HNF-56359
Revision 0

Hanford Site Summer Bat Monitoring Report for Calendar Year 2013

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728

P.O. Box 650
Richland, Washington 99352

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Mission Support Alliance

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1.0 Introduction

The U.S. Department of Energy, Richland Operations Office (DOE-RL) conducts ecological monitoring on the Hanford Site to collect and track data needed to ensure compliance with an array of environmental laws, regulations, and policies governing DOE activities. Ecological monitoring data provides baseline information about the plants, animals, and habitat under DOE stewardship at Hanford required for decision-making under the *National Environmental Policy Act* (NEPA) and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). In addition, ecological monitoring helps ensure that DOE, its contractors and other entities conducting activities on the Hanford Site are in compliance with the *Hanford Site Comprehensive Land Use Plan* (DOE/EIS-0222-F). DOE-RL places priority on monitoring those plant and animal species or habitats with specific regulatory protections or requirements; or that are rare and/or declining (federal or state listed endangered, threatened, or sensitive species); or of significant interest to federal, state, or tribal governments or the public.

Several species of bats have been documented on the Hanford Site, with nine species identified during the Nature Conservancy (TNC) surveys in 1997 and 1998, and an additional eight species listed as potentially present (Soll 1999 et al., Table 1). The survey conducted by Mission Support Alliance (MSA) during the summer of 2012 also documented nine species (Lindsey et al. 2012, Table 1).

Table 1. Bat species previously encountered on the Hanford Site by Nature Conservancy and Mission Support Alliance

Common Name	Scientific Name	Abbreviation	TNC Acoustic	TNC Captured	MSA Acoustic 2012
pallid bat	*Antrozous pallidus*	Anpa	X	X	X
big brown bat	*Eptesicus fuscus*	Epfu	X		X
silver-haired bat	*Lasionycteris noctivagans*	Lano	X	X	X
hoary bat	*Lasiurus cinereus*	Laci	X		X
California myotis	*Myotis californicus*	Myca		X	X
western small-footed myotis	*Myotis ciliolabrum*	Myci		X	X
little brown myotis	*Myotis lucifigus*	Mylu		X	X
Yuma myotis	*Myotis yumanensis*	Myyu		X	X
canyon bat	*Parastrellus hesperus*	Pahe	X		X

Of the species documented on the Hanford Site, pallid bats, western small-footed myotis, and canyon bats are listed as Washington Department of Fish and Wildlife (WDFW) State Monitor Species (WDFW 2013). In addition, roosting concentrations of big-brown bats, pallid bats, and all roosts for bats in the genus *Myotis* are considered Priority Habitats by the WDFW (WDFW 2013). Roosting congregations can be maternity colonies, winter roosts, or night roosts. Males typically day-roost alone or in small groups, and do not have the same strict roosting habitat requirements as maternity colonies. Maternity colonies are specialized locations where groups of female bats roost together to give birth and raise their young. Individuals show strong fidelity to these roosting locations, and the same roosts are used year-after-year. These locations are selected for proximity to food and water resources, as well as appropriate temperature, humidity, and light conditions. The bats congregate to share body heat in order to conserve energy. These maternity locations are vital to successful reproduction. Night roosts are located close to feeding areas and are used by bats for resting and digestion between feeding bouts. Bats are known to habitually use night roosts from night-to-night and from year to year (Ormsbee et al. 2007). Although some species that occur on the Hanford Site are migratory (silver-haired bat, hoary bat), most bats remain in the region during the winter. Due to cold temperatures and lack of available food (insects), bats must hibernate in winter roosts to survive. Winter roosts are selected for cold and constant temperatures so bats can down-regulate their body temperature, slowing their metabolism and conserving energy, to survive through the winter. Bats select all communal roost types for very specific conditions that may not be otherwise available in the same areas.

Identification and protection of roosting locations is becoming increasingly important with the outbreak of the fungal infection referred to as White Nose Syndrome (WNS). White nose syndrome is affecting bats in the eastern United States and Canada, and is rapidly expanding westward. Bats save energy during the winter by reducing their body temperature and entering a state of hibernation called torpor. They break these torpor bouts by warming their body temperature back up at regular intervals through the winter; these events are termed "arousals". Bats are thought to use these arousals for depuration, defecation, grooming, breeding, and possibly drinking. Although these arousals represent a relatively small portion of the time the bats spend winter roosting, a large amount (up to 80%) of their energy stores for the season are burned during arousals (Thomas et. al. 1990). Bats are thought to increase the number of arousals due to WNS, likely for additional grooming. Although other factors may be contributing, the excessive arousals cause bats to exhaust their energy stores prior to the end of the winter, resulting in starvation. This disease spreads quickly through roosting colonies and causes fatality rates up to 100% at infected winter roosts (more information available at whitenosesyndrome.org). Because of the collapse of these bat colonies and the potential expansion of this disease westward, it is extremely important to identify and characterize roosts to provide a baseline in case the disease reaches this area. Bat researchers must follow strict WNS Protocols established by the U.S. Fish and Wildlife Service (FWS) and other agencies when working with bats (WNS 2012).

Bats are sensitive to disturbance, especially while pregnant and lactating. Early identification of roost areas can help avoid impacts to these sensitive species. DOE-RL has shown a commitment to protecting bats on the Hanford Site, providing protection for known roost sites and mitigating for unavoidable impacts to other roosting locations. Washington Closure Hanford, a contractor to DOE-RL, has identified maternity colonies of Yuma myotis and pallid bats in abandoned buildings in the 100-F and 100-D Areas of the Hanford Site and protected these important maternity colonies, which are some of the largest in the State of Washington (West et al. 2011, Table 2). However, little data are available on the location of maternity colonies or night-roost locations across the remainder of central Hanford.

Table 2. Bat Roosts Known on the Hanford Site Prior to 2013

Description	Primary Roost Type	Primary Species Present
105-F Reactor Bat Boxes	Maternity	Pallid Bats
105-H Reactor Bat Boxes	Unknown	Unknown
183-D Facility	Maternity	Pallid Bats
183-F Clearwell	Maternity	Yuma myotis
190-D Pipe Tunnel Entrance	Maternity	Yuma myotis
190-DR Pipe Tunnel Entrance	Maternity	Yuma myotis
Cornelius Pump House	Unknown	Pallid Bats
Hanford Townsite School	Unknown	Unknown

A graded approach was used to determine whether bat activity exists in other areas across the Hanford Site. Acoustic surveys, mist netting, and infrared cameras can be used together to determine the species present and to document bat roosting locations.

2.0 Methods

Potential roosting, activity centers (e.g. water sources), or natural flyways were identified initially using aerial photography and walking surveys. It was not necessary for bats to be present during these initial habitat surveys, so work was performed prior to the season when bats are actively forming maternity colonies, which typically lasts from mid-March through October on the Hanford Site.

Evaluation of the identified survey locations was performed with an acoustic detector. A Pettersson D500x Bat Detector was selected for its ability to operate remotely and make high-resolution (full spectrum) recordings over extended periods (e.g. >1 week). The detector was placed inside of a 50-caliber ammunition box, used as a weatherproof enclosure, along with a 6-volt 14-amp battery (Figure 1). An external microphone was used by threading a cord through a hole in the side of the ammunition box and sealing it with a cork. A waterproof windscreen was placed over the external microphone to minimize noise recordings that occur during high winds and to protect the microphone from moisture. Finally, a tripod was used to extend the microphone off the ground by approximately 6 feet to increase recording quality (Szewczak n.d.) (Figure 2).

Detector settings were selected using recommendations from Tyburec (2011), adjusted for local conditions. Settings were generally:

Sampling Frequency: 500
Pre-Trig: off
Recording Length: 1.0 second
High Pass Filter: Yes
Auto Record: Yes
Trigger Sensitivity: High
Input Gain: 80
Trigger Level: 200

Figure 1. Pettersson D500x and External Battery Inside of Ammunition Box Weather Enclosure

Figure 2. Pettersson D500x Deployed at the Cornelius Pumphouse

The bat detector is automatically triggered by ultrasonic sound, and was set to record for one second after each trigger, with no delay between recordings. Thus, a single bat could potentially trigger the detector multiple times. The detector was set this way to ensure that the highest quality call was available from each bat pass to support more accurate species identification. This setting remained the same throughout the project and each trigger was treated as a single bat pass for the purposes of data analysis. Recordings made with the Pettersson D500x can also be used to determine peak activity times for each monitoring location because each recording is time-stamped. Activity around maternity colonies should peak during emergence, which typically occurs shortly after twilight. Data showing low levels of bat activity around twilight, followed by a peak in bat activity an hour or more after twilight, could indicate the area is being used as a night roost.

The detector was deployed at each location for a minimum of three qualifying weather nights, in order to minimize weather-related impacts on level of activity calculations. A qualifying weather night, for the purposes of this project, consisted of average wind speed of less than 15 mph, minimum temperature greater than 50 degrees Fahrenheit, and no measurable precipitation, as recorded by the Hanford Meteorological Station's (HMS) nearest weather monitor (http://www.hanford.gov/page.cfm/HMS). Acoustic recordings were analyzed, using SonoBat™ 3 automated analysis software and manual review, to help determine the species present and the relative level of activity (calls/bat-night). A bat-night, for the purposes of this project, occurred between sunset, and sunrise of the following day. Therefore, the bat detector was set to begin recording at sunset, and stop at sunrise; these times were adjusted throughout the season.

Mist netting and infrared video recording was planned to help define the species present and potential roost locations. Mist netting was performed with all necessary permits from Washington Department of Fish and Wildlife and in accordance with the established White Nose Syndrome Decontamination Protocol (WNS 2012). The video camera used during 2013 was a Sony Handycam™ (HDR-SR12) on nightshots mode, with an external IRLamp6 infrared light.

3.0 Results

Eleven locations were selected for acoustic surveys during the summer of 2013 (Figure 3). Acoustic monitoring began on May 6 and continued through August 26. The detector was deployed for a total of 42 nights during this monitoring period. The detector was tipped over during one deployment, due to high winds, but otherwise operated successfully throughout the season. Thirty-eight nights met the weather conditions to be considered "suitable", and a total of 2,193 bat passes were documented during those suitable recording nights. A summary of the monitoring results, including species detected, is shown in Table 3. The number of bat passes documented at each location, per suitable recording night, is shown in Figure 4. The number of bat passes for each species recorded across all monitoring locations is shown in Figure 5, while the number of sites where each species was detected is shown in Figure 6.

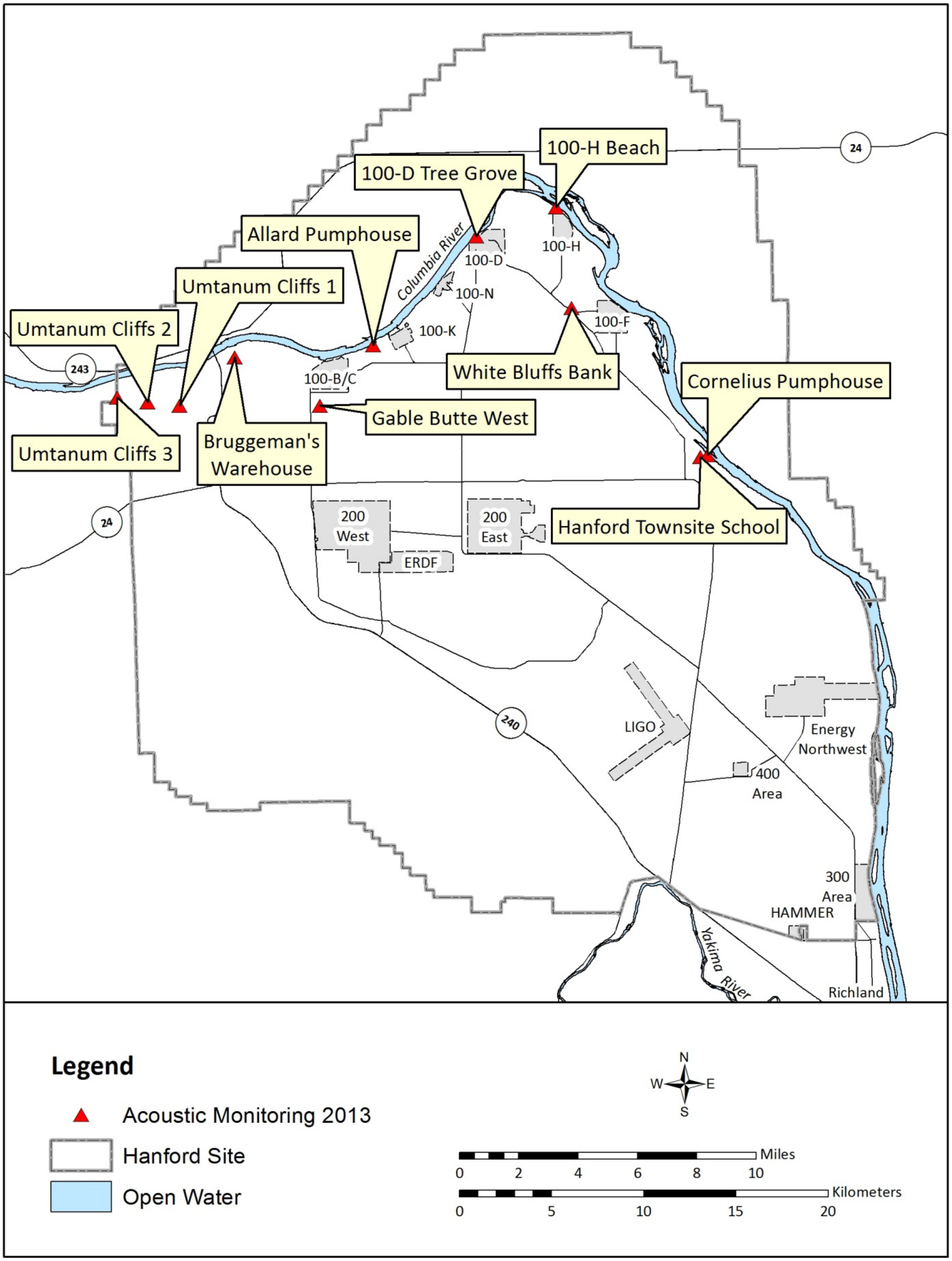

Figure 3. Acoustic Monitoring Locations Surveyed During 2013

Table 3. Acoustic Monitoring Results for 2013

Site	Start Date	End Date	Suitable Recording Nights	Total Bat Passes	Species Detected Acoustically
White Bluffs Bank	5/6/2013	5/13/2013	5	54	Anpa, Laci, Lano, Myca, Mylu, Myyu
Bruggeman Warehouse	7/3/2013	7/8/2013	4	60	Laci, Lano, Mylu
Allard Pumphouse	7/8/2013	7/11/2013	3	33	Lano, Mylu, Myyu
Hanford Townsite School	7/11/2013	7/15/2013	4	234	Anpa, Lano, Myci, Mylu, Myyu
Cornelius Pumphouse	7/15/2013	7/18/2013	3	421	Anpa, Laci, Lano, Myca, Mylu, Myyu
Gable Butte	7/18/2013	7/22/2013	4	680	Mylu, Pahe
Umtanum Cliff 1	7/22/2013	7/25/2013	3	64	Anpa, Laci, Lano, Myca, Mylu, Myyu, Pahe
Umtanum Cliff 2	7/25/2013	8/1/2013	1	399	Anpa, Laci, Lano, Myca, Mylu, Pahe
Umtanum Cliff 3	8/14/2013	8/19/2013	5	37	Anpa, Laci, Lano, Mylu, Pahe
100-H Beach	8/19/2013	8/22/2013	3	39	Laci, Lano, Mylu, Myyu, Pahe
100-D Tree Grove	8/22/2013	8/26/2013	3	172	Anpa, Laci, Lano, Mylu, Myyu

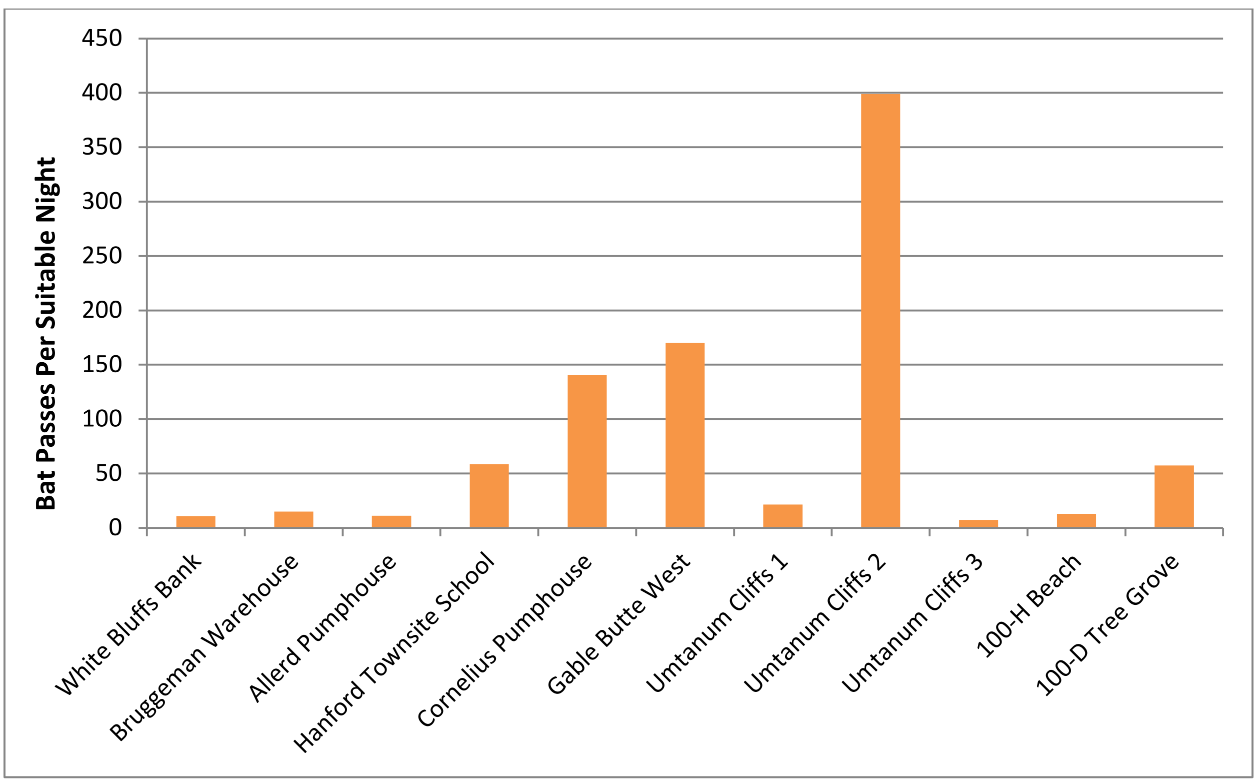

Figure 4. Bat Passes per Suitable Recording Night at All 2013 Acoustic Monitoring Locations

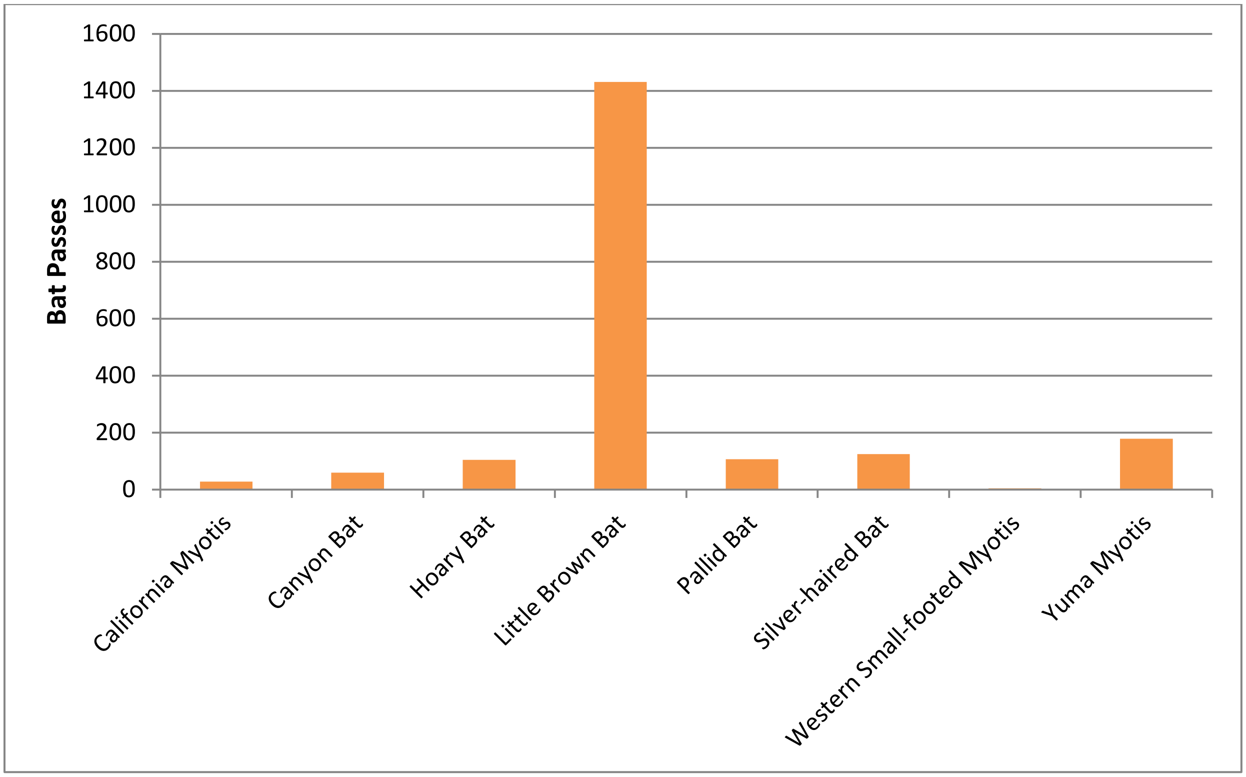

Figure 5. Total Bat Passes by Species at All 2013 Monitoring Locations

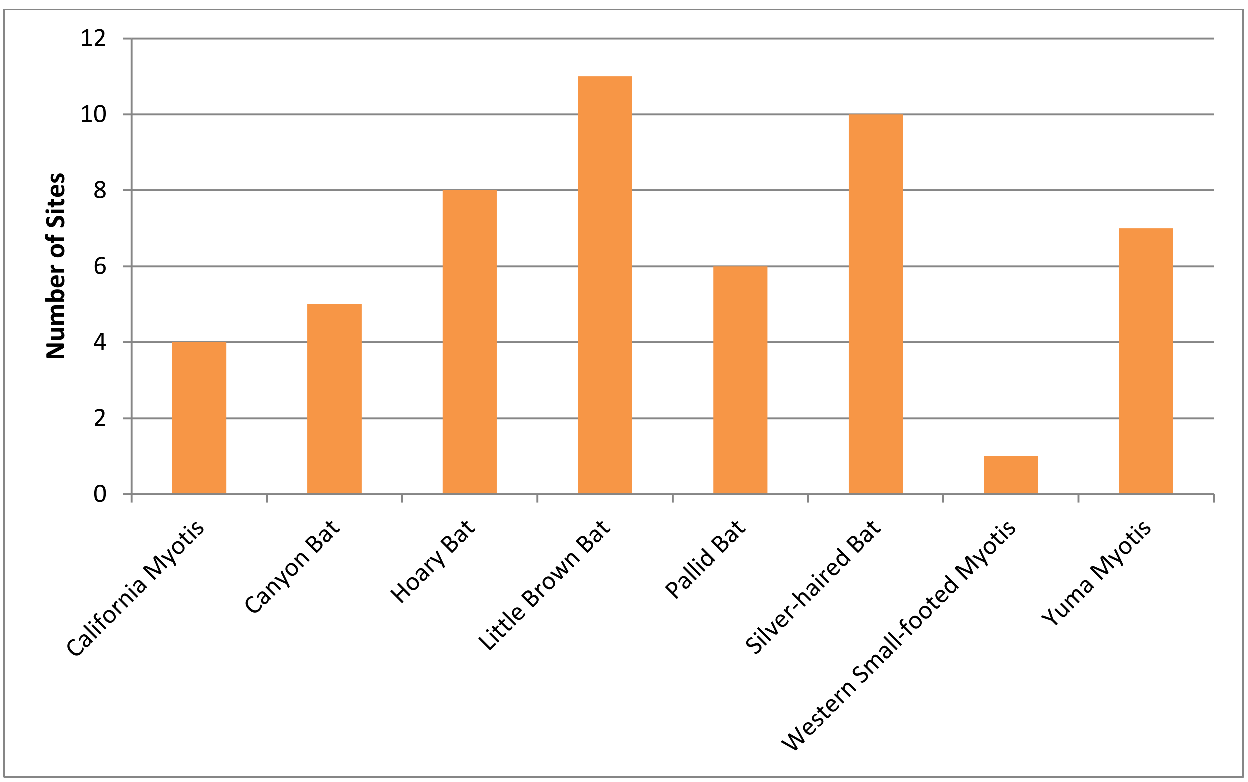

Figure 6. Number of Sites Where Each Species was Detected Acoustically (11 Total Sites)

Mist netting was performed at two locations during 2013; White Bluffs Bank and Gable Butte West. No bats were captured during either mist netting session. Although no bats were captured with mist nets at the White Bluffs Bank, pallid bats were documented with manual Pettersson D240x acoustic detectors due to the presence of social calls which are diagnostic for the species. This information was combined with infrared video analysis conducted during the mist netting session that showed bats entering the building roughly an hour after twilight (Figure 7). This information indicates that pallid bats are using the White Bluffs Bank as a night roost. The nearest known day roost for pallid bats is at the 100-F Area, 2.3 Kilometers [1.4 miles] west of the White Bluffs Bank. High winds combined with clear skies and a full moon limited the effectiveness of the mist deployment at Gable Butte West, and several bats were observed avoiding the nets which were moving in the wind.

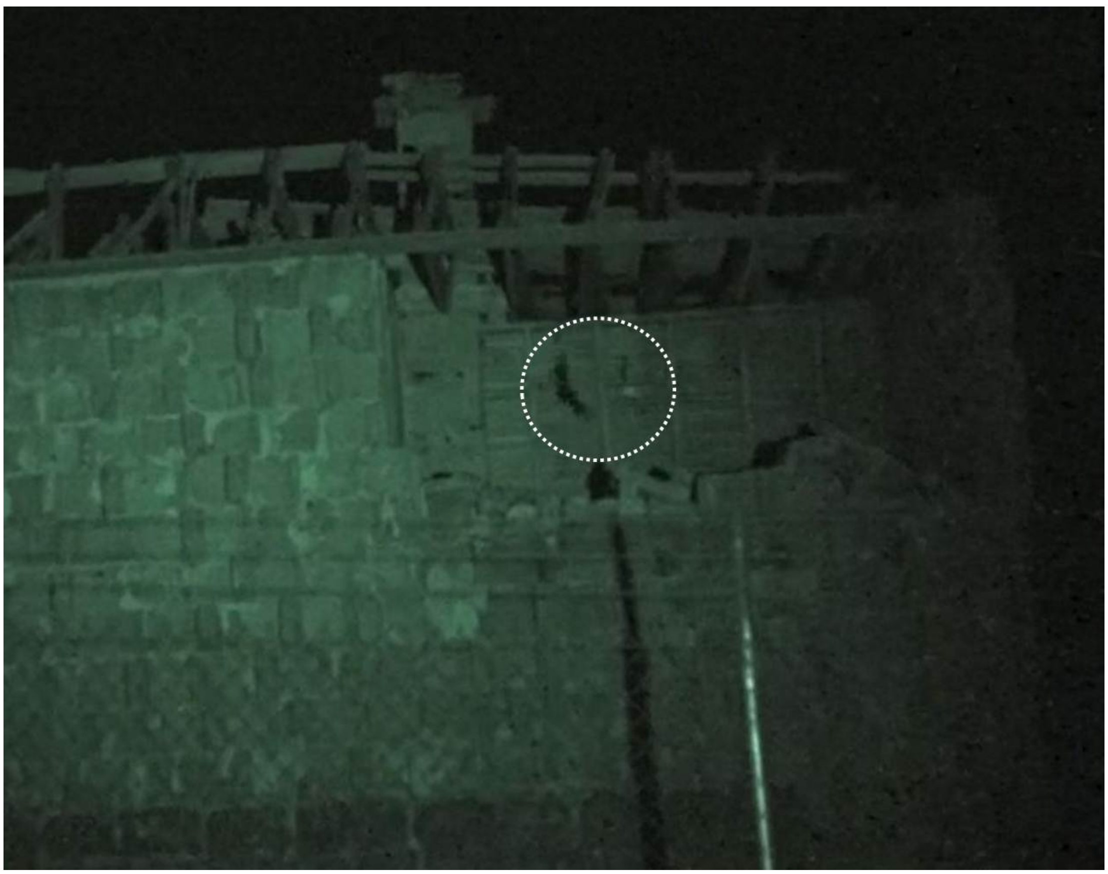

Figure 7. Pallid Bat Observed During 2013 Infrared Video Monitoring at White Bluffs Bank

4.0 Discussion

The combination of a full spectrum bat detector (Pettersson D500x) and bat call analysis software (SonoBat™ 3) allows for the most accurate acoustic species determination currently available to bat biologists, a science that has advanced significantly since the acoustic data was collected and analyzed by TNC on the Hanford Site during 1997 and 1998. The use of a full spectrum bat detector, along with the SonoBat™ 3 acoustic analysis software, allowed the 2013 project to distinguish between myotis species acoustically, which was not possible during TNC's Biodiversity Index, where zero-crossing bat detectors were used. However, the use of acoustic data for species determination still has limitations. Several of the bat species have call repertoires that overlap significantly, and the variation within a single individual's calls can be broader than the difference between separate species or even separate families (Szewczak n.d., Lausen 2011). Significant overlap in call repertoire exists between California Myotis and Yuma Myotis, little brown bats and western small-footed Myotis, and between pallid bats, big brown bats and silver-haired bats. Diagnostic call characteristics do exist within some recordings that allow for confident species determination (e.g. pallid bat social calls, flat silver-haired calls, etc.), but a combination of acoustic and capture data would be necessary for certain determination of all species. Most hoary bat and canyon bat calls have unique characteristics easily distinguished from the other species suspected on the Hanford Site. None of the species listed as "potentially present" by TNC were documented during 2013.

The number of bat passes cannot be used to determine population size because a single bat can trigger the detector multiple times. However, bat passes per night can be used to determine a relative level of bat activity. A summary of the findings at each 2013 monitoring location is given below.

White Bluffs Bank: As described in the Results section, pallid bats were found using the White Bluffs Bank as a night roost. Silver-haired bats, hoary bats, and Yuma myotis were also recorded at this location at relatively low levels.

Bruggeman's Warehouse: A low level of bat activity (15 passes per night) was documented at Bruggeman's Warehouse, consisting mostly of silver-haired bats, which do not typically form maternity colonies. Silver-haired bats are known to roost in specific locations habitually and it appears one or more could be using this structure.

Allard Pumphouse: The Allard Pumphouse had a similar level of bat activity, with 11 bat passes per night, but the majority were little brown bats. Due to the proximity of the Allard Pumphouse to the Columbia River, additional information gathering, especially utilizing infrared video, would be necessary to determine whether bats are using the building as a night roost or maternity colony or simply feeding on abundant aquatic emergent insects in the area.

Hanford Townsite School: The Hanford Townsite School had a moderate (59 passes per night) level of bat activity. Little brown bats and pallid bats appear to be abundant at this location. The building is likely functioning as a night roost for a moderate number of individuals, as opposed to a maternity roost, due to the lack of acoustic detections during emergence times. An inspection of the interior of the building, along with infrared video would help determine whether the building houses a maternity colony for either species.

Cornelius Pumphouse: The Cornelius Pumphouse appears to function as a night roost for pallid bats. Pallid bats were detected at this location, but not during emergence time, indicating that the building does not function as a day roost. The Cornelius Pumphouse is also very active for other bat species such as little brown bats and Yuma Myotis but additional information would be necessary to determine the type of roost that exists. Bat passes totaled 140 per suitable recording night at this location. Additional surveys using infrared video would help determine how each species is utilizing the structure.

Gable Butte West: The Gable Butte West location serves as a natural funnel between large cliff faces along the south side of Gable Butte. Bats recorded at this location are likely roosting in the cliffs and using the natural flyway to access the Columbia River to the North. An extremely high number of little brown bat recordings were made, including many calls during the emergence period near dusk, indicating a maternity colony potentially exists in the cliffs adjacent to the Gable Butte West location. The use of radio telemetry, infrared video, or other methods may be necessary to pinpoint maternity colony locations along the one kilometer [0.6 mile] long cliff face adjacent to the monitoring location.

Umtanum Cliffs 1: Umtanum Cliffs 1 is located two kilometers [1.2 miles] south of the Columbia River within a large complex of cliffs at the east end of Umtanum Ridge. This location had relatively few bat passes (21 per night) but had high species richness with seven species recorded.

Umtanum Cliffs 2: Umtanum Cliff 2 is located along the same Umtanum Ridge cliff complex but is also only 300 meters [984 feet] from the Midway Substation. Although not confirmed, a colony of bats was thought to be present in the Midway Substation. The Umtanum Cliffs 2 location had the highest level of bat activity recorded during 2013, with 399 bat passes recorded during the single suitable recording night. As described earlier, the microphone stand was knocked over by high winds, which negatively impacted recording quality and quantity and rendered the remainder of the data collected at Umtanum Cliffs 2 unusable. However, the large number of little brown bat recordings made during the single recording night, including many calls during the emergence period near dusk, indicates that a colony of little brown bats may be present in the Midway Substation. A walkthrough inspection of the building, along with infrared video recording and mist netting could confirm the colony.

Umtanum Cliffs 3: Umtanum Cliffs 3 had the lowest number of recordings per night, of the sites along Umtanum Ridge, at only seven bat passes per night. However, species diversity remained high with five documented.

100-H Beach: The 100-H Beach deployment had a relatively low level of bat activity (13 calls per night) and was used to establish a background level for shoreline detection locations.

100-D Tree Grove: The 100-D Tree Grove location was selected due to observed guano accumulations in abandoned Black-billed Magpie nests within the tree grove. A moderate level of bat activity was recorded, which was dominated by Yuma myotis. This is not surprising based on the known maternity colonies of Yuma myotis present just 500 meters [1,640 feet] south in the 100-D Area. In addition, hoary bats were recorded 55 times at the 100-D Tree Grove location, accounting for over half of all hoary bat recordings across all areas in 2013. Based on this information, it appears possible that hoary bats could be the species roosting in abandoned Black-billed magpie nests in the area. DNA analysis of the guano may be necessary to confirm this hypothesis.

Data from 2013 was combined with pre-2013 bat roosting data to populate Table 4.

Table 4. Bat Roosts Known on the Hanford Site Following the 2013 Survey

Description	Primary Roost Type	Primary Species Present
105-F Reactor Bat Boxes	Maternity	Pallid Bats
105-H Reactor Bat Boxes	Unknown	Unknown
183-D Facility	Maternity	Pallid Bats, Yuma myotis
183-F Clearwell	Maternity	Yuma myotis
190-D Pipe Tunnel Entrance	Maternity	Yuma myotis
190-DR Pipe Tunnel Entrance	Maternity	Yuma myotis
Cornelius Pump House	Suspected Night Roost**	Pallid Bats
Hanford Townsite School	Suspected Night Roost**	Pallid Bats, Little Brown Bats
White Bluffs Bank*	Night Roost**	Pallid Bats
Midway Substation*	Suspected Maternity**	Little Brown Bats
Gable Butte West Cliffs*	Suspected Maternity**	Little Brown Bats
*new roost for 2013, **new determination for 2013		

For the acoustic data collected in 2013 to be comparable to other datasets in terms of calls per night, detector settings would need to be similar. This is especially true for recording duration and delay between recordings, as these factors can greatly influence the level of activity indicated by the number of recordings. The data collected during 2013 used the same equipment, methods, and detector settings as were used during the summer of 2012 on the Hanford Site (Lindsey et. al 2012). Recordings with multiple species were only counted as single bat passes (Figure 8). The maximum number of calls per night (96) from the 2012 dataset was recorded at the Gable Butte 1 location, which is at the opposite end of the same cliff section as the Gable Butte West location surveyed during 2013. This is further indication of the high level of bat activity along that cliff, which likely houses one or more maternity colonies. A map of all monitoring locations for 2012 and 2013, with the number of bat passes per suitable weather night, is shown in Figure 9.

Figure 8. 2013 Simultaneously Recorded Yuma Myotis and Hoary Bat on SonoBat™ 3 from 2013

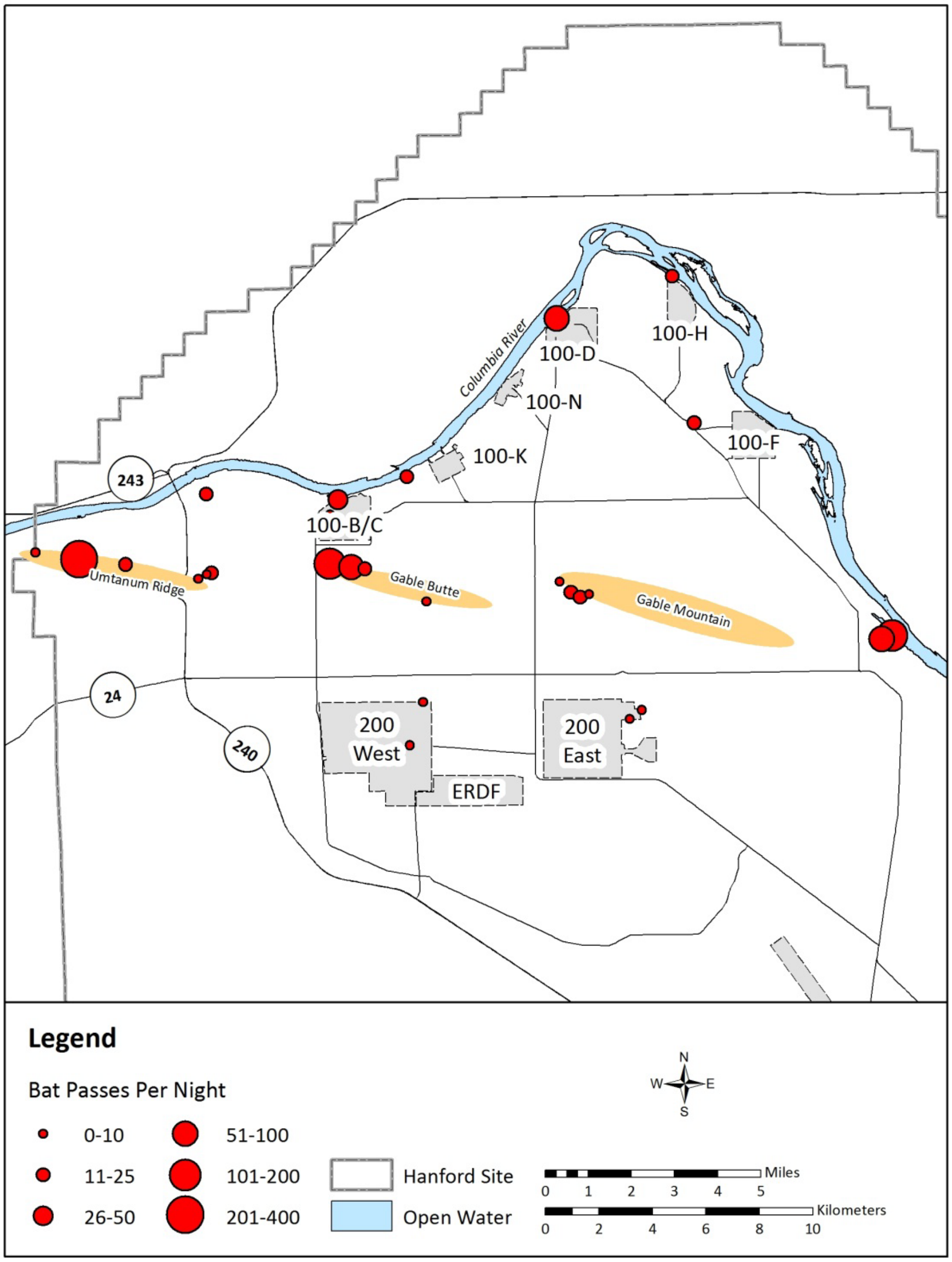

Figure 9. Bat Passes per Night at All Summer Acoustic Monitoring Locations for 2012 and 2013

Little brown bats were the most recorded bat during 2012 and 2013. Little brown bats appear to be the most abundant bat in cliff areas, which have been the primary focus over the two MSA survey years at the Hanford Site. Yuma myotis and pallid bats are the most detected bats in the 100-Areas of the Hanford Site near abandoned buildings, but are rarely detected elsewhere. These two species have benefited greatly due to the presence of anthropogenic habitats on the Hanford Site. Hoary bats and silver-haired bats were recorded frequently during 2012 and 2013, even in areas far from trees that are their typical roosting habitat. Canyon bats were expected to be abundant across talus and cliff habitat types on the Hanford Site. TNC documented canyon bats at all rocky locations using zero-crossing acoustic detectors. Canyon bats were detected at all cliff/talus locations monitored in 2013, although the number of passes was relatively low at these locations, averaging only six passes per night. California Myotis and western small-footed Myotis were recorded intermittently across the Hanford Site. Although calls were recorded that fit the call characteristics for these two species, their call repertoires overlap significantly with the Yuma Myotis and little brown bats. A combination of mist netting and acoustic analysis may be necessary to confirm the presence of these two species on the Hanford Site. Big brown bats were not documented in 2013; the big brown bat's call repertoire overlaps significantly with pallid bats and silver-haired bats. Big brown bats were detected acoustically during 2012, and during TNC's surveys. Due to the potential for misclassification of either silver-haired bats or pallid bats as big brown bats during either of the previous two studies, and the lack of any capture data for the species, the occurrence of big brown bats on the Hanford Site remains in question.

Weather can significantly affect the level of observed bat activity, for a variety of reasons (Burles et al. 2009). Thus, the use of accurate weather data increases the quality of call-per-night comparisons by removing variability caused by adverse weather. Weather data were obtained from the nearest HMS weather monitoring station, which record weather data every 15 minutes. Acoustic monitoring locations were at most nine kilometers [5.6 miles] from a weather monitoring station, and the closest location was only 750 meters [2,461 feet] from a station. Weather data were requested from HMS Staff after the detector was in the field for three consecutive nights and analyzed to determine whether three suitable nights were recorded, or if any nights exceeded the defined threshold requiring the detector to remain at the location. This high-resolution weather data increased the accuracy and comparability of our recording data.

Mist netting efforts remain challenging in the open landscapes of the Hanford Site. The lack of natural features that concentrate bats (e.g. streams, dense trees, etc.), along with drainage winds that characterize summer evenings, make successful mist netting challenging at many potential roosting areas on the Hanford Site.

A single Pettersson D500x system, as described in Section 2.0, Methods, has now been used successfully through two summers and one winter season on the Hanford Site totaling 232 recording nights. The system can be easily transported and quickly deployed by one person. The system has endured peak summer temperatures approaching 110 degrees Fahrenheit and winter temperatures of only 10 degrees Fahrenheit in addition to snow, wind, rain, and sun exposure. The design allowed the detector to be placed on uneven terrain, using the telescoping tripod legs, and deployment causes no ground disturbance in sensitive habitats. All associated equipment remains functional, demonstrating the effectiveness of the deployment strategy used.

Continuing bat work on the Hanford Site could include acoustic monitoring at additional locations, mist netting for species confirmation, and infrared video and mist netting for locating maternity colonies. Additional winter acoustic monitoring (November to February), and characterization of conditions at potential winter roosting location (e.g. temperature), could supply data needed to help explain the little-known winter roosting habits, requirements, and locations of bats on the Hanford Site.

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