figure 3: All Species Usage Map. Drafting winds are commonly used by raptors and other large birds to save energy and cover large distances while hunting or traveling. In flatter areas east and south of the wind turbines, observation records become more scarce and scattered, likely a result of decreased drafting.

4.0.1 Spatial Distribution of Four Key Species

Distribution trends of the four key species were more distinct than the overall general trends of all species. A map showing the locations of all observation records of the four key species is shown in Figure 4: Key Species Usage Map

All observation records for burrowing owl were noted from Observation Point #1 and Observation Point #2. These observation points are located in the eastern portion of the study area, which represent the lowest and flattest topography of the study area. In addition, these two observation points were designed to represent areas outside of the turbine zone and subsequently are over 800 meters from the nearest turbine. The eastern portion of the study area appears to be the only active burrowing owl area near the project. Burrowing owls were the least common of

the four key species, and no burrowing owl mortalities were recorded during the year. The low number of burrowing owl observations could also be explained by their flight pattern, which generally does not involve flying high enough above the terrain to be detected from adjacent ridgelines. The majority of burrowing owl observations were made while the owls were perching outside of burrows or flying along low ravines.

American kestrels were detected less frequently than golden eagles or red-tailed hawks. This is in part related to the seasonality of American kestrels—they are more common on site during the winter months. This may be due to a lack of suitable nesting habitat directly on site. Observations noted during the spring, summer, and fall months make up approximately 25 percent of the entire year's observations for this species. Areas where observations were recorded include the southern and northern ends of the A-string ridge, the southern end of the P-string, and along the southern end of a ridgeline between Turbines C10 and C11. Other scattered observations were documented in the eastern portion of the study area within lower elevations. The one American kestrel mortality was recorded near Turbine A9 along the middle of the ridge and turbine string.

Golden eagle use on site was distributed throughout the study area with increased observations along the ridge surrounding Turbine C11, as well as within the valley separating the A-string from the C-string turbines. A reduced number of observations were noted along the leeward (eastern) side of the C-string ridge. Additional records were documented along the transmission towers, which were commonly used for perching. The three golden eagle mortalities that were recorded during the year were all discovered along the A-string, as shown in Table 6: Avian and Bat Mortalities.

Red-tailed hawk was the most commonly observed species during the avian use and abundance surveys. Records were distributed throughout the survey area. Concentrated areas of use were located along the eastern sides of ridgelines near Turbines A14, A1, A7, and C11, and the P-string. Red-tailed hawks were the most common mortalities recorded on site with mortalities found near Turbines C5, A6, and A11.

4.0.2 Influencing Factors

Several factors can influence the avian use and abundance study data. One drawback is that observations were only made once per month, leading to a small overall sample size. This potentially allows for observations to be recorded on atypical days, not accurately displaying typical avian use and abundance. Another influencing factor is the need for observers to subjectively estimate the location, height, and distance of birds flying. Observers had to translate the location of a flying bird onto aerial maps leading to potential inaccuracies in mapping information. Also, because observations were recorded every 30 seconds, birds could enter and leave the survey area without being recorded.

Table 6: Avian and Bat Mortalities

Species	Date Found	Classification	Focal Species	Age	Sex	Nearest Turbine	Distance from Turbine (Meters)	Location within Turbine String	Evidence of Scavenging	Decay	Notes
Bats											
Hoary bat (*Lasiurus cineeus*)	3/14/08	Mortality	No	Adult	Unknown	C12	5	Middle	The carcass was scavenged by invertebrates.	The carcass was dried out and consisted of only skin and bones.	The skull was fractured.
Raptors											
Red-tailed hawk (*Buteo jamaicensis*)	1/31/08	Clean Sweep	Yes	Unknown	Female	C5	36	Middle	The carcass was hollowed out and the lower half was missing.	The carcass was dry and comprised of feathers and bones. The fatality was estimated to be greater than one month old.	This individual was found during the initial clean sweep surveys.
Red-tailed hawk	2/7/08	Clean Sweep	Yes	Adult	Unknown	A6	55	Middle	The remains of the carcass were hollowed out.	The remains were comprised of only feathers and bones. The fatality was estimated to be greater than one month old.	The ulna, radius, and scapula were fractured. This individual was found during the initial clean sweep surveys.
Red-tailed hawk	5/16/08	Mortality	Yes	Adult	Female	A11	42	Middle	The carcass was hollowed out, and beetles and maggots were present.	Dried flesh was still present. The carcass was estimated to be over one week old.	The right humerus was fractured.
Golden eagle (*Aquila chrysaetos*)	7/24/08	Mortality	Yes	Juvenile	Male	A4	49	Middle	The carcass was scavenged by invertebrates.	Dried flesh was still present. The carcass was believed to be greater than two weeks old.	The humerus was cleanly fractured.
Golden eagle	7/24/08	Mortality	Yes	Juvenile	Female	A7	64	Middle	The carcass was scavenged by invertebrates.	Dried flesh was still present. The carcass was believed to be greater than two weeks old.	The right wing and right leg were fractured and severed from body.
American kestrel (*Falco sparverius*)	7/25/08	Mortality	Yes	Adult	Female	A9	50	Middle	Only feathers were discovered.	Only feathers remained. Carcass was estimated to be over one week old.	None
Prairie falcon (*Falco mexicanus*)	8/22/08	Mortality	No	Adult	Male	A9	30	Middle	Only the left wing and scattered feathers were discovered.	The remains were dry and estimated to be greater than one week old.	None
Golden eagle	1/4/09	Incidental	Yes	Juvenile	Male	A2	30	Middle	This carcass was not scavenged.	The carcass was believed to have been no more than two days old.	The carcass was found during avian use and abundance surveys. The severed wing was discovered near Turbine A4.

Species	Date Found	Classification	Focal Species	Age	Sex	Nearest Turbine	Distance from Turbine (Meters)	Location within Turbine String	Evidence of Scavenging	Decay	Notes
Red-tailed hawk	1/16/09	Mortality	Yes	Adult	Female	C5	37	Middle	Evidence of scavenging was present with fresh exposed flesh. No invertebrate scavengers were present and bird scat was observed near the carcass. The right wing and both legs were scavenged and found 50 meters from turbine.	Little to no decay of the carcass was observed. Fresh flesh lead to the assumption that the carcass was between zero and three days old.	The right wrist was fractured
Non-Raptors											
Lesser goldfinch (*Carduelis psaltria*)	2/14/08	Incidental	No	Adult	Female	A15	16	End	No evidence of scavenging was present.	The carcass was fresh and estimated to be between zero and three days old.	The right scapula was fractured/dislocated. The carcass was found during avian use and abundance surveys.
Unknown sparrow (Family Emberizidae)	4/19/08	Incidental	No	Adult	Unknown	C6	80	Middle	It was unclear whether carcass was scavenged. The head was missing.	Because the flesh was fresh, the carcass was estimated to be less than three days old.	The head was missing and the species was therefore unable to be identified.
Yellow warbler (*Dendroica petechia*)	5/10/08	Mortality	No	Adult	Male	P6	69	Middle	The carcass was scavenged between discovery in morning and the attempt to retrieve it at the end of the day.	The carcass was fresh and estimated to be under three days old.	The femur was fractured.
Unknown goldfinch (*Carduelis* sp.)	5/15/08	Mortality	No	Adult	Male	A3	73	Middle	The carcass was not scavenged.	The carcass was estimated to between four and seven days old.	None
Rock pigeon (*Columba livia*)	5/15/08	Mortality	No	Adult	Unknown	A5	7	Middle	The carcass was not scavenged.	The carcass was estimated to be between zero and three days old.	The neck was fractured.
Horned lark (*Eremophila alpestris*)	5/17/08	Mortality	No	Adult	Male	V1	26	End	Scavenged by invertebrates	The flesh was dried. The carcass was estimated to be between one week and one month old.	None
Western tanager (*Piranga ludoviciana*)	6/21/08	Mortality	No	Adult	Male	V1	59	End	Hollowed out though unclear as to type of scavenger.	The flesh was dry. The carcass was estimated to be greater than one week old.	The carcass was decapitated.
Black-throated gray warbler (*Dendroica nigrescens*)	8/21/08	Mortality	No	Adult	Female	A2	56	Middle	Any evidence of scavenging was difficult to assess due to the fact that the carcass was greater than two weeks old.	The flesh was dried. The carcass was estimated to be between two weeks and one month old.	The wings and skull were fractured.

Figure 7: 2008 Avian and Bat Mortalities Map

Buena Vista Avian and Bat Monitoring Project

- Turbine
- Bird or Bat Mortality
- Cellular Phone Relay Tower
- Meteorological Tower
- Observation Point
- PG&E Transmission Tower
- Tree Grove
- Dirt Access Road
- Gravel Access Road
- Contour Line

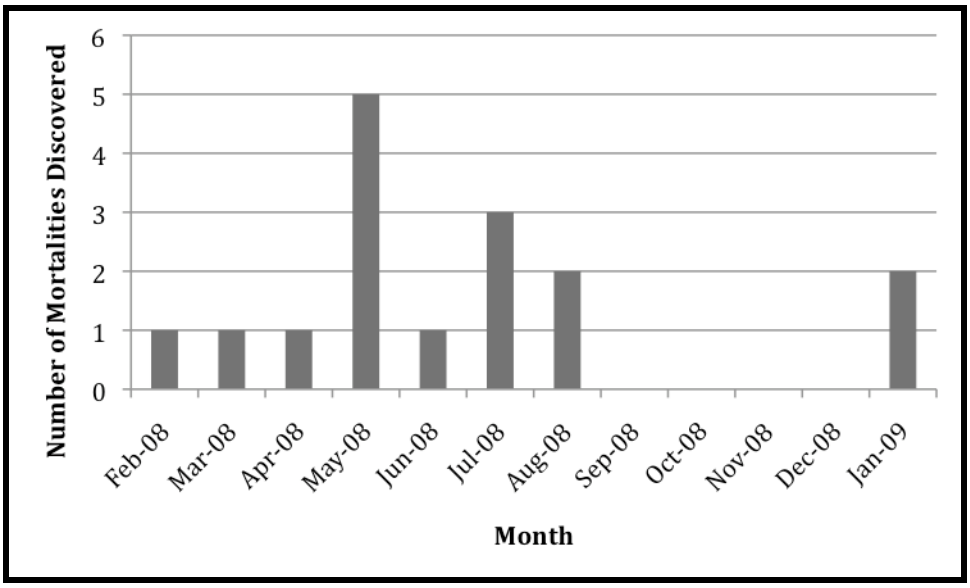
INSIGNIA ENVIRONMENTAL

1:11,000

N W E S

0 500 1,000 2,000 3,000 4,000 Feet

Figure 8: Seasonal Distribution of Carcass Discovery



4.1 SEARCHER EFFICIENCY TRIALS

As discussed in Section 3.1 Searcher Efficiency Trials, variations in the searcher efficiency rate were observed in relation to the seasonality of the trial, as well as the species and size variation used. A discussion of these trends, as well as other factors that may have contributed to the variation in the results, is provided below.

4.1.0 Searcher Efficiency Related to Species/Size

As shown in Table 5: Searcher Efficiency Rates, large-bodied birds had an 87.5 percent rate of discovery, while small-bodied birds had a 50 percent rate of discovery. Differences in the efficiency rate between the large and small birds were a consistent trend throughout all four seasons. This may have been related not only to the size of the birds, but also to the species of birds. Different species can introduce differing color patterns or scavenging rates affecting the overall searcher discovery rate. To represent large-bodied birds, rock pigeon was the primary species utilized. Most carcasses exhibited the typical gray body color, though a small number were brown. No white rock pigeons were used. The typical small-bodied species, Japanese quail, had a mottled brown coloration similar to the natural landscape. Native species used during the winter season had a variety of color patterns, including white barn owl, gray waxwing, and auburn red-tailed hawk. Winter 2008/2009 season carcasses also introduced a variety of sizes into the trial. With this greater variation in species, it was noted that efficiency rates were still greater for the medium/large-bodied birds than for the small-bodied birds. When compared to searcher efficiency rates at other wind farms in the western U.S., it can be seen that the observed searcher efficiency rates at Buena Vista are similar to those from other wind farms, as shown in Table 7: Comparison to Other Searcher Efficiency Rates.

Table 7: Comparison to Other Searcher Efficiency Rates

Location	Small Bird Efficiency	Medium/Large Bird Efficiency
Byron, California (Buena Vista)	50	87.5
Klondike, Oregon[5]	75[6]	92[7]
Foote Creek Rim, Wyoming[8]	59[9]	92[10]
Altamont Pass, California[11]	51[12]	80[13]

4.1.1 Seasonal Differences in Efficiency Rate

Differences in the searcher efficiency rate were observed between the designated seasons, as shown in Table 5: Searcher Efficiency Rates. Overall efficiency rates of 75 percent were recorded in both the summer 2008 and fall 2008, while rates of 65 percent and 60 percent were recorded during the spring 2008 and winter 2008/2009 seasons, respectively. For large-bodied birds, the spring 2008 and fall 2008 searcher efficiency trials showed the highest efficiency rate; however for small-bodied birds, the summer 2008 and fall 2008 searcher efficiency trials reflected the highest rate of discovery for this size class. Potential reasons for these trends may be related to vegetation cover or weather, both of which vary significantly throughout the year. These factors are further discussed in Section 4.1.2 Other Potential Influences to Searcher Efficiency.

4.1.2 Other Potential Influences to Searcher Efficiency

Searcher efficiency can be affected by a variety of factors, ranging from the ability of the surveyor to environmental conditions. Potential biases or other external influences that may have affected the overall searcher efficiency rate include:

- Weather conditions
- Vegetation cover
- Knowledge of the trial
- Addition of new searchers
- Species utilized
- Scavenging

[5] Johnson, 2003
[6] House sparrows (*Passer domesticus*) and western meadowlarks were used to represent small birds.
[7] Rock doves, mallards, and chukars (*Alectoris chukar*) were used to represent medium to large birds.
[8] Young, 2003
[9] Adult house sparrows and juvenile Japanese quail were used to represent small birds.
[10] Mallards and rock doves were used to represent medium to large sized birds.
[11] Smallwood and Thelander, 2007
[12] Estimates within the Altamont Pass were broken into sub-classes—estimates for small-bodied non-raptors are shown. A complete species composition was not included.
[13] Estimates within the Altamont Pass were broken into sub-classes—estimates for large-bodied non-raptors are shown. A complete species composition was not included.

Weather Conditions

Weather conditions, such as high winds, dense fog, rain, or excessive heat, have the potential to affect a surveyor's efficiency rate based on natural ability to cope with extreme conditions. To reduce this influence on the trials, mortality surveys were not conducted during conditions where winds exceeded 55 kilometers per hour, and summer surveys were generally conducted early in the day to avoid the heat. A summary of weather conditions recorded during the trials is shown in Table 8: Searcher Efficiency Trial Weather Conditions. As shown in Table 8: Searcher Efficiency Trial Weather Conditions, trials were conducted on two occasions during days with precipitation. It should be noted that the precipitation was light and did not prevent surveyors from conducting a full day's worth of surveys on these two dates.

Vegetation

Vegetation cover in the area can also affect the ability of the surveyor. Vegetation cover within Buena Vista is summarized by annual grassland that is subject to livestock grazing. During winter and spring seasons, vegetation in the area can grow to waist-height, especially in areas where grazing may not have occurred. This increased vegetation can make locating carcasses difficult due to decreased visibility. During the summer and fall seasons, vegetation is generally grazed to near ground-level, and the lack of precipitation slows or eliminates vegetation growth. As would be expected, the summer 2008 and fall 2008 searcher efficiency trials resulted in the highest searcher efficiency rates—both 75 percent. Searcher efficiency rates during the winter 2008/2009 and spring 2008 trials were 60 percent and 65 percent, respectively.

Knowledge of the Trial

Surveyors were not aware of searcher efficiency trials prior to their occurrence in order to prevent searcher bias, where searcher efforts might have been altered if they had been aware of the trial. In order to eliminate confusion between trial carcasses and actual mortalities, all carcasses were marked on one leg with brown electrical tape. This inevitably alerted surveyors of the trial once the first marked bird was discovered. To decrease potential searcher bias related to knowing that a trial was underway, differing numbers of birds were utilized on each survey day. While not completely eliminating searcher bias, surveyors were not aware if they had found all of the carcasses that had been placed until the end of the day, thereby helping to decrease searcher bias.

Addition of New Searchers

Only one surveyor was employed to conduct the mortality surveys for the spring 2008 and summer 2008 seasons. After survey efforts were doubled beginning in August of 2008, an additional searcher began work on the project. Because searcher efficiency rates may differ between individuals, this could affect the overall searcher efficiency rate of the fall 2008 and winter 2008/2009 seasons when compared to the spring 2008 and summer 2008 searcher efficiency trials. Because the overall efficiency rate did not greatly differ between the two searchers, it can be assumed that this did not significantly effect on overall efficiency rates.

Table 8: Searcher Efficiency Trial Weather Conditions

Date	Time (a.m.)	Temperature (F)	Wind Direction	Wind Speed (mph)	Precipitation (Y/N)
Spring					
4/18/08	7:30	55	SW	25	N
5/9/08	7:30	65	W	25	N
5/10/08	7:30	67	NW	25	N
5/15/08	7:30	82	None	0	N
Summer					
5/16/08	7:30	87	None	0	N
6/19/08	7:30	82	N	5	N
6/20/08	7:30	83	None	0	N
6/21/08	7:30	79	S	5	N
Fall					
10/16/08	7:30	60	E	10	N
10/17/08	7:30	58	E	5	N
10/30/08	8:30	55	E	5	N
10/31/08	8:30	52	E	10	Y
Winter					
12/12/08	7:45	52	None	0	N
1/9/09	8:00	50	S	20	N
1/29/09	8:00	55	SE	15	N
2/13/09	7:30	45	W	10	Y

Species Composition

An influence on overall searcher efficiency could be attributed to the composition of species utilized for the trials. Due to limitations in the availability of native bird carcasses, rock pigeons and Japanese quail were utilized to represent the two size classes of birds for the spring 2008, summer 2008, and fall 2008 trials. After additional native carcasses were obtained from local rescue organizations, a greater variety of species was utilized. The overall searcher efficiency rate was lower during the winter 2008/2009 trial than during the spring 2008, summer 2008, and fall 2008 trials, as shown in Table 5: Searcher Efficiency Rates. While it may be proposed that the greater species composition may have altered efficiency rates, it should be noted, that of the undiscovered birds, half were of the native species and half were Japanese quail.

Scavenging

Scavenging by local wildlife, such as coyotes or ravens, has the potential to impact the observed searcher efficiency rate if carcasses are removed prior to the searchers surveying the area. This has the potential to lower the estimated searcher efficiency rate. Of the 80 carcasses that were placed in the wind farm, 25 were missed by the surveyors. Of those 25 birds, 52 percent were not recovered by the surveyors at the end of the day and were assumed to have been scavenged. Because it is unknown whether the carcasses were removed prior to or after the areas had been surveyed, it is difficult to tell if they were missed by the surveyor or scavenged. In one instance, a marked carcass was discovered the following day on a fencepost, obviously transported and partially consumed by a scavenger.

4.2 CARCASS REMOVAL TRIALS

Carcass removal rates are subject to many of the same influences that can affect the searcher efficiency trials such as weather, vegetation cover, or species composition.

4.2.0 Scavenger Swamping

Scavenger swamping is commonly identified as a potential influence to carcass removal trials. Scavenger swamping refers to the theory that the introduction of a high number of carcasses into the environment within a short time period will exceed the capability of local scavengers to remove them at the natural rate. These unscavenged carcasses then remain on site and become unattractive to vertebrate scavengers. These remaining mummified carcasses then typically persist through the remainder of the trial and have been shown to greatly increase the mean removal rate (Smallwood 2007). Because of this phenomenon, it can be difficult to determine whether the sample size is appropriately sized (Bell 2009). Because the sample size was consistent throughout each trial, scavenger swamping is not assumed to have influenced the results between seasons, as discussed further in Section 4.2.2 Seasonal Differences in Carcass Removal.

4.2.1 Carcass Removal Related to Species/Size

Carcass removal trials revealed correlations in scavenging trends between the two different species that were used. Rock pigeons, which represented the large-bodied carcasses, were more often scavenged in place, producing a high ratio of feather spots. In contrast, feather spots were fairly uncommon from the Japanese quail carcasses. This may be in part related to the size of the

carcasses, as opposed to the species. Presumably, smaller carcasses are easier to carry away, especially by avian scavengers, when compared to larger ones. The comparison of carcass scavenging is shown in Figure 9: Carcass Scavenging by Species. In relation to turbine-related mortalities, this would potentially result in less small-bodied carcasses detected during the standardized carcass searcher trials, as there would be less evidence of mortality as opposed to larger bodied mortalities. In addition, because only two species were used for the trials, it is not known whether there are significant differences in molting patterns, which would increase or decrease the likelihood of leaving a feather spot.

4.2.2 Seasonal Differences in Carcass Removal

Carcass removal rates were the highest during the fall 2008 and winter 2008/2009 seasons where approximately 80 percent of carcasses were scavenged during the first 72 hours. Overall seasonal trends in carcass removal are shown in Figure 6: Carcass Removal by Season. Differences in carcass removal rates within different seasons may be related to factors such as the available prey base or vegetation cover. No fluctuations in the scavenger population composition or size were expected, as the two primary scavengers on site—coyote and common raven—are common year-round in the area.

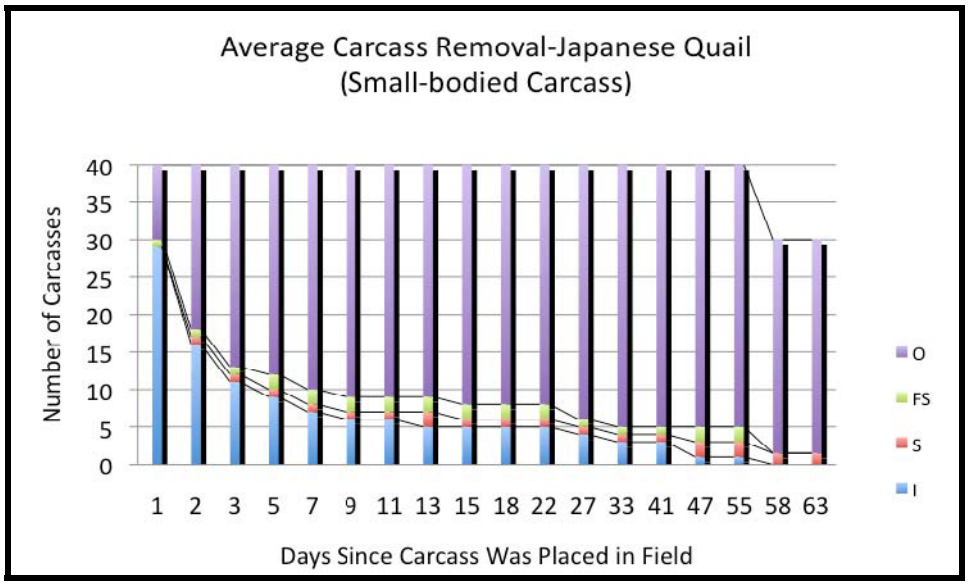
Prey Base

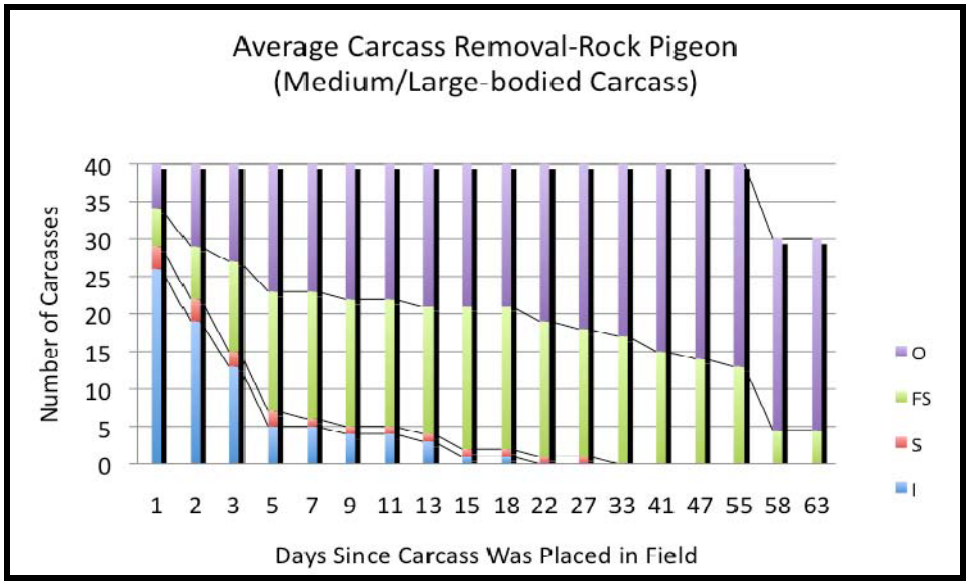
California ground squirrel populations fluctuate throughout the year in accordance with the amount of available food, breeding season, and predation, resulting in changes in the amount of prey for coyotes, bobcats, raptors, and other species. Because California ground squirrels are a primary source of prey in the area, fluctuations in the amount of available food may affect the observed scavenging rate, as some species may only resort to scavenging in times when food is more scarce.

Vegetation Cover

The increase in vegetation growth during the winter and spring has the potential to decrease the efficiency of scavengers, such as ravens or raptors, which rely on visibility to locate prey in the field. Vegetation cover is greatly reduced during the summer and, by the fall, the project area is grazed to near ground level. This low amount of vegetation cover can extend into the winter season depending upon precipitation, as was observed during the winter 2008/2009 surveys. Due to the low amount of early seasonal precipitation, vegetation was slow to begin its growing season. Because winter 2008/2009 season carcasses were placed in November, after the project area was grazed, the increase in open cover may have increased the scavenging rate. In contrast, because summer 2008 season carcasses were placed in May when tall vegetation was prevalent, scavenging may have been delayed or reduced.

Figure 9: Carcass Scavenging by Species





Note: Total values for days 58 and 63 are reduced because the spring 2008 trial ended on day 57. Descriptions of the items in the legend are provided in Table 4: Carcass Scavenging Classifications.

4.3 ESTIMATED AVIAN AND BAT MORTALITIES

4.3.0 Adjusted Mortality Rate

Based on the statistical methodology outlined in the monitoring plan, the estimated number of facility-related fatalities was calculated by:

$$M = \frac{N \cdot \bar{c}}{\hat{\pi}}$$

where N equals the number of turbines, $\bar{c}$ equals the observed number of carcasses, and $\hat{\pi}$ equals the estimate of the probability that a casualty is not removed by a scavenger and is detected. The following equation was used to estimate $\hat{\pi}$:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I}\left(\frac{e^{I/t} - 1}{e^{I/t} - 1 + p}\right)$$

where p is the estimated observer detection probability, I is the interval in days (I=30) between searches, and $\bar{t}$ is the mean carcass removal time (days).

Using the unadjusted number of mortalities, 13, the estimated total number of facility-related fatalities for 2008/2009 was approximately 43.7 (90 percent confidence interval of 16.0 to 122.6). This rate was not calculated using the two clean sweep individuals or the three incidental discoveries. This results in an estimation of 1.15 mortalities per year per turbine. Because each turbine is 1.0 MW, this number also represents the number of mortalities per year per MW. In terms of raptor mortalities, the estimated number of facility-related fatalities was 0.44 mortalities per year per turbine, totaling 16.7 raptor mortalities per year. This number is below the estimated 80 raptor mortalities per year outlined in the EIR (Contra Costa County 2004) and the estimated 54 key species mortalities per year outlined in the settlement agreement. The estimated number of facility-related mortalities for each of the four key species is outlined in Table 9: Estimated Key Species Mortalities. The estimated number of key species mortalities per year, not including incidental findings, was 13.7. This is greater than a 70 percent reduction—the standard established in the settlement agreement—and therefore would not initiate any type of operational or development restrictions. Estimates of the number of mortalities per year for the key species all fell within or below the estimated range outlined in the EIR, with the exception of golden eagles, as shown in Table 9: Estimated Key Species Mortalities.

Mortality estimates were calculated assuming that each turbine was surveyed once per month for one year. Because doubled survey efforts were only implemented for approximately 6 months, a full year of data was not available reflecting these survey methods. Because of the high seasonal variability in mortality discovery throughout the year, it was determined that a full year of doubled survey efforts was needed in order to provide a first estimate of the number of facility-related fatalities with the decreased survey interval.

Table 9: Estimated Key Species Mortalities

Species	EIR Estimated Mortalities Per Year	Observed Number of Mortalities[14]	Estimated Number of Mortalities Per Year	90% Confidence Interval
Burrowing owl	0	0	0	0
American kestrel	0.7–3.2	1	2.3	0–8.3
Golden eagle	2.5–4	2	4.6	0–13.1
Red-tailed hawk	5.3–7.7	2	6.8	1.6–15.8

4.3.1 Alternative Rates

Incidental Finds

In addition to the estimated total number of facility-related fatalities outlined in the monitoring plan, an alternative mortality rate was calculated to include incidental findings in the mortality rate. Assuming that an incidental mortality is still facility-related, an alternative estimate was calculated. Because the incidental mortalities were all noted within the standardized survey area, but not within a designated survey period, it is difficult to know whether, if left in place, they would be scavenged prior to the next standardized turbine survey in the area and therefore, be undetected. After including the incidental mortalities within the standardized turbine mortalities, the estimate of the total number of facility-related fatalities increased from 43.7 to 49.4. This estimate includes one additional raptor—a golden eagle—and two additional non-raptors—a lesser goldfinch and an unknown sparrow. With the addition of the golden eagle, the estimated number of key species mortalities would raise from 13.7 to 15.2. These differences in the estimated number of facility-related fatalities are shown in Table 10: Alternative Estimates of Facility-Related Fatalities. Changes to the protocol for the discovery of mortalities during avian use and abundance surveys are being reviewed and may remedy the question of how to classify these incidental findings for the coming survey years.

Alternate Estimates

In addition to the methodology outlined in the monitoring plan, an additional equation commonly used to estimate mortalities was used to determine how their values differed. The second equation does not take into account *I,* the interval between surveys. This alternate estimator of adjusted of mortality is:

$$M_A = \frac{M_U}{R \cdot p'}$$

where M_U is the unadjusted number of fatalities per turbine, R is the proportion of carcasses remaining since the last fatality search during a carcass removal trial, and p' is the proportion of

[14] The observed number of mortalities only includes individuals discovered during regularly scheduled mortality surveys, therefore, incidental findings and clean sweep mortalities are not included.

carcasses found by fatality searchers during searcher efficiency trials (Smallwood 2007). When calculating this number for Buena Vista, it resulted in the same values previously calculated—43.6 facility-related fatalities per year, including similar estimations for the various key species.

Table 10: Alternative Estimates of Facility-Related Fatalities

Species	Observed Number of Mortalities	Estimated Number of Mortalities Per Year	Alternative Observed Number of Mortalities[15]	Alternative Estimated Number of Mortalities
Raptors	6	16.6	7	18.1
Non-raptors/bats	7	27.0	9	31.2
Burrowing owl	0	0	0	0
American kestrel	1	2.3	1	2.3
Golden eagle	2	4.6	3	6.1
Red-tailed hawk	2	6.8	2	6.8

4.3.2 Seasonal Distribution of Fatalities

As shown in Figure 8: Seasonal Distribution of Carcass Discovery, the turbine-related mortalities were not equally distributed throughout the year. No mortalities were recorded from August 22, 2008 until January 4, 2009. As stated in the California State Attorney General's settlement agreement with BV LLC, if the turbine-related mortality reduction goals were not reached, shutdowns may occur from November 15 to February 28. Only 2 of the 18 mortalities, including an incidental finding, were recorded within this timeframe, suggesting that limited operations within this period may not result in a significant reduction in overall mortalities.

4.3.3 Species Variation of Fatalities

Of the 18 recorded mortalities, 13 different species were identified. The most common species was golden eagle with two standardized mortalities and one incidental detection. The second most common species was red-tailed hawk with two standardized mortalities. Two red-tailed hawk individuals were identified during the clean sweep surveys, though they were not considered to have been killed during the survey timeframe. All other species were detected only once each.

4.3.4 Spatial Distribution of Fatalities

Trends relating to the spatial distribution of mortalities can help to identify areas where disproportionally high numbers of mortalities are detected. As shown in Figure 7: 2008 Avian and Bat Mortalities Map, mortalities were detected along all four turbine strings. Of the 18 mortalities, 11 were recorded along the A-string, 2 along the V-string, 1 along the P-string, and 4

[15] Alternative rates include incidental discoveries in addition to fatalities discovered during standardized carcass surveys.

along the C-string. While these numbers vary, it should be considered how many turbines exist within each string in order to fully determine their impact. For example, while only two mortalities were recorded along the V-string, the string only consists of two turbines. The individual turbines with the highest number of observed mortalities were Turbines A2, C5, V1, and A9, all of which had two mortalities. When these towers are compared to Figure 3: All Species Usage Map, it should be noted that all of these turbines were located along the tops of northward-facing slopes, though avian usage did not necessarily appear to be higher. Areas where limited or no turbine-related mortalities were recorded include Turbines C1 to C3, C7 to C10, and P1 to P6. Avian usage at these turbines appeared to be lower than that surrounding the A-string turbines but greater than the V-string turbines. These turbines vary in elevation and height but are all located along the eastern side of the wind farm. These areas likely correspond to areas where prevailing wind patterns and topography may result in either reduced avian and bat use or increased visibility or potential avoidance of the turbines.

Spatial distribution of raptor mortalities on site, including incidental and clean sweep individuals, was concentrated to two areas. The first was within the northern end of the middle portion of the C-string (Turbines C4 to C10), where two mortalities were recorded. The second area was between Turbines A2 and A11, where the remaining seven raptor mortalities were recorded. For non-raptor mortalities, areas of concentrated mortalities existed between Turbines A2 and A5, where three mortalities were recorded, and along the V-string (Turbines V1 and V2), where two mortalities were recorded. No correlation was noted between the remaining three non-raptor mortalities. Because only one bat mortality was recorded (Turbine C12), it is infeasible to establish trends in bat mortality.

4.3.5 Mortalities Related to Turbine Height

Turbine heights at Buena Vista range from 45 meters to 60 meters. Because the height of the turbine can affect its position in the wind column, changes in the turbine height have the potential to reduce or increase the number of mortalities. Table 11: Turbine Heights in Relation to Observed Mortalities displays the number of raptor and non-raptor mortalities, including incidentals, which were observed in relation to the heights of the turbines where they were discovered. It should be noted that while differences in the number of mortalities can be seen, there also exists a differing number of turbines within each height range. It should also be noted that when the turbines were constructed, the height was based upon terrain and wind patterns. These spatial differences in the terrain and wind patterns may be the factor influencing the number of mortalities and not necessarily the turbine heights.

Table 11: Turbine Heights in Relation to Observed Mortalities

Turbine Height (meters)	Number of Turbines	Number of Raptor Mortalities	Number of Non-Raptor and Bat Mortalities
45	7	0	3
55	24	6	5
60	7	1	1

5 – RECOMMENDATIONS

The avian and bat mortality study will continue until February 2011, unless otherwise recommended by the TAC. Avian use and abundance surveys will continue until 2010. As outlined in the monitoring plan, searcher efficiency trials and carcass removal trials have been completed and will not continue unless otherwise requested by the TAC.

5.0 CONTINUATION OF SEARCHER EFFICIENCY TRIALS AND CARCASS REMOVAL TRIALS

As outlined in the monitoring plan, searcher efficiency trials and carcass removal trials were designed to be implemented for the first year of the study only, in order to determine baseline efficiency and scavenging information about the surveyors and wind farm. As discussed in Section 4.1 Searcher Efficiency Trials, observed searcher efficiency rates were similar to those observed at other wind farms in the western U.S. In addition, efficiency appeared to be more reliant on carcass size as opposed to carcass species, as shown during the winter 2008/2009 trial when a greater variety of species were introduced but yielded similar efficiency rates.

Carcass removal trials have also been completed, as outlined in the monitoring plan. Because there is no reason to believe that differences in the scavenging rate would be observed over multiple years, continuation of the trials are not necessary for the remainder of the 3-year study.

5.1 STATISTICAL METHODOLOGY

Due to the small sample size of the data collected (13 mortalities) bootstrapping[16] may be determined to be an unnecessary step in the statistical process, especially during the first few years of the study. Because the data set was so small, bootstrapping was not effective in determining if the dataset was robust. Statistical methods should be reviewed in order to determine if the methodology is designed to appropriately address small datasets.

Beginning in September, carcass surveys were increased from once per month to twice per month. Upon the completion of the first year of doubled survey efforts, the total number of facility-related fatalities per year can be re-calculated to include the lower search interval. Statistical methodology should be developed to incorporate the single survey period (February 2008 through August 2008) with the ongoing doubled survey period so that the data may be utilized in collaboration with data from the remainder of the study. This procedure should then be reviewed and approved by the TAC for adoption into the monitoring plan.

6 – REFERENCES

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[16] Bootstrapping is a statistical process that involves the repeated re-estimation of a parameter using random samples with replacement from the original data. This allows for analysis of many different variations in the data.

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ATTACHMENT A: REPRESENTATIVE PHOTOGRAPHS

ATTACHMENT A: REPRESENTATIVE PHOTOGRAPHS

Photograph 1: The C-string, shown during typical summer or fall vegetative conditions

Photograph 2: The C-string, shown during the winter

Photograph 3: An example of a turbine blade strike injury, shown here on the humerus of a golden eagle

Photograph 4: Facing west from Observation Point #1, showing the lower and flatter terrain of the eastern portion of the study area

Photograph 5: The single hoary bat mortality recorded during the year

Photograph 6: An unknown goldfinch mortality

Photograph 7: A golden eagle mortality

ATTACHMENT B: AVIAN AND BAT MONITORING PLAN FOR THE BUENA VISTA WIND ENERGY PROJECT

Avian and Bat Monitoring Plan
for the
Buena Vista Wind Energy Project

Contra Costa County, California

June 21, 2007

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Acknowledgement

An original draft of the monitoring plan for Buena Vista was authored by both WEST Inc. and Dr. Shawn Smallwood.

1.0 INTRODUCTION AND BACKGROUND

This monitoring program has been developed for the Buena Vista Wind Farm located in the Altamont Pass Wind Resource Area in Contra Costa County, California. In April of 2005 Contra Costa County approved a land use permit application and certified an Environmental Impact Report (EIR) for the repowering of the Buena Vista Wind Farm. The repowering project involved the removal of 179 older wind turbines and replacing them with 38 new, larger more efficient turbines. The turbines are located on 2,400 acres of agricultural land in the Byron area with multiple property owners.

One of the significant environmental impacts identified in the EIR for the Buena Vista repowering project was avian mortality due to collisions with the new turbines. To address the issue of avian mortalities a number of mitigation measures were identified in the EIR, including requiring the preparation of an avian monitoring program to estimate avian fatality rates from the new turbines and establishment of a Technical Advisory Committee (TAC). The function of the TAC is to review the monitoring program and the results of the monitoring, and to recommend additional mitigation based on the results of the monitoring.

As part of the approved conditions and the adopted mitigation monitoring program, development of a scientifically defensible monitoring program to estimate avian fatality rates is required. This document will serve as the required monitoring program for the Buena Vista repowering project.

2.0 TECHNICAL ADVISORY COMMITTEE

A Technical Advisory Committee (TAC) will be established to review and evaluate the results of this monitoring program and to advise the Contra Costa County Community Development Department regarding additional monitoring or remedial actions. Mortality data will be made available for review by the TAC as needed. The County will provide a mechanism for promptly notifying TAC members of fatalities. An annual report will be prepared at the end of the first year of monitoring.

The TAC will determine if avian fatalities can be attributed to particular wind turbines and, if so, the reasons for those fatalities. The TAC will be responsible for reviewing available data on the fatality, including the condition of the carcass, the estimated time of death, proximity of turbines, and topographical considerations. Through this process, the monitoring contractor and the TAC will attempt to determine 1) the mechanism of fatality, 2) whether the fatality can be causally related to a specific wind turbine, and 3) whether the cause of fatality is reflective of a pattern of fatalities associated with a specific turbine or with other siting or design factors.

The TAC will review the information provided at the end of each monitoring year, and make recommendations regarding the scope of the monitoring program for the future monitoring years. Proposed change may include increases or decreases in fatality monitoring efforts, or other changes in the scope based on results of the previous monitoring years.

The TAC may be dissolved if it is determined by Contra Costa County that TAC consultation is no longer required. This could occur if impacts are demonstrated to be minimal and adequately mitigated (as determined by Contra Costa County).

3.0 AVIAN USE AND BEHAVIOR SURVEYS

3.1 360° Visual Scan Surveys

Studies have quantified avian use and behavior within the Altamont Pass Wind Resource Area (APWRA) since 1998 (Smallwood and Thelander 2004a,b). The avian use and behavior studies will be conducted within the repowering area, within areas of existing older turbines, and within reference areas where turbines were recently removed. Approximately 4 stations (T1-T4) will be established within the repowering area on the Buena Vista property. Tentative station locations and 800-m viewsheds are identified in Figure 1. Two reference stations will be established to the east of the PG&E transmission line. These reference stations will provide information on avian use and behavior in areas where turbines do not exist but where topography is similar, and should provide some information regarding bird avoidance or attraction to turbine areas. The final locations will be determined in the field, and will be established to ensure good viewsheds and

proper identification of bird species near turbine strings, but far enough away from turbines to minimize observer bias.

The duration of each 360° visual scan will be 30 minutes. Approximately two visits to each survey point will be conducted each month during the monitoring period (minimum two years). Bird use and activity sampling effort will be stratified by time of day. Thus, behaviors will be divided between those observed during morning and afternoon sessions. The morning sessions start at 0700 hrs and continue until 1200 hrs. The afternoon sessions last from 1201 hrs until 1800 hours. Environmental conditions recorded at the beginning of each session include temperature, wind speed, and cloud cover. Surveys will not be conducted when the wind speed reaches more than 55 km/hr.

Data recorded for each observation will follow methods found in Smallwood and Thelander (2004a, b). When birds are detected, the corresponding information will be entered onto data sheets and maps using an alphanumeric coding system. The location of each bird or flock is marked sequentially on the map every 30 seconds. With a topographic map available for each observer on each plot and each session, the observer can plot sequential numbers onto the map corresponding with the locations of raptors observed at regular intervals (1-minute). Attributes will be associated with each plotted number including species, number of individuals seen, whether it is the same individual or group as previously recorded, specific behavior (e.g., soaring, contour hunting, "fly-through"), height above ground, and type of perch being used. If perching is observed, the time and specific perching structure will be recorded. Perching structures are grouped into four different categories according to their characteristics: (1) turbine devices, (2) electrical distribution poles, (3) metal/electrical towers, and (4) landscape features (e.g., rock piles, fences, etc.). After the observation session, these attributes will be entered into a computer spreadsheet. All plotted numbers which are linked to the attribute data will then be digitized and managed as a GIS database developed and maintained by the monitoring consultant.

Effects of observer/detection bias for estimating and reporting distances and behaviors will be reduced by periodically conducting paired observations. At those times we will calibrate differences between observers in terms of distances, turbine and tower sizes, and depth perception.

To further minimize bias, all bird behaviors will be recorded on standardized data sheets with consistent names of bird activities, behavior categories, and other features needed for consistent data recording between observers. It is likely that such calibration efforts will occur monthly.

4.0 AVIAN AND BAT FATALITY STUDY

The primary objective of the fatality studies is to estimate the annual number of avian and bat fatalities attributable to the Project. The standardized fatality monitoring phase of the study will begin once all the turbines are constructed and operational. The study will be conducted for at least three years, with a less intensive monitoring program (e.g., Wildlife Response and Reporting System (WRRS) and other agreed-upon system) in place for the life of the Project, including during the construction phase. The initial effort in the first year of monitoring (e.g., search interval, number of scavenging and searcher efficiency trials) may be modified in the subsequent years based on recommendations from the TAC. The methods are broken into four primary components: 1) standardized carcass searches, 2) an incidental casualty and injured bird reporting system (WRRS), 3) searcher efficiency trials, and 4) carcass removal trials. During the intensive monitoring study, the WRRS will be passively implemented, meaning that no discovered bird carcasses will be moved or disturbed in any way. Carcasses will not be moved until the intensive monitoring study has completed its objectives related to these carcasses, such as monitoring how long it is before scavengers remove the carcass (such trials may be performed on a subset of the carcasses discovered).

The number of avian and bat fatalities attributable to collision with wind turbines will be estimated based on the number of avian and bat fatalities found in the casualty search plots whose death appears related to collision with these structures. All carcasses located within areas surveyed, regardless of species, will be recorded and a cause of death determined, if possible, based on inspection of the carcass. Some carcasses may be necropsied to aid in determining cause of death. Total number of avian and bat carcasses will be estimated by adjusting for "removal bias" (e.g., scavenging), searcher efficiency bias, and search area bias. Carcasses where the cause of death is not apparent will be included in the mortality estimate. Including fatalities when cause of death is

unknown will lead to an overestimate of the true number of wind project fatalities. Most projects have used this conservative approach (e.g., Foote Creek Rim, Wyoming; Vansycle, Oregon; and Stateline, Oregon and Washington) because of the relative high costs associated with obtaining accurate estimates of natural or reference mortality.

4.1 Definitions and Field Methods

4.1.1 Selection and Delineation of Carcass Search Plots

All 38 turbines will be searched. Rectangular plots a minimum distance of 75 m from the turbines and centered on the turbine/turbine strings will be searched by walking parallel transects. Carcass searches will be conducted at each turbine approximately once every month, which is relatively consistent with searches conducted by Smallwood and Thelander (2004b). The first search will be conducted to clear the plots of evidence of old carcasses and document fatalities that may have occurred during the testing and early operational phase. Approximately half of the sampled turbines will be surveyed during one week (3 consecutive days), and the other half will be sampled the next week (3 consecutive days), so that carcass search technicians will have a presence in the wind project on more days during the study period.

4.1.2 Standardized Carcass Searches

Objective: to systematically search the Project for avian and bat fatalities that are attributable to collision with Project facilities.

Personnel trained in proper search techniques will conduct the carcass searches. Initially, transects will be set approximately 6-10 meters apart within the area to be searched. A searcher will walk at a rate of approximately 45-60 meters per minute along each transect searching both sides out to 3 meters for casualties. We anticipate that it should take approximately 1 person-hour to survey the search area around each turbine.

When a fatality is discovered, information about the location, condition, and type of bird is recorded on a standard datasheet (see Appendix A for examples of various field and laboratory forms for the carcass searches and fatalities discovered). The following information is collected for each bird or bat fatality:

- Fatality number (a unique number for each bird/bat that includes the year, month, date, and a number corresponding to the number found each day. For example, the third bird found Oct. 10, 2005 would be #20051010-03).

- Species- Species is identified as accurately as possible (red-tailed hawk, unknown Buteo, unknown hawk). If unknown, it is listed as "unknown small bird" (smaller than a mourning dove), "unknown medium bird" (between a mourning dove and raven), "unknown large bird" (red-tail hawk-sized or larger).

- Age & Sex- if able to determine based on plumage or other characteristics.

- Location of Turbine in String – Describe if the turbine is on the end of the string, in the middle

- Site- the gate at which the fatality was found, including the company that manages it.

- Plot# - The plot that the turbine associated with the fatality is in.

- Turbine Number- the nearest intact turbine (has a motor and blades). This information is included even if the fatality is far from any turbines or appears to be an electrocution.

- Photo Number- At least five photographs are taken with a digital camera: 1 of the fatality before it is disturbed and 1 of the surrounding area (such as overhead lines, turbines, fences, electrical poles, roads). The photo ID number is recorded and photos are regularly downloaded from the camera.

- Degree- the compass bearing from the nearest intact turbine to the fatality.

- Distance- the distance from the nearest intact turbine to the fatality in meters.

- GPS location- in UTMs (datum NAD27).

- Scavenger- the type of scavenger (vertebrate or invertebrate), if possible to determine.

- Insects Present – if the bird has insects on it and, if so, what type.

- Decay- stage of decay of the carcass (e.g., fresh, flesh and feathers, flesh and bone, feathers and bone, bones only, feathers only).

- Scavenging Effects – The state of the carcass due to scavengers

- Flesh- condition of the flesh of the carcass (fresh, gooey, dried).

- Eyes –condition of the eyes

- Enamel- if the waxy covering on the culmen and claws is present or not.

- Color- if the color of the leg scales or cere have begun to fade.
- Body parts- all body parts found (for example, "whole bird" or "right wing" or "flight feathers only" or "skull, vertebrae, and sternum"). Bone measurements are included here.
- Types of Injuries – Describe any visible injuries (e.g., broken R wing, crushed skull)
- Cause of Death – Describe likely cause of death (e.g., blade strike, trapped in turbine, electrocution, predation, other, unknown)
- Estimated Time of Death – Estimate time of death, broken down by categories (0-3 days [fresh], <1 week, <1 month, >1 month, unknown)
- How ID'ed- how species was determined (e.g., "bone measurements" or "plumage"). If rare species, give detail of determination in "Notes".
- Notes- information such as time of death (if possible), details for identification of rare species, band number if banded, obvious injuries, and cause of death other than turbine collision (electrocution, predation, overhead lines, hit by car, etc.).
- Searchers- first and last initials of all present in case of future questions.

All carcasses found will be labeled or assigned with a unique number. Fresh fatalities may be left in the field for scavenging trials. Those that are not left in the field for scavenging trials will be bagged, and frozen for future reference and possible necropsy. A copy of the data sheet for each carcass will be maintained, bagged, and frozen with the carcass at all times.

If a State or Federally Threatened or Endangered species such as a golden eagle is found, information about the fatality is collected and a flag(s) with a metal stake is used to mark the location. This type of fatality is called into Operations at the end of the day and the Project wildlife specialist collects these. If a non-native species such as rock pigeon, European starling, or house sparrow is found, information on the fatality will be collected, and the searchers will collect the carcass and dispose of it off-site. All other species are placed in a bag with a label including the turbine number, species, date found, and fatality number, and placed in the Project freezer at the field house. If the species cannot be identified in the field, the carcass may be taken to the UCD Wildlife Museum to attempt identification. All carcasses in the freezer are taken to the U.S. Fish & Wildlife office in Sacramento for disposal when the freezer fills up.

When only parts of a carcass are found, there must be at least 5 bones or at least 10 feathers for it to be considered a fatality. Anything less than this could be remains of a previously found fatality, have been dragged in from somewhere else, or in the case of feathers, be as a result of molt. If 1-4 bird bones are found, the find is documented as usual, with a note at the top of the datasheet stating that there are less than 5 bones (the find will not be included in data analysis).

Fatalities found by maintenance personnel within designated search areas are documented by the Project respondent, marked with black electrical tape on the legs, and left in place for MC searchers to find. When MC searchers find a fatality marked with black tape, it is documented and reported as any other fatality.

Birds used for scavenging trials are marked with green electrical tape. These birds are not recorded as fatalities. Rock pigeon or house sparrows marked with green tape that are found after scavenger trials are over are collected and disposed of offsite. If a red-tailed hawk that was used for scavenging trials is found, it is bagged, labeled with the appropriate ID code, and put in the freezer. The Project wildlife specialist maintains ID codes for red-tailed hawks used in scavenging trials, and she must immediately be notified when the bird is removed from the field and placed in the field house freezer.

If an injured native bird is found at any time on site, Operations is contacted immediately and the Project Respondent or Project Biologist will come to take the bird to a local rehab facility. During the implementation of this fatality study, the Project Biologist will be a member of the monitoring consultant, while the Project Respondent will be a employee or contractor of the Project owner's.

Fatalities found incidentally by the MC staff outside the search area (more than 150m from wind turbines or other wind power facilities) are documented and collected following the protocol for fatalities found during searches. The fatality is noted as incidental at the top of the datasheet. Fatalities found by maintenance personnel and others not conducting the formal searches within 150 m of a wind turbine, meteorological tower, substation, or road will be documented using a

wildlife incident reporting system (see WRRS section below).

5.1.3 Searcher Efficiency Trials

Objective: to estimate the percentage of avian and bat fatalities which are found by searchers.

Searcher efficiency studies will be conducted in the same areas as carcass searches by the Monitoring Consultant. Searcher efficiency will be estimated for size of carcass, habitat type (e.g., road versus grassland), and season. Estimates of searcher efficiency will be used to adjust the number of carcasses found, correcting for detection bias.

Searcher efficiency trials will begin when turbines are placed into operation. Personnel conducting the searches will not know when trials are conducted or the location of the detection carcasses. During each season approximately 10 bird carcasses of two different size classes will be placed in the search area throughout the search period, for a total of approximately 80 searcher efficiency trial carcasses for the entire year. Species such as house sparrows and European starlings will be used to represent small-sized birds. Species such as rock doves, hen mallards, hen pheasants, and raptors will be used to represent medium- to large-sized birds. A minimum of two dates will be used each season for a minimum total of 8 trial dates during the first year. Bat carcasses may also be used if bat fatalities are found.

Carcass location is determined by randomly selecting a compass bearing and distance (within the regular search area of 75m) using the "=RANDBETWEEN" function in Excel. Carcasses are marked with green tape on the legs and placed (by dropping from waist height) within the areas to be searched prior to the search on the same day.

Immediately after searches are conducted, the trial administrator determines how many of the efficiency trials were detected by the searcher, and returns to the search plots to recover any undetected trial carcasses. The number and location of the detection carcasses found during the carcass search is recorded, and the number of carcasses available for detection during each trial is determined immediately after the trial by the person responsible for distributing the carcasses. Carcass locations and trial results are recorded on standard datasheets (Appendix A)

5.1.4 Wildlife Response and Reporting System and Incidental Fatality Discoveries

The Wildlife Response and Reporting System (WRRS) is a monitoring program set up for searching and handling of avian casualties found by maintenance personnel. The Monitoring Consultant will provide an initial protocol for the WRRS to the Project Owner's for implementation. Construction and maintenance personnel will be trained in methods. This monitoring program includes reporting carcasses discovered incidental to construction and maintenance operations.

Any carcasses discovered by maintenance personnel will be recorded, photographed, and reported to a Project Respondent. The Respondent will identify the fatality and fill out the Casualty Information Form. The fatality will NOT be collected unless it is a federal endangered or threatened species. If the fatality is a federally listed species, the USFWS will be contacted for handling instructions.

5.1.5 Carcass Removal Trials

Objective: to estimate the length of time avian and bat fatalities remain in the search area.

Carcass removal studies will be conducted throughout the monitoring year by the Monitoring Consultant. Estimates of carcass removal will be used to adjust carcass counts for removal bias. Carcass removal includes removal by predation or scavenging, or removal by other means such as being plowed into a field.

Carcass removal trials likely will occur during each of the following seasons, but times for these trials may vary: (1) spring migration (March 16 - May 31); (2) breeding season (May 31-August 15); (3) fall migration (August 16-October 31) and (4) winter (November 1-March 15).

Each season during the first year of monitoring, approximately 10 bird carcasses of two size classes will be distributed resulting in a total of approximately 40 trial carcasses used in carcass removal studies for the first year of monitoring. This information may be combined with the carcass removal studies conducted throughout other portions of the APWRA (APWRA MONITORING TEAM 2006). The TAC will determine the need for this component of study in the subsequent

monitoring years. If permitted, fresh fatalities found during searches will be used as removal trial birds. These may be supplemented with carcasses legally obtained from raptor rehabilitation centers, wildlife agencies, game farms etc. Some of the fresh carcasses found during searches may be left in the field and serve as carcasses for this component.

Carcass location will be determined by randomly selecting a compass bearing and distance (within the regular search area of 75m) using the "=RANDBETWEEN" function in Excel. Carcasses will be marked with tape on the legs and dropped from waist height at each predetermined location. Upon placing carcasses, the technician will note the species, whether the bird is belly-up or belly-down, utm coordinates, date, and time. Turbines where experimental carcasses are placed will be marked with a pin flag, but the actual location of each carcass will remain unmarked to avoid alerting scavengers to the carcass location.

Carcasses will be monitored over an approximately 60-day period. Carcasses will be checked every day for the first 3 days after placement, every other day for the next two weeks, then once per week for the remainder of the 60-day trial. At each visit the technician will note whether the carcass is intact (I), scavenged (S), a feather spot (FS; >10 feathers), or absent (0; <10 feathers). In addition, the type and degree of scavenging and possible scavengers will be described. All remaining trial carcasses and feathers will be removed after the trial period. Carcass locations and conditions over the study period are recorded on standard datasheets (Appendix A).

5.2 Data Handling and Statistical Analysis Methods For Fatality Data

The estimate of the total number of wind turbine-related fatalities will be based on three components: 1) observed number of carcasses, 2) searcher efficiency expressed as the proportion of planted carcasses found by searchers, and 3) removal rates expressed as the length of time a carcass is expected to remain in the study area and be available for detection by the searchers.

5.2.1 Observed Number of Carcasses

The average number of carcasses detected per turbine is:

$$\bar{c} = \frac{\sum_{i=1}^{k} c_i}{k}$$

where c_i is the number of carcasses detected at turbine i for the period of study, and k is the number of turbines searched.

5.2.2. Estimation of Searcher Efficiency

Searcher efficiency is expressed as p, the estimated proportion of trial carcasses found by searchers. The variance of the estimate, $v(p)$, is calculated by the formula:

$$v(p) = \frac{p(1-p)}{d}$$

where d is the total number of carcasses placed. Carcass detection rates will be estimated by major habitat type, carcass size, and season. Data will be pooled across seasons if detection rates are not significantly different between seasons.

5.2.3 Estimation of Carcass Removal

Estimates of carcass removal are used to adjust carcass counts for removal bias. Carcass removal includes removal by predation or scavenging, or removal by other means such as being plowed into a field. The length of time a carcass remains in the study area before it is removed is denoted as t_i. Mean carcass removal time is expressed as $\bar{t}$, the average length of time a carcass remains at the site before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s}$$

where s is the number of carcasses used in the scavenging trials. Modifications to the estimator will be made if there are trial carcasses that remain at the end of the 20-day trial period (Shumway et al. 1989, Barnard 2000, Erickson et al. 2003).

5.2.4 Estimation of the Total Number of Facility-Related Fatalities

To calculate the total number of facility-related fatalities (M), the observed fatality rate is divided by $\hat{\pi}$, an estimate of the probability a casualty is not removed by a scavenger (or other means), and is detected:

$$M = \frac{N * \bar{c}}{\hat{\pi}}$$

where N is the total number of turbines in the windfarm, and $\hat{\pi}$ is calculated by:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I}\left(\frac{e^{I/\bar{t}} - 1}{e^{I/\bar{t}} - 1 + p}\right)$$

where p is the estimated observer detection probability, I is the interval (days) between searches (I=30), and $\bar{t}$ is the mean carcass removal time (days). This estimator is based on the assumption the carcass removal times follow an exponential distribution (Schoenfeld 2004). Alternative models (e.g., log-normal) will be fit to the carcass removal data, and alternative estimators will be evaluated if the exponential distribution is not the best fitting model. We denote m_1 as the estimated mortality per turbine per year (M/N) and m_2 as the estimated mortality per MW per year (M/(N*E)), where E is the turbine's energy capacity in MW. Modifications may be made with approval from the TAC.

Annual fatality estimates will be calculated for raptors, small-sized birds, moderate/large birds, all birds combined, and bats. Final reported estimates of m_1 and m_2 and associated standard errors and 90% confidence intervals will be calculated using bootstrapping (Manly 1997) based on a computer program written in SAS. For each iteration of the bootstrap, the turbines and associated mortality data, searcher efficiency trial birds and associated data, and the scavenging removal trial birds and associated data are sampled with replacement. Estimates of $\bar{c}$, $\bar{t}$, p, and m are calculated for each of 5,000 bootstrap samples. Final estimates of $\bar{c}$, $\bar{t}$, p, and m, and associated bootstrap percentile confidence intervals are calculated from the 5,000 bootstrap estimates.

In addition, comparisons of observed fatality rates (unadjusted for scavenging and searcher efficiency) at the new turbines will be compared to observed fatality rates of other turbine types within the APWRA from previous studies (Smallwood and Thelander 2004a,b), and from concurrent studies (APWRA MONITORING TEAM 2006) in the Altamont Pass WRA. A sample of most turbine types in the Altamont Pass will be monitored concurrently with the new

turbines (APWRA MONITORING TEAM 2006). Fatality estimates will be calculated and compared on a per MW capacity basis, a per rotor-swept area basis, a per turbine basis, and possible other metrics related to turbine operations (e.g., per hours of operation).

6.0 DISPOSITION OF DATA

Monitoring reports should be submitted to the County, USFWS, and DFG annually. Monitoring reports should include:

- a summary of raptor use surveys,
- a summary of mortality surveys,
- a description of environmental factors (e.g., weather) that may be affecting results, and
- a description of remedial actions taken.

In addition, a summary of all raptor fatalities will be submitted to Contra Costa each month.

7.0 REFERENCES

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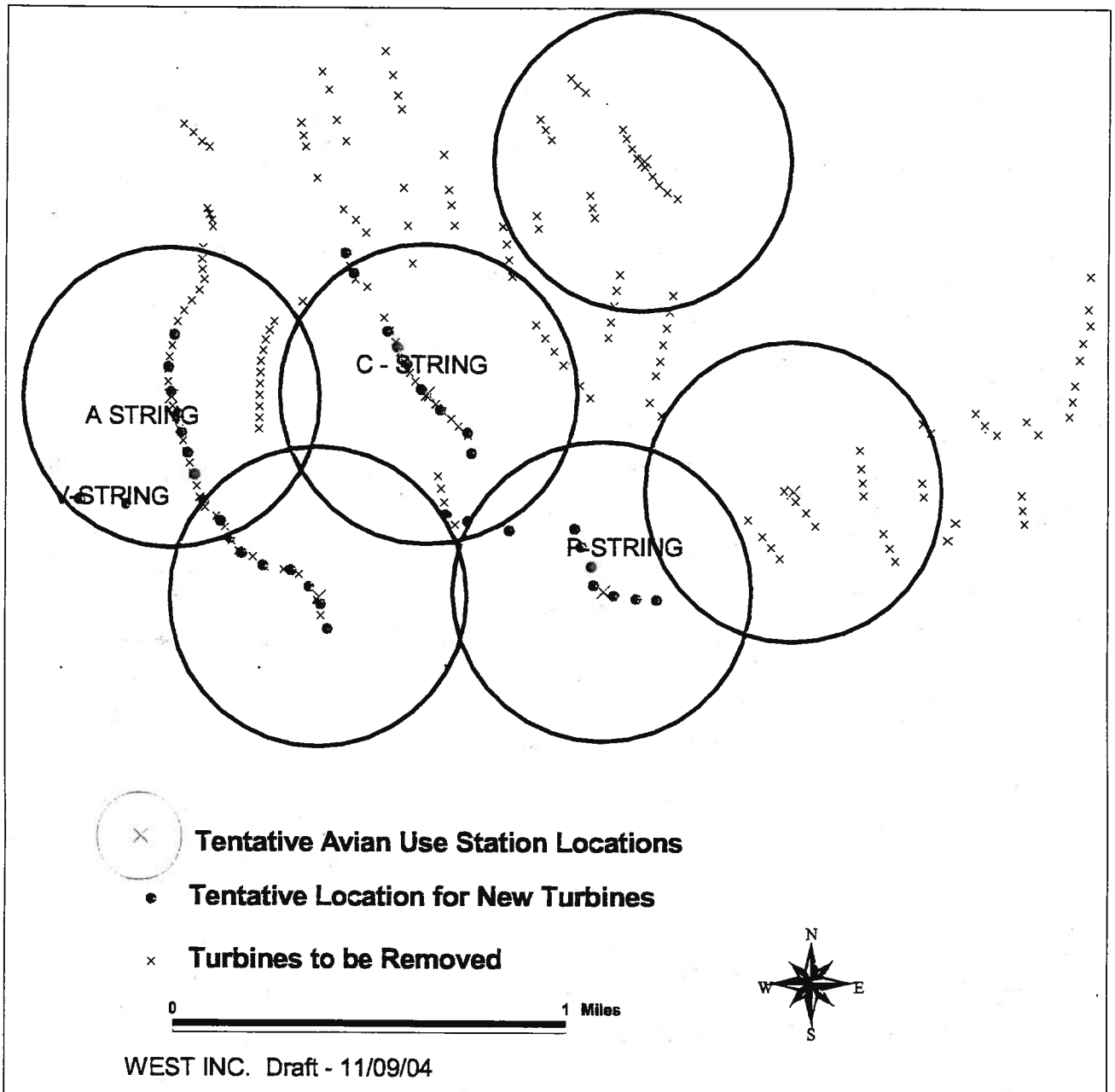

Figure 1. Location of repowering area, existing turbines to be removed, and tentative locations for avian point-count stations and new turbine locations.

APPENDIX A

AVIAN OBSERVATION, CARCASS SEARCH, SEARCHER EFFICIENCY,

AND CARCASS REMOVAL TRIAL DATA FORMS

Observation #: **Start Time:** **Observer:** **Page of**

Date: **End Time:**

Beginning Weather

% Cloud Cover

Temperature (C°)

Wind (km/hr) Direction

Avg speed

Max speed

Visibility Good Fair Poor

Precipitation

Ending Weather

% Cloud Cover

Temperature (C°)

Wind (km/hr) Direction

Avg speed

Max speed

Visibility Good Fair Poor

Precipitation

List of Other Birds Observed (Smaller than MODO)

Species	Number	Notes

Avian Use and Behavior Observation Form, Page 1

Avian Use and Behavior Observation Form, Page 2

Time	ID	Species	Action	Ht	Perch	T m	ID	Act	Ht	Per	T m	ID	Act	Ht	Per	T m	ID	Act	Ht	Per	Notes

CASUALTY SEARCH FORM-keep with carcass **Buena Vista**

DATE: _____ OBSERVER: _____

PLOT TYPE (circle one): turbine met tower powerline other PLOT NO.: _____

TIME BEGIN: _____ TIME END: _____

CASUALTIES FOUND:

SPECIES	SAMPLE NO.	HABITAT
_____	_____	_____
_____	_____	_____
_____	_____	_____

SEARCHER EFFICIENCY CARCASSES FOUND:

SPECIES	ID TAG	HABITAT
_____	_____	_____
_____	_____	_____

CASUALTY INFORMATION FORM - FIELD FORM **Buena Vista**

Fatality#_____ Species_____ Age & Sex _____
Site_____ Plot # _____ Turbine#_____
Location of turbine in string:_____
Photo #'s (at least 5, 4 of fatality)_____
Degree_____ Distance_____
GPS (UTMs, NAD27)_____
Type of Scavenger n/a / vertebrate / invertebrate / unclear
Insects Present Y / N Types beetles / ants / flies / maggots / other / exoskeletons
Decay fresh / feathers and flesh / flesh and bone / bone and feathers / bone / n/a
Scavenging Effects n/a / flesh exposed / bone exposed / hollowed out / feathers only
Flesh fresh / gooey / dried / n/a
Eyes round, fluid filled / sunken / dried / empty, skull / no head
Enamel present not present n/a culmen / claws
Color leg scales: n/a / original / partially bleached / bleached
cere: n/a / original / partially bleached / bleached
Body Parts: _____
_____
_____

Types of Injuries: _____

Evidence of Death:

blade strike / trapped in turbine (oiled) / electrocution / predation / other / unknown

Estimated Time Since Death:

0-3 days (fresh) / 4-7 days / <month / >month / unknown

How ID'ed: _____
Notes: _____
_____
Searchers_____

Searcher Efficiency Trials: Carcass Placement Log Buena Vista

General Information: Season_____ Month_____ Other_____

No.	Species/Age	Placed By	Date	Time	Plot: Location	Found? (yes/no)	Retrieved? (yes/no)	Notes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Weather notes for days that carcasses are placed:

Date_____ Time_____ Temp_____ Wind Dir._____ Wind Speed_____ Precip_____

Date_____ Time_____ Temp_____ Wind Dir._____ Wind Speed_____ Precip_____

Date_____ Time_____ Temp_____ Wind Dir._____ Wind Speed_____ Precip_____

Date_____ Time_____ Temp_____ Wind Dir._____ Wind Speed_____ Precip_____

Carcass Removal Trials Form (page 1) Buena Vista

General Information: Season_____ Month_____ Other_____

Information Regarding Carcass When Placed							Condition[1] of Carcass on Days Checked										Possible Scavenger	Notes
No.	Species /Age	Plot & Location	Expos.[2]	Placed By	Date	Time	Day	Day	Day	Day	Day	Day	Day	Day	Day	Day		
1																		(1)
2																		(2)
3																		(3)
4																		(4)
5																		(5)
6																		(6)
7																		(7)
8																		(8)
9																		(9)
10																		(10)
					Checked by:													

[1] Condition: **I** = intact, no evidence of scavenging, **S** = evidence of scavenging, **FS** = feather spot, **0** = carcass not present or <10 feathers

[2] Exposure: **1** = exposed position, **2** = hidden, **3** = partially hidden

General Comments:

Carcass Removal Trials Form (page 2)

Notes about location of each carcass and other carcass specific comments and photo numbers

(1)	
(2)	
(3)	
(4)	
(5)	
(6)	
(7)	
(8)	
(9)	
(10)	

ATTACHMENT C: CASUALTY INFORMATION FIELD FORM

CASUALTY INFORMATION FIELD FORM					**Buena Vista**
Fatality No.:	**Species:**			**Age/Sex:** /	
Turbine No.:	**Location of Turbine in String:**				
Photo No. (5)	**1.**	**2.**	**3.**	**4.**	**5.**
Degree:		**Distance:**			
GPS (UTM, NAD27)					
Type of Scavenger:	☐ N/A	☐ Vertebrate	☐ Invertebrate	☐ Unclear	
Insects Present: ☐ **Yes** ☐ **No** *If yes:* ☐ Beetles ☐ Ants ☐ Flies ☐ Maggots ☐ Other ☐ Exoskeletons					
Decay:	☐ Fresh	☐ Feathers and Flesh	☐ Feathers and Bone	☐ Flesh and Bone	☐ Bone ☐ N/A
Scavenging Effects:	☐ N/A	☐ Flesh Exposed	☐ Bone Exposed	☐ Hollowed Out	☐ Feathers Only
Flesh:	☐ Fresh	☐ Gooey	☐ Dried	☐ N/A	
Eyes:	☐ Round/Fluid-filled	☐ Sunken	☐ Dried	☐ Empty, Skull	☐ No Head
Enamel:	☐ Present	☐ Not Present	☐ N/A	Culmen / Claws *(circle one)*	
Color:	**Leg Scales:** ☐ N/A	☐ Original	☐ Partially Bleached	☐ Bleached	
	Cere: ☐ N/A	☐ Original	☐ Partially Bleached	☐ Bleached	
Body Parts:					
Types of Injuries:					
Evidence of Death: ☐ Blade Strike ☐ Trapped in Turbine (oiled) ☐ Electrocution ☐ Predation ☐ Other ☐ Unknown					
Estimated Time Since Death:	☐ 0-3 Days (fresh)	☐ 4-7 Days	☐ < Month	☐ >Month	☐ Unknown
How Identified:					
Notes:					
Searchers:					