PLEASANT RIDGE EXHIBIT 104

Bat Acoustic Studies for the Pleasant Ridge Wind Resource Area Livingston County, Illinois

Final Report
July 15 – October 21, 2009

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EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in July 2009 designed to assess bat use within the proposed Pleasant Ridge Wind Resource Area in Livingston County, Illinois. Acoustic surveys for bats using Anabat^{TM} SD1 ultrasonic detectors were conducted at five stations using six Anabats from July 15 to October 21, 2009. One station was placed in an area expected to receive high bat activity to be used as reference site. The remaining five stations were located at met towers, or non-reference areas. Detectors were placed below two met towers for the entire study. One paired set of detectors (raised and ground) and one raised unit was rotated between the remaining three met towers each week, so that monitoring occurred at five of the six stations each survey week.

The objective of the acoustic bat surveys was to estimate the seasonal and spatial use of the Pleasant Ridge Wind Resource Area by bats. Overall, a total of six Anabat units recorded 2,696 bat passes during 501 detector-nights. Averaging bat passes per detector-night across all locations, a mean of 4.28 bat passes per detector-night was recorded. Excluding the reference station, the remaining five Anabat units recorded 923 bat passes during 411 detector-nights, yielding a mean of 2.36 bat passes per detector-night. Bat activity was approximately twice as high at non-reference ground units (3.09±0.24 bat passes per night) than what was recorded at the raised units (1.14±0.15 bat passes per night).

Across all stations, the majority (60.1%) of the calls were less than 30 kilohertz in frequency (e.g., big brown bat, hoary bat, silver-haired bat), while 25.7% were 30 to 40 kilohertz in frequency (e.g. eastern red bat). The remaining calls were by high-frequency bat species (e.g. *Myotis* species). For non-reference stations, a slightly higher percentage of passes were by low-frequency species (68.8%), while high-frequency species comprised 16.4% of all passes and passes by mid-frequency bats accounted for 14.8% of passes recorded at non-reference stations. Species identification was possible for the hoary and eastern red bat, which made up less than 1% and 2.5% of passes at all stations, respectively. When the reference station is excluded from analysis, hoary bats composed less than 1% of all bat passes, and eastern red bats made up 2.6% of bat passes. Activity levels for bat passes peaked in late July at the reference station. For non-reference stations, activity levels peaked in late August. Activity levels for hoary and eastern red bats were highest in late July/early August, suggesting these species may migrate through the study area during this time period.

The mean number of bat passes per detector-night was compared to existing data from nine studies of seven wind-energy facilities where both bat activity and mortality levels have been measured. The level of bat activity documented at the Pleasant Ridge Wind Resource Area was higher than that at wind-energy facilities in Minnesota and Wyoming, where reported bat mortalities are low, but was much lower than at facilities in the eastern US, where reported bat mortality is highest. Assuming that a relationship between bat activity and bat mortality exists, bat fatality levels at the PRWRA may be expected to be more similar to fatality rates observed at wind-energy facilities in the Midwest than those reported in the eastern US.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Invenergy LLC (Invenergy) is proposing to develop a wind-energy facility in Livingston County, Illinois. Invenergy requested Western EcoSystems Technology, Inc. (WEST) develop and implement a standardized protocol for baseline studies of bat use in the Pleasant Ridge Wind Resource Area (PRWRA) for the purpose of estimating the impacts of the wind-energy facility on bats. The protocol for this baseline study is similar to protocols used at other wind-energy facilities in the US and involves passive acoustic sampling using Anabat ™ ultrasonic SD1 bat detectors.

The following is a final report describing the results of Anabat surveys during the 2009 study season within the proposed PRWRA. 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 PRWRA is approximately 109,278 acres (170.75 square miles [mi^2]) in size and is located in southern Livingston County, Illinois. Ford County borders the south and eastern edges and McLean County borders the west edge of the PRWRA near the town of Fairbury (Figure 1). According to the National Landcover Dataset (USGS NLCD 2001), the dominant landcover type within the PRWRA is cultivated cropland (corn [*Zea mays*] and soybean [*Glycine max*]), comprising 92.3% (100,866 acres; 157.60 mi^2) of the total land area. Developed areas are the second most common cover type, comprising 5.1% (5,573 acres; 8.71 mi^2) of the PRWRA and are generally confined to the town of Strawn, farms, and homesteads. Pasture/hayfields and deciduous forests occupy 1.2% of the study area each (1,327 and 1,320 acres [2.07 and 2.06 mi^2], respectively), and the remaining area is comprised of small amounts of woody wetlands, barren land, open water, and grassland. The PRWRA falls within the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois (Woods et al.2007). The Central Corn Belt Plains Ecoregion is composed of vast glaciated plains and is scattered with sand sheets and dunes. Much of the Central Corn Belt Plains Ecoregion was originally dominated by tall-grass prairie and had scattered groves of trees and marshes occurring on level uplands. Today, most of the Ecoregion has been cleared to make way for highly productive farms producing corn, soybeans, and livestock. Streams within the Central Corn Belt Ecoregion have been tilled, ditched, and tied into existing drainage systems, which has caused a reduction in the amount of aquatic habitat. Streams running through the PRWRA are channelized; however, there are natural streams that include Indian Creek, a tributary to the Vermilion River, and the South Fork of the Vermilion River.

METHODS

Bat Acoustic Surveys

The objective of the bat use surveys was to estimate the spatial and temporal use of the PRWRA by bats. Bats were surveyed using Anabat™ SD1 bat detectors (Titley Scientific™, Australia).

Bat detectors are a recommended method to index and compare habitat use by bats. The use of bat detectors for calculating an index to bat impacts is a primary bat risk assessment tool for baseline wind-energy development surveys (Arnett 2007, Kunz et al. 2007a). Bat activity was surveyed using six Anabat detectors from July 15 to October 21, 2009, a period corresponding to likely fall bat migration in central Illinois.

Bat use was monitored at five stations with six total Anabats within the PRWRA (Figure 1). Three detectors were placed at fixed ground-based locations: two were placed at the base of meteorological (met) towers (PR3 and PR4) and one unit was placed at a reference area (PR5) in the northern portion of the PRWRA in habitat thought to be attractive to bats for foraging and drinking opportunities. Data collected from the reference station were analyzed separately from the other stations. Three detectors (one paired set of Anabat detectors and one lone Anabat detector) 'roamed' between three met tower locations (PR1g and PR1h, PR2g and PR2h, and PR6g and PR6h) in the southern portion of the PRWRA. Each week one of the three met towers with 'roaming' Anabat detectors would have a pair of Anabat detectors (one at the base of the tower and one raised unit), and a second met tower would have a raised unit, and the remaining met tower would have no Anabat detector. These three Anabat detectors were rotated between the met towers to increase spatial coverage.

Anabat detectors record bat echolocation calls with a broadband microphone. The echolocation sounds are then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16 was used for the study. Bat echolocation detectors also detect other ultrasonic sounds, such as those sounds made by insects, raindrops hitting vegetation, and other sources. A sensitivity level of six was used to reduce interference from these other sources of ultrasonic noise. Calls were recorded to a compact flash memory card with large storage capacity. 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 98 feet (ft; 30 meters [m]) 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, Nevada) ultrasonic emitter as described in Larson and Hayes (2000). All units were programmed to turn on each night approximately one half-hour before sunset and turn off approximately one half-hour after sunrise.

Anabat detectors were placed inside plastic weather-tight containers with a hole cut in the side of the container for the microphone to extend through. Microphones for Anabat detectors on the ground were encased in polyvinyl chloride (PVC) tubing with two drain holes that curved skyward at 45 degrees outside of the container to minimize the potential for water damage due to rain. Silica gel packets were placed in each container to minimize the amount of moisture due to condensation and were replaced on a weekly basis Containers were raised approximately 3.3 ft (1.0 m) off the ground to minimize echo interference and lift the unit above vegetation (Appendix A). The Anabat units with raised microphones were protected from weather identically; however, the microphone itself was fixed on the met tower at a height of 147.6 ft (45 m) above the ground. Microphones were encased in a Bat-Hat weather-resistant housing (EME Systems, Berkeley, California) with a Plexiglas reflector plate underneath the microphone, and the microphone was attached to a coaxial cable that transmitted ultrasonic sounds to an Anabat unit at the base of the tower (Appendix A).

Statistical Analysis

Bat Acoustic Surveys

The unit of activity was the number of bat passes (Hayes 1997). A bat pass was 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). In this report, the terms bat pass and bat call are used interchangeably. The number of bat passes was determined by downloading the data files to a computer and tallying the number of echolocation passes recorded. Total number of passes was corrected for effort by dividing by the number of detector-nights.

For each station, bat calls were sorted into three groups based on their minimum frequency that roughly corresponds to species groups of interest. For example, most species of *Myotis* bats echolocate at frequencies above 40 kilohertz (kHz), while species such as the eastern red bat (*Lasiurus borealis*) typically have echolocation calls between 30 and 40 kHz, and species such as big brown (*Eptesicus fuscus*), silver-haired (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), have echolocation frequencies at or below 25 kHz. Therefore, calls were classified as high-frequency (HF; more than 40 kHz), mid-frequency (MF; 30 to 40 kHz), or low-frequency (LF; less than 30 kHz). To establish which species may have produced calls in each category, a list of species with the potential to occur in the PRWRA was compiled from range maps (Table 1; Harvey et al. 1999, BCI website). Data determined to be noise produced by a source other than a bat or calls that did not meet the pre-specified criteria to be termed a pass were removed from the analysis.

Within these species groups of interest categories, an attempt was made to identify calls made by two *Lasiurus* species: hoary and eastern red bats. Calls that had a distinct U-shape and exhibited variability in the minimum frequency across the call sequence were identified as belonging to the *Lasiurus* genus (C. Corben, pers comm.). Hoary and eastern red bats were distinguished based on minimum frequency; hoary bats typically produce calls with minimum frequencies between 18 to 24 kHz, whereas eastern red bats typically emit calls with minimum frequencies between 30 to 43 kHz (J. Szewczak, pers comm.). Only sequences containing three or more calls were used for species identification, which may have resulted in a conservative estimate of bat passes by each species. These are conservative parameters; given the high intra-specific variability of *Lasiurus* calls, and the number of call files that were too fragmented for proper identification; it is likely that more hoary and eastern red bat calls were recorded than were positively identified.

The total number of bat passes per detector-night was used as an index for bat use in the PRWRA. Bat pass data represented levels of bat activity rather than the numbers of individuals present because individuals could not be differentiated by their calls. To assess potential for bat mortality, the mean number of bat passes per detector-night (averaged across ground-based 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

Overall Activity

Five sampling locations (PR1, PR2, PR3, PR4, and PR6) were considered non-reference stations, and were monitored on a total of 99 nights during the period July 15 to October 21, 2009. Non-reference Anabat units recorded 923 bat passes on 411 detector-nights (Table 2). Averaging bat passes at non-reference locations per detector-night across locations, 2.36 ± 0.20 (mean ± standard error [SE]) bat passes per detector-night were recorded. Data from the one reference location (PR5) was analyzed separately as a reference station and this station was monitored for 99 nights during the period July 15 to October 21, 2009. The reference unit recorded 1,773 bat passes on the 90 detector-nights and the average was 19.7 ± 2.94 bat passes per detector-night (Table 2). The number of noise files varied throughout the study period (Figure 3a and 3b). All Anabats recorded for 84.77% of the study period and coverage varied by date due to equipment malfunctions (Figure 2).

Spatial Variation

Across the PRWRA and excluding the reference station, ground-based units averaged more bat calls per night (3.09 ± 0.24) than the raised stations (1.14 ±0.14 bat calls per night; Table 2). Bat activity was relatively higher at the reference station (PR5; 19.7 ± 2.94 bat passes per night; Table 2; Figure 4a) than at the ground-based and raised non-reference stations. Comparing data across the roaming stations (PR1, PR2 and PR6) when both raised and ground-based units were being monitored simultaneously, the ground-based units recorded more bat calls than the raised units (Figure 5). Both ground-based and raised units primarily recorded LF and MF bat calls; however, the ground-based units recorded much higher levels of HF bat calls relative to the raised units (Figure 5).

Temporal Variation

For the non-reference stations, bat activity was higher during the last week in July throughout August and peaked during the week of August 26 to September 1 (Table 3b, Figure 6b). Activity dropped slightly during the week of September 2 – 8; however, levels of activity peaked again during the week of September 9 – 15 and then activity decreased to levels approximately equal to or lower than the mean at the non-reference stations for the entire study (Table 3b, Figure 6b). Peak activity at the reference station occurred during the first two weeks of monitoring, July 15 – 28. No bat activity was recorded the week of July 29 – August 4 due to equipment malfunctions, and bat activity remained approximately equal to or lower than the mean bat use at the reference station for the remainder of the study (Table 3a, Figure 6a).

Bat activity at the non-reference ground-based stations increased more rapidly than what was recorded at the non-reference raised stations (Figure 7a). The reference station recorded 50% of all bat calls (Table 3a and Figure 7b) approximately three weeks before the non-reference stations recorded 50% of all bat call recorded at all non-reference stations (Table 3b and Figure 7a).

Species Composition

Non-reference Stations
Patterns of activity between the frequency groups recorded at non-reference ground-based stations were similar across the PRWRA (Table 2); passes by LF bats (66.6%) outnumbered passes by HF bats (20.08%) and MF bats (13.3%; Table 2; Figure 4b). Additionally, patterns of activity recorded at non-reference raised stations were similar across the PRWRA (Table 2); passes by LF bats (77 %), outnumbered passes by MF bats (20.4%) and HF bats (2.6%; Table 2; Figure 4b). At the non-reference stations, peak HF and MF bat passes occurred from July 22-28, and peak MF bat passes occurred from July 15-21 (Table 3b; Figure 6b). Activity by LF species appeared to peak slightly later, with most LF passes recorded from August 26 to September 15 (Table 3b; Figure 6b).

Passes attributable to hoary bats comprised 0.9% of the total bat passes and 1.4% of all LF passes detected at the non-reference stations (Table 2). The highest hoary bat activity was recorded by Anabat units PR1h, PR3, and PR4 (Table 2; Figure 8b). At the paired units (PR1, PR2, and PR3), there were more hoary bat calls recorded at the raised units than at the ground-based units (Table 2). The majority of hoary bat activity at non-reference stations was recorded July 22 – 28 (41.2%; Table 4b; Figure 9c). No hoary bats were recorded early or late in the study period (Table 4b; Figure 9b).

Passes attributable to eastern red bats comprised 2.6% of all the bat passes and 17.56% of all MF passes detected at non-reference stations (Table 2). Approximately 58% of all red bat calls were recorded by Anabat units PR1h and PR3 collectively (Table 2; Figure 8b). Approximately 64% of eastern red bat passes were detected between August 5 to September 1 (Table 4b; Figure 9b). No eastern red bat calls were recorded after September 29 (Figure 9b).

Reference Station
At the reference station, the majority (55.5%) of bat passes were by LF species, then MF species (31.4%), and HF species (13.1%; Table 2; Figure 4a). Peak activity for LF, MF, and HF bats occurred much earlier than non-reference stations, with activity peaking between July 15 – 28 (42.1%, 56.0%, and 37.7%, respectively; Table 3a; Figure 6a).

Passes attributable to hoary bats comprised 0.5% of the total bat passes and 0.9% of all LF passes detected at the reference station in the PRWRA (Table 2). Peak hoary bat activity was recorded between July 15 – 28 (53.2%; Table 4a; Figure 9a). No hoary bats were recorded from August 12 – 25 or after September 16 (Table 4a; Figure 9a).

Passes attributable to eastern red bats comprised 2.4% of all bat passes and 4.4% of all MF passes recorded at the reference station (Table 2). More eastern red bats were recorded from July 22 – 28 (48.4%) than during any other week of the survey period (Table 4a; Figure 9b). A smaller peak occurred from August 12 – 25. Eastern red bats were not detected during the weeks of September 16 – 22, September 30 to October 6, or after October 20 (Table 4a; Figure 9b).

DISCUSSION

Potential Impacts

Assessing the potential impacts of wind-energy development to bats at the PRWRA is complicated by the current lack of understanding of why bats die at wind turbines (Kunz et al. 2007b, Baerwald et al. 2008), combined with the inherent difficulties of monitoring elusive, nocturnal-flying mammals (O'Shea et al. 2003). Additionally, because installed capacity for wind-energy has increased rapidly in recent years, the availability of well-designed studies from existing wind-energy facilities lags development of proposed facilities (Kunz et al. 2007b). To date, monitoring studies of wind-energy facilities suggest that:

a) bat mortality shows a rough correlation with bat activity (Table 5);

b) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September);

c) migratory tree-roosting species (eastern red, hoary, and silver-haired bats) comprise almost 75% of reported bat fatalities, and;

d) the highest reported fatalities have occurred at wind-energy facilities located along forested ridge tops in the eastern and northeastern US. However, recent studies in agricultural regions of Iowa, Wisconsin and Alberta, Canada, report relatively high fatalities as well (Table 5).

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

Overall Activity

To date, nine studies of seven wind-energy facilities have recorded both Anabat detections per night and bat mortality (Table 5), and eight of these studies measured bat activity concurrently with fatality studies. While these studies show correlation between activity and fatalities, the expectation among the scientific and resource-management communities is that a similar relationship holds for pre-construction activity and post-construction fatalities. The addition of pre-construction data sets, like the one collected from the PRWRA, will contribute to the understanding of the relationship between bat activity near wind turbines and bat fatalities. To our knowledge, data for the studies in Table 5 were collected 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.

Bat activity recorded by non-reference ground-based detectors within the PRWRA (3.09±0.24 bat passes per detector-night; Table 2) was higher than that observed at wind-energy facilities in Minnesota and Wyoming, where bat mortality was relatively low, but bat activity at the PRWRA was much lower than activity recorded at facilities in West Virginia, Iowa, and Tennessee, where bat mortality rates were relatively high (Table 5).

Spatial Variation

Recorded bat activity was highest at the reference station, PR5 (19.7±2.94 bat passes per night). This station was located in a grassy verge along the north fork of the Vermilion River that likely attracted bats for foraging and drinking opportunities. Non-reference ground-based detectors had relatively lower bat activity (3.09±0.24 bat passes per night) and non-reference raised detectors had the lowest bat activity (1.14±0.15 bat passes per night). However, data regarding differences in bat passes between the ground-based and raised detectors at the paired stations should be interpreted with caution since the raised detector was outfitted with a Plexiglas reflector and the ground unit was outfitted with a PVC tube at a 45 degree angle. Slack et al. (2008) found the Plexiglas reflector plate recorded approximately ½ the number of bat calls as the PVC tube during simultaneous monitoring, and some calls at the raised units may have not have been recorded. If the assumption is made that only ½ of the number of bat calls at raised units were recorded, the raised units would have recorded 2.28 bat passes per night which is approximately 1/3 less than the bat passes at ground units.

Comparing the paired stations, PR1, PR2, and PR6, provided relatively even coverage of the southern portion of the PRWRA use by bats at ground level and within the ZOR. The ground units consistently recorded twice as many bat calls as the raised units (Table 2; Figure 5). The species composition of the ground and raised stations differed slightly. LF bats were the most recorded bat at raised and ground stations; however, HF bats were recorded more often at ground stations than raised stations and more MF bats were recorded at raised stations than ground stations (Table 2; Figure 5). This suggests that HF species, such as myotis, do not fly and echolocate as often as other species near blade height as other bat species.

Detectors placed near met towers or at potential turbine locations may be used to contextualize activity relative to previous studies that have measured both activity and fatality levels (e.g., Table 5), but such sampling locations are not generally in areas likely to attract or retain bats. Thus, in all likelihood, the data collected at these sampling locations provide a lower bound on the estimate of potential facility-wide bat activity. The increased levels of bat activity recorded at the reference station, relative to the non-reference stations, provides an upper bound for the estimated activity levels by bats within the PRWRA. Increased activity recorded at the reference station is likely attributable to the presence of habitat attractive to bats as roosting, foraging, or drinking sites. Individual bats are likely to spend longer periods of time at this type of location as they forage, drink, or interact socially, and thus may be recorded multiple times. The increased level of activity at the reference station should not, however, be correlated with increased numbers of bats, as bat passes do not translate directly to the number of bats present.

Temporal Variation

For resident bats that undertake relatively local or regional movements to hibernacula, both adults and young-of-the-year must accumulate the fat reserves that will see them through the winter; the number of foraging areas and the intensity of use in foraging areas can increase to meet those needs. For tree-roosting species of bats that do not hibernate, movements toward southern wintering grounds appear to begin in late July and echolocation passes by these species tend to increase as they migrate. Both migratory and hibernating species begin to engage in reproductive behaviors in late summer and fall, which for hibernating species is associated with increased grouping and increased travel between groups (Brack 2006), and this may also be the case for migratory tree-roosting species (Cryan 2008). The end result is increased flights for foraging and mating opportunities during the summer and fall, which is detected during acoustic surveys and which appears to correlate to the time period of increased fatalities recorded at wind turbines.

Bat activity peaked earlier at the reference stations compared to the non-reference stations. The earlier peak in activity in the reference area likely represents use by volant juveniles and foraging of individuals to build up fat reserves before fall migration or fall migration out of the area (Brack 2006). Peak activity occurred later at non-reference stations, and may represent a larger percentage of migrating bats. Increased levels of bat activity observed at met towers followed the general pattern seen in other studies both in the Midwest and elsewhere (Kunz et al. 2007a), and likely reflects the general phenology of temperate zone bats. The increased levels of activity seen during this study in August may represent movement of migrating bats through the area, which may also explain the greater number of low-frequency bats at this time. Activity dropped drastically after July at the reference station. likely indicating that most resident bats had already migrated through the PRWRA. Activity also dropped drastically at the non-reference stations after September 29, indicating that most bats had migrated through these areas.

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). 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 call rates and timing of mortality, with both call rates and mortality peaking during the fall. Based on the available data for this studies survey period, it is expected that bat mortality at the PRWRA will be highest in late July and late August through early September.

Species Composition

Of the nine species of bat likely to occur in the PRWRA, seven are known fatalities at wind-energy facilities (Table 1). Approximately 60% of passes were by LF bats, suggesting higher relative abundance of species such as hoary, silver-haired, and big brown bats. Hoary bats made up less than 1% of all LF passes and were most active in late July, corresponding to the reproductive season for this species. There were likely more hoary bat passes at the PRWRA than what was reported due to the strict crieteria used for species identification. To date, some LF species, (e.g., hoary [36.76% of all bat fatalities] and silver-haired bats [10.41% of all bat fatalities]) have been found as fatalities in higher proportions than other LF species in the Midwest (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007). LF species also comprised a greater proportion of bat calls at raised versus ground units during this study. Hoary bats and silver-haired bats could potentially have a higher fatality risk within the PRWRA. However; big brown bats have also been reported as comprising a relatively high percentage of fatalities at a wind-energy facility in Wisconsin (Gruver et al. 2009).

Approximately 26% of passes at the PRWRA were classified as MF passes and less than 1% of those passes were classified as eastern red bats. In the Midwest, eastern red bats are the second most recorded fatality (22.31% of all bat fatalities) at wind-energy facilities during fatality searches (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007).. There were likely more eastern red bat passes at the PRWRA than what was reported due to the strict criteria employed for species identification. Eastern red bat may be the most at-risk MF bat species at the PRWRA.

At raised stations, LF passes outnumbered MF and HF passes, which most likely reflects different foraging behaviors among species. Generally, LF species tend to forage in less cluttered conditions (e.g., at greater heights) than HF species due to their wing morphology and echolocation call structure (Norberg and Rayner 1987). Due to this behavior, LF species, such as hoary bat and silver-haired bat, are potentially at a greater risk of turbine collisions than HF species, which typically fly at lower altitudes. LF species are also more commonly reported as fatalities at most-wind-energy facilities.

While LF species generally outnumber HF species as fatalities at most wind-energy facilities, two notable exceptions exist within the Midwest. More little brown bats (28.7%) were reported as fatalities than silver-haired bats (23.5%), big brown bats (19%), hoary bats (16.6%) and eastern red bats (7.3%) at the Blue Sky Green Field wind-energy facility in Wisconsin (Gruver et al. 2009). Little brown bats also comprised substantial proportion of the bat fatalities at a wind-energy facility in Iowa (Jain 2005). It is unclear why species composition of fatalities differed at these two wind-energy facilities, and more research regarding bat and wind-energy facility interactions are needed within the Midwest.

Regional Fatality Studies

To date, the highest levels of bat fatalities have been reported from turbines on forested Appalachian ridges (Arnett et al. 2008). However, recent reports of moderate to high levels of bat fatalities in agricultural settings (Jain 2005; Baerwald 2008; Gruver et al. 2009) suggest that open landscapes are no guarantee of low fatality rates.

Studies at wind-energy facilities across North America show a wide range of bat mortality rates, ranging from zero to 39.70 bat fatalities per megawatt (MW) per year (Table 5). Although the pool of available data for the Midwest is somewhat limited, studies from the Midwest have indicated that bat fatality rates for Midwestern wind-energy facilities have ranged between 0.76 and 24.57 bat fatalities/MW/year (Gruver et al. 2009; Koford et al. 2005; Howe et al. 2002; Johnson et al. 2002, 2003, 2004; Kerlinger et al. 2007). Only one study is currently publicly available of bat fatality rates within Illinois. Kerlinger et al. (2007) estimated 1.9 bat fatalities/MW/year occurred at the Crescent Ridge wind-energy facility in Bureau County, Illinois. This fatality estimate is low compared to other studies. However, the two lowest bat fatality rates at wind-energy facilities reported within the Midwest occurred at studies of facilities in tilled agriculture (corn and soybean) where crops were not cleared for the study (Johnson et al. 2002, 2003 and 2004; Kerlinger et al. 2007).

Potential Fatality Rates at the Pleasant Ridge Wind Resource Area

Assuming that a relationship between pre-construction bat activity and bat mortality exists, bat fatality levels at the PRWRA may be expected to be more similar to fatality rates observed at wind-energy facilities in the Midwest, and lower than the highest fatality rates observed in the eastern US. The relationship between bat passes and bat fatalities will be better defined as the results of monitoring at other wind-energy facilities in the Midwest become available.

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Table 1. Bat species determined from range-maps (Harvey et al. 1999, BCI website, Hoffmeister 2002) as likely to occur within the Pleasant Ridge Wind Resource Area, sorted by call frequency.

Common Name	Scientific Name
High-frequency (> 40 kHz)	
little brown bat[2]	*Myotis lucifugus*
northern bat[2]	*Myotis septentrionalis*
Indiana bat[2,3]	*Myotis sodalis*
tri-colored bat[,2]	*Perimyotis subflavus*
Mid-frequency (30-40 kHz)	
eastern red bat[1,2]	*Lasiurus borealis*
evening bat	*Nycticeius humeralis*
Low-frequency (< 30 kHz)	
big brown bat[2]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

1 = long-distance migrant
2 = known casualty from wind turbines
3= Federally listed species

Table 2. Results of acoustic bat surveys conducted at the Pleasant Ridge Wind Resource Area from July 15 through October 21, 2009.

Anabat Station	Location	# of HF Bat Passes	# of MF Bat Passes	# of LF Bat Passes	# of Eastern Red Bat Passes*	# of Hoary Bat Passes**	Total Bat Passes	Detector-Nights	Bat Passes/ Night ± one standard error
Reference Data									
PR5	ground	232	557	984	43	9	1,773	90	19.7±3.06
Non-Reference Data									
PR1g	ground	23	12	58	3	1	93	19	4.89±0.72
PR1h	raised	1	21	68	7	2	90	54	1.67±0.25
PR2g	ground	20	9	56	2	0	85	28	3.04±0.54
PR2h	raised	2	18	79	2	1	99	63	1.57±0.30
PR3	ground	46	28	145	7	2	219	89	2.46±0.28
PR4	ground	44	38	186	3	2	268	75	3.57±0.45
PR6g	ground	13	10	39	0	0	62	42	1.48±0.29
PR6h	raised	2	1	4	0	1	7	41	0.17±0.07
Total ground		**146**	**97**	**484**	**15**	**5**	**727**	**253**	**3.09±0.24**
Total raised		**5**	**40**	**151**	**9**	**4**	**196**	**158**	**1.14±0.15**
Total		**151**	**137**	**635**	**24**	**9**	**923**	**411**	**2.36±0.20**
All Bat Data									
Total ground		**378**	**654**	**1,468**	**58**	**14**	**2,500**	**343**	**5.86±0.52**
Total raised		**5**	**40**	**151**	**9**	**4**	**196**	**158**	**1.14±0.14**
Total		**383**	**694**	**1,619**	**67**	**18**	**2,696**	**501**	**4.28±0.36**

*Passes by eastern red bats included in mid-frequency (MF) numbers; **Passes by hoary bats included in low-frequency (LF) numbers.

Table 3a. Weekly bat activity and the contribution of each week (%) to total recorded activity for high-frequency (HF), mid-frequency (MF), low-frequency (LF) and all bats at the reference station within the Pleasant Ridge Wind Resource Area from July 15 through October 21, 2009.

Week	HF Pass Rate	HF % Composition	MF Pass Rate	MF % Composition	LF Pass Rate	LF % Composition	All Bats Pass Rate	All Bats % Composition	Cumulative % Composition
07/15/09 to 07/21/09	4.86	13.5	9.86	11.1	33.71	23.4	48.43	18.0	18.0
07/22/09 to 07/28/09	8.71	24.2	39.86	44.9	27.00	18.7	75.57	28.1	46.1
07/29/09 to 08/04/09	NA	NA	NA	NA	NA	NA	NA	NA	NA
08/05/09 to 08/11/09	3.80	10.6	8.00	9.0	10.20	7.1	22.00	8.2	54.3
08/12/09 to 08/18/09	4.29	11.9	5.00	5.6	13.71	9.5	23.00	8.6	62.8
08/19/09 to 08/25/09	3.00	8.3	6.86	7.7	10.71	7.4	20.57	7.7	70.5
08/26/09 to 09/01/09	1.29	3.6	3.00	3.4	6.00	4.2	10.29	3.8	74.3
09/02/09 to 09/08/09	1.29	3.6	1.57	1.8	8.29	5.7	11.14	4.1	78.4
09/09/09 to 09/15/09	2.00	5.6	1.86	2.1	7.00	4.8	10.86	4.0	82.5
09/16/09 to 09/22/09	1.00	2.8	0.43	0.5	5.86	4.1	7.29	2.7	85.2
09/23/09 to 09/29/09	1.57	4.4	0.43	0.5	6.29	4.3	8.29	3.1	88.3
09/30/09 to 10/06/09	0.57	1.6	1.71	1.9	10.57	7.3	12.86	4.8	93.0
10/07/09 to 10/13/09	0	0	0.14	0.2	1.00	0.7	1.14	0.4	93.5
10/14/09 to 10/20/09	1.57	4.4	2.00	2.2	3.00	2.1	6.57	2.4	95.9
10/21/09 to 10/21/09	2.00	5.6	8.00	9.0	1.00	0.7	11.00	4.1	100

NA Not applicable, no data recoded

Table 3b. Weekly bat activity and the contribution of each week (%) to total recorded activity for high-frequency (HF), mid-frequency (MF), low-frequency (LF) and all bats at non-reference stations within the Pleasant Ridge Wind Resource Area from July 15 through October 21, 2009.

Week	HF Pass Rate	HF % Composition	MF Pass Rate	MF % Composition	LF Pass Rate	LF % Composition	All Bats Pass Rate	All Bats % Composition	Cumulative % Composition
07/15/09 to 07/21/09	0.04	0.6	0.21	4.0	0.36	1.7	0.61	1.9	1.9
07/22/09 to 07/28/09	0.52	9.2	0.48	9.0	1.09	5.1	2.09	6.5	8.4
07/29/09 to 08/04/09	0.75	13.3	1.00	18.9	0.50	2.4	2.25	7.0	15.4
08/05/09 to 08/11/09	0.44	7.8	0.76	14.3	1.84	8.7	3.04	9.5	24.9
08/12/09 to 08/18/09	0.80	14.2	0.91	17.2	1.51	7.2	3.23	10.1	35.0
08/19/09 to 08/25/09	0.63	11.1	0.54	10.2	2.00	9.5	3.17	9.9	44.9
08/26/09 to 09/01/09	0.71	12.7	0.51	9.7	2.80	13.2	4.03	12.6	57.4
09/02/09 to 09/08/09	0.56	9.9	0.18	3.3	2.15	10.2	2.88	9.0	66.4
09/09/09 to 09/15/09	0.42	7.5	0.36	6.9	3.00	14.2	3.79	11.8	78.2
09/16/09 to 09/22/09	0.03	0.5	0.06	1.1	1.12	5.3	1.21	3.8	82.0
09/23/09 to 09/29/09	0.17	3.0	0.07	1.3	2.33	11.0	2.57	8.0	90.0
09/30/09 to 10/06/09	0.26	4.6	0.15	2.8	1.19	5.6	1.59	5.0	95.0
10/07/09 to 10/13/09	0	0	0.06	1.2	0.06	0.3	0.12	0.4	95.3
10/14/09 to 10/20/09	0.06	1.1	0	0	0.44	2.1	0.50	1.6	96.9
10/21/09 to 10/21/09	0.25	4.4	0	0	0.75	3.5	1.00	3.1	100

Table 4a. Weekly bat activity and the contribution of each week (%) to total recorded activity for hoary bats and eastern red bats at the reference station within the Pleasant Ridge Wind Resource Area from July 15 through October 21, 2009.

Week	Hoary Bat Pass Rate	Hoary Bat % Composition	Eastern Red Bat Pass Rate	Eastern Red Bat % Composition	All Bats Pass Rate	All Bats % Composition	Cumulative % Composition
07/15/09 to 07/21/09	0.29	21.3	0.86	13.8	48.43	18.0	18.0
07/22/09 to 07/28/09	0.43	31.9	3.00	48.4	75.57	28.1	46.1
07/29/09 to 08/04/09	NA	NA	NA	NA	NA	NA	NA
08/05/09 to 08/11/09	0.20	14.9	0.20	3.2	22.00	8.2	54.3
08/12/09 to 08/18/09	0	0	0.86	13.8	23.00	8.6	62.8
08/19/09 to 08/25/09	0	0	0.57	9.2	20.57	7.7	70.5
08/26/09 to 09/01/09	0.14	10.6	0.14	2.3	10.29	3.8	74.3
09/02/09 to 09/08/09	0.14	10.6	0.14	2.3	11.14	4.1	78.4
09/09/09 to 09/15/09	0.14	10.6	0	0	10.86	4.0	82.5
09/16/09 to 09/22/09	0	0	0	0	7.29	2.7	85.2
09/23/09 to 09/29/09	0	0	0.14	2.3	8.29	3.1	88.3
09/30/09 to 10/06/09	0	0	0	0	12.86	4.8	93.0
10/07/09 to 10/13/09	0	0	0.14	2.3	1.14	0.4	93.5
10/14/09 to 10/20/09	0	0	0.14	2.3	6.57	2.4	95.9
10/21/09 to 10/21/09	0	0	0	0	11.00	4.1	100

NA Not applicable, no data recoded

Table 4b. Weekly bat activity and the contribution of each week (%) to total recorded activity for hoary bats and eastern red bats for non-reference stations within the Pleasant Ridge Wind Resource Area from July 15 through October 21, 2009.

Week	Hoary Bat Pass Rate	Hoary Bat % Composition	Eastern Red Bat Pass Rate	Eastern Red Bat % Composition	All Bats Pass Rate	All Bats % Composition	Cumulative % Composition
07/15/09 to 07/21/09	0	0	0.07	9.1	0.61	1.9	1.9
07/22/09 to 07/28/09	0.13	41.2	0.09	11.1	2.09	6.5	8.4
07/29/09 to 08/04/09	0	0	0	0	2.25	7.0	15.4
08/05/09 to 08/11/09	0.04	12.6	0.16	20.4	3.04	9.5	24.9
08/12/09 to 08/18/09	0.03	9	0.14	18.2	3.23	10.1	35.0
08/19/09 to 08/25/09	0.06	18.0	0.11	14.6	3.17	9.9	44.9
08/26/09 to 09/01/09	0	0	0.09	10.9	4.03	12.6	57.4
09/02/09 to 09/08/09	0	0	0.03	3.8	2.88	9.0	66.4
09/09/09 to 09/15/09	0.06	19.1	0.06	7.7	3.79	11.8	78.2
09/16/09 to 09/22/09	0	0	0	0	1.21	3.8	82.0
09/23/09 to 09/29/09	0	0	0.03	4.2	2.57	8.0	90.0
09/30/09 to 10/06/09	0	0	0	0	1.59	5.0	95.0
10/07/09 to 10/13/09	0	0	0	0	0.12	0.4	95.3
10/14/09 to 10/20/09	0	0	0	0	0.50	1.6	96.9
10/21/09 to 10/21/09	0	0	0	0	1.00	3.1	100

Table 5. Wind-energy facilities in North America with mortality 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-energy facilities have been made public.

Wind Energy Facility	Bat Use Estimate[A]	Mortality Estimate[B]	No. of Turbines	Total MW
Pleasant Ridge, IL (non-reference ground)	**3.09**			
Midwest				
Top of Iowa, IA (2004)	34.9[C]	10.27	89	80
Top of Iowa, IA (2003)	34.9[C]	7.16	89	80
Crescent Ridge, IL		3.27	33	49.5
Buffalo Ridge, MN (Phase III)	2.1[C]	2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)	2.1[C]	2.59	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	2.1[C]	2.16	143	107.25
NPPD Ainsworth, NE		1.16	36	59.4
Buffalo Ridge, MN (Phase I)		0.76	73	25
Blue Sky Green Field, WI[D]	7.7	24.57	88	145
Kewaunee County, WI		6.55	31	20
Buckeye, OH	5.3[E]			
Black Fork, OH	1.1[F]		112	200
Western				
High Winds, CA (2004)		3.01	90	162
Stateline, OR/WA (2003)		2.52	454	300
Nine Canyon, WA		2.47	37	48
Big Horn, WA		1.90	133	199.5
Combine Hills, OR		1.88	41	41
High Winds, CA (2005)		1.82	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

Table 5. Wind-energy facilities in North America with mortality 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-energy facilities have been made public.

Wind Energy Facility	Bat Use Estimate[A]	Mortality Estimate[B]	No. of Turbines	Total MW
	Rocky Mountains			
Summerview, Alb. (2006)		14.62	39	70.2
Summerview, Alb. (2005/2006)		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; 2001/2002)		1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2	1.05	69	41.4
	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 Ellensburg, NY		5.45	54	80
Noble Clinton, NY		3.63	67	100.5
Mars Hill, ME (2007)		2.91	28	42
Erie Shores, Ontario		1.51	66	99

Table 5. Wind-energy facilities in North America with mortality 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-energy facilities have been made public.

Wind Energy Facility	Bat Use Estimate[A]	Mortality Estimate[B]	No. of Turbines	Total MW
Southern Plains				
Oklahoma Wind Energy Center, OK		0.53	68	102
Buffalo Gap, TX		0.10	67	134

A=bat passes per detector night
B=number of bat fatalities/MW/year
C=averaged across phases and/or study years, and may not be directly related to mortality estimates
D=fatality and Anabat data not collected concurrently
E= Only includes data collected at met towers
F=Only includes fall migration data from October 2 – November 15

Data from the following sources:

Facility	Use Estimate	Mortality Estimate	Facility	Use Estimate	Mortality Estimate
High Winds, CA (2004)		Kerlinger et al. 2006	Crescent Ridge, IL		Kerlinger et al. 2007
Stateline, OR/WA (2003)		Erickson et al. 2004	Buffalo Ridge, MN (Phase III)		Johnson et al. 2004
Nine Canyon, WA		Erickson et al. 2003	Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Johnson et al. 2004
Big Horn, WA		Kronner et al. 2008	Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Johnson et al. 2004
Combine Hills, OR		Young et al. 2006	NPPD Ainsworth, NE		Derby et al. 2007
High Winds, CA (2005)		Kerlinger et al. 2006	Buffalo Ridge, MN (Phase I)		Johnson et al. 2000
Stateline, OR/WA (2002)		Erickson et al. 2004	Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2010
Vansycle, OR		Erickson et al. 2000	Kewaunee County, WI		Howe et al. 2002
Klondike, OR		Johnson et al. 2003	Buffalo Mountain, TN (2006)		Fiedler et al. 2007
Hopkins Ridge, WA		Young et al. 2007	Mountaineer, WV	E.Arnett (pers com. 2005)	Kerns and Kerlinger 2004
Klondike II, OR		NWC and WEST 2007	Buffalo Mountain, TN (2000-2003)	Fiedler 2004	Nicholson et al. 2005
Wild Horse, WA		Erickson et al. 2008	Meyersdale, PA		Arnett et al. 2005
SMUD, CA		URS et al. 2005	Casselman, PA		Arnett et al. 2009
Summerview, Alb. (2006)		Baerwald 2008	Maple Ridge, NY (2006)		Jain et al. 2007
Summerview, Alb. (2005/6)		Brown and Hamilton 2006	Noble Bliss, NY		Jain et al. 2009c
Judith Gap, MT		TRC 2008	Mount Storm, WV (2008)	Young et al. 2009	Young et al. 2009
Summerview, Alb. (2007)		Baerwald 2008	Maple Ridge, NY (2007)		Jain et al. 2008
Foote Creek Rim, WY (Phase I; 1999)		Young et al. 2003	Noble Ellensburg, NY		Jain et al. 2009a
Foote Creek Rim, WY (Phase I; 2001/2)	Gruver 2002	Young et al. 2003	Noble Clinton, NY		Jain et al. 2009b
Foote Creek Rim, WY (Phase I; 2000)	Gruver 2002	Young et al. 2003	Mars Hill, ME (2007)		Stantec 2008
Top of Iowa, IA (2004)	Jain 2005	Jain 2005	Erie Shores, Ont.		James 2008
Top of Iowa, IA (2003)	Jain 2005	Jain 2005	Oklahoma Wind Energy Center, OK		Piorkowski 2006
Bukeye, OH	Stantec 2008		Black Fork, OH	Ecology and Environment 2009	
			Buffalo Gap, TX		Tierney 2007

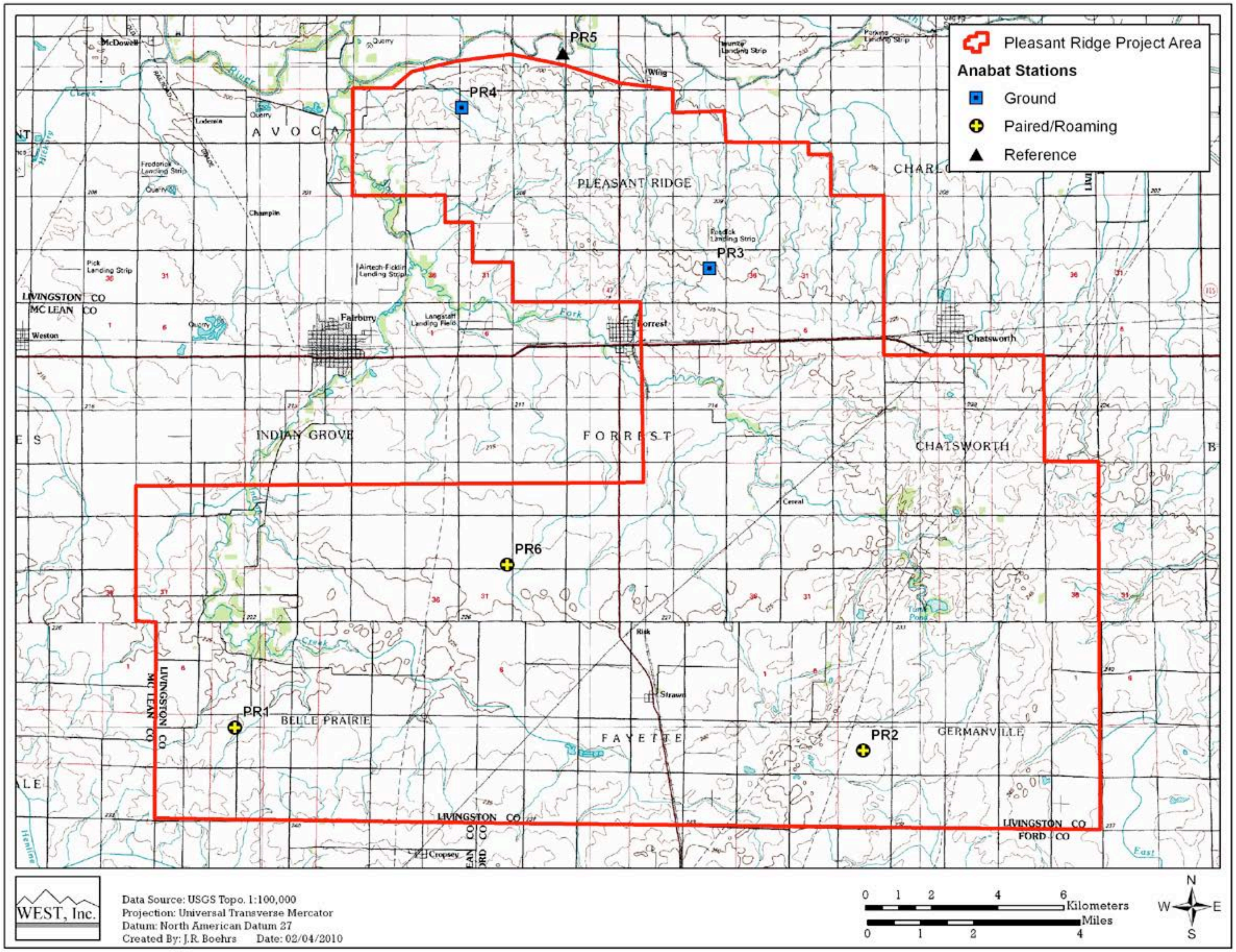


Figure 1. Study area map and Anabat sampling stations at the Pleasant Ridge Wind Resource Area.

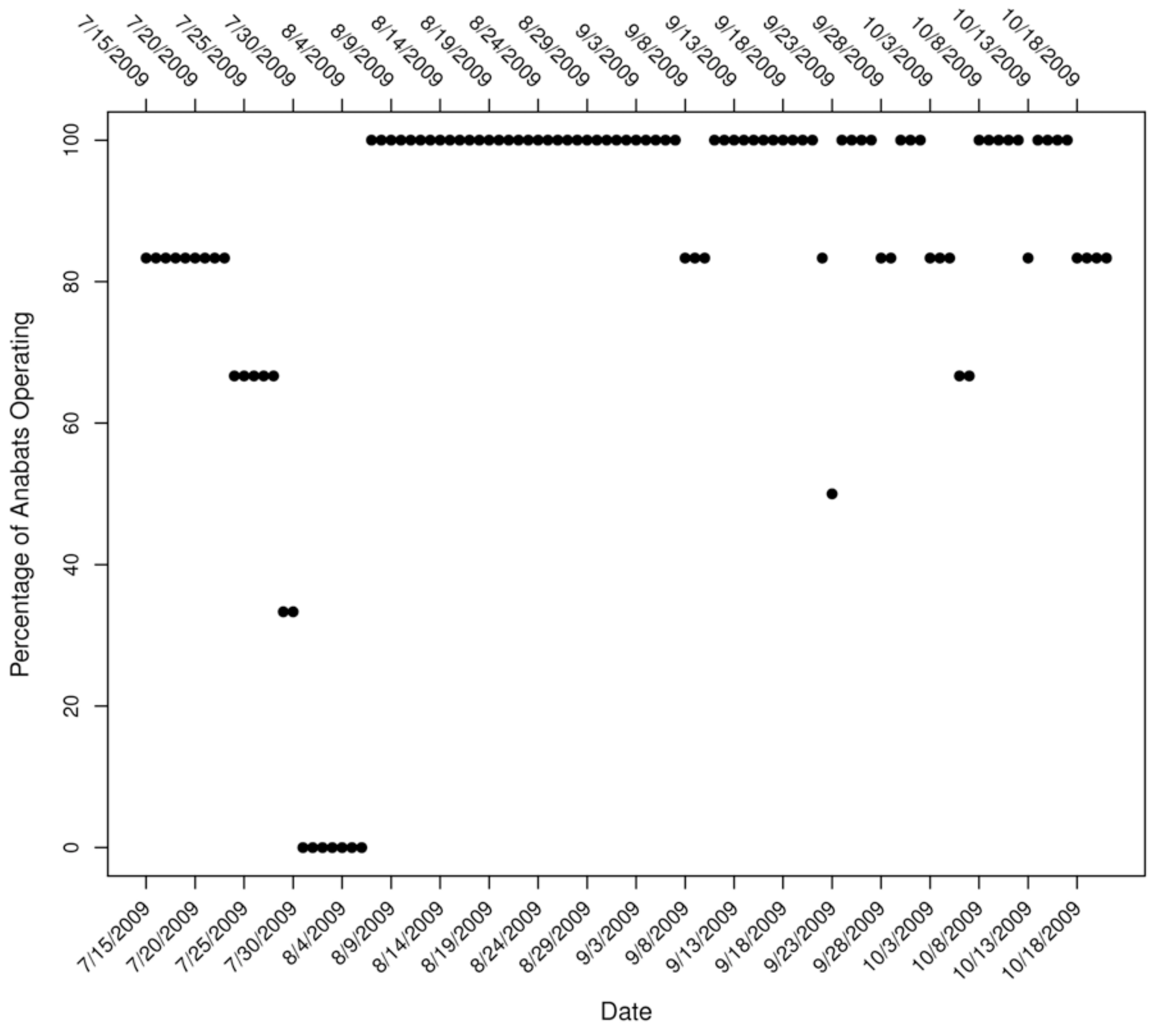


Figure 2. Percentage of all Anabat detectors (n = 9) at the Pleasant Ridge Wind Resource Area operating during each night of the study period July 15 through October 21, 2009.

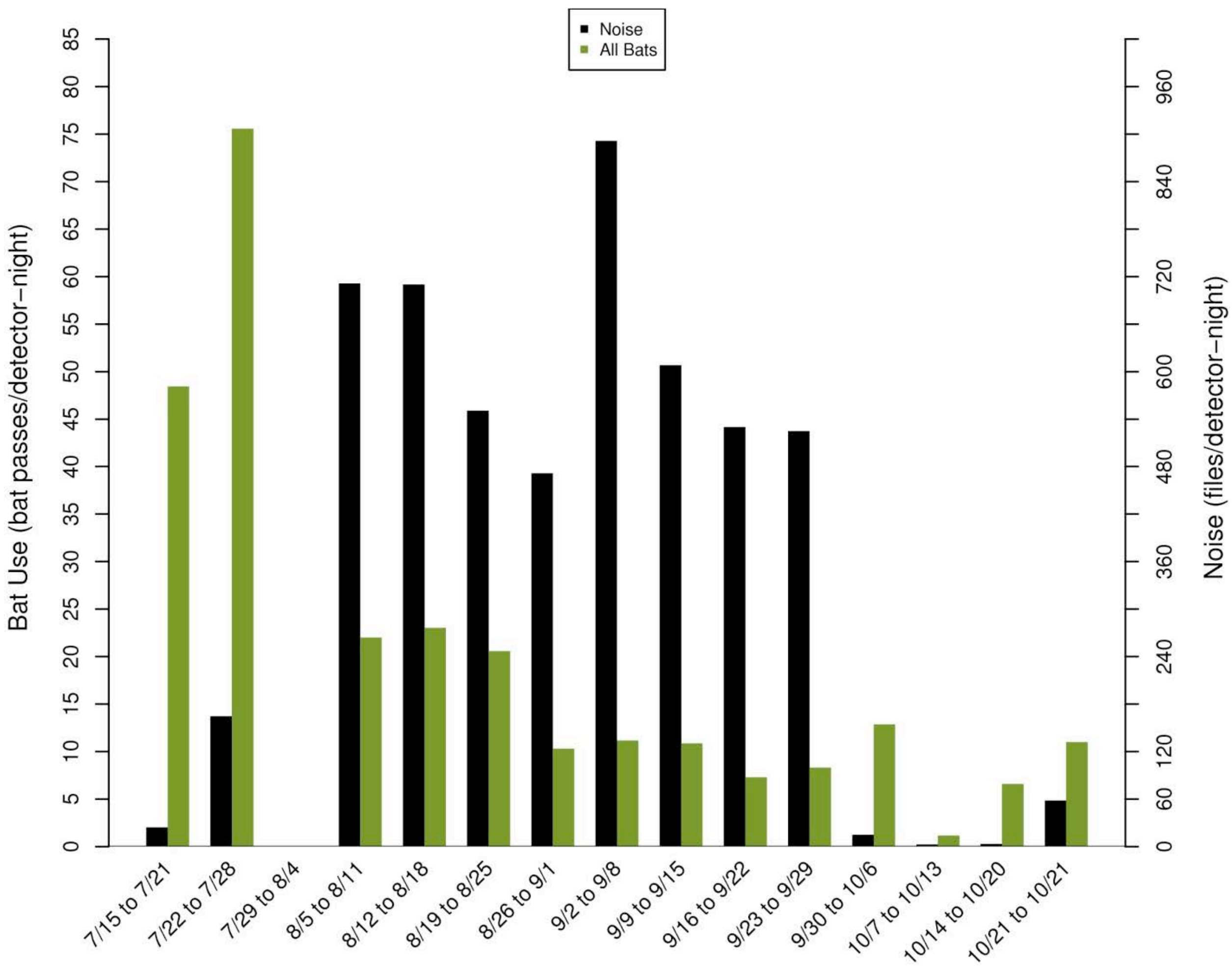


Figure 3a. Number of bat passes and noise files detected per detector-night for the reference station at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009, presented weekly.

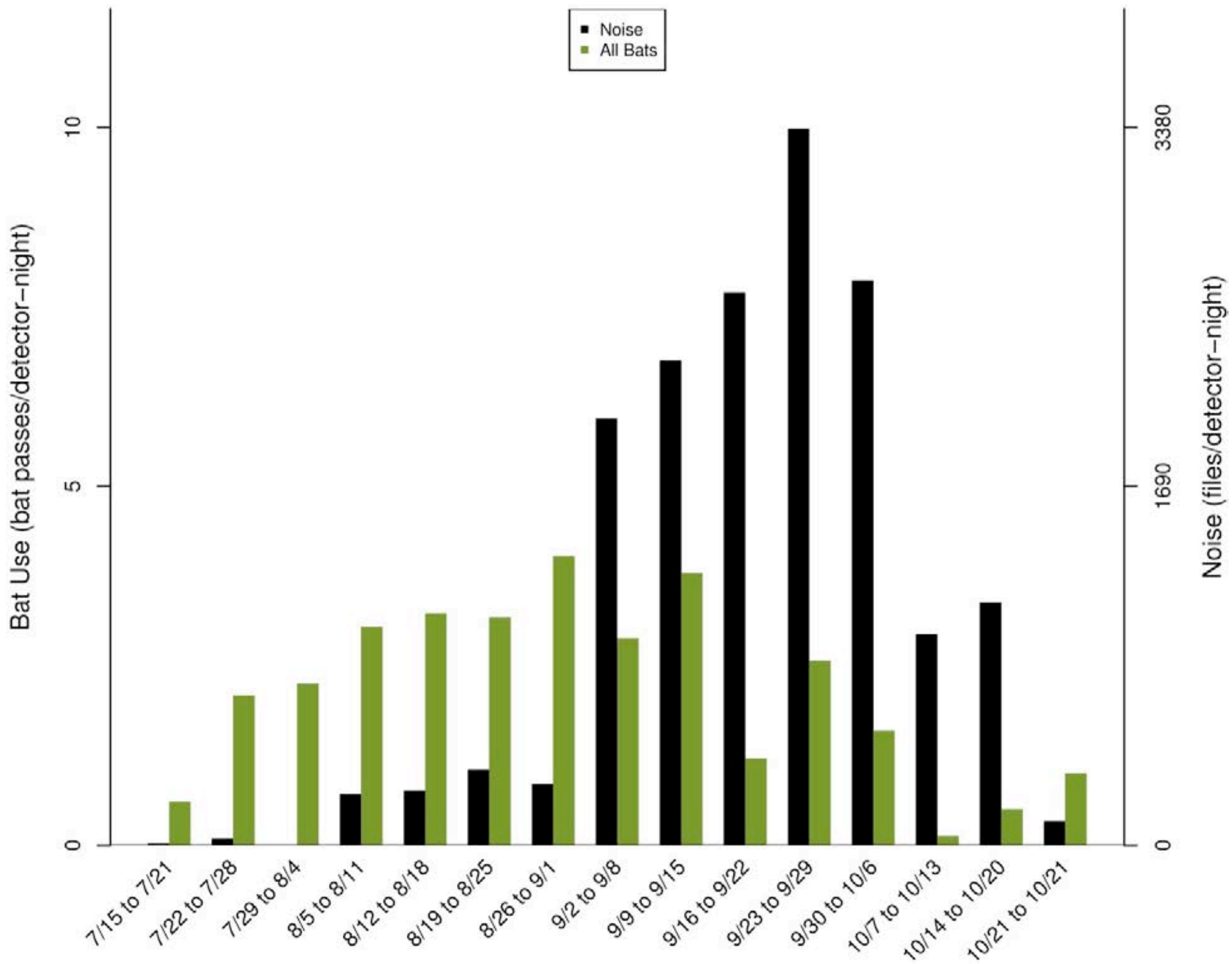


Figure 3b. Number of bat passes and noise files detected per detector-night for non-reference stations at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009, presented weekly.

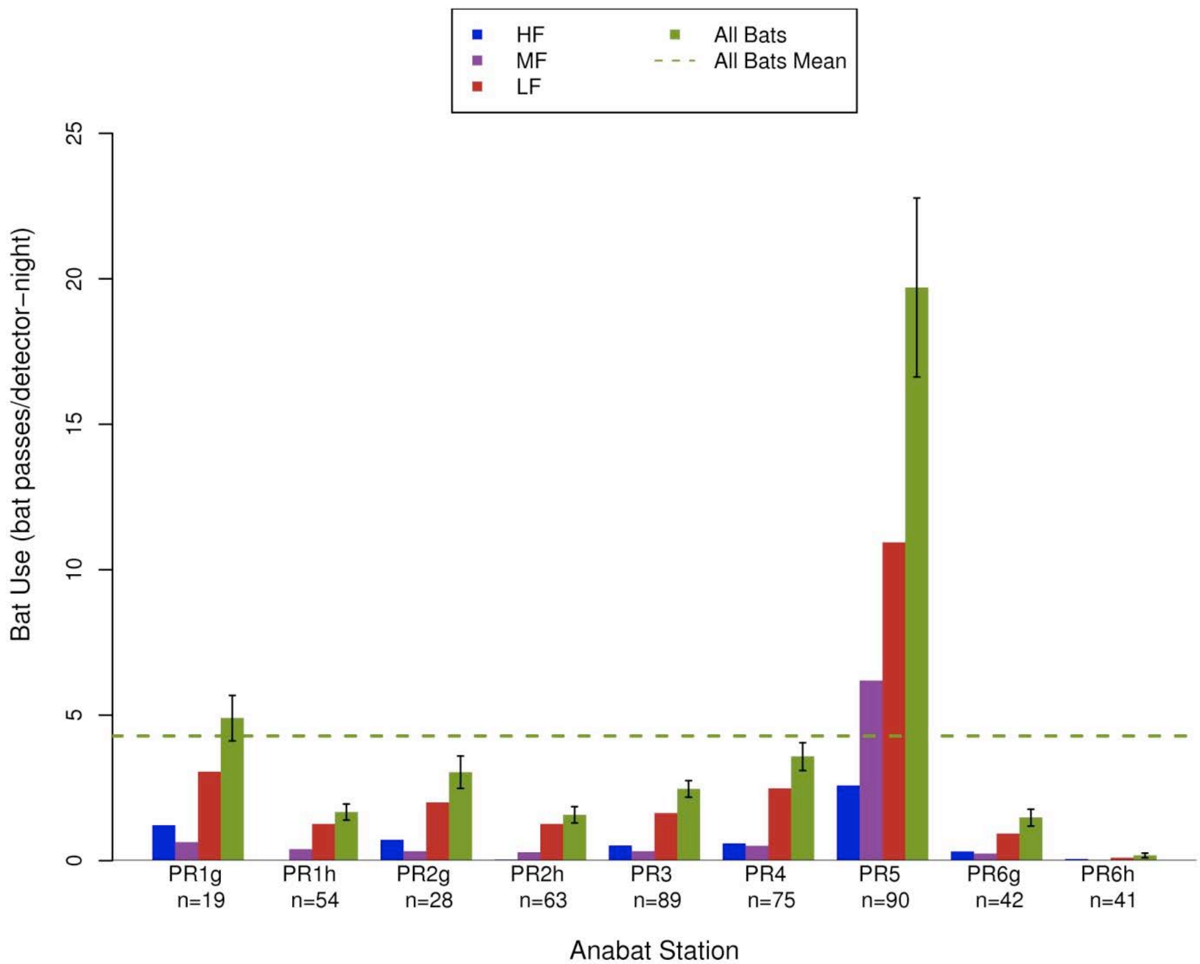


Figure 4a. Number of bat passes per detector-night by Anabat location for all stations at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21 2009.

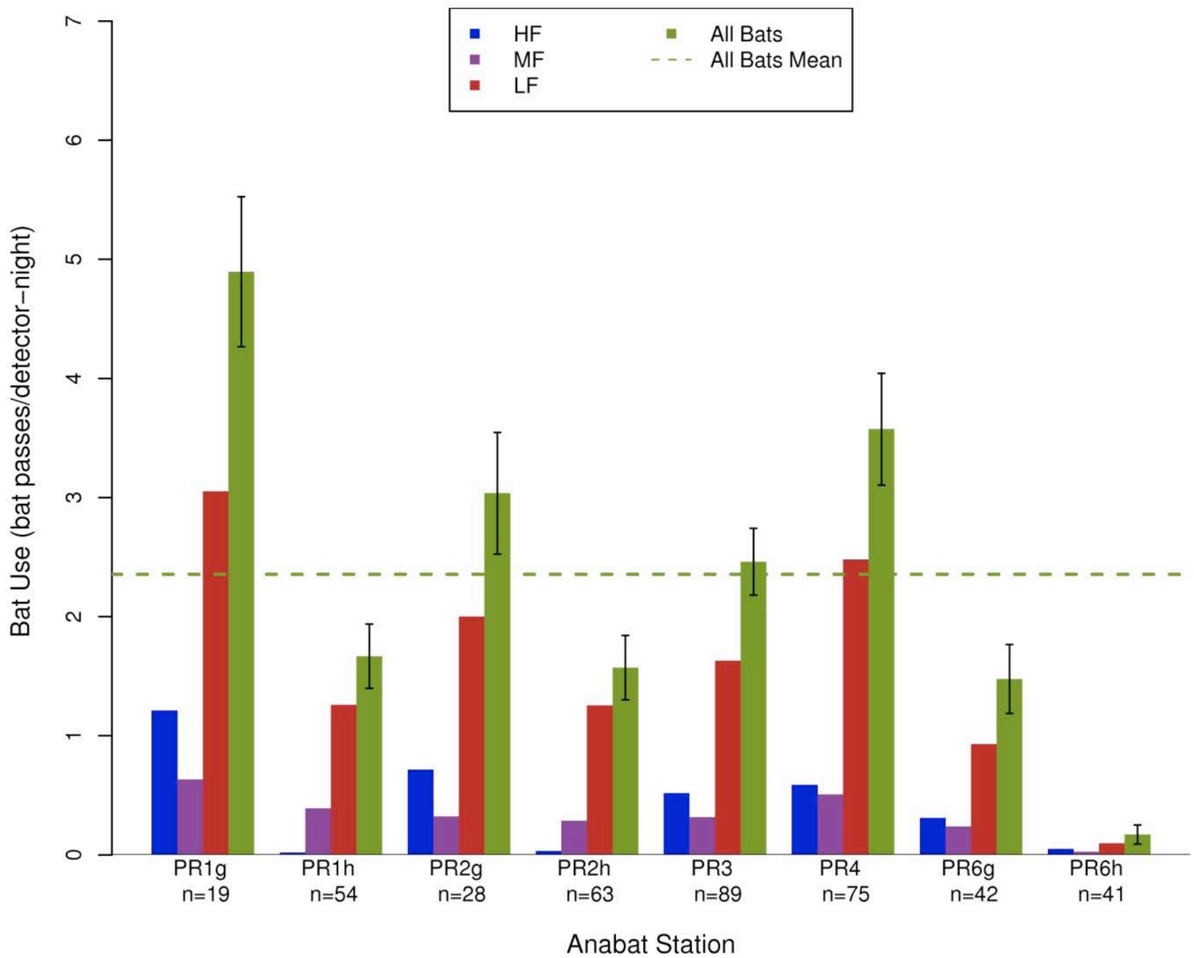


Figure 4b. Number of bat passes per detector-night by Anabat location for non-reference stations at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009.

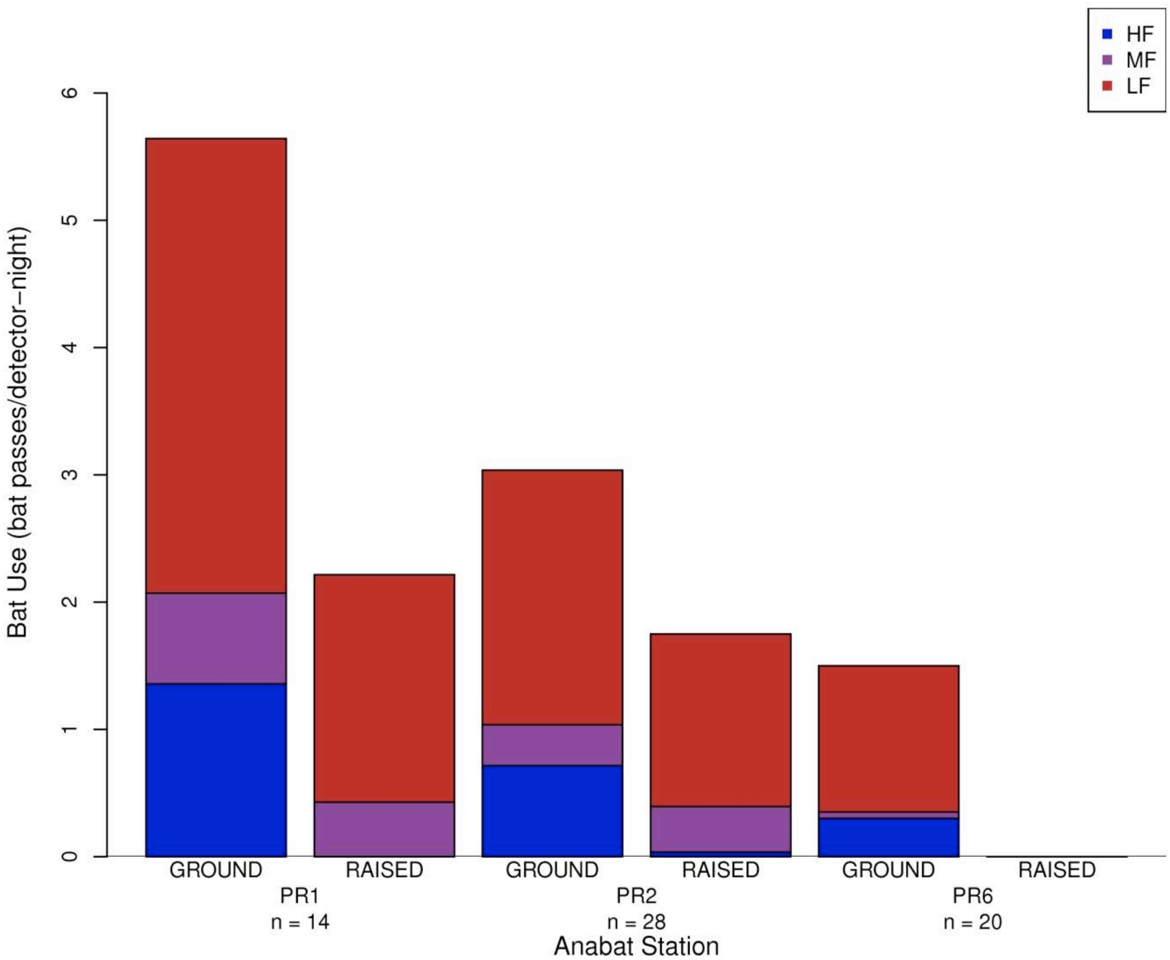


Figure 5. Number of high-frequency (HF), mid-frequency (MF), and low-frequency (LF) bat passes per detector-night recorded at paired ground and high Anabat unit stations when measured concurrently at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009.

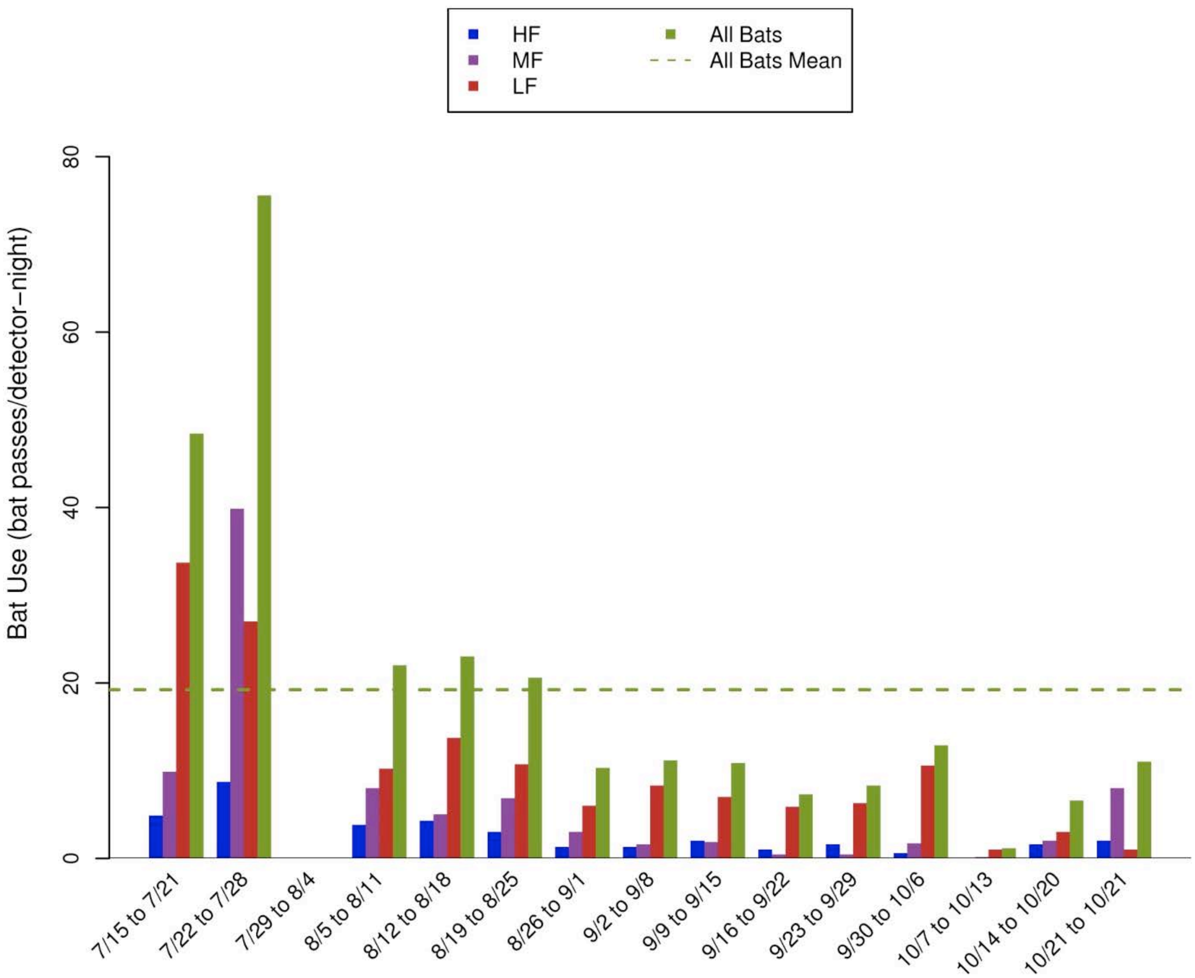


Figure 6a. Weekly activity by high-frequency (HF), mid-frequency (MF), and low-frequency (LF) bats at the reference station within the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009.

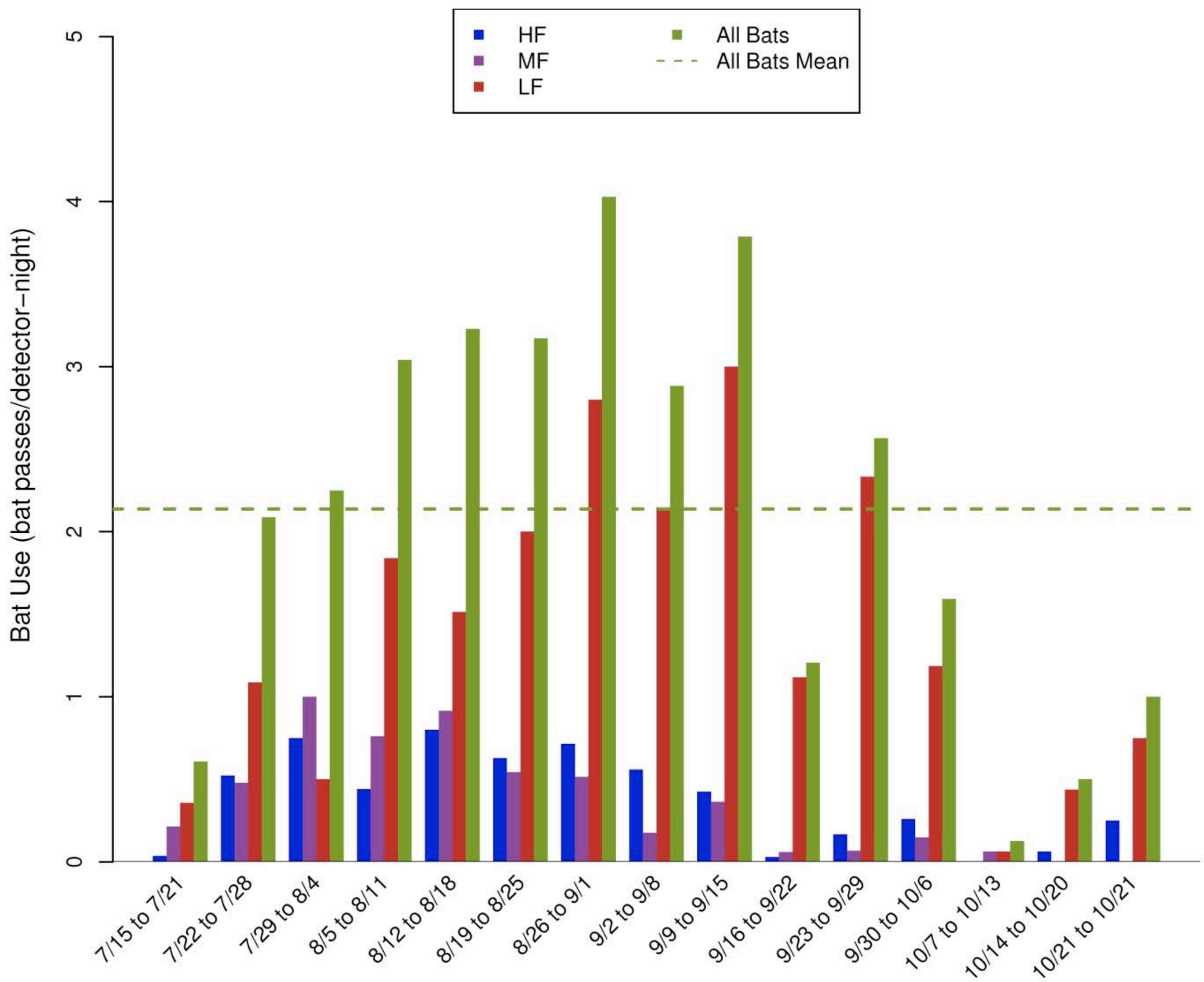


Figure 6b. Weekly activity by high-frequency (HF), mid-frequency (MF), and low-frequency (LF) bats at non-reference stations within the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009.

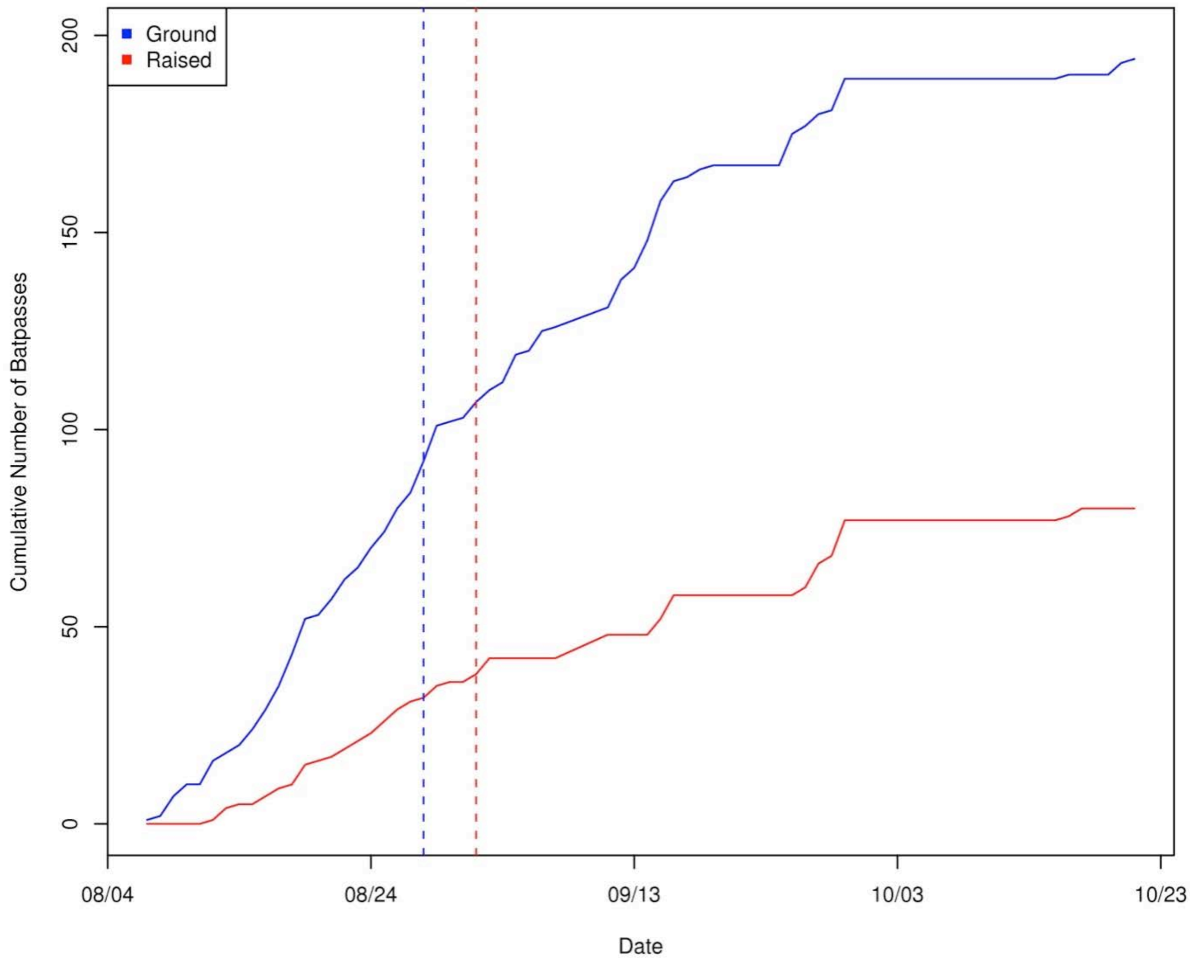


Figure 7a. Empirical cumulative distribution of bat passes at non-reference ground and raised stations within the Pleasant Ridge Wind Resource Area, July 15 through October 21, 2009. Dashed vertical lines indicate the point at which 50% of the calls occurred, an indication of the median date of bat activity.

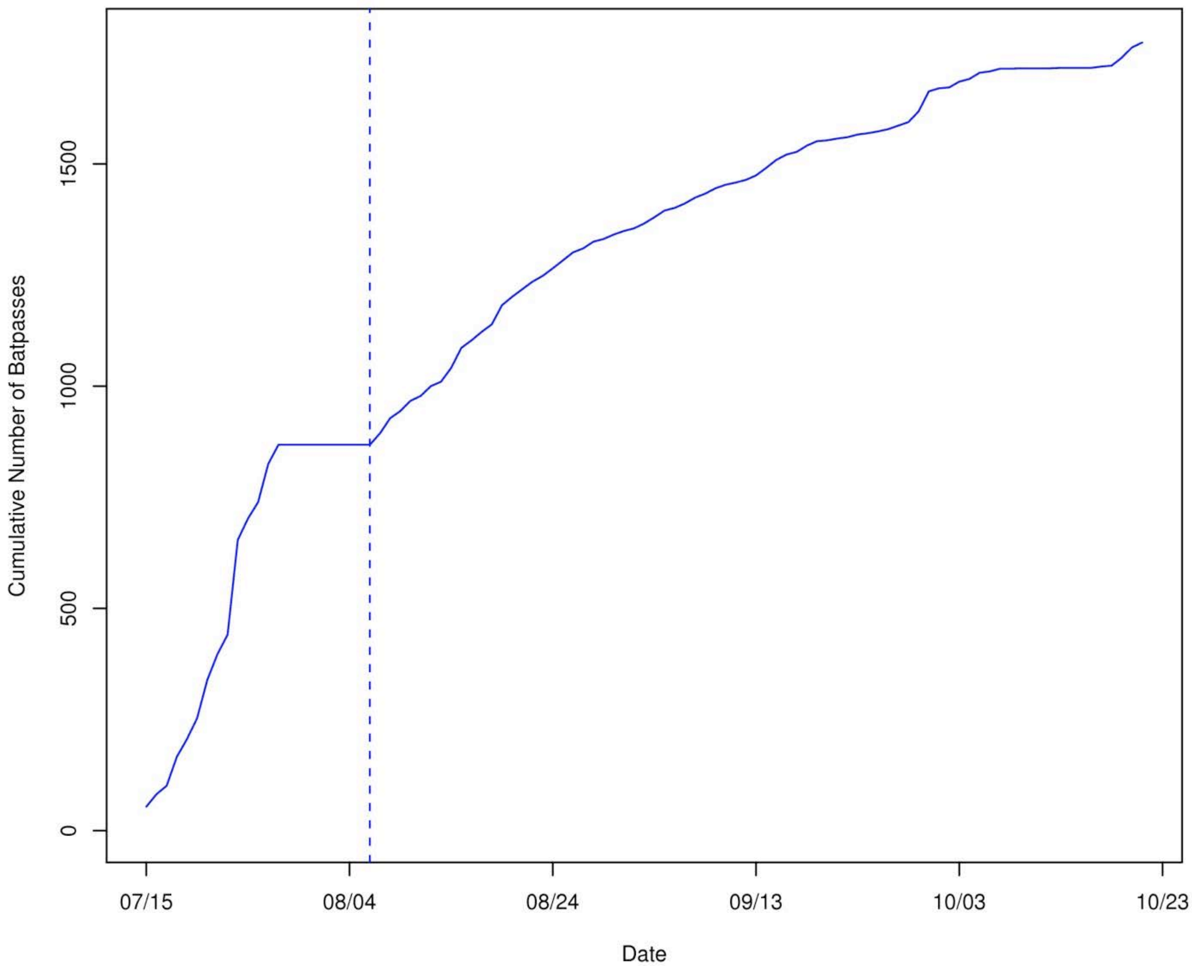


Figure 7b. Empirical cumulative distribution of bat passes at the reference station within the Pleasant Ridge Wind Resource Area, July 15 through October 21, 2009. Dashed vertical lines indicate the point at which 50% of the calls occurred, an indication of the median date of bat activity.

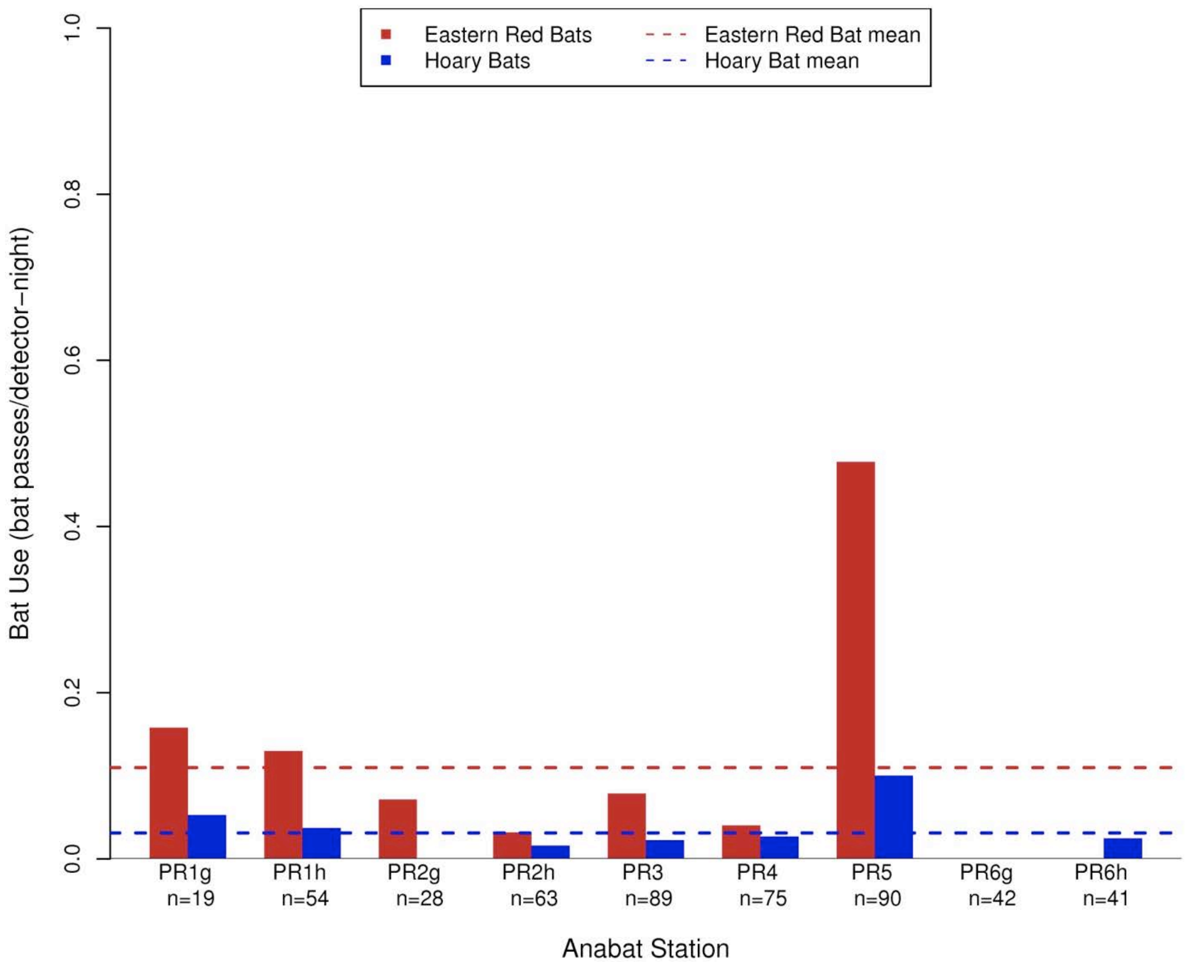


Figure 8a. Number of hoary and eastern red bat passes per detector–night by Anabat station for all stations at the Pleasant Ridge Wind Resource Area, for the study period July 15 through October 21, 2009.

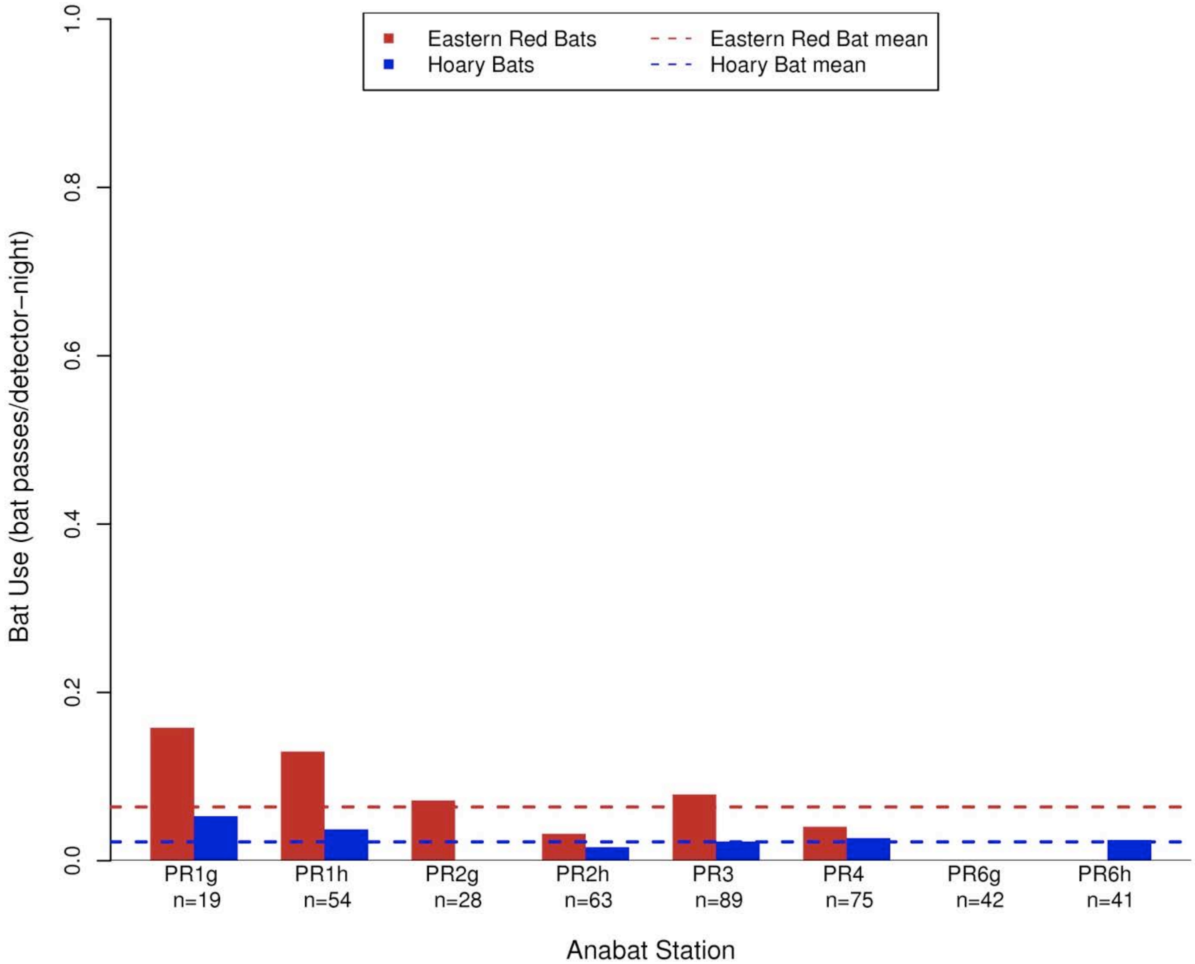


Figure 8b. Number of passes per detector–night by hoary bats and eastern red bats for non-reference Anabat stations at the Pleasant Ridge Wind Resource Area, for the study period July 15 through October 21, 2009.

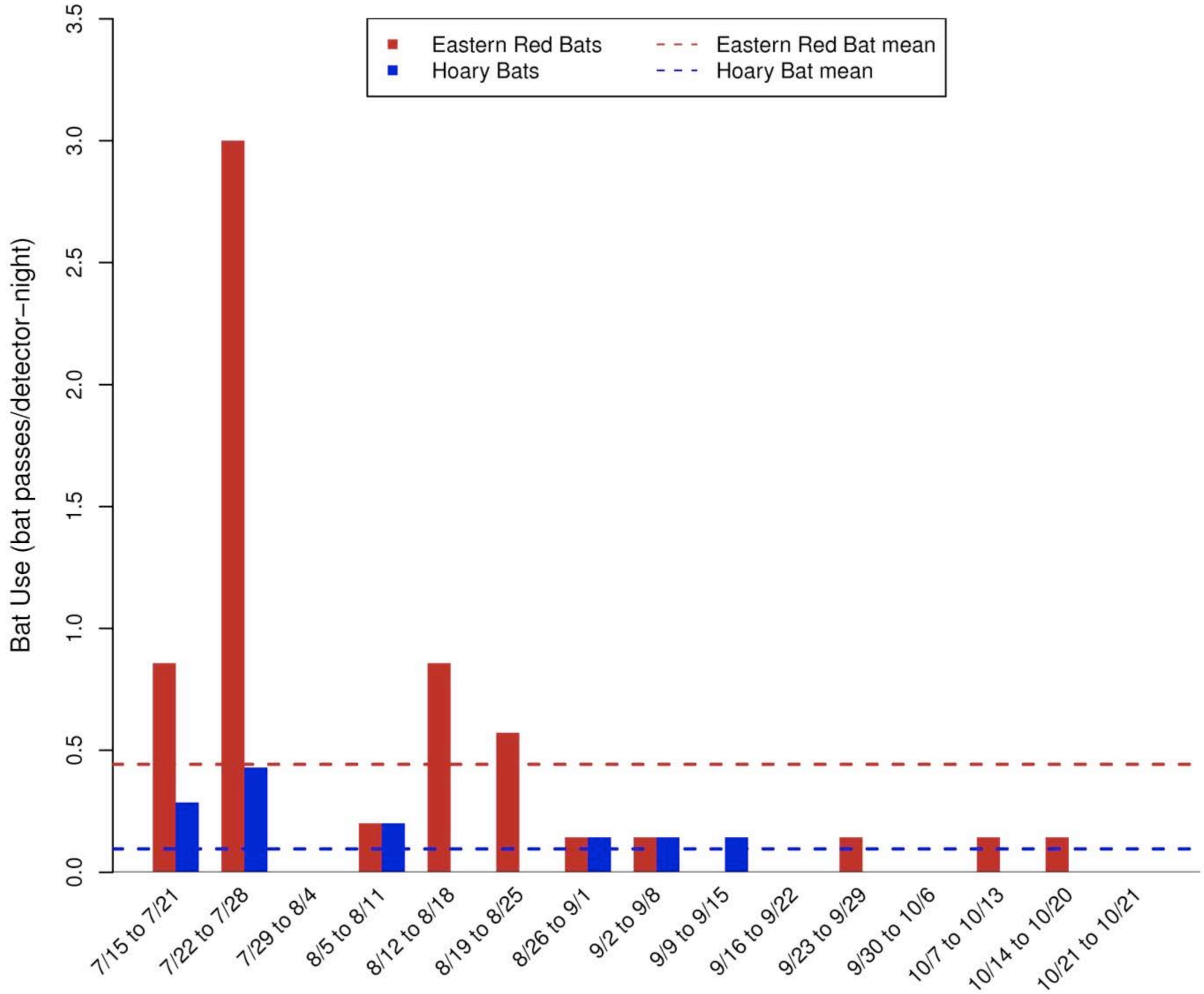


Figure 9a. Number of passes per detector–night by hoary bats and eastern red bats for the reference station at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009, presented weekly.

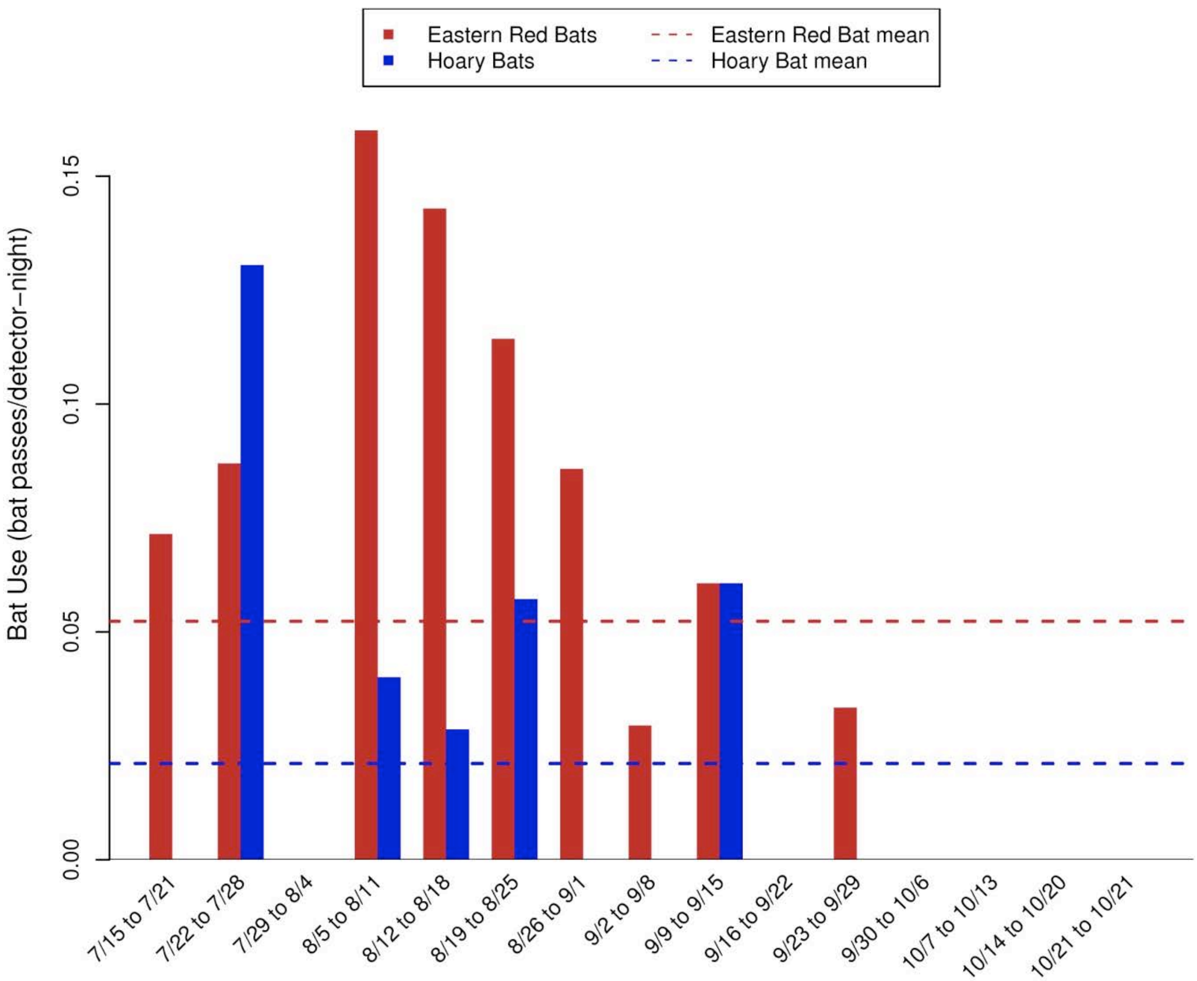
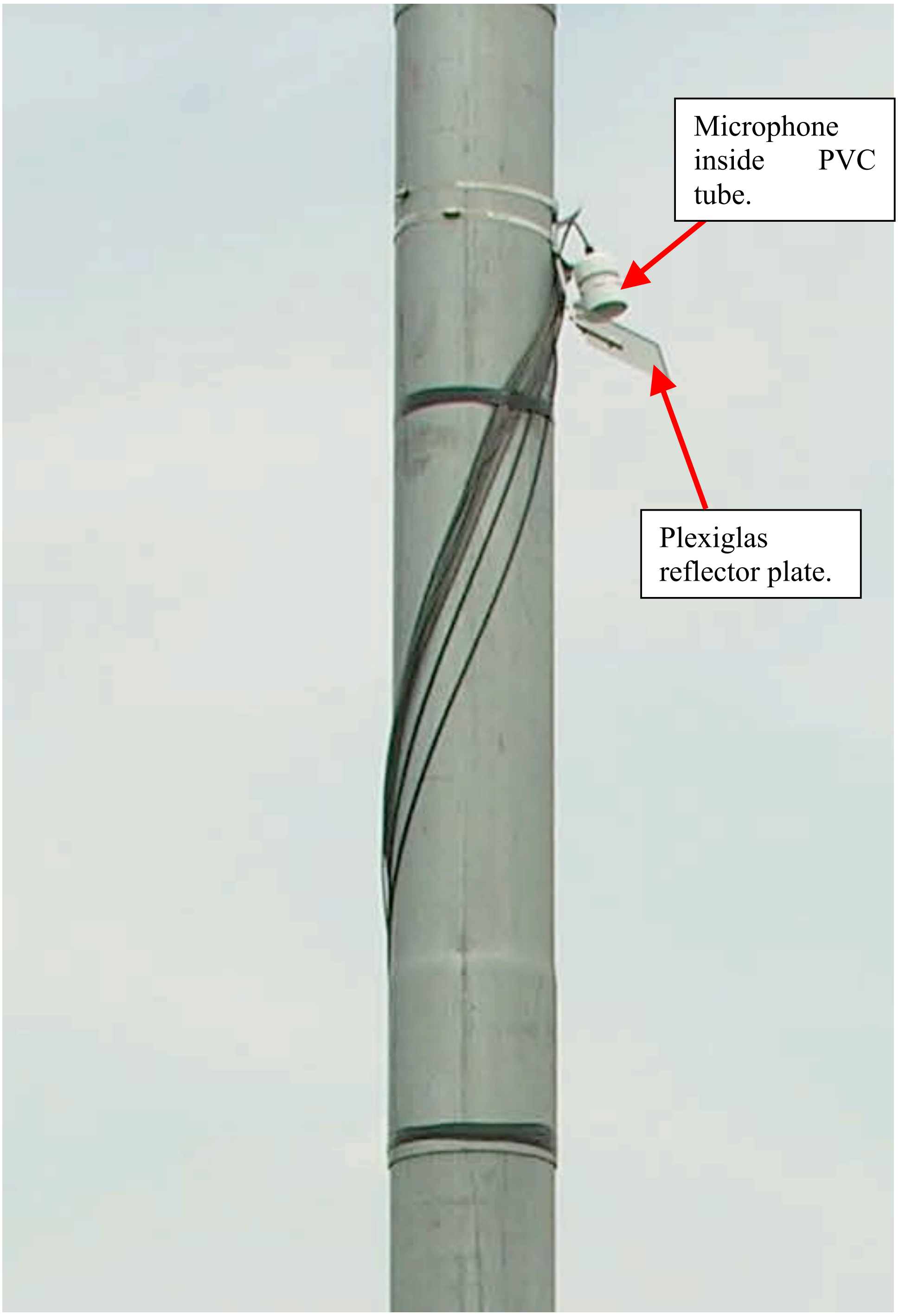
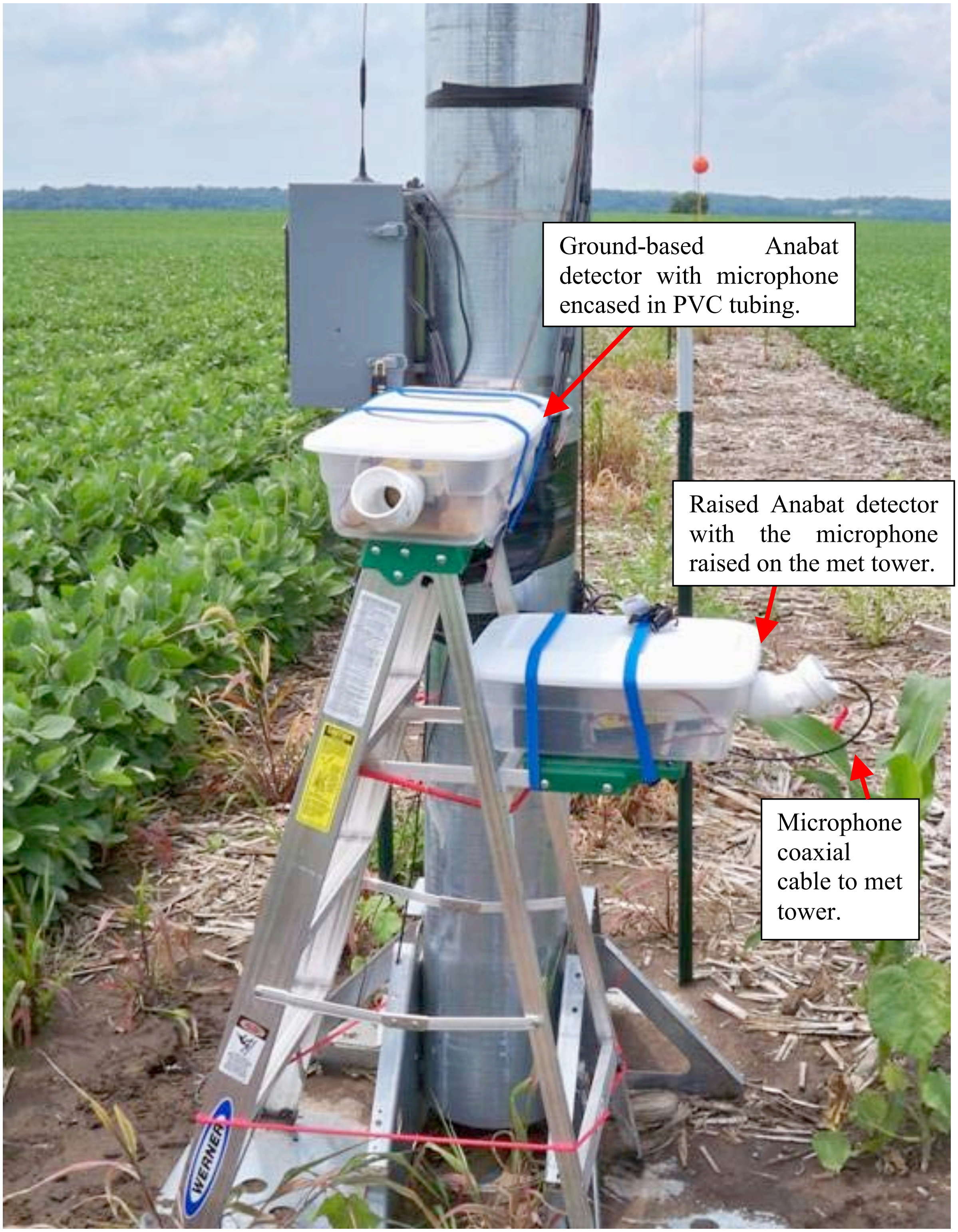


Figure 9b. Number of passes per detector–night by hoary bats and eastern red bats for non-reference stations at the Pleasant Ridge Wind Resource Area for the study period July 15 through October 21, 2009, presented weekly.

Appendix A: Photographs of Anabat units.



Raised Anabat setup on met tower with microphone mounted on tower inside a PVC tube with a Plexiglas reflector plate.



Ground-based Anabat setup at met tower with unit encased in weatherproof housing (top). Raised Anabat detector enclosed in weatherproof housing (bottom; microphone raised and mounted on tower).