IBERDROLA RENEWABLES

April 22, 2011

Mr. Iain Fisher, CEQA Project Manager
Energy Division
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102-3296

Re: Tule Wind Project - Response to Data Request No. 15

Dear Mr. Fisher:

Tule Wind, LLC (Tule Wind), a wholly owned subsidiary of Iberdrola Renewables, Inc. (IRI) received your Data Request No. 15 regarding the Tule Wind Project. Attached is the visual simulation depicting the Modified Project Layout138 kV transmission line simulation as requested. The second requested item, Western EcoSystems Technology, Inc. Bat Acoustic Studies for the Tule Wind Resource Area (January 24, 2011) was provided to Rica Nitka of Dudek on April 21 via FTP site.

If you have questions regarding this information, please contact Patrick O'Neill at 858 712-8313 or 858-437-7422.

Sincerely,

Jeffrey Durocher
Wind Permitting Manager

cc (via e-mail): Greg Thomsen, BLM (GThomsen@blm.gov)
Thomas Zale, BLM (Thomas_Zale@blm.gov)
Jeffery Childers, BLM (jchilders@blm.gov)
Rica Nitka, Dudek (rnitka@dudek.com)
Patrick O'Neill, HDR Engineering (Patrick.oneill@hdrinc.com)

Attached (FTP Site):

- Modified Project Layout138 kV transmission line simulation.

- Previously provided: The Western EcoSystems Technology, Inc. Bat Acoustic Studies for the tule Wind Resource Area (January 24, 2011)

IBERDROLA RENEWABLES, Inc.
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Portland, OR 97209
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Bat Acoustic Studies for the Tule Wind Resource Area San Diego County, California

Final Report
September 2008 – November 2010

Prepared for:

Tule Wind, LLC
1125 NW Couch Street, Suite 700
Portland, Oregon

Prepared by:

Jeff Gruver, Kimberly Bay, Michelle Sonnenberg, and Elizabeth Baumgartner

Western EcoSystems Technology, Inc.
2003 Central Avenue
Cheyenne, Wyoming

January 24, 2011

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in September 2008 designed to assess levels of bat activity within the proposed Tule Wind Resource Area, San Diego County, California. Acoustic surveys for bats using Anabat™ SD-1 ultrasonic detectors at four fixed stations were conducted from September 4, 2008, to August 10, 2009, and again at nine fixed stations and nine roaming stations from March 11 to November 15, 2010. The objective of the acoustic bat surveys was to estimate the seasonal and spatial patterns of activity in the study area by bats, and provide a qualitative estimate of potential impacts to bats form turbine operation. During 2008/2009, four Anabat detectors paired at two met towers recorded 4,592 bat passes on 842 detector-nights, or a mean of 5.53 bat passes per detector-night. During 2010 surveys, eight Anabat units paired at four meteorological towers recorded a total of 14,667 bat passes on 939 detector-nights (a mean of 16.42 bat passes per detector-night). Across both survey seasons ground-based met tower Anabat stations recorded 16,657 passes across 940 detector nights, yielding a mean of 17.7 passes per detector-night.

During the 2010 surveys, Anabat fixed and roaming stations were established near features likely to be attractive for bats to determine a probable maximum level of bat activity for the project area. Stations were established on the McCain and Thing Valley sides of the project. Bat passes at the fixed and roaming bat feature stations averaged 64.59 per detector-night. While bat activity recorded at the bat features was relatively high, it cannot be equated to numbers of bats, and likely consisted primarily of foraging activity meaning multiple passes of the same bat.

Peak levels of bat activity were recorded in early August during the 2008/2009 study, whereas 2010 activity peaked from in late August. In 2008/2009 nearly three-quarters (72.6%) of the calls were greater than 40 kilohertz (kHz) in frequency (e.g., western red bat, canyon bat), 17.4% were between 15 and 30 kHz (e.g., silver-haired bat, hoary bat), 5.3% were between 30 and 40 kHz (e.g., western yellow bat), and the remaining calls were less than 15 kHz (e.g., big-free tailed bat). In 2010, species composition was similar to that recorded in 2008/2009, with high-frequency passes outnumbering other types at nearly all detector stations.

The mean number of bat passes per detector-night recorded at ground-based stations at met towers (17.7 passes per detector-night) was compared to existing data from nine wind energy facilities where both bat activity rates and mortality levels have been measured. The level of bat activity documented at the Tule Wind Resource Area (TWRA) was higher than that at wind facilities in Minnesota and Wyoming, where reported bat mortalities are low, but was lower than at facilities in the eastern United States, where reported bat fatalities have been highest. Assuming that a relationship between bat activity rates and bat mortality exists, and that it extends to the western US, bat fatalities at TWRA may be lower than that recorded in the Midwest and East, but could be higher than other wind energy facilities in the West. The post-construction fatality monitoring program should be designed to accurately estimate the levels of bat mortality, as well as spatial and temporal patterns of the fatalities.

STUDY PARTICIPANTS

Western EcoSystems Technology

Jeffery Gruver	Project Manager, Bat Biologist
Kimberly Bay	Data and Report Manager
Michelle Sonnenberg	Statistician
JR Boehrs	GIS Technician
Elizabeth Baumgartner	Report Compiler
Andrew Krause	Field Supervisor
Nathan Mudry (EGIS, LLC)	Field Technician
Michael Cecil	Field Technician

REPORT REFERENCE

Gruver, J., K. Bay, M. Sonnenberg, and E. Baumgartner. 2011. Bat Acoustic Studies for the Tule Wind Resource Area. San Diego, California. Final Report: September 2008 – November 2010. Technical report prepared for Tule Wind, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

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INTRODUCTION

Tule Wind, LLC is proposing to develop a wind energy facility in San Diego County, California, and engaged Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for baseline studies of bat activity levels in the Tule Wind Resource Area (TWRA) for the purpose of estimating the impacts of the wind energy facility on bats, and to assist with siting turbines to minimize impacts to bats. The protocol for this baseline study is similar to protocols used at other wind energy facilities in the United States. The protocol has been developed based on WEST's experience studying wildlife and wind turbines at wind energy facilities throughout the US and included passive acoustic sampling using Anabat™ bat detectors to quantify bat activity in the study area.

The following is a final report describing the results of Anabat surveys during the 2010 study season within the proposed wind resource area. This report also compares 2010 acoustic bat data with data collected at the TWRA during 2008/2009 acoustic bat surveys. In addition to site-specific data, this report presents existing information and results of bat monitoring studies conducted at other wind energy facilities. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The proposed TWRA is in southeast San Diego County and includes Sections 5, 6, 7, & 8, Township 3N, Range 10E. It is approximately 4 miles (6 kilometers [km]) northwest of Live Oak Springs, California (Figure 1). The project area is flanked by the Laguna and In-Koh-Pah Mountains, but lies primarily within the McCain Valley. The project area also includes portions of Thing Valley to the west as well as the intervening ridge. Elevation of the project area ranges from approximately 3300 to 4,400 feet (ft; 1000 to 1341 meters [m]) above sea level in the McCain Valley, but reaches 5800 ft (1771 m) on the ridge. Vegetation in the project is predominately chapperal-scrub.

Bat habitat within the project area is limited primarily to willow and live oak trees found in drainages and valley bottoms (e.g., Cottonwood Creek Campground), and large boulder-like rock formations scattered throughout the McCain Valley. In addition, several abandoned mines were known on State of California Land Commission property in the northwest portion of the project area. These mines were visually surveyed by WEST personnel in March 2010. Only 1 of the openings, a vertical shaft that extended approximately 75 ft before bending, appeared suitable as a roost structure (WEST 2010; Appendix B).

METHODS

Bat Acoustic Surveys

The objective of the bat acoustic surveys was to estimate the seasonal and spatial patterns of activity of the TWRA by bats. Bats were surveyed using Anabat™ SD1 bat detectors (Titley Scientific™, Australia). The use of bat detectors for calculating an index to bat impacts is a primary bat risk assessment tool for baseline wind development surveys (Arnett 2007; Kunz et al. 2007*a*). Acoustic surveys for bats were conducted from September 4, 2008 to August 10, 2009 at two extant met towers. In 2010, surveys occurred from March 12 to November 15, 2010, the period corresponding with the majority of annual bat activity at this site based on 2008/2009 surveys (Gruver et al. 2009).

Eight detectors were used at four meteorological (met) towers with one detector placed near the ground and one unit was raised on the met tower to a height of approximately 148 ft (45 m). Paired detectors at met towers were used to compare bat activity at different heights (ground versus raised) and to monitor bat activity in the rotor-swept zone per CEC guidelines (California Energy Commission 2007). Anabat detectors near the ground were placed in plastic weather-tight containers with a hole in the end for the microphone and PVC elbow (45º bend) to protect the microphone (Appendix C1). In addition, fixed and roaming Anabat stations were established throughout the project area at features suspected to be attractive for bats. The intent of monitoring at these locations was to increase spatial coverage and establish a probable upper bound on bat activity for this site.

For the 2008/2009 survey, bat activity was monitored from September 4, 2008 to August 10, 2009. For the purposes of comparison with the 2010 data, the 2008/2009 data set was truncated to include only the months of March through November. Therefore, the dates included in the 2008/2009 analysis for this report were September 4 to November 15, 2008 and March 11 to August 10, 2009. Detectors were placed near the ground at two fixed stations (Figure 1). At both of these stations, ground-based detectors were paired with detectors raised on meteorological towers to compare bat activity at different heights (ground versus raised) and monitor bat activity at heights within the eventual rotor-swept zone (CEC 2007). Weather protection and method of elevating microphones were identical to the 2010 surveys, except that the Bat-Hat was equipped with a traditional reflector-plate, rather than the 45º PVC elbow (Appendix C1).

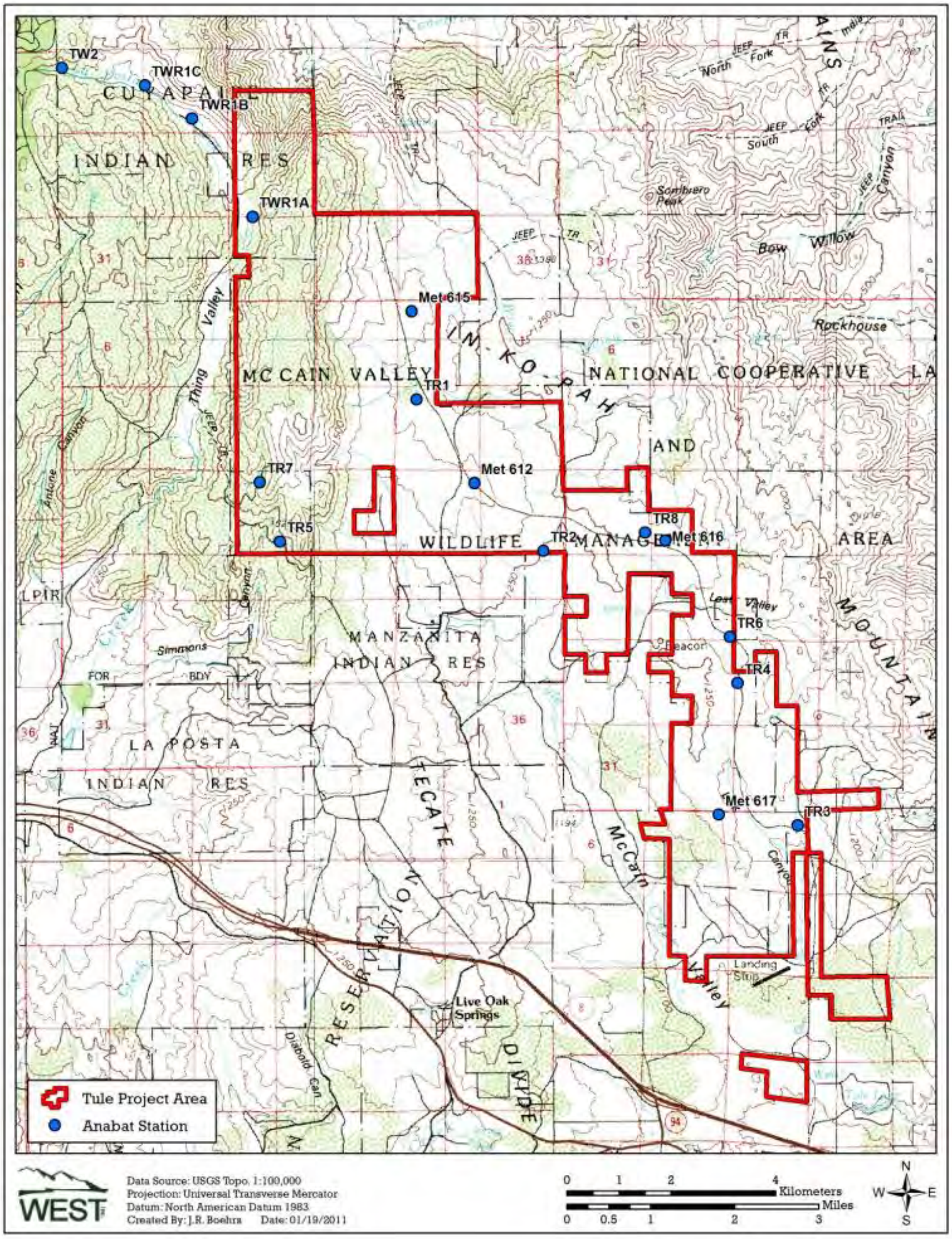


Figure 1. Study area map and Anabat sampling stations at the Tule Wind Resource Area.

Anabat detectors record bat echolocation calls (and other ultrasonic sounds) using a broadband microphone. These sounds are quantified and described by the internal zero-crossing module, which counts each time the sound wave crosses from positive to negative pressure (i.e., zero-crossing) per unit time. Rather than count each zero-crossing, the number of crossings are sampled, and the sampling frequency is referred to as the Division Ratio. The division ratio commonly used for Anabat studies is 16, which was also used for the study. To reduce the incidence of extraneous ultrasonic sounds (e.g., insects, wind, vegetation, etc.), that may mask the presence of bat echolocation signals, the sensitivity level of the detector was set to a value of 6. The detection range of Anabat detectors depends on a number of factors (e.g., echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, atmospheric conditions; Limpens and McCracken 2004), but is generally less than 30 m (98 ft) due to atmospheric absorption on echolocation pulses (Fenton 1991). To ensure similar detection ranges among detectors, microphone sensitivities were calibrated using a BatChirp (Tony Messina, Las Vegas, NV) ultrasonic emitter as described in Larson and Hayes (2000).

All units were programmed to turn on each night approximately 30 minutes (min) before sunset and turn off approximately 30 min after sunrise, and data were recorded to a compact flash memory card with large storage capacity. To minimize the potential for water damage due to rain, Anabat detectors were placed inside plastic weather-tight containers that had a hole cut in the side through which the microphone extended. The microphones were encased in poly-vinyl chloride (PVC) tubing that curved skyward at 45 degrees outside the container, and holes were drilled in the PVC tubing. Detectors protected in this manner have been found to detect similar numbers and quality of bat calls as detectors exposed directly to the environment (Britzke et al. 2010). Containers were raised approximately 1 m (3.3 ft) off the ground to minimize echo interference and lift the unit above vegetation. Elevated Anabat detector microphones were raised using a pre-installed pulley system, and the microphone was protected using a Bat-Hat (EME Systems, Berkeley, CA). The Bat-Hat was modified for the 2010 studies to have the same 45º elbow as the ground-based detectors, as differences in weather protection for the microphone have been shown to results in differences in measured activity (Britzke et al. 2010). Studies conducted in 2008/2009 had the traditional reflector-plate design, which may have resulted in relatively lower measured activity rates at elevated locations.

Statistical Analysis

Bat Acoustic Surveys

Bat activity was measured by counting numbers of bat passes (Hayes 1997), defined as a continuous series of two or more call notes produced by an individual bat with no pauses between call notes of more than one second (White and Gehrt 2001, Gannon et al. 2003). Counts of bat passes were determined by downloading the detectors' data files to a computer and tallying the number of echolocation passes recorded. Total number of passes was standardized to unit of effort by dividing by the number of detector-nights. A detector-night is defined as one detector collecting data for one night. In this report, the terms bat pass and bat call are used interchangeably.

Initial surveys conducted from September 2008 to August 2009 indicated that while there was a small amount of bat activity during the winter months, the vast majority of bat activity occurred between approximately mid-Mar and mid-November (Gruver et al. 2009). Therefore, surveys in 2010 were restricted to that period. To facilitate comparison with the 2010 data, the 2008/2009 data set was truncated to include only the months of March through November. Therefore, the dates included in the 2008/2009 analysis for this report were September 4 to November 15, 2008 and March 11 to August 10, 2009.

Peak bat activity was estimated by calculating the maximum average activity rate for any seven day period, not restricted to a particular starting date. When calculating the period of highest activity, if results were the same for multiple combinations of seven-day periods in succession, the peak activity period is described as the entire range of days over which the same result occurs. The week (or weeks, in case of a tie) with the highest sum indicate the period of highest sustained bat activity.

All bat passes were sorted into four groups, based on their minimum frequency, that correspond roughly to species groups of interest. For example, most species of *Myotis* bats echolocate at frequencies greater than 40 kilohertz (kHz), whereas species such as the western yellow bat (*Lasiurus xanthinus*) typically have echolocation calls that fall between 30 and 40 kHz. Species such as silver-haired (*Lasionycteris noctivagans*) and hoary bat (*Lasiurus cinereus*) have echolocation that fall between 15 kHz and 30 kHz, and species such as the big free-tailed bat (*Nyctinomops macrotis*) and the spotted bat (*Euderma maculatum*) produce calls below 15 kHz. Therefore, bat passes were classified as high-frequency (HF; greater than 40 kHz), mid-frequency (MF; 30 - 40 kHz), low-frequency (LF; 15 - 30 kHz), and very low-frequency (VLF; less than 15 kHz). To establish which species may have produced passes in each category, a list of species expected to occur in the study area was compiled from range maps

Table 1. Bat species determined from range-maps (BCI website; Harvey et al. 1999) as likely to occur within the Tule Wind Resource Area, sorted by call frequency.

Common Name	Scientific Name
High-frequency (> 40 kHz)	
western red bat[1,3]	*Lasiurus blossevillii*
California leaf-nosed bat	*Macrotus californicus*
ghost-faced bat	*Mormoops megalophylla*
California bat	*Myotis californicus*
western small-footed bat	*Myotis ciliolabrum*
long-legged bat[3]	*Myotis volans*
Yuma bat	*Myotis yumanensis*
canyon bat[3]	*Parastrellus hesperus*
Mid-frequency (30-40 kHz)	
western yellow bat[3]	*Lasiurus xanthinus*
western long-eared bat	*Myotis evotis*
little brown bat[2,3]	*Myotis lucifugus*
Low-frequency (15-30 kHz)	
pallid bat	*Antrozous pallidus*
Townsend's big-eared bat	*Corynorhinus townsendii*
big brown bat[3]	*Eptesicus fuscus*
silver-haired bat[1,3]	*Lasionycteris noctivagans*
hoary bat[1,3]	*Lasiurus cinereus*
fringed bat	*Myotis thysanodes*
pocketed free-tailed bat[3]	*Nyctinomops femorosaccus*
Brazilian free-tailed bat[3]	*Tadarida brasiliensis*
Very low-frequency (< 15 kHz)	
spotted bat[2]	*Euderma maculatum*
western mastiff bat	*Eumops perotis californicus*
big free-tailed bat[3]	*Nyctinomops macrotis*

[1] long-distance migrant
[2] species distribution on edge or just outside project area
[3] known casualty from wind turbines

(Table 1; Harvey et al. 1999, Bat Conservation International [BCI] website). Data determined to be noise (produced by a source other than a bat) or call notes that did not meet the pre-specified criteria to be termed a pass were removed from the analysis.

Bat activity was defined as the number of bat passes per detector-night, and was used as an index for potential bat risk in the TWRA. Because individuals cannot be differentiated by their calls, bat pass data represent relative levels of bat activity rather than the total numbers of individuals present. To assess potential for bat mortality, the mean number of bat passes per detector-night (averaged across ground-based met tower monitoring stations) was compared to existing data from wind energy facilities where both bat activity and mortality levels have been measured.

RESULTS

Bat Acoustic Surveys

Bat activity at the TWRA was monitored at 8 meteorological (met) tower sampling locations (2 heights at 4 towers) and at 10 bat feature and roaming sampling locations on a total of 250 nights during the period March 11 to November 15, 2010. Fixed station Anabat units were operable for 71.6% of the sampling period, while the roaming station units were operable for 81.9% of the sampling period (Figure 2a). Equipment failures, consisting primarily of worn microphone cables and low battery levels, occurred intermittently during the studies, but most detectors were operating on any given night (Figure 2a and 2b).

During the 2008/2009 study period, bat activity was monitored at four sampling locations (2 heights at 4 towers) from September 4, 2008 to August 10, 2009 (Gruver et al. 2009). However, for comparison with 2010, the 2008/2009 data set was truncated to include only the months of March through November. Within that date range, Anabat units recorded data on a total of 226 nights. Anabat units were operable for 94.5% of this sampling period (Figure 2b).

In 2008/2009, a total of four Anabat units recorded 4,592 bat passes on 842 detector-nights. Averaging bat passes per detector-night across all stations, a mean (± standard error) of 5.53±0.47 bat passes per detector-night was recorded (Table 2). The average bat activity for ground stations was 10.00±0.81 bat passes per detector-night, and for raised stations was 1.07±0.12 bat passes per detector-night (Table 2). The data for 2008/2009 was truncated to include only the months of May through November, encompassing the dates September 4 to November 15, 2008 and March 11 to August 10, 2009. For analysis of the complete 2008/2009 data set see Gruver et al. 2009.

At the met tower stations in 2010, a total of eight Anabat units recorded 14,667 bat passes on 939 detector-nights. Averaging bat passes per detector-night across all stations, a mean (± standard error) of 16.42±1.61 bat passes per detector-night was recorded (Table 2).

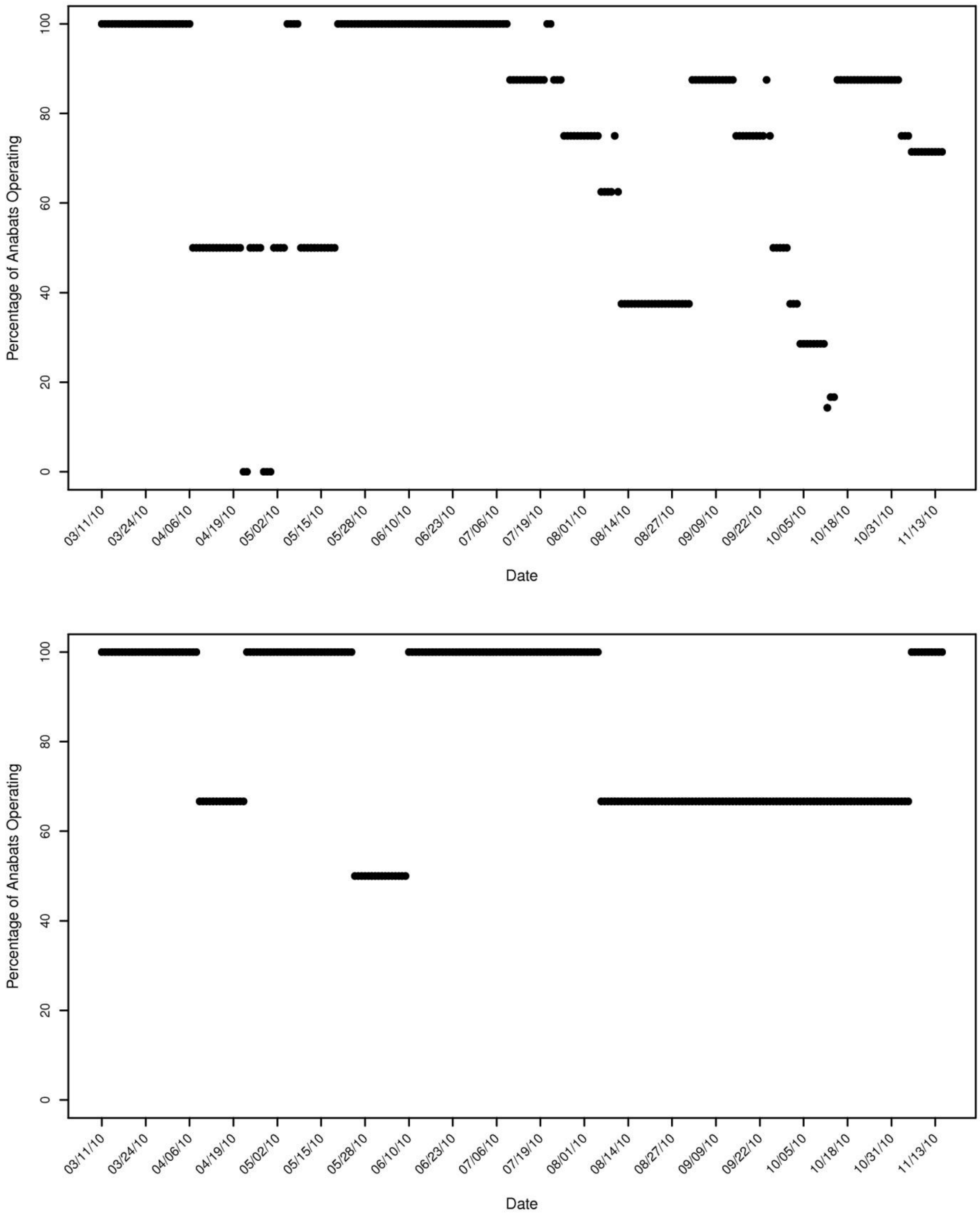


Figure 2a. Percentage of Anabat detectors at the Tule Wind Resource Area operating during each night of the study period March 11 – November 15, 2010, at the meteorological (met) tower stations (top; n=8) and bat feature and roaming stations (bottom; n=10).

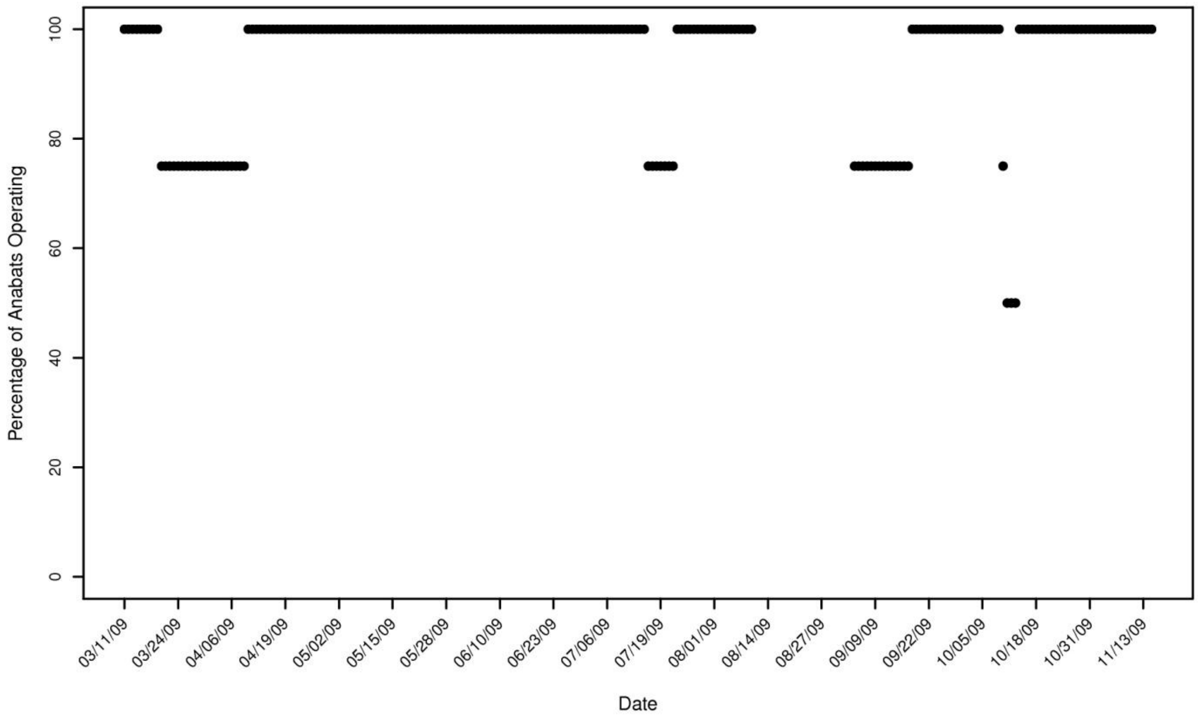


Figure 2b. Percentage of Anabat detectors (n=4) at the Tule Wind Resource Area operating during each night of the study period September 4 to November 15, 2008 and March 11 to August 10, 2009. The 2009 dates are placed before the 2008 dates for comparison purposes. No data available for the dates August 11 to September 3.

The average bat activity for ground stations was 26.16 ± 2.73 bat passes per detector-night, and for raised stations was 6.69 ± 1.27 bat passes per detector-night (Table 2). For all non-met tower stations, 64,766 bat passes were recorded on 551 detector-nights, with an average of 69.09 ± 4.99 bat passes per detector-night (Table 2).

Bat feature stations were established to assess a probable upper bound on bat activity for this project area. At the fixed bat feature station TR1, 41,472 bat passes were recorded on 208 detector-nights, yielding an average of 199.38 bat passes per detector-night. At the five roaming bat feature stations, a total of 2,196 bat passes were recorded on 104 detector-nights, a mean of 21.11 passes per detector-night. The average across all bat feature stations was 64.59 bat passes per detector-night. Four roaming stations were established along Thing Valley Road in the northwest portion of the project area to increase spatial coverage. These detector stations recorded a total of 21,098 bat passes on 239 nights, a mean of 88.28 passes per detector-night. It should be noted however, that only station TWR1A (51.2 ± 14.99 passes per detector-night) was located within the project boundary. Station TWR1A also recorded more VLF passes than any other station, collecting 55.8% of all VLF passes recorded in 2010 and 34.9% of all VLF passes recorded during both years. Also unlike other stations, the number of LF passes at TWR1A was much greater than the number of passes in the other frequency groups (Table 2).

Table 2. Number of bat passes by frequency group, and all bats, detector-nights, and bat passes per detector-night for Anabat stations at the Tule Wind Resource Area. Stations TU1 (2008/2009) and T1 (2010) monitored at the same location. All other stations were at different locations across years.

Anabat Station	Location	Type	# of HF Bat Passes	# of MF Bat Passes	# of LF Bat Passes	# of VLF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/ Night*
					2008-2009 Stations**				
TU1g	ground	Fixed	1,879	109	289	58	2,335	203	11.50±1.31
TU1h	raised	Fixed	29	2	145	44	220	201	1.09±0.14
TU2g	ground	Fixed	1,389	128	222	61	1,800	212	8.49±0.81
TU2h	raised	Fixed	36	6	143	52	237	226	1.05±0.17
	Total Ground		**3,268**	**237**	**511**	**119**	**4,135**	**415**	**10.00±0.81**
	Total Raised		**65**	**8**	**288**	**96**	**457**	**427**	**1.07±0.12**
	Grand Total		**3,333**	**245**	**799**	**215**	**4,592**	**842**	**5.53±0.47**
					2010 Met Stations				
T1g	ground	Fixed	3,063	129	261	43	3,496	220	15.89±1.58
T1h	raised	Fixed	659	23	373	31	1,086	190	5.72±1.37
T2g	ground	Fixed	2,503	84	140	4	2,731	104	26.26±2.36
T2h	raised	Fixed	10	5	62	5	82	64	1.28±0.19
T3g	ground	Fixed	2,354	42	101	4	2,501	81	30.88±5.46
T3h	raised	Fixed	163	9	69	14	255	119	2.14±0.34
T4g	ground	Fixed	3,255	189	336	14	3,794	120	31.62±5.71
T4h	raised	Fixed	626	16	78	2	722	41	17.61±4.73
	Total Ground		**11,175**	**444**	**838**	**65**	**12,522**	**525**	**26.16±2.73**
	Total Raised		**1,458**	**53**	**582**	**52**	**2,145**	**414**	**6.69±1.27**
	Grand Total		**12,633**	**497**	**1,420**	**117**	**14,667**	**939**	**16.42±1.61**
					2010 Bat Feature Stations				
TR1	ground	Fixed	37,582	1,266	2,620	4	41,472	208	199.38±16.11
TR3	ground	Roaming	1,851	12	59	1	1,923	28	68.68±16.92
TR4	ground	Roaming	63	1	8	0	72	19	3.79± 1.15
TR5	ground	Roaming	4	0	8	0	12	14	0.86± 0.42
TR7***	ground	Roaming	112	0	1	0	113	1	113.00± NA
TR8	ground	Roaming	63	2	11	0	76	42	1.81± 0.60
					2010 West-side Stations				
TW2	ground	Roaming	8,354	1,882	3,785	17	14,038	102	137.63±13.19
TWR1A	ground	Roaming	235	49	1,768	201	2,253	44	51.20±14.99
TWR1B	ground	Roaming	623	135	158	6	922	53	17.40± 3.48
TWR1C	ground	Roaming	2,562	456	853	14	3,885	40	97.12±14.16
	Non-met Total		**51,449**	**3,803**	**9,271**	**243**	**64,766**	**551**	**69.09± 4.99**

* ± bootstrapped standard error.

** analysis only includes March-November data from the 2008-2009 study (Gruver et al. 2009). TU1 (2008/2009) is same station as T1 (2010)

*** data from only one night, therefore no standard error

Spatial Variation

At the met tower stations in 2010, average bat passes per detector-night was highest at station T4 for both ground and raised stations (31.62 and 17.61 bat passes per detector-night, respectively; Table 2; Figure 3). Average bat activity was similar at ground stations T3g and T2g (30.88 and 26.26, respectively) but was lower at station T1g (15.89). Levels of bat activity among the remaining raised stations were similar, ranging from 1.28 at station T2h to 5.72 at T1h (Table 2; Figure 3a).

One met tower was used for monitoring in both 2008/2009 (TU1g and TU1h) and 2010 (T1g and T1h). The data for 2008/2009 was truncated to include only the months of May through November, encompassing the dates September 4 to November 15, 2008 and March 11 to August 10, 2009. In 2008/2009, station TU1g recorded a total of 2,335 bat passes on 203 detector-nights, averaging 11.50 ± 1.31 bat passes per detector-night. In 2010, station T1g recorded a total of 3,496 bat passes on 220 detector-nights, averaging 15.89 ± 1.58 bat passes per detector-night. Raised station TU1h recorded a total of 220 bat passes on 201 detector-nights in 2008/2009, yielding an average of 1.09 ± 0.14 bat passes/detector-night. In 2010, raised station T1h recorded 1,086 bat passes on 190 detector-nights, and averaged 5.72 ± 1.37 bat passes per detector-night (Table 2; Figure 3a).

Among the 2010 bat feature stations, fixed station TR1, a location expected to receive high use by foraging bats, recorded the most activity by far with 41,472 total bat passes recorded over 208 detector-nights, averaging 199.38 ± 16.11 bat passes per detector-night. Station TR7, near an abandoned mine opening, also had high bat activity (113 bat passes in one detector-night), however this station was only operable for one detector-night and is therefore not comparable to the other stations. Relatively high levels of bat activity were recorded at station TR3 as well, averaging 68.68 ± 16.92 bat passes per detector-night. The remaining bat feature stations (TR4, TR5, and TR8) all had comparatively lower levels of bat activity, with each station averaging less than four bat passes per detector-night. Levels of bat activity recorded at the west-side stations were somewhat higher, ranging from 17.40 ± 3.48 bat passes per detector-night at station TWR1B to 137.63 ± 13.19 at station TW2. However, it should be noted that only station TWR1A was located within the project area boundary. That station recorded 51.20±14.99 passes per detector-night. For all non-met tower stations, a total of 64,766 bat passes were recorded on 551 detector-nights, with an average of 69.09 ± 4.99 bat passes per detector-night (Table 2; Figure 3b).

Comparing paired detectors at met towers on just the nights that both ground and raised detectors were operating in 2010, bat activity was much higher at all ground stations except T4. Although bat activity was higher at station T4g, it was only slightly higher than that recorded at T4h. In 2008/2009, bat activity was much higher at ground units for both paired stations (Figure 4).

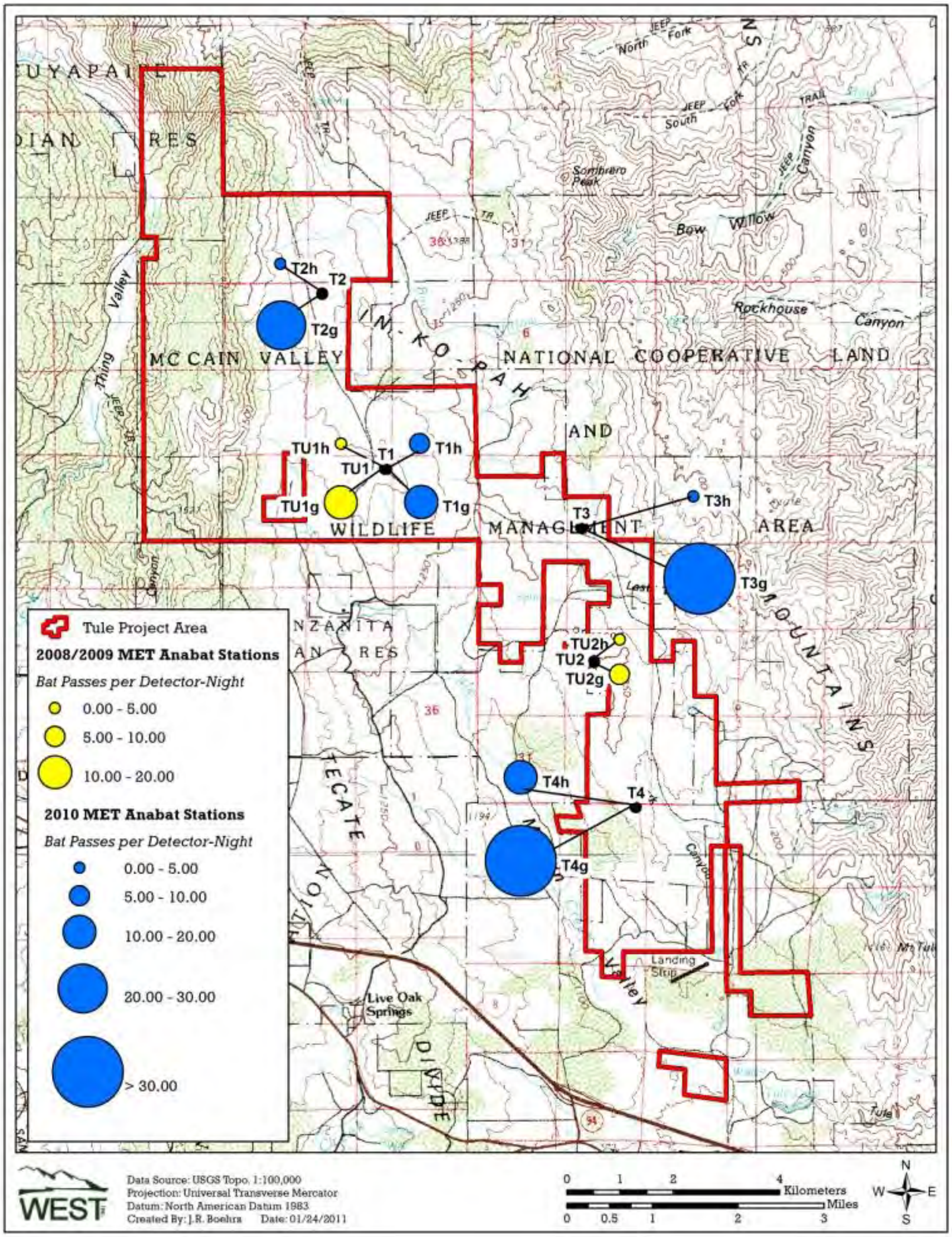


Figure 3a. Bat activity at meteorological tower stations within the Tule Wind Resource Area for the 2008/2009 and 2010 study periods. Stations T2, T3 and T4 were established after met towers were erected in late June 2010, whereas T1 began data collection on March 12, 2010.

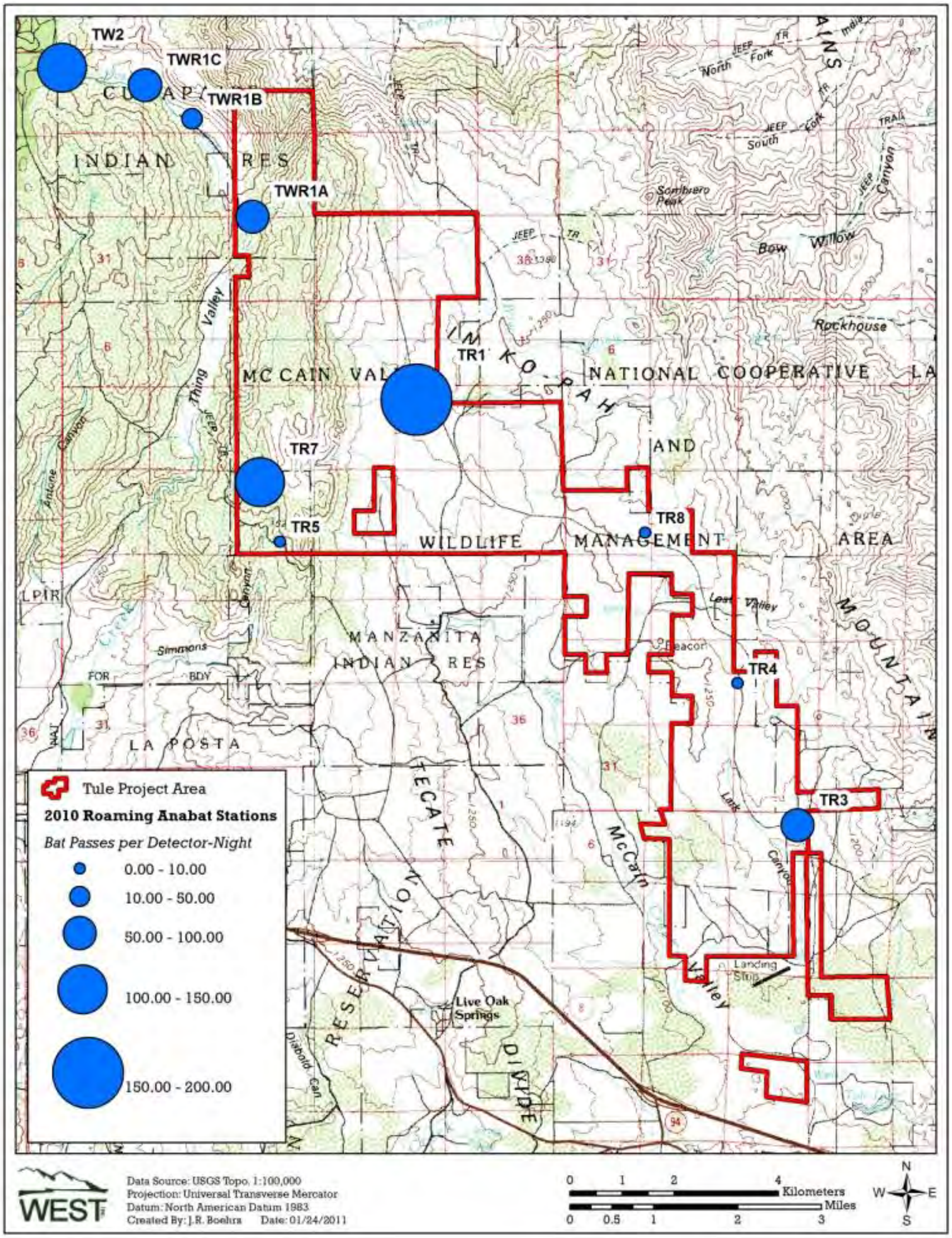


Figure 3b. Bat activity at fixed and roaming bat feature stations within the Tule Wind Resource Area for the study period March 11 to November 15, 2010. Station TR1 was a fixed station along a stream with canopy cover and likely attracted foraging bats.

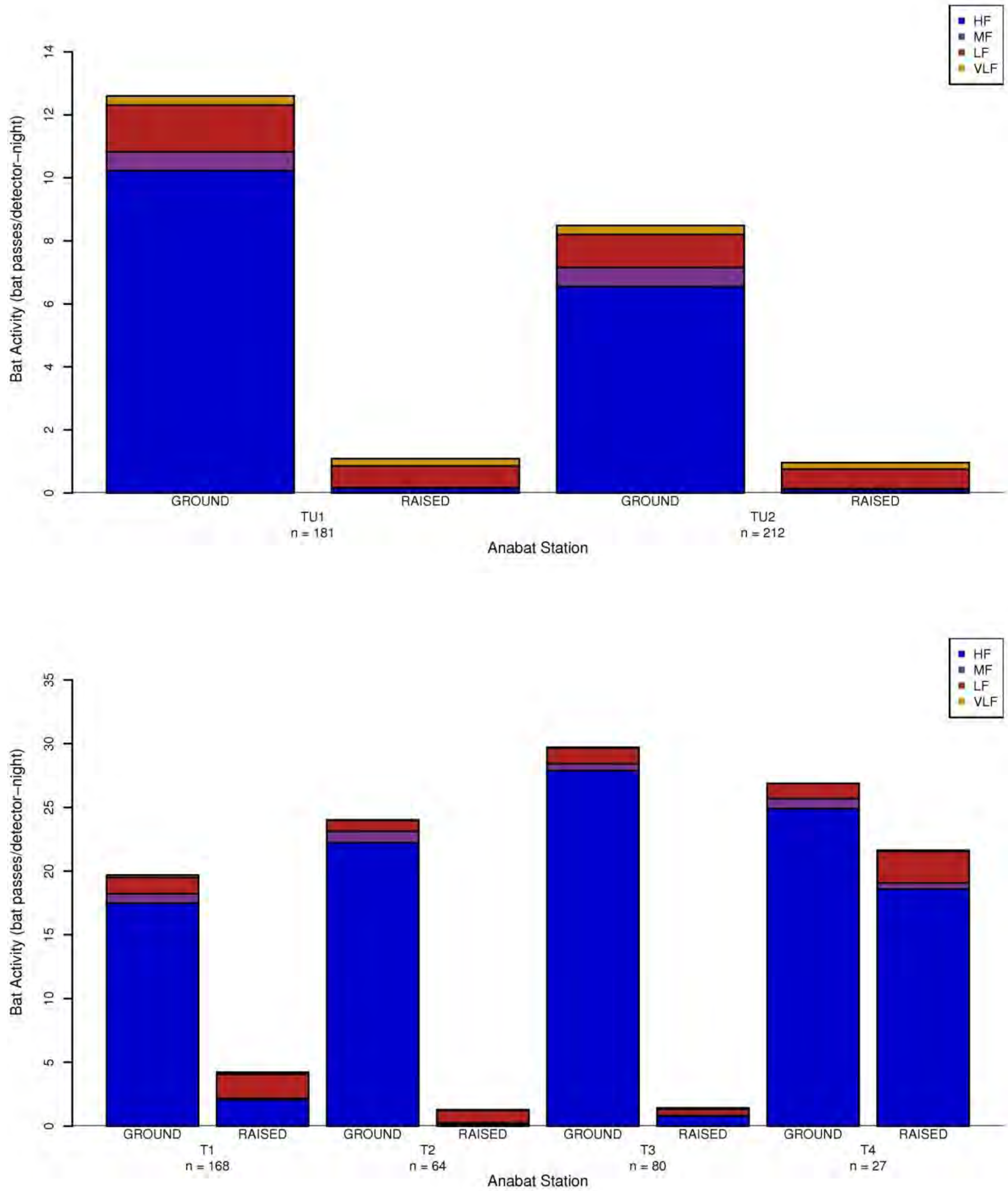


Figure 4. Number of high-frequency (HF), mid-frequency (MF), low-frequency (LF), and very low-frequency (VLF) bat passes per detector-night recorded at paired ground and raised Anabat stations at the Tule Wind Resource Area for the study periods September 4 – November 15, 2008 and March 11 – August 10, 2009 (top) and March 11 – November 15, 2010 (bottom).

Temporal Variation

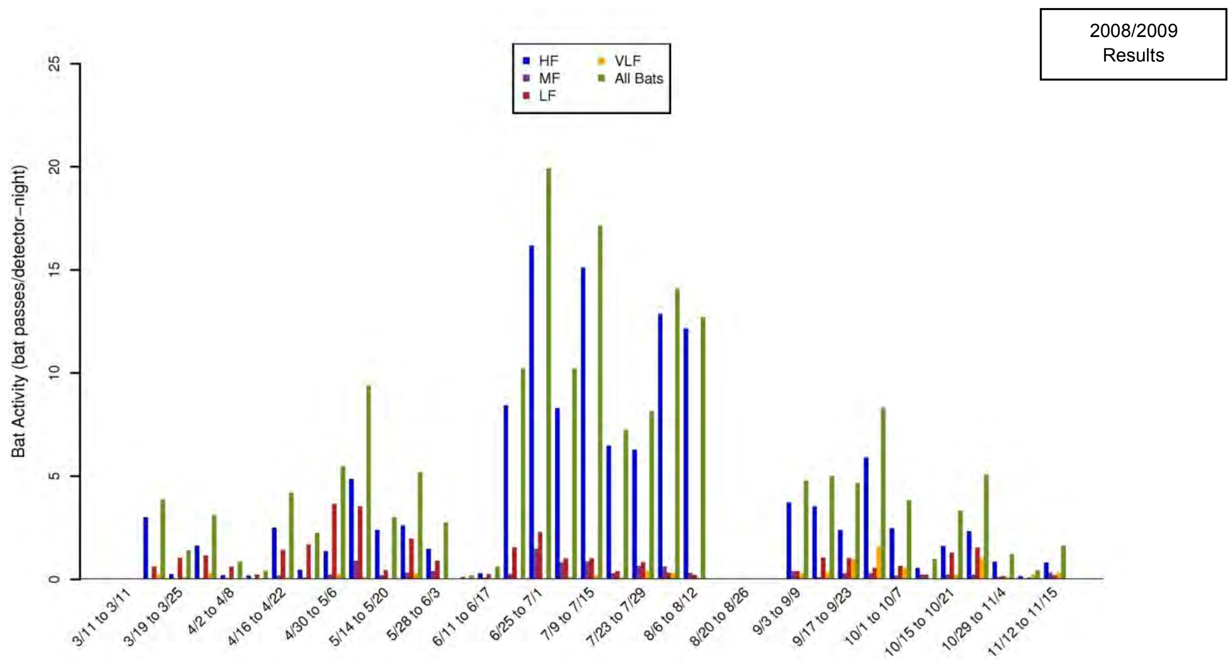
In 2010, overall bat activity at the met towers increased during the study period (Figure 5), peaking during the week of August 12-18 (67.67 bat passes per detector-night; Table 4). Activity decreased steadily through September to relatively low levels by mid-October. In 2008/2009, overall bat activity increased through late June, remaining at relatively high levels until mid-August. No surveys occurred from August 11 to September 3, 2009. Moderate levels of activity were recorded in September 2008, decreasing to low levels by November 2008 (Table 4; Figure 5).

The temporal patterns of overall bat activity at stations TU1/T1 were similar to the pattern of all stations combined for their respective years (Figures 5, 6). Bat activity levels peaked at station TU1 between August 9-10, 2009, with 45 bat passes per detector-night. In 2010, detectors at that same location recorded peak activity a few weeks later, between August 30 and September 5, 2010, with 55.23 bat passes per detector-night (Table 5; Figure 6).

Temporal patterns of bat activity between ground and raised stations were similar (Figure 8), and followed the overall trend. The number of passes recorded at ground stations was higher than at raised throughout both years of study, with the exception of one week during the 2010 study (May 7-13, 2010), when raised stations recorded more passes than ground stations.

Table 4. Periods of peak activity for high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF), and all bats at the Tule Wind Resource Area for the study periods March 11 – November 15, 2010.

Species Group	Start Date of Peak Activity	Number of Nights	Bat Passes per Detector-Night
March 11 – November 15, 2010 (met Stations)			
HF	Aug 12	7	67.67
MF	Aug 12	7	4.29
LF	Aug 12	7	7.52
VLF	Sept 29	7	0.41
All Bats	Aug 12	7	79.76
March 11 – November 15, 2010 (Roaming Stations)			
HF	May 31	7	525.00
MF	Aug 5	7	31.77
LF	June 2	7	181.86
VLF	June 15	7	9.05
All Bats	May 31	7	704.29



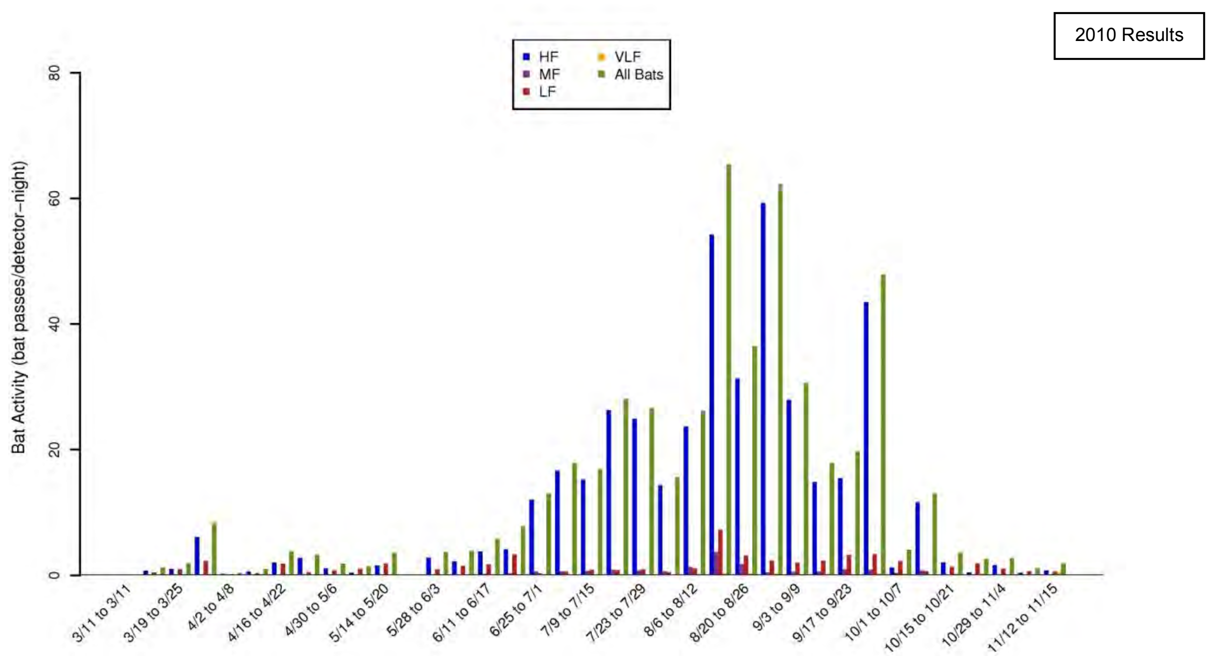


Figure 5. Weekly patterns of bat activity by high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF) and all bats at the Tule Wind Resource Area for the study periods September 4 – November 15, 2008 and March 11 – August 10, 2009 (top) and March 11 – November 15, 2010 (bottom). The 2009 dates are placed before the 2008 dates in the top figure for comparison purposes, and the bottom figure only includes data from the 2010 met tower stations.

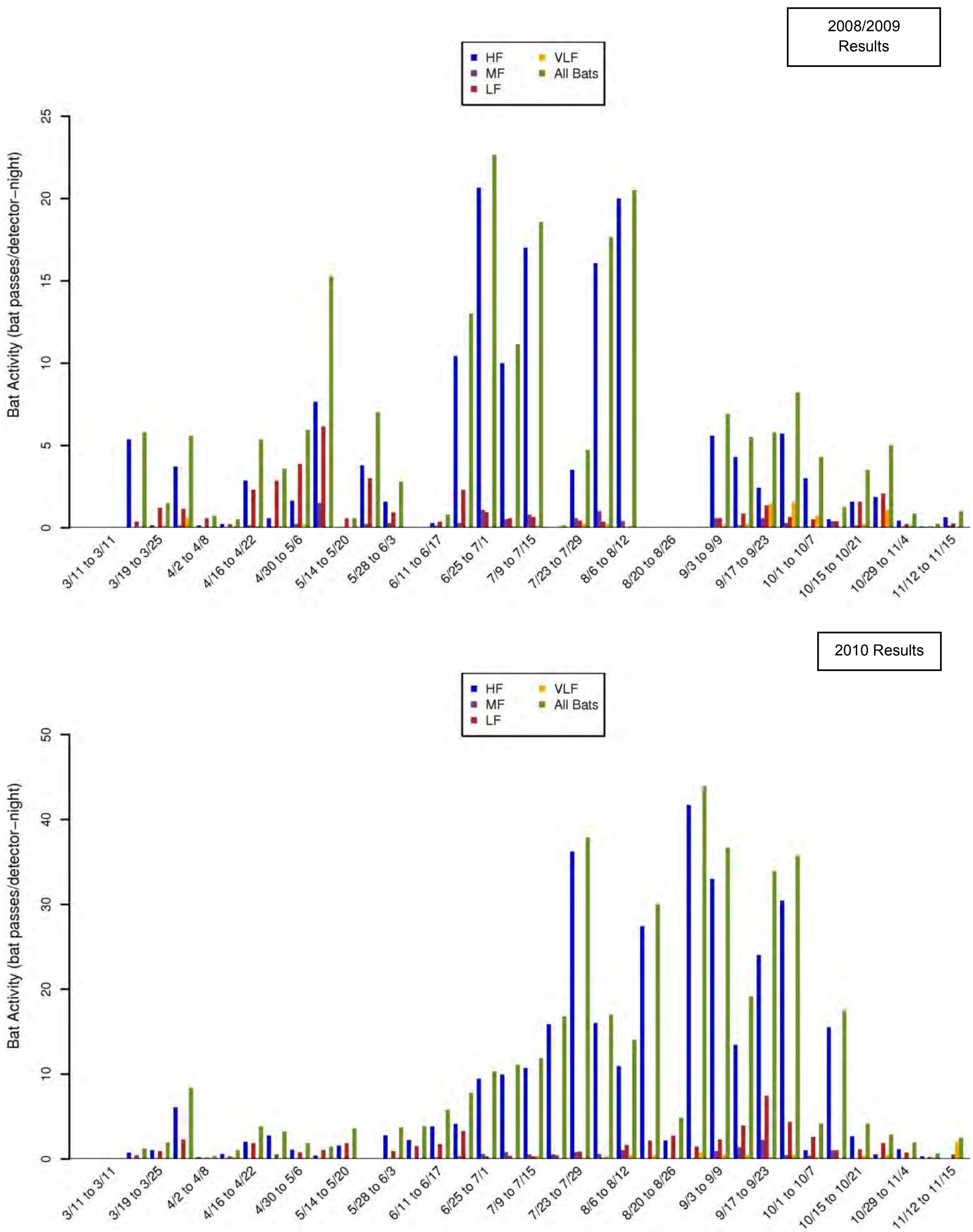


Figure 6. Weekly patterns of bat activity by high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF), and all bats at the Tule Wind Resource Area for the only met station used in both studies: 2008/2009 (TU1; top) and 2010 (T1; bottom).

Table 5. Periods of peak activity for high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF), and all bats at stations T1 and TU1 (same meteorological tower) at the Tule Wind Resource Area for the study periods March 11 – November 15, 2010, and September 4 - November 15, 2008/March 11 - August 10, 2009.

Species Group	Start Date of Peak Activity	Number of Nights	Bat Passes per Detector-Night
Station T1 (March 11 – November 15, 2010)			
HF	Aug 30	7	51.61
MF	Sept 13	7	3.00
LF	Sept 13	7	8.21
VLF	Nov 9	7	1.43
All Bats	Aug 30	7	55.23
Station TU1 (September 4 - November 15, 2008/March 11 - August 10, 2009)			
HF	Aug 9	7	44.23
MF	May 7	7	1.50
LF	May 4	7	6.25
VLF	Sept 23	7	1.79
All Bats	Aug 9	7	45.00

Species Composition

In 2008/2009, the majority of bat passes were from high-frequency bats (HF; 72.6% of all passes) followed by low-frequency passes (LF; 17.4%), mid-frequency passes (MF; 5.3%), and very low-frequency passes (VLF; 4.7%; Table 2), and this pattern was largely consistent among the two ground stations (Figure 3b). The distribution of bat passes recorded by raised stations differed from the ground stations in 2008/2009, with passes by LF bats accounting for the highest percentage of passes (63.0%), follow by VLF bats (21.0%), HF bats (14.2%), and MF bats (1.8%). Weekly patterns of activity were varied among species groups. HF bats peaked first between August 9-15, 2008, followed by VLF bats (September 22-28, 2008), LF bats (May 4-10, 2009), and MF bats June 26 – July 2, 2009 (Table 6).

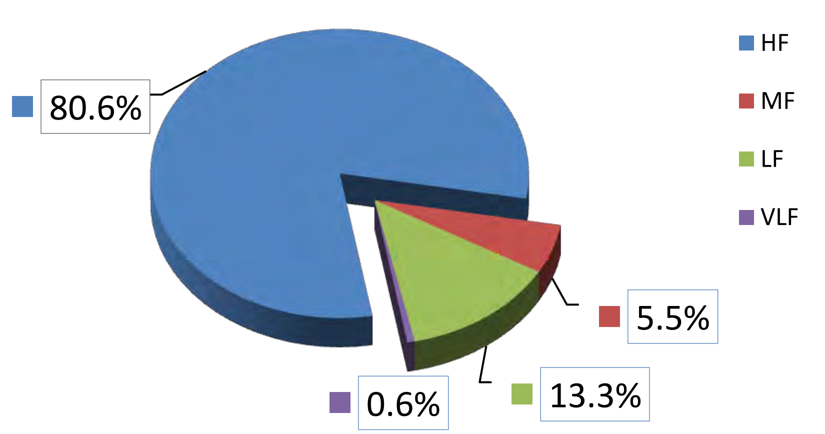


Figure 9. Percentage of high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF) bat passes recorded in the TWRA during 2008/2009 and 2010 surveys.

At the met towers in 2010, passes by high-frequency bats (HF; 86.1% of all passes) greatly outnumbered passes by low-frequency bats (LF; 9.7%), mid-frequency bats (MF;

3.4%), and very low-frequency bats (VLF 0.8%; Table 2), and this pattern was largely consistent among ground stations, suggesting that the species in the HF group are generally more abundant throughout the project area (Table 2; Figure 3a). Among raised stations, HF bats comprised about 68%, LF 27%, and MF and VLF bats each accounted for about 2.5% of passes. Weekly patterns of activity were similar among HF, MF, and LF species, with activity peaking in mid-August, while activity levels of VLF bats did not peak until late September/early October (Table 4; Figure 5).

At roaming stations, passes by HF bats were the overwhelming majority, accounting for just over 90% of all activity. The only stations that did not hold this pattern were TR5 and TWR1A (Table 2). Passes by LF bats accounted for 78.5% of overall bat activity at station TWR1A, with each remaining guild accounting for 10.4% of overall passes or less. Bat activity at roaming stations peaked in June and July for HF, LF and VLF bats, and in early to mid-August for MF bats (Table 4).

Table 6. Periods of peak activity for high-frequency (HF), mid-frequency (MF), low-frequency (LF), very low-frequency (VLF), and all bats at the Tule Wind Resource Area for the study period September 4 - November 15, 2008 and March 11 - August 10, 2009.

Species Group	Start Date of Peak Activity	Number of Nights	Bat Passes per Detector-Night
September 4 - November 15, 2008 / March 11 - August 10, 2009			
HF	Aug 9	7	26.38
MF	June 26	7	1.57
LF	May 4	7	5.05
VLF	Sept 22	7	1.75
All Bats	Aug 9	7	27.38

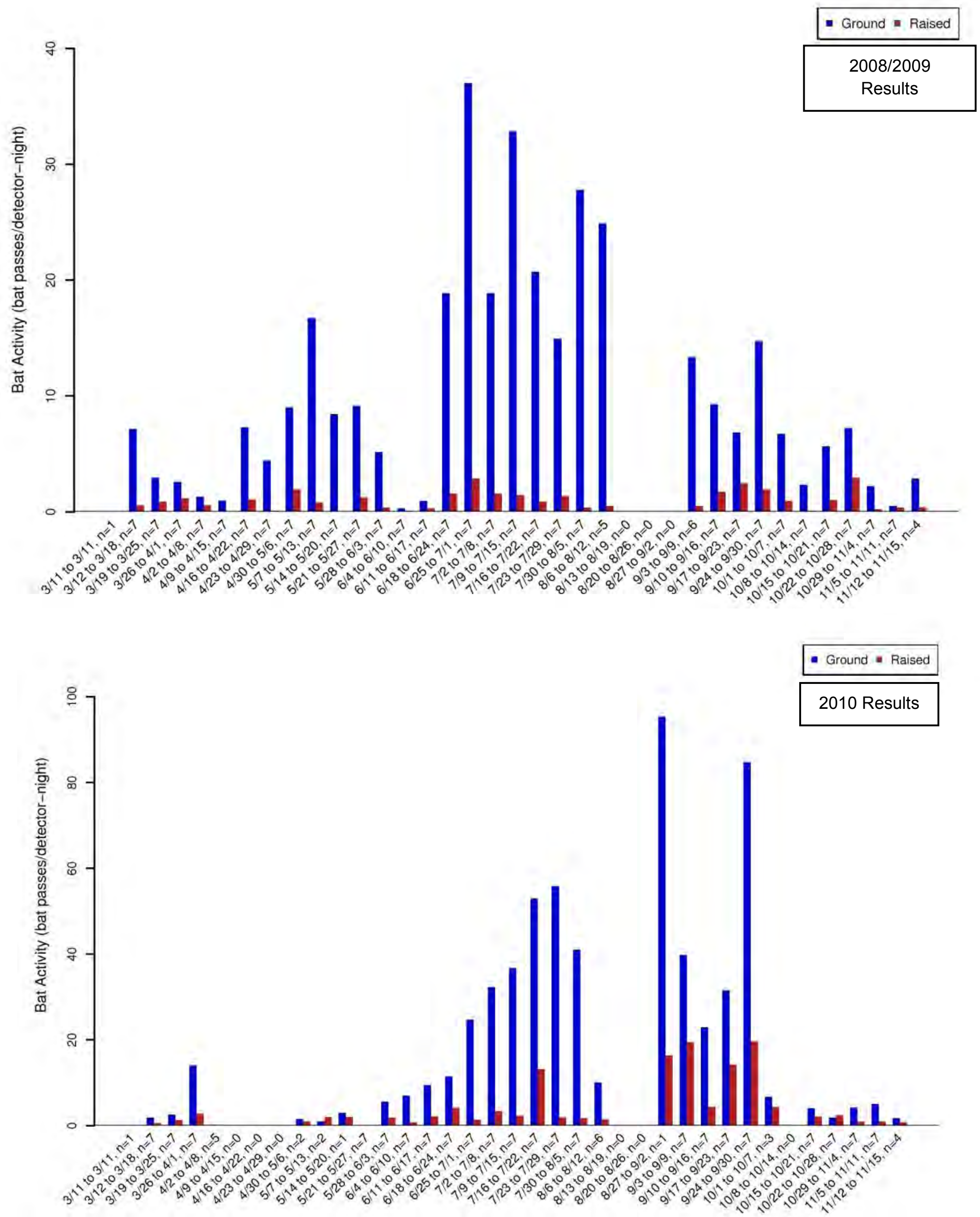


Figure 8. Weekly patterns of bat activity at ground and raised stations within the Tule Wind Resource Area during the study periods September 4 – November 15, 2008 and March 11 – August 10, 2009 (top) and March 11 – November 15, 2010 (bottom). The 2009 dates are placed before the 2008 dates in the top figure for comparison purposes, and the bottom figure only includes data from the 2010 met tower stations.

DISCUSSION

Potential Impacts

Assessing the potential impacts of wind energy development to bats at the TWRA is complicated because the proximate and ultimate causes of bat fatalities at turbines are poorly understood (Kunz et al. 2007b, Baerwald et al. 2008, Cryan and Barclay 2009; Long et al. 2010a, b), and because monitoring elusive, night-flying animals is inherently difficult (O'Shea et al. 2003). In addition, availability of study results from existing wind energy facilities has lagged the influx of newly proposed facilities (Kunz et al. 2007b), and many of the available study results are from very different habitats (e.g., Northwest, Midwest and Northeast), rather than the desert southwest where this proposed project is located. Nonetheless, to date monitoring studies of wind energy facilities suggest that:

1) bat mortality shows a rough correlation with bat activity (Appendix A1; Kunz et al. 2007*b*);

2) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September; Johnson 2005; Arnett et al. 2008);

3) migratory tree-roosting species (eastern red, hoary, and silver-haired bats) comprise almost 75% of reported bats killed (Arnett et al. 2008), and;

4) the highest reported fatalities occur at wind energy facilities located along forested ridge tops in the eastern and northeastern US. However, some facilities in agricultural regions report relatively high fatalities as well (Appendix A1).

Based on these patterns, current guidance to estimate potential mortality levels at a proposed wind energy facility involves evaluation of the on-site bat acoustic data in terms of activity levels, seasonal variation, and species composition (Kunz et al. 2007*b*), as well as comparison to regional fatality patterns.

Overall Bat Activity

To date, few studies of wind energy facilities have recorded both bat passes per night and bat fatality rates (Appendix A1). Those that have generally show correlation between activity and fatalities, and it is assumed that an association may exist for pre-construction activity and post-construction fatalities. However, to date such a relationship has not been established empirically due to lack of sufficient data. For those studies that have measured both activity and fatalities, data were collected during the late summer and fall using Anabat detectors placed near the ground (i.e., none raised on met towers) and none of the detectors were located near features attractive to bats. Therefore, this report relies on the mean bat activity for ground-based detectors at met towers to assess potential risk of bat fatality at the TWRA relative to the nine studies with similar data.

Bat activity recorded by ground-based detectors at met towers within the TWRA between March and November was 10.0 ± 0.81 passes per detector-night during the 2008/2009 surveys, and 26.16 ± 2.73 passes per detector-night during 2010 surveys. These rates are relatively high compared to that observed at facilities in Minnesota and Wyoming, where bat mortality was low, but are lower than activity recorded at sites in West Virginia, Iowa, and Tennessee, where bat mortality rates were high (Table 7). Although bat species composition, habitat and other factors differ among these sites and differ from TWRA, based on an expected relationship between pre-construction bat activity and post-construction fatalities, bat mortality rates at the TWRA could be expected to be greater than the 2.4 bat fatalities/MW/study period reported at Buffalo Ridge, Minnesota, but lower than the 39.70 fatalities/MW/study period reported at Buffalo Mountain, Tennessee.

Spatial Variation

For the 2008/2009 survey, four detectors were placed at 2 extant met towers, and in 2010, eight detectors were used at four met towers, per CEC recommendation (CEC 2007). Because met towers are generally not located in habitat that are particularly attractive to bats, fixed and roaming survey stations were established in areas with features considered to be attractive to bats to attain an estimate of the upper limit of high activity levels for the TWRA. One fixed-station detector (TR1) was placed at a bat feature in habitat attractive for foraging. Station TR1 was located near Cottonwood Creek Campground along a creek with plentiful trees and canopy cover. Three other detectors were moved periodically among the remaining nine stations, of which five were located near rocky terrain and ephemeral water courses in the McCain Valley (TR3, TR4, TR5, TR7, and TR8), and four were located west of the ridge separating McCain and Thing Valleys to provide estimates of bat activity in the northwest corner of the TWRA. As expected, bat activity levels at the roaming stations were generally higher than those recorded at the met stations. The ephemeral presence of water, and habitat diversity on the west-side may have contributed to activity levels recorded on the west-side were varied than in the McCain Valley. However, they were within the range of the levels of activity recorded at other stations in the McCain Valley.

Temporal Variation

Of the two met towers used for monitoring in 2008/2009, one was re-used during 2010. Activity at station TU1 (2008/2009) and T1 (2010) varied somewhat between years, but the difference was not unusually large. Differences in pass rates between 2008/2009 and 2010 at the single tower monitored in both surveys were likely due to normal annual variation in activity, but may have been influenced partially by using reflector plate microphone housings in 2008/2009 versus PVC elbow housings in 2010 at elevated stations, which can produce differences in measured activity (Britzke et al. 2010). If so, activity at the raised units would be expected to have greater differences than activity measured near ground level. Indeed, the measured activity at raised station T1h was approximately 5 times higher in 2010 than in 20008/2009, whereas activity at T1g was approximately 25-30% higher in 2010 (Table 2). Assuming that activity measured at this station can be considered reflective of bat activity project-wide, then the inter-annual differences suggest that overall bat activity in the project area in 2010 may have been somewhat than 2008/2009.

In 2008/2009, the number of bat passes recorded per detector-night at the TWRA peaked during week of August 9 (Table 5). In 2010, peak 7-day bat activity started a few weeks later, on August 30. During both years, activity decreased in late September and October and few bats were detected in November. The activity in August and September likely represents bats migrating through the area toward hibernacula or wintering areas. Differences in the timing of peak movements between years likely reflect interannual variation in bat activity, and highlight the value of multi-year bat monitoring studies.

Many fatality studies of bats at wind energy facilities in the US have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005; Arnett et al. 2008), though relatively few studies have monitored for fatalities during spring and early summer (Kunz et al. 2007*b*). While the survey effort varies among the different studies, the studies that combine Anabat surveys and fatality surveys show a general association between the timing of increased bat pass rates and timing of mortality, with both pass rates and fatalities peaking during the fall. Based on the available data from the TWRA, it is expected that bat fatalities at the TWRA may be highest between in August and September. However, data from roaming stations indicate peaks in May and June as well, which may also be reflected in higher fatality levels during spring and early summer. Although overall fatalities were low, the temporal pattern of bat fatalities at the Dillon Wind Project (Riverside County, CA) show peaks in both spring and fall (Chatfield et al. 2009).

Species Composition

Of the 22 species of bats likely to occur in the study area, 10 are known fatalities at wind energy facilities (Table 1). Of these 10, 3 are HF species, 2 are MF species, 5 are LF species and 1 is in the VLF group. In both 2008/2009 and 2010, passes by HF species accounted for the majority of recorded bat activity. Based on data compiled by WEST from publicly available sources, bats with HF echolocation have comprised 16.8% of all fatalities in North America, whereas 61.9% of fatalities have been species with LF echolocation, especially hoary and silver-haired bats. During the two seasons of acoustic monitoring in the TWRA, passes by HF species far outnumbered those by other frequency groups. Of the HF species that may occur in the TWRA and that are documented fatalities at wind projects in North America, only the little brown bat has been found in relatively large numbers (Appendix A2). However, this may simply reflect the areas the data come from, rather than the relative risk to those species. Two HF species that likely occur in TWRA that have not been documented in large numbers are the western red bat (*Lasiurus blossevillii*) and canyon bat (*Parastrellus hesperus*). These are closely related to the eastern red bat (*Lasiurus borealis*) and tricolored bat (*Perimyotis subflavus*), two species that are commonly found during fatality studies in other parts of North America. That their western cousins have not been documented in large numbers may reflect the relative rarity of the species (in the case of western red bat), differences in behavior, or few studies in areas where they occur.

Of the LF species that may occur in the TWRA, 5 are known fatalities at wind projects in North America. Of these, hoary and silver-haired bats have comprised the majority of fatalities documented to date (Appendix A2), although Mexican free-tailed bats have been recovered in relatively large numbers at some facilities located near large colonies (Piorkowski and O'Connell 2010). Like hoary and silver-haired bats, Mexican free-tailed bats are migratory, and have wings adapted for fast, relatively high straight flight. Although a number of hypotheses as to the causes of bat fatalities at wind turbines exist (Cryan and Barclay 2010), the flight style and behaviors of these and other species of free-tailed bats may place them at relatively greater risk of collisions or near-misses at turbine blades.

Regional Fatality Studies

Bat mortality studies at wind energy facilities across North America show a wide range of bat fatality rates, ranging from 0.07 to 39.70 bat fatalities/MW/study period (Appendix A1). To date, fatality rates have been highest in the Northeast and lowest in the Northwest, although a high degree of variation in fatality rates is present for most regions. So far, few fatality data have been made public from projects in the Southwest. The most germane region to compare the potential for bat fatality in the TWRA is the West, which includes 3 projects from California, though only one (Dillon) is similar in geographic location and habitat to the proposed Tule project.

Based solely on comparison to other fatality surveys in the West region, fatalities at the TWRA could range between 0.07 and 2.52 bat fatalities/MW/study period. However, considering the level of bat activity recorded in the project area, as well as the varied terrain and habitats, the potential for bat fatalities above the regional mean cannot be discounted. As a predictive tool, pre-construction bat activity surveys become stronger when paired with post-construction fatality and acoustic surveys. Only with the addition of more complete data sets will we be able to correlate and quantify relative risk from pre-construction surveys. Therefore, at a minimum, a post-construction fatality monitoring program should be designed to accurately estimate the levels of bat mortality, the spatial and temporal patterns of the fatalities, and the post-construction levels of bat activity, and these data should be included in an analysis of the predictive value of pre-construction acoustic surveys.

REFERENCES

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fieldler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72(1):61-78.

Arnett, E.B., M.R. Schirmacher, M.M.P. Huso, and J.P. Hayes. 2009. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. Annual Report Prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. June 2009. http://www.batsandwind.org/pdf/2008%20Casselman%20Fatality%20Report.pdf

Baerwald, E.F. 2008. Variation in the Activity and Fatality of Migratory Bats at Wind Energy Facilities in Southern Alberta: Causes and Consequences. Thesis. University of Calgary, Calgary, Alberta, Canada.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18(16): R695-R696.

Bat Conservation International, Inc. (BCI). 2002. Bat Species: US Bats. Bat Conservation International, Inc., Austin, Texas. www.batcon.org.

Brown, W.K. and B.L. Hamilton. 2006. Monitoring of Bird and Bat Collisions with Wind Turbines at the Summerview Wind Power Project, Alberta: 2005-2006. Prepared for Vision Quest Windelectric, Calgary, Alberta by TEAM Ltd., Calgary, Alberta, and BLH Environmental Services, Pincher Creek, Alberta. September 2006. http://www.batsandwind.org/pdf/Brown2006.pdf

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

Chatfield, A., W. Erickson, and K. Bay. 2009. Avian and Bat Fatality Study Dillon Wind-Energy Facility, Riverside County, California. Final Report, Prepared for: Iberdrola Renewables, Portland, OR. Prepared by: Western EcoSystems Technology, Inc., Cheyenne, WY

Cryan, P.M. and R.M.R. Barclay. 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy, 90:133-1340.

Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-Construction Monitoring Report for Avian and Bat Mortality at the NPPD Ainsworth Wind Farm. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, for the Nebraska Public Power District.

Erickson, W.P., G.D. Johnson, M.D. Strickland, and K. Kronner. 2000. Avian and Bat Mortality Associated with the Vansycle Wind Project, Umatilla County, Oregon: 1999 Study Year. Technical report prepared by WEST, Inc. for Umatilla County Department of Resource Services and Development, Pendleton, Oregon. 21pp.

Erickson, W.P., K. Kronner, and B. Gritski. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report. September 2002 - August 2003. Prepared for the Nine Canyon Technical Advisory Committee and Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. October 2003. http://www.west-inc.com/reports/nine_canyon_monitoring_final.pdf

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Final Report: July 2001 - December 2003. Technical report for and peer-reviewed by FPL Energy, Stateline Technical Advisory Committee, and the Oregon Energy Facility Siting Council, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. December 2004. http://www.west-inc.com

Erickson, W.P., J.D. Jeffrey, and V.K. Poulton. 2008. Puget Sound Energy, Wild Horse Wind Facility, Post-Construction Avian and Bat Monitoring. First Annual Report: January - December 2007. Prepared for Puget Sound Energy, Ellensburg, Washington, and the Wild Horse Wind Facility Technical Advisory Committee, Kittitas County, Washington. Prepared by Western EcoSystems Technology Inc. (WEST), Cheyenne, Wyoming. January 2008.

Fiedler, J.K. 2004. Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee. M.S. Thesis. University of Tennessee, Knoxville, Tennessee. August, 2004. http://www.tva.gov/environment/bmw_report/bat_mortality_bmw.pdf

Fiedler, J.K., T.H. Henry, C.P. Nicholson, and R.D. Tankersley. 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority, Knoxville, Tennessee. https://www.tva.gov/environment/bmw_report/results.pdf

Gannon, W.L., R.E. Sherwin, and S. Haymond. 2003. On the Importance of Articulating Assumptions When Conducting Acoustic Studies of Habitat Use by Bats. Wildlife Society Bulletin 31: 45-61.

Gruver, J.C. 2002. Assessment of Bat Community Structure and Roosting Habitat Preferences for the Hoary Bat (Lasiurus cinereus) near Foote Creek Rim, Wyoming. M.S. Thesis. University of Wyoming, Laramie, Wyoming.

Gruver, J.C. 2008. Bat acoustic studies for Blue Sky Green Field Wind Project, Fond du Lac County, Wisconsin. Technical report prepared for We Energies, Milwaukee, WI

Gruver, J., K. Bay, and T. Lyon. 2009. Bat Acoustic Studies for the Tule Wind Resource Area, San Diego County, California, September 4th, 2008 – August 10th, 2009. Prepared for: Iberdrola Renewables, Portland, Oregon. Prepared by: Western EcoSystems Technology, Inc., Cheyenne, Wyoming.,

Gruver, J., M. Sonnenburg, K. Bay and W. Erickson. 2009. Post-construction bat and bird fatality study at the Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin: July 21, 2008 – October 31, 2008 and March 15, 2009 – June 4, 2009. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Arkansas Game & Fish Commission and US Fish and Wildlife Service, Arkansas.

Hayes, J.P. 1997. Temporal Variation in Activity of Bats and the Design of Echolocation-Monitoring Studies. Journal of Mammalogy 78: 514-524.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study - 2006. Final Report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study - 2007. Final report prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009a. Annual Report for the Noble Ellenburg Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009b. Annual Report for the Noble Clinton Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009c. Maple Ridge Wind Power Avian and Bat Fatality Study Report - 2008. Annual Report for the Maple Ridge Wind Power Project, Post-construction Bird and Bat Fatality Study - 2008. Prepared for Iberdrola Renewables, Inc, Horizon Energy, and the Technical Advisory Committee (TAC) for the Maple Ridge Project Study. Prepared by Curry and Kerlinger, LLC. May 14, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, and D. Pursell. 2009d. Annual Report for the Noble Bliss Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

James, R.D. 2008. Erie Shores Wind Farm Port Burwell, Ontario: Fieldwork Report for 2006 and 2007 During the First Two Years of Operation. Report to Environment Canada, Ontario Ministry of Natural Resources, Erie Shores Wind Farm LP - McQuarrie North American and AIM PowerGen Corporation. January 2008.

Johnson, G.D. 2005. A Review of Bat Mortality at Wind-Energy Developments in the United States. Bat Research News 46(2): 45-49.

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

Johnson, G.D., W.P. Erickson, and J. White. 2003. Avian and Bat Mortality During the First Year of Operation at the Klondike Phase I Wind Project, Sherman County, Oregon. March 2003. Technical report prepared for Northwestern Wind Power, Goldendale, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. http://www.west-inc.com

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

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

Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont: July 1996-July 1998. NREL/SR-500-28591. Prepared for Vermont Public Service, Montpelier, Vermont. US Department of Energy, National Renewable Energy Laboratory, Golden, Colorado. March 2002. 95 pp. http://www.nrel.gov/docs/fy02osti/28591.pdf

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilkerson, B. Fischer, and A. Hasch. 2006. Post-Construction Avian and Bat Fatality Monitoring for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds LLC, FPL Energy by Curry and Kerlinger, LLC. April 2006.

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

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Facility, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. Technical report prepared by Curry and Kerlinger, LLC., for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee. Curry and Kerlinger, LLC. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kronner, K., B. Gritski, and S. Downes. 2008. Big Horn Wind Power Project Wildlife Fatality Monitoring Study: 2006?2007. Final report prepared for PPM Energy and the Big Horn Wind Project Technical Advisory Committee by Northwest Wildlife Consultants, Inc. (NWC), Mid-Columbia Field Office, Goldendale, Washington. June 1, 2008.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak. 2007a. Assessing Impacts of Wind-energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management, 71:2449-2486.

Kunz, T. H., E.B Arnett, W P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007b. Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. Frontiers in Ecology and the Environment 5:315-324.

Nicholson, C.P., J. R.D. Tankersley, J.K. Fiedler, and N.S. Nicholas. 2005. Assessment and Prediction of Bird and Bat Mortality at Wind Energy Facilities in the Southeastern United States. Final Report. Tennesee Valley Authority, Knoxville, Tennessee.

Norberg, U.M. and J.M.V. Rayner. 1987. Ecological Morphology and Flight in Bats (Mammalia: Chiroptera): Wing Adaptations, Flight Performance, Foraging Strategy and Echolocation. Philosophical Transactions of the Royal Society of London B 316:335-427.

Northwest Wildlife Consultants, Inc. (NWC) and Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Monitoring Report for the Klondike II Wind Power Project. Sherman County, Oregon. Prepared for PPM Energy, Portland, Oregon. Managed and conducted by NWC, Pendleton, Oregon. Analysis conducted by WEST, Cheyenne, Wyoming. July 17, 2007.

O'Shea, T.J., M.A. Bogan, and L.E. Ellison. 2003. Monitoring Trends in Bat Populations of the United States and Territories: Status of the Science and Recommendations for the Future. Wildlife Society Bulletin 31:16-29.

Piorkowski, M.D. and T.J. O'Connell. 2010. Spatial pattern of summer bat mortality from collisions with wind turbines in mixed-grass prairie. American Midland Naturalist, 164:260-269.

Stantec Consulting Inc. (Stantec). 2008. 2007 Spring, Summer, and Fall Post-Construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC, Cumberland, Maine, by Stantec Consulting, formerly Woodlot Alternatives, Inc., Topsham, Maine. January, 2008.

Stantec Consulting Inc. (Stantec). 2009a. Post-Construction Monitoring at the Mars Hill Wind Farm, Maine - Year 2, 2008. Prepared for First Wind Management, LLC, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting Inc. (Stantec). 2009b. Ripley Wind Power Project Post-construction Monitoring Report. Project No.1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Report by Stantec, Jacques Whitford Stantec Limited, Markham, Ontario. April 30, 2009. www.jacqueswhitford.com

Tierney, R. 2007. Buffalo Gap I Wind Farm Avian Mortality Study: February 2006-January 2007. Final Survey Report. Prepared for AES SeaWest, Inc. TRC, Albuquerque, New Mexico.TRC Report No. 110766-C-01. May 2007.

TRC Environmental Corporation. 2008. Post-Construction Avian and Bat Fatality Monitoring and Grassland Bird Displacement Surveys at the Judith Gap Wind Energy Project, Wheatland County, Montana. Prepared for Judith Gap Energy, LLC, Chicago, Illinois. TRC Environmental Corporation, Laramie, Wyoming. TRC Project 51883-01 (112416). January 2008. http://www.newwest.net/pdfs/AvianBatFatalityMonitoring.pdf

URS, W.P. Erickson, and L. Sharp. 2005. Phase 1 and Phase 1A Avian Mortality Monitoring Report for 2004-2005 for the Smud Solano Wind Project. Prepared for Sacramento Municipal Utility District (SMUD), Sacramento, California. Co-Authors: Wally Erickson, Western EcoSystems Technology, Inc. (WEST) and Lynn Sharp, Environmental Consultant. August 2005.

White, E.P. and S.D. Gehrt. 2001. Effects of Recording Media on Echolocation Data from Broadband Bat Detectors. Wildlife Society Bulletin 29: 974-978.

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

Young, D.P. Jr., J. Jeffrey, W.P. Erickson, K. Bay, and V.K. Poulton. 2006. Eurus Combine Hills Turbine Ranch. Phase 1 Post Construction Wildlife Monitoring First Annual Report. Technical report prepared for Eurus Energy America Corporation, San Diego, California, and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, and V.K. Poulton. 2007. Puget Sound Energy Hopkins Ridge Wind Project Phase 1 Post-Construction Avian and Bat Monitoring First Annual Report, January - December 2006. Technical report for Puget Sound Energy, Dayton, Washington and Hopkins Ridge Wind Project Technical Advisory Committee, Columbia County, Washington. Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Walla Walla, Washington. 25 pp.

Young, D.P. Jr., W.P. Erickson, K. Bay, S. Nomani, and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July - October 2008. Prepared for NedPower Mount Storm, LLC, Houston, Texas, by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming.

Appendix A1: Regional Bat Fatality Data

Appendix A1. Wind energy facilities in North America with fatality data for bat species, grouped by geographic region. Bat activity rates are included where available. To date, no bat fatality estimates or studies from southwestern or southeastern wind facilities have been made public.

Wind Energy Facility	Bat Activity Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
Tule Wind Resource Area	17.7			
	Western			
Stateline, OR/WA (2003)		2.52	454	300
High Winds, CA (2004)		2.51	90	162
Nine Canyon, WA		2.47	37	48
Dillon, CA		2.17	45	45
Leaning Juniper, OR		1.98	67	100.5
Big Horn, WA		1.90	133	199.5
Combine Hills, OR		1.88	41	41
High Winds, CA (2005)		1.52	90	162
Stateline, OR/WA (2002)		1.20	454	300
Vansycle, OR		1.12	38	24.9
Klondike, OR		0.77	16	24
Hopkins Ridge, WA		0.63	83	150
Klondike II, OR		0.41	50	75
Wild Horse, WA		0.39	127	229
SMUD, CA		0.07		15
	Rocky Mountains			
Summerview, Alb. (2006)	5.3	14.62	39	70.2
Summerview, Alb. (2005/6)		10.27	39	70.2
Judith Gap, MT		8.93	90	135
Summerview, Alb. (2007)		8.23	39	70.2
Foote Creek Rim, WY (Phase I; 1999)		3.97	69	41.4
Foote Creek Rim, WY (Phase I; 2001/2)		1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2	1.05	69	41.4
	Midwest			
Blue Sky Green Field, WI	7.7[D]	24.57	88	145
Top of Iowa, IA (2004)	34.9[C]	10.27	89	80
Top of Iowa, IA (2003)	34.9[C]	7.16	89	80
Kewaunee County, WI		6.55	31	20
Buffalo Ridge, MN (Phases II&III; 2001)	2.2	4.03	281	210.75
Crescent Ridge, IL		3.27	33	49.5
Buffalo Ridge, MN (Phase III; 1999)		2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)		2.59	143	107.25
Buffalo Ridge, MN (Phase II; 1998)		2.16	143	107.25
Buffalo Ridge, MN (Phases II&III; 2002)	1.9	1.73	281	210.75
NPPD Ainsworth, NE		1.16	36	59.4
Buffalo Ridge, MN (Phase I; 1999)		0.76	73	25
	Southern Plains			
Oklahoma Wind Energy Center, OK		0.53	68	102
Buffalo Gap, TX		0.10	67	134

Appendix A1. Wind energy facilities in North America with fatality data for bat species, grouped by geographic region. Bat activity rates are included where available. To date, no bat fatality estimates or studies from southwestern or southeastern wind facilities have been made public.

	Northeastern			
Buffalo Mountain, TN (2006)		39.70	18	29
Mountaineer, WV	38.3	31.69	44	66
Buffalo Mountain, TN (2000-2003)	23.7	31.54	3	2
Meyersdale, PA		18.00	20	30
Casselman, PA		15.66	23	34.5
Maple Ridge, NY (2006)		15.00	120	198
Noble Bliss, NY		14.66	67	100
Mount Storm, WV (2008)	35.2	12.11	82	164
Maple Ridge, NY (2007)		9.42	195	321.75
Noble Ellenburg, NY		5.45	54	80
Noble Clinton, NY		3.63	67	100.5
Mars Hill, ME (2007)		2.91	28	42
Stetson Mountain, ME	0.30	1.40	38	57

A=bat passes per detector-night; calculated as total passes divided by total detector-nights at ground met tower stations in 2008/2009 and 2010.
B=number of bats fatalities per megawatt per study period
C=averaged across phases and/or study years, and may not be directly related to fatality estimates
D=bat activity not measured concurrently with bat fatality studies
Data from the following sources:

Facility	Use Estimate	Fatality Estimate
High Winds, CA (2004)		Kerlinger 2006
Stateline, OR/WA (2003)		Erickson et al. 2004
Nine Canyon, WA		Erickson et al. 2003b
Big Horn, WA		Kronner et al. 2008
Dillon, CA		Chatfield et al. 2009
Combine Hills, OR		Young et al. 2006
High Winds, CA (2005)		Kerlinger 2006
Stateline, OR/WA (2002)		Erickson et al. 2004
Vansycle, OR		Erickson et al. 2000
Klondike, OR		Johnson et al. 2003b
Hopkins Ridge, WA		Young et al. 2007
Klondike II, OR		NWC and WEST 2007
Wild Horse, WA		Erickson et al. 2008
SMUD, CA		URS, Erickson et al. 2005
Summerview, Alb. (2006)		Baerwald 2008
Summerview, Alb. (2005/6)		Brown and Hamilton 2006
Judith Gap, MT		TRC 2008
Summerview, Alb. (2007)		Baerwald 2008
Foote Creek Rim, WY (Phase I; 1999)		Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2001/2)	Gruver 2002	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2000)	Gruver 2002	Young et al. 2003b
Top of Iowa, IA (2004)	Jain 2005	Jain 2005
Top of Iowa, IA (2003)	Jain 2005	Jain 2005
Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2010

Facility	Use Estimate	Fatality Estimate
Crescent Ridge, IL		Kerlinger et al. 2007
Buffalo Ridge, MN (Phase III)		Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Johnson et al. 2004
NPPD Ainsworth, NE		Derby et al. 2007
Buffalo Ridge, MN (Phase I)		Johnson et al. 2000
Oklahoma Wind Energy Center, OK		Piorkowski 2006
Buffalo Gap, TX		Tierney 2007
Buffalo Mountain, TN (2006)		Fiedler et al. 2007
Mountaineer, WV	Arnett (pers comm. 2005)	Kerns and Kerlinger 2004
Buffalo Mountain, TN (2000-2003)	Fiedler 2004	Nicholson 2005
Meyersdale, PA		Arnett et al. 2005
Casselman, PA		Arnett et al. 2009
Maple Ridge, NY (2006)		Jain et al. 2007
Noble Bliss, NY		Jain et. al 2009
Mount Storm, WV (2008)	Young et. al 2009	Young et. al 2009
Maple Ridge, NY (2007)		Jain et al. 2008
Noble Ellensburg, NY		Jain et. al 2009
Noble Clinton, NY		Jain et. al 2009
Mars Hill, ME (2007)		Stantec 2008b
Kewaunee County, WI		Howe et al. 2002
Stetson Mountain, ME	Stantec 2009	Stantec 2009

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Appendix A2: Summary of Bat Fatalities from Wind Energy Facilities in North America

Appendix A2. Summary of bat fatalities by species from wind energy facilities in North America. Data compiled by WEST from publicly available fatality reports. See Appendix A1 for complete list of sources. Species in bold are likely to occur in the project area.

Echolocation Group and Species	Scientific Name	Occurs in Project Area?	Total Fatalities	Percent of Total
HF			**763**	**16.8**
little brown bat	***Myotis lucifugus***	Yes	420	9.23
tricolored bat	*Perimyotis subflavus*	No	296	6.51
unknown myotis			26	0.57
western yellow bat	***Lasiurus xanthinus***	Yes	8	0.18
northern long-eared bat	*Myotis septentrionalis*	No	5	0.11
western red bat	***Lasiurus blossevillii***	Yes	4	0.09
Seminole bat	*Lasiurus seminolus*	No	2	0.04
eastern small-footed bat	*Myotis leibii*	No	2	0.04
MF			**811**	**17.8**
eastern red bat	*Lasiurus borealis*	No	808	17.76
evening bat	*Nycticeius humeralis*	No	3	0.07
LF			**2814**	**61.9**
hoary bat	***Lasiurus cinereus***	Yes	1774	39.00
silver-haired bat	***Lasionycteris noctivagans***	Yes	677	14.88
big brown bat	***Eptesicus fuscus***	Yes	186	4.09
Mexican free-tailed bat	***Tadarida brasiliensis***	Yes	175	3.85
unidentified free-tailed bat			2	0.04
VLF			**2**	**0.04**
pocketed free-tailed bat	***Nyctinomops femorosaccus***	Yes	2	0.04
Unidentified			**159**	**3.5**
unidentified bat			159	3.50
Grand Total			**4549**	**100**

Appendix B: Assessment of Abandoned Mines for Evidence of Bat Use

TECHNICAL MEMORANDUM

Summary of Abandoned Mines as
Potential Bat Roosts at the
Proposed Tule Wind Project
San Diego, California

Submitted by:
Western **E**co**S**ystems **T**echnology, Inc.
2003 Central Ave.
Cheyenne, Wyoming 82001

April 21, 2010

Introduction

Iberdrola is considering the development of a wind energy development in San Diego County, California (Figure 1). In the northwestern portion of the proposed project, several abandoned mines exist on State Lands Commission property (Figure 2). Iberdrola requested that Western EcoSystems Technology (WEST) investigate these mines for their potential as bat habitat.

Methods

WEST biologists surveyed the mines shafts externally, following protocols described in Sherwin et al. (2009). Externally, mines were examined for size and area of opening, internal condition, and depth. Where it was safe to do so, shafts were surveyed internally. One biologist remained outside the shaft while maintaining visual and vocal contact with the biologist inside. The interior of the shafts were examined for presence of bats, evidence of bat use (e.g., guano, urine staining, culled insect parts), and presence of cracks and crevices that might harbor roosting bats.

Results

The cluster of mine shafts in the southeastern section of the SLC Parcel (Figure 2) consists of 6 openings ranging from undercut schisms to straight tubular shafts. Most of the openings were of the latter type, and appeared to have been produced as exploratory mining shafts.

Mine openings in the south section ranged from small, dirt-filled orifices to 4- by 6-ft rock openings. Two of the openings had partially back-filled openings that were approximately 2.5 ft high. Shafts were generally large enough to walk upright in, and tended to be approximately 6 ft high, 4 ft wide and approximately 30-100 ft deep.

None of the shafts showed any evidence of previous bat use. None of the shafts evidenced much potential for bat use. The back of the shafts were not deep enough to be out of the twilight zone (i.e., not completely dark), and were likely too shallow to provide suitable day-roosting roosting opportunities for bats.

Four of the six openings may be suitable for use as night-roosts (i.e., temporary resting structures), though if night-roosting occurs it apparently is not in high densities. To assess whether these structure attract or harbor large numbers of bats, one Anabat™ bat detector was placed down-slope of the majority of the openings during the period March 25 to April 7, 2010. A total of 8 bat passes were recorded during that period, 4 of which were likely produced by hoary bat (Lasiurus cinereus), a species that does not use subterranean roosts (Shump and Shump 1982). These results add support to the results of the visual surveys and suggest that bats do not use the structures.

In the northwestern portion of the SLC parcel, both vertical and horizontal shafts are present (Figure 2). Two vertical shafts and one horizontal shaft were investigated externally only. One of the vertical shafts had wood beams bracing the opening and was approximately 25 ft deep. It was partially caved-in or backfilled, and appeared to offer little potential as a bat roost. The other vertical shaft was surrounded by a fence, and the opening was covered with brush, provided no access for bats.

The horizontal shaft opening is approximately 3 ft by 6 ft. Wood beams support the opening, ceiling and walls. The shaft goes in approximately 75 ft, and then turns to the right. The opening and shaft appeared unstable, and no internal survey was attempted. Therefore, it is unclear how deep the shaft goes after the bend. Because the depth of the shaft was unknown, and the shaft otherwise appeared to have some potential as a bat roost, one Anabat bat detector was placed near the openings on April 8, 2010. The data are expected to be retrieved on April 22, 2010 and were not available at the time of this report. WEST intends to leave the Anabat detector near this location for longer-term monitoring during the 2010 survey season.

References

Sherwin, R.E., J.S. Altenbach, and D.L. Waldien. 2009. Managing abandoned mines for bats. Bat Conservation International, Austin, Texas.

Shump, K.A. and A.U. Shump. 1982. Lasiurus cinereus. Mammalian Species, 185:1-5.

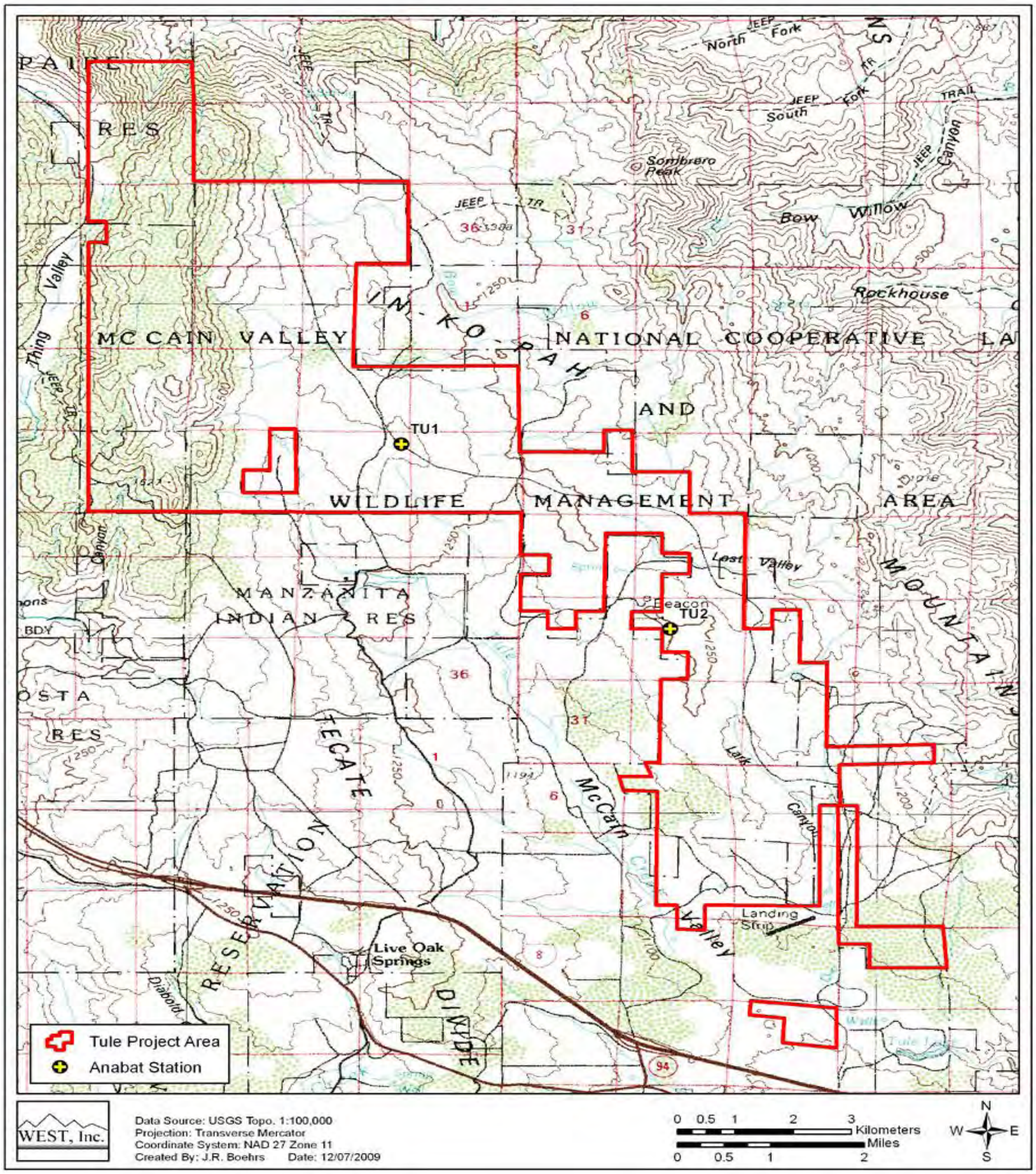

Figure 1. Study area map and 2008/2009 Anabat sampling stations at the Tule Wind Resource Area.

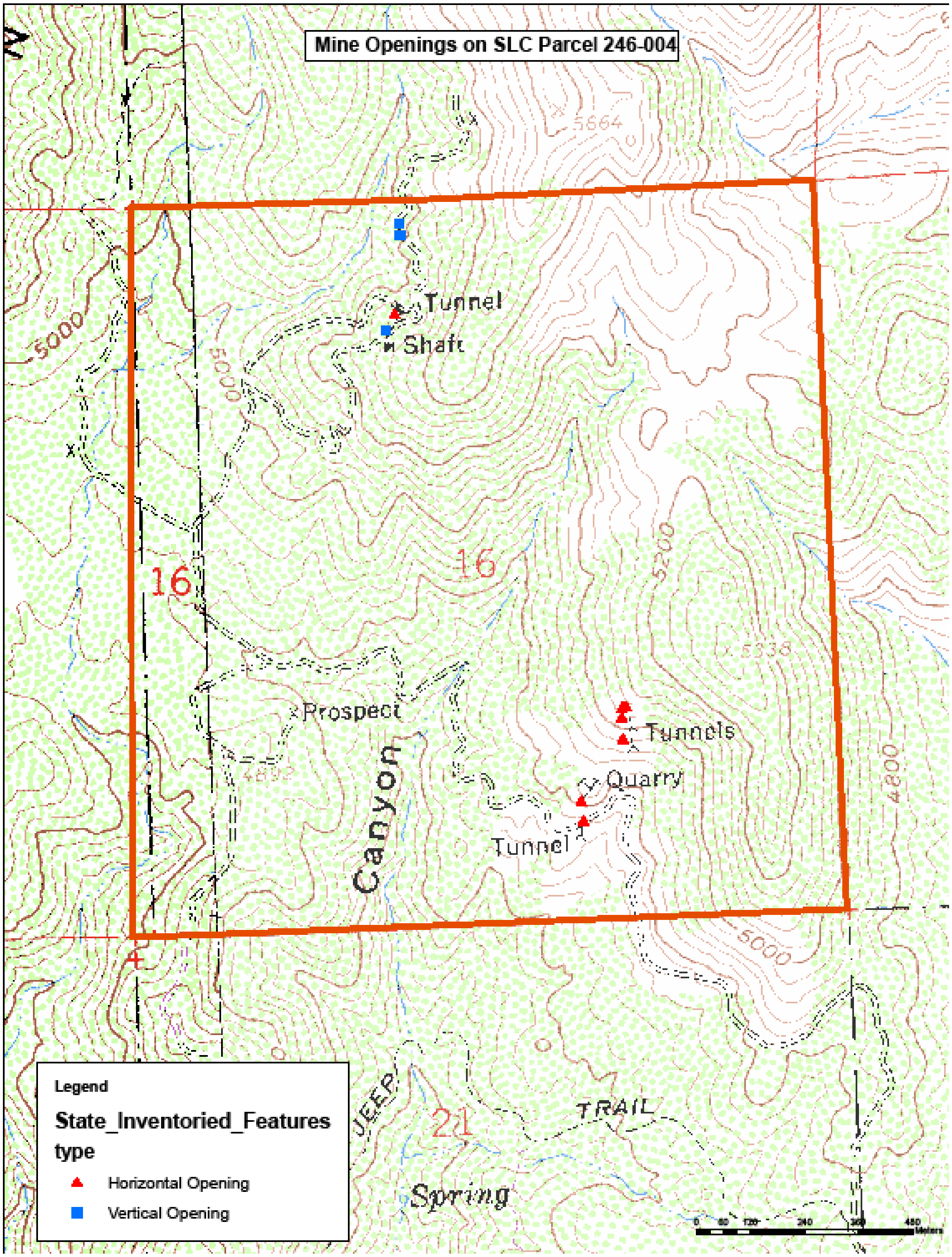

Figure 2. Location of abandoned mine openings on the State Lands Commission parcel in the proposed Tule Wind Project. This parcel is located in the northwest portion of the proposed project.

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Appendix C1: Photographs of Anabat Equipment and Deployment

Clock-wise from upper left: ***Example of a bat-feature location; Bat-Hat on met tower at top of pulley with PVC elbow (2010); Bat-Hat with reflector plate (2008/2009); Ground-based Anabat at met tower*.**

Appendix C2: Summary of Anabat Stations and Dates

Appendix C2. Summary of Anabat Stations and Dates at each location at TWRA for surveys September 4, 2008 to Aug 10, 2009 and March 12 to November 15, 2010.

Station	Station Type	Habitat	Dates at Location
TU1	Met tower 612 (paired)	Chapparal/oak scrub	Sep 4, 2008 - Aug 10, 2009
TU2	Met tower 613 (paired)	Chapparal/oak scrub	Sep 4, 2008 - Aug 10, 2009
T1	Met tower 612 (paired)	Chapparal/oak scrub	Mar 12 - Nov 15, 2010
T2	Met tower 615 (paired)	Chapparal/oak scrub	Jun 30 - Nov 15, 2010
T3	Met tower 616 (paired)	Chapparal/oak scrub	Jun 30 - Nov 15, 2010
T4	Met tower 617 (paired)	Chapparal/oak scrub	Jun 30 - Nov 15, 2010
TR1	Fixed, Bat Feature	Stream with abundant large oak	Mar 12 - Nov 15, 2010
TR2[1]	Roaming, Bat Feature	Water Trough in manzanita shrubland	Mar 12 - Mar 23, 2010
TR3	Roaming, Bat Feature	Stream with oak canopy cover	Mar 12 - Mar 23, 2010
TR4	Roaming, Bat Feature	Ephemeral water course, large boulders	Mar 25 - Apr 7, 2010; May 21 - Jun 10, 2010
TR5	Roaming, Bat Feature	Near abandoned mine	Mar 26 - Apr 8, 2010
TR7	Roaming, Bat Feature	Near abandoned mine	Apr 9 - Apr 23, 2010
TR8	Roaming, Bat Feature	Ephemeral water course, large boulders	Mar 25 - May 5, 2010
TWR1A	Roaming Bat Feature	Oak woodland, sage, creekbed with ephemeral flow	Aug 11 - Sep 2, 2010; Oct 15 - Nov 5, 2010
TWR1B	Roaming Bat Feature	Shrubland/grass, base of ridge, near creekbed with ephemeral flow	Jul 2 - Jul 21, 2010; Sep 3 -Sep 24, 2010
TWR1C	Roaming Bat Feature	Pines, oaks, near creekbed with ephemeral flow	Jul 22 - Aug 10, 2010; Sep 25 - Oct 14, 2010
TW2	Roaming Bat Feature	Pines, oaks, steep slope and open waters/seep	Jun 12 - Jun 24, 2010; Jul 23 - Nov 15, 2010

1. Detector stolen between Mar 12 and Mar 23