Department of Defense

Legacy Resource Management

09-390

The Bat Grid Inventory and Monitoring Project: A Regional Approach to Inventorying and Monitoring Bat Populations 2009 Report

Pat Ormsbee, USFS

November 9, 2011

DoD Legacy Bat Grid 2009 Report

Pat Ormsbee

11/09/2011

Background

This report reflects results from the second year of data collection under The Legacy Program for The Bat Grid Inventory and Monitoring Project that spans the Pacific Northwest. Detailed background on the project is available in the 2008 Inventory Report. As a synopsis, species identification and distribution are fundamental for addressing conservation issues such as wind-energy mortalities, effects of global warming, and catastrophic die-offs at both hibernacula and maternity sites (e.g. White Nose Syndrome in the northeast U.S.).

Baseline data on the identification, presence, and distribution of the 16 bat species in the Pacific Northwest (PNW, **Table 1**) is essential for developing conservation strategies for this taxon yet historically such data has not been systematically collected. The Bat Grid Inventory and Monitoring Project was designed as a collaborative strategy to inventory and monitor bat species across Oregon and Washington with unprecedented geographic and scientific resolution. Participants in The Bat Gird include numerous federal, state, tribal, and private partners. The project provides a standardized protocol to collect baseline inventory and monitoring data for 16 species of bats in the Pacific Northwest using acoustic, genetic, and morphometric techniques.

In 2008, The Bat Grid Project was expanded to include seven Department of Defense (DoD) facilities in Washington, as well as DoD personnel and their partners from Washington, Oregon, and Utah. In 2009, four DoD facilities in Washington and five facilities in Oregon were included in The Bat Grid. Data integrity was maintained via standardized training, mentoring, oversight, equipment, collection methods, data standards and submission, as well as centralized data warehousing and management. The Bat Grid Project also provided a venue for testing and implementing field and analyses methods to improve bat inventory and monitoring efficiency and accuracy.

Table 1. *Sixteen bat species in the PNW and their state heritage ranking.*

Species	Heritage
Corynorhinus townsendii (Townsend's big-eared bat)	S2-WA, S2- OR
Antrozous pallidus (pallid bat)	T3T4, S2-OR, S3-WA
Euderma maculatum (spotted bat)	S2-OR, S3-WA
Myotis thysanodes (fringed myotis)	T2, S3-WA, S2-OR
Myotis volans (long-legged myotis)	S3-OR, S3/4-WA
Myotis lucifugus (little brown bat)	No status
Myotis evotis (western long-legged myotis)	S4-OR, S4-WA
Eptesicus fuscus (big brown bat)	No status
Myotis yumanensis (Yuma myotis)	No status
Myotis californicusi (California myotis)	S3-OR, S5-WA
Myotis keenii (Keen's myotis)	S1-WA
Myotis ciliolabrum (western small-footed myotis)	S3/4-OR, S4-WA
Tadarida brasilliensis (Mexican free-tailed bat)	S4-OR
Parastrellus hesperus(canyon bat)	S3-WA
Lasionycterus noctivagans (silver-haired bat)	S3/4-OR, S3/4-WA
Lasiurus cinereus (hoary bat)	S3-OR, S4-WA

The specific objectives of The Bat Grid Project are:

• develop better methods for collecting acoustic, morphologic, and genetic data so that species can be more effectively identified and their presence and distribution better understood.

• contribute to baseline inventory and long-term monitoring of bat species presence, and develop responsive conservation efforts for this taxon in the Pacific Northwest,

• incorporate DoD lands in the Pacific Northwest into The Bat Grid Project,

• collaborate with related efforts (e.g., the Utah Great Basin Bat Conservation Initiative and The Western Bat Working Group) to improve efficiency and effectiveness for species identification and field survey efforts, and

• develop a model for bat inventory and monitoring that can be applied regionally or nationally.

Methods

Sampling Design and Survey Protocol

The Bat Grid sampling design is a wall-to-wall sampling grid of equal-sized sample cells and sample units known as “The Bat Grid”. The wall-to-wall sampling grid is comprised of 50 x 50 km cells that are further subdivided into 25, 10 x 10 km sample units (**Figure 1**).

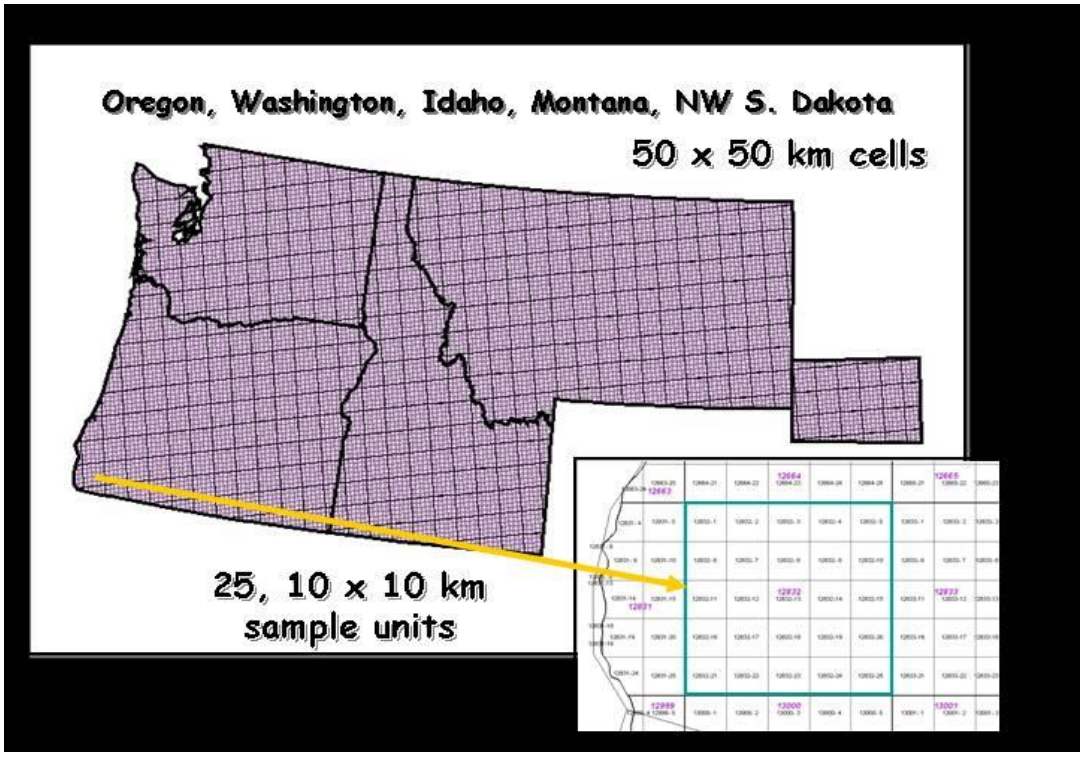

Figure 1. *Geographic display of The Bat Grid Sampling Frame of 50 x 50 km grid cells, each comprised of 25, 10 x 10 km sample units.*

The sampling grid was developed after reviewing other sampling grids already developed for inventory and monitoring strategies across most or all of the United States. The grids that were reviewed included: The Breeding Bird Atlas and Breeding Bird Survey Programs, The Forest Inventory Assessment Program, and the EPA Survey Grid. In all cases, these grids were of an inappropriate or inconsistent scale, unavailable for general use, or the grid dimensions made it difficult to locate grid cells on the ground (e.g. hexagonal cells). Although this specific project focused on Oregon and Washington, the sampling grid has been developed in a GIS by the USFS for all of North America and is available at ftp://ftp2.fs.fed.us/incoming/rsac/wildlife . Numerous biometricians and statisticians were consulted in the development of The Bat Grid sampling frame including, Jim Alegria, Carol Apple, Ted Weller, Pat Manley, Bill Zielinski, Dick Holhausen, Christina Vojta, Rudy King, and Daryl MacKenzie.

Monitoring sample units were randomly selected while inventory sample units were selected either randomly or subjectively in association with specific management projects or locations of interest. The 10 km x 10 km sample units (SUs) selected for monitoring were randomly selected from 50 km x 50 km grid cells. The function of the 50 km x 50 km cells is to insure a somewhat even distribution of sampling units across the region and different habitat types. Sample unit selection was limited to federal, state, other public lands, or private lands where long term (10 years) access to conduct surveys was assured. In some cases, additional sample units were randomly selected when a GIS review or field reconnaissance showed that habitat features that support target species (e.g. cliffs and spotted bats) were lacking in the sample units originally selected. In general, survey sites were selected within reasonable access of a road to avoid excessive foot travel at night when conducting surveys.

Sampling Specific DoD Facilities

Nine DoD Facilities were incorporated into the Bat Grid during 2009 (Washington: NAVMAG Indian Island, Yakima Training Center, Jim Creek Naval Station, and Bangor NSB; Oregon: Camp Rilea, Camp Adaire, Kingsley AFB, Portland ANGB, and Redmond BIAK). Personnel from each of these facilities assisted survey efforts by providing facility maps and identifying potential survey sites. Information about our survey crew and vehicles was provided to each facility for security clearance. Each DoD facility was inventoried for potential sites during daylight hours and a minimum of 1 mistnet and 2 acoustic surveys were conducted between dusk and 01:00 hrs. Three or more individuals from the US Forest Service, BLM, Port of Portland, City of Portland, Bats Northwest, and other partners conducted surveys in collaboration with DoD Facility personnel at the 9 facilities. In most cases, DoD or Port of Portland personnel were required to escort surveyors during surveys and portions of some facilities were off limits for surveying because of safety or security requirements. Specific details of each facility survey are provided in the "Results" section of this report.

Survey protocol

A standardized survey protocol was used that included:

- Simultaneously mist netting (Kunz and Kurta, 1988) and conducting acoustic surveys for 3.5 hrs a night to collect morphologic, acoustic, and genetic data.
- Additional remote acoustic stations (www.sonobat.com).
- Hand-net and visual surveys at roost sites when appropriate.
- Surveys were focused on species presence in each sample unit as opposed to abundance of individuals, using a list of known or suspected species in the sample unit as a target.
- Each survey was conducted at a unique site, except when suitable sites were limited, such as under xeric habitat conditions, in which case, surveys were repeated at sites.

- The target period for conducting surveys was June 1 – September 15.

Monitoring

The Bat Grid monitoring strategy was originally developed in 2006 and included consultation with Darryl MacKenzie (Proteus), Ted Weller (USFS), and Christina Vojta (USFS) to develop a pilot approach for monitoring bats across the PNW. IN 2008, Tom Rodhouse (NPS) began initial design and testing for trend analysis of the data. IN 2009, data from 74 sample units from across Oregon and Washington were used in the monitoring analysis.

Analysis was conducted for data collected from 2006, 2007, 2008, and 2009. A preliminary analysis was conducted on the four years of data using occupancy and Bayesian statistics to calculate probability of occurrence for each bat species using the statistical software packages "R" and "Winbugs". Four years of capture and acoustic data on species presence and absence was applied to estimates of occupancy using posterior distributions via Markov Chain Monte Carlo simulations. The analyses were preliminary because they lacked inclusion of ecological covariates such as the presence of habitat features that might influence occupancy estimates. The inclusion of covariates and subsequent publication of the results is forthcoming.

Training

Two training sessions were conducted and included material targeting returning surveyors in need of a refresher on survey techniques and updates to the techniques or protocol. The training sessions were conducted at 2 locations, Ephrata, WA and Burns, OR. Training consisted of 4 days of classroom and 4 nights of field instruction and was conducted by Pat Ormsbee (USFS/BLM) and Joe Szewczak (Humboldt State University), and Aimee Hart (USFS/BLM). Additionally, on the job training was provided at 6 of the 9 DoD facilities where surveys were conducted.

Although training was specific to The Bat Grid Project, basic techniques on capture and species ecology, life history, and identification were included. Additionally, experienced participants served as mentors and were paired with novices so that the latter group would continue to receive guidance and instruction after the training session ended. Equipment, software, and pre-exposure rabies vaccines were provided for select participants and data collection forms and standards were provided for all trainees. The training session and refresher were free and class size was limited.

Data collection

Trained personnel "adopted" selected survey units in their geographic area of interest in which to conduct surveys. Additionally, Aimee Hart and Michelle Slosser served as a "tiger team" that traveled around the region assisting participants to conduct surveys.

Bats were captured using standard mist-net techniques or when captured at night roosts, using handnet techniques (Kunz and Kurta, 1988). Morphometrics, gender and age data, and a 3 mm wing biopsy from

the wing membrane between the 4th and 5th digit were collected from captured bats (Zinck et al. 2004). Each captured bat was assigned a unique identifier that served as a common link to all data collected for that individual (morphometrics, biopsy label, and call file designation).

Biopsies were individually stored in vials with desiccant and labeled with their unique identifier. A target of 5 biopsies per species, per 50 km x 50 km cell was established and biopsies were only collected from adult bats.

Guano also was collected at roost sites. DNA is extracted from the guano and applied to a micro-array chip designed for all species of bats in the PNW. The micro-array chip has small DNA-sensitive probes on its surface and each probe is designed to react only to a specific species. When the micro-array is exposed to DNA from multiple species, such as that extracted from piles of guano at a roost site, probes on the surface of the array illuminate to indicate the detection of DNA associated with specific species. Currently, some of the species-specific probes for the *Myotis* genus are being refined as these species can be difficult to differentiate genetically, regardless of the method used.

Acoustic records were collected using Pettersson D240X and D500 detectors (http://www.batsound.com/). Calls collected from captured bats were recorded using a tether pole and/or by hand releasing light-tagged bats (Szewczak 2000, Parsons and Szewczak 2007). Calls were downloaded to a laptop and loaded onto Sonobat software (http://www.sonobat.com/). Call files were labeled to reflect the unique identifier assigned to each captured bat.

Remote, auto-record stations also were used to collect calls from free-flying bats. These stations were comprised of a digital recorder (iriver, http://www.iriver.com/) attached to a Pettersons D240x or D500. The units were secured to a pole that was inserted in the ground so that the detector/recording units were approximately 2-4 m above the ground (http://www.sonobat.com/DigitalAutoRecording.html).

Surveys were conducted by 2 or more trained field personnel and began at sunset for the duration of 3.5 hours. All bats were processed and released as quickly as possible and capture of juvenile bats was documented, but these individuals were not subjected to processing and were released immediately.

Data management

Data were electronically submitted to P. Ormsbee using an excel spreadsheet template and entered into a master MS Access database. Copies of the data are made available each year for inclusion in corporate data systems managed by the BLM and USFS and for State heritage programs. Digital copies of bat calls also were submitted to P. Ormsbee for compilation. Once compiled, calls were submitted to Dr. Joe Szewczak at Humboldt State University for analysis using an automated batch species identification program. Wing biopsies were sent to J. Zinck at Portland State University (PSU) for storage, DNA extraction, and analysis of select samples.

Results

Participation

A total of 36 participants (affectionately known as "Gridders") attended the 2 training sessions in Ephrata, WA, and in Burns, OR, including 2 DoD employees representing the Yakima Training Center. Additional attendees represented USFS (11), BLM (7), USFWS (2), Paiute-Burns and Salish/Kootenai Confederated Tribes (4), The Nature Conservancy (2), Bats Northwest (5), and Citizen Scientists (2).

On-the-job-training was provided for 9 DoD employees or contract biologists at Yakima Training Center, Bangor NSB, Camp Rilea, Camp Adair, Kingsley AFB, and Portland ANGB.

Approximately 177 individuals participated in The Bat Grid Inventory and Monitoring Project in 2009 and an estimated 6084 volunteer or in-kind hours were contributed to conducting Bat Grid surveys or for processing data.

Additionally, The Nature Conservancy of Washington donated free housing for training attendees, Portland State University donated genetic lab space and use for sample and data storage and DNA processing, and Humboldt State University donated acoustic lab use for storing and processing call data and field equipment, laptops, and software for training sessions.

Survey effort

Approximately 430 surveys were conducted in 2009. Of the 430 surveys, 63 (15%) were conducted on DoD lands. The 2009 survey effort represents approximately 1,770,883 acres [An average of 6 surveys are required to cover a 10 km x 10 km sample unit or 24,710 acres; thus (430 surveys/6 surveys) x 24,710 ac = 1,770,883 ac]. Approximately seventy-five 10 km x 10 km sample units were actually surveyed 1 or more times and 38 roost surveys were conducted at roost structures.

Monitoring effort

Of the 75 sample units surveyed, 40 were designated monitoring units. Twenty-four additional sample units had 2 or more surveys and although they were not formally designated as monitoring units, they were included in some of the analyses on species presence and detection probabilities.

Preliminary monitoring results

Occupancy statistics were calculated for 13 of 16 species (Figure 2). Three species, *Euderma maculatum* (spotted bat)*, Myotis keenii* (Keen's myotis), and *Tadarida brasiliensis* (Mexican free-tail bat) were excluded from the analysis because of the lack of survey data or data quality issues. For each species, the results are interpreted as probabilities of occurrence within a sample unit anywhere across the PNW. For instance, *Myotis* californicus (MYCA) has a 79% probability of occurring in any sample unit across Oregon or Washington, with a confidence interval of 63-85% (**Figure 2**). The majority of species reflect occupancy probabilities of greater than 60%, an indication that these species are fairly stable, well distributed, and have a reasonable probability of being detected (> 40%).

The occupancy estimates for *Antrozous pallidus* (pallid bat) and *Corynorhinus townsendii* (Townsend's big-eared bat) were lower than 60% (50% and 55% respectfully) and had large confidence intervals

indicating low precision and accuracy. This is most likely because of the small number of positive data points actually collected for these species, indicative of low detection rates. In the case of *C. townsendii*, this is likely the artifact of data collection methods (mist net and acoustics). This species is more effectively detected conducting roost surveys where it can be visually documented while roosting. In the case of *A. pallidus*, it is more likely to be a reflection of the actual rarity of detections and presence inherent in this species.

Two species, *Myotis thysanodes* (fringed myotis) and *Parastrellis hesperus* (canyon bat) resulted in occupancy probabilities with relatively tight confidence intervals, indicating adequate data, but with values much lower than that of other species with similar range of confidence. These data (approximately 35% +- 1 and 33% +- 1 respectfully) reflect a reasonable level of detection and a relatively low level of occurrence when compared to other species in the region.

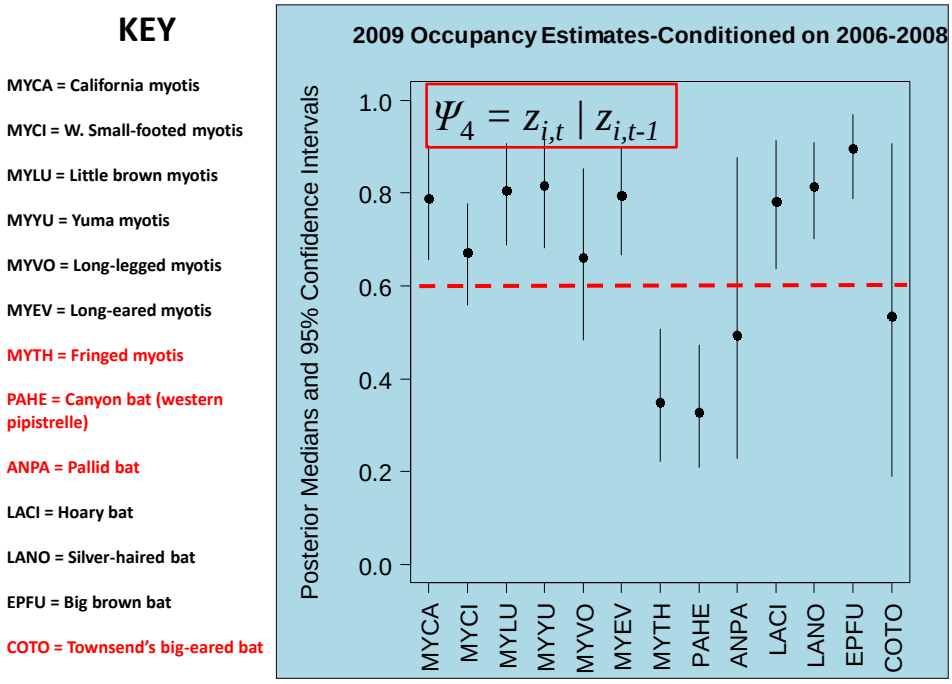

Figure 2. *Average probability of occupancy (psi) within a 100 km^2 sample unit with confidence intervals for 13 species of bats across the Pacific Northwest. Calculations for psi were completed using occupancy and Bayesian methods. Species in red lettering are those with lower than average occupancy probabilities.*

The contribution of acoustic data to the analysis was significant when compared to capture data alone (**Figure 3**). The inclusion of acoustic data in the analysis improved accuracy and precision of the results and increased the probability of occupancy because of improved probability of detection afforded by incorporating both capture and acoustic detection methods.

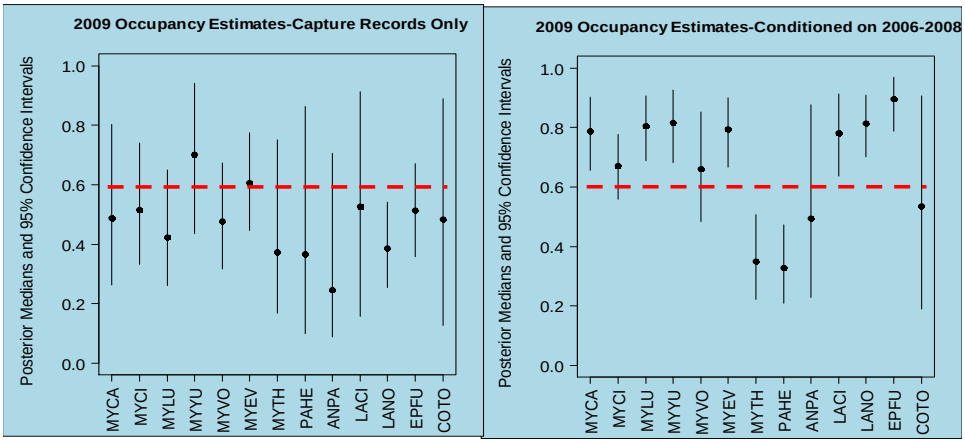

Figure 3. *Occupancy probabilities for capture-only data compared to those for capture and acoustic data for the same sample units and time period. In general, precision and accuracy are improved (tighter confidence intervals) and higher probabilities of detection indicate improved detection by including acoustic data.*

Genetics and tool development

Approximately 120 wing biopsies and 10 guano samples were collected for potential DNA analysis in 2009. Genetic data analysis was focused on *Myotis lucifugus* to contribute to a better understanding of the genetic footprint for this species in light of the dramatic declines associated with it in the Northeast from White Nose Syndrome. Mitochondrial and microsatellite DNA analysis was conducted to contribute to the broader genetic understanding of this species across North America.

Acoustics and tool development

In 2009, we continued to conduct beta tests of the Sonobat automated call analysis system being developed by Joe Szewczak at Humboldt State University. The beta testing of Sonobat resulted in development of Sonobat 3.0 in 2010. Because of the development of Sonobat 3.0, species outputs from the automated call system for data collected for 2006-2009 were vetted by Joe Szewczak and results were included in the monitoring analysis.

Data records

In 2009, data associated with 1,320 captured bats for 14 confirmed species were entered in to the Bats Access database. Twelve hundred and nineteen automated acoustic calls were identified to species using Sonobat 3.0 automated species identification software and entered in the database.

Specific DoD Results

This section presents the 2009 Bat Grid survey results for each DoD facility. A description of each facility and an overview of habitat are provided. Survey maps are included for the 2008 and 2009 survey sites as well as historical survey sites that were provided to us or already existed in our data base. Bat Grid survey sites are distinguished between "capture/acoustic" sites (those sites where surveys were conducted using a combination of mist netting and acoustic methods) and "acoustic" sites (those sites where surveys entailed remote acoustic stations). Very few roost sites were surveyed at DoD facilities, in part because gaining access to survey structures that were potentially used for roosting was often problematic because of security issues or the sheer volume of potential roost sites in large buildings such as hangars. Potential roost sites that were surveyed are discussed in the text.

A summary table for each facility includes what species were detected or not, at which sites species were captured, detected using acoustic methods, and whether or not a species would even be expected in the general geographic area. Sonobat 3.0 (Oregon and Washington) was used to automatically assign species designation to acoustic data. A brief discussion of the implications of results is provided for each facility. Implications also include any recommendations appropriate for the findings.

Yakima Training Center

Yakima Training Center (YTC) is located approximately 9 miles north of Yakima. It is bounded by I-90 in the north, the Columbia River to the east, the Yakima River and I-82 corridors to the west, and farmland and shrub steppe to the south. It covers approximately 327,000 acres representing elevations between 1000 and 4000 feet with an average elevation of 2500 feet. The YTC includes a relatively small and concentrated urban development associated with the main entrance along the southwest boundary. The majority of the installation is characterized by high desert, undeveloped shrub-steppe habitat, much of which includes non-native plant species. The landscape is accentuated with volcanic formations, dry gulches, large rock outcroppings, and old silica mines. Outside of the Columbia River, surface water is limited to a few canals, small creeks, natural springs, and heliponds, many of which are ephemeral. Water sites are often characterized by dense riparian vegetation of reeds, cattails, and duckweed that cover the water surface.

Bat Grid Surveys were conducted on August 24th and 25th. A total of 8 acoustic and mist net surveys were conducted (2 mist net and 6 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across both developed and undeveloped portions of the installation (**Figure 4**).

Ten bat species were captured and/or confirmed acoustically and 1 additional species was suspected acoustically. Three additional species of bats could be expected in central Washington associated with habitats found on YTC but were not detected (**Table 2**).

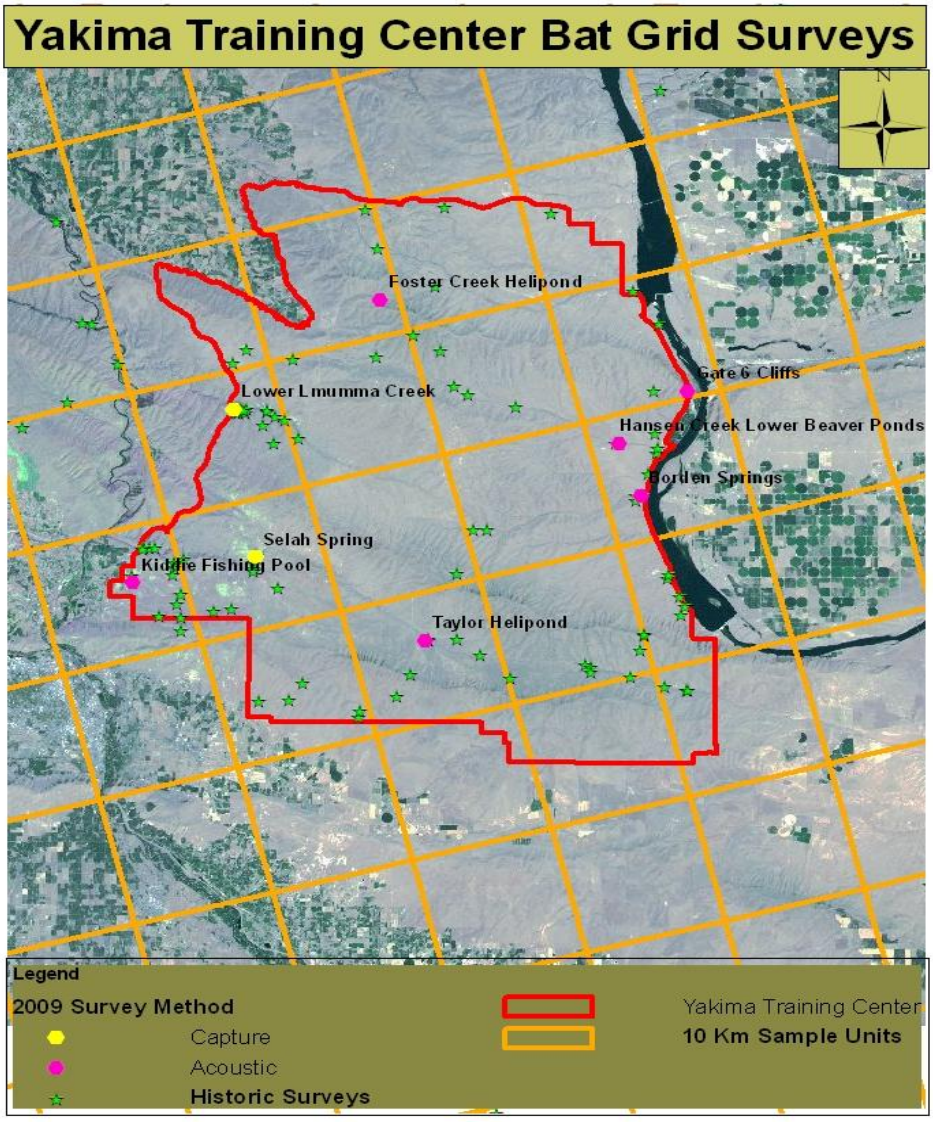

Figure 4. *Geographic display of Yakima Training Center Bat Grid survey sites for surveys conducted August 24-26, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic locations of bat surveys include 2008 Bat Grid surveys as well as surveys conducted prior to The Bat Grid.*

Table 2. *Bat species detected during the 2009 Bat Grid Project at YTC. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in eastern Washington and associated with habitats present at YTC are identified under "Generally Expected".*

2009 Yakima Training Center Species Detections				
Species	**Captured**	**Acoustic Confirmed**	**Not detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(Pallid bat)**		Borden Springs, Gate 6 Cliffs		X
Euderma maculatum **(Spotted bat)**			X	X
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**		Gate 6 Cliffs		X
Myotis lucifugus **(little brown bat)**		Borden Springs, Gate 6 Cliffs, Kiddie Fishing Pool, Taylor Helipond		X
Myotis evotis **(western long-legged myotis)**			X	X
Eptesicus fuscus **(big brown bat)**		Borden Springs, Kiddie Fishing Pool		X
Myotis yumanensis **(Yuma myotis)**		Borden Springs, Gate 6 Cliffs		X
Myotis californicus **(California myotis)**	Lower Lmumma Creek (*M. californicus/ciliolabrum, species not confirmed*)	Gate 6 Cliffs, Kiddie Fishing Pool		X
Myotis keenii **(Keen's myotis)**			X	
Myotis ciliolabrum **(western small-footed myotis)**	Lower Lmumma Creek (*M. californicus/ciliolabrum, species not confirmed*)	Borden Springs, Gate 6 Cliffs, Hansen Cr Lower Beaver Ponds , Lower Lmumma Creek , Selah Spring, Taylor Helipond		X
Tadarida brasiliensis **(Mexican free-tailed bat)**			X	
Parastrellus hesperus **(canyon bat)**		Borden Springs, Gate 6 Cliffs, Hansen Cr Lower Beaver Ponds		X
Lasionycteris noctivagans **(silver-haired bat)**		Gate 6 Cliffs		X
Lasiurus cinereus **(hoary bat)**		Borden Springs, Gate 6 Cliffs, Hansen Cr Lower Beaver Ponds, Kiddie Fishing Pool, Taylor Helipond		X

Implications – Since 10 of 14 potential bat species were detected at YTC, additional inventory surveys would be most effective in focusing on areas most likely to support undetected species. Surveys for *Corynorhinus townsendii* (Townsend's big-eared bat) would be best focused on potential roost sites. Surveys for *Myotis thysanodes* (fringed myotis) would be best focused on small water features with stands of trees, although both of these species can be rare in habitat types represented on the YTC. Surveys for *Euderma maculatum* (Spotted bat) would be best focused along the breaks of the Columbia River or at other locations where cliff systems and water are present.

Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms. All of the bat species detected on YTC rely on rock features, trees, or snags for roosting and reliable, clean, open water sources for drinking. Water sources that are choked with vegetation are not available to bats for drinking and native riparian vegetation is more likely to support healthy, native insect populations as prey species for bats. Providing perennial clean water sources surrounded by native vegetation, such as wetlands, or open guzzlers to augment ephemeral water sources can provide quality drinking and foraging habitat to support summer and migratory bats.

Bangor Naval Submarine Base

Bangor NSB is located approximately 20 miles southwest of Seattle, WA and straddles the Puget Sound, with the majority of the base on the eastern shore of The Olympic Peninsula. It covers approximately 7000 acres at a general elevation of 300 feet with little elevation gradient. The Base includes significant urban development with park and recreation areas. Undeveloped portions of Bangor represent managed coastal coniferous forests interspersed with man-made and natural water features such as ponds, reservoirs, canals, and streams.

Bat Grid Surveys were conducted August 4th and 5th. A total of 7 acoustic and mist net surveys were conducted (1 mist net and 6 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across both developed and undeveloped portions of the base (See **Figure 5**).

Nine bat species were captured and/or confirmed acoustically. Two additional species of bats could be expected on the Olympic Peninsula associated with habitats found on Bangor NSB but were not detected (**Table 3**).

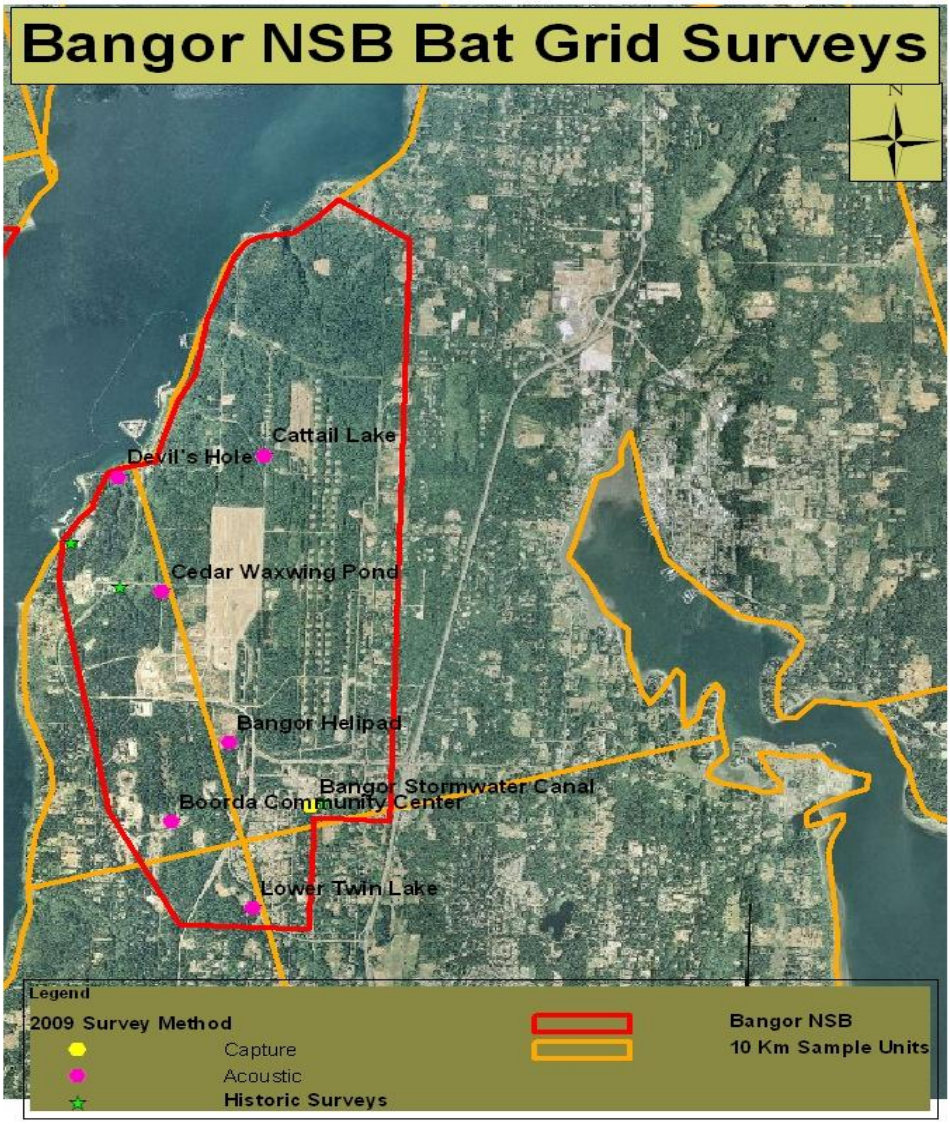

Figure 5. *Geographic display of Bangor NSB Bat Grid survey sites, for surveys conducted August 4th-5th, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic surveys include Bat Grid sites surveyed in 2008 and surveys prior to The Bat Grid.*

Table 3. *Bat species detected during the 2009 Bat Grid Project at Bangor NSB. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected on the Olympic Peninsula, Washington and associated with habitats present at Bangor are identified under "Generally Expected".*

2009 Bangor NSB Species Detections				
Species	**Captured**	**Acoustic Detection**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(pallid bat)**			X	
Euderma maculatum **(spotted bat)**			X	
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**		Cattail Lake, Boorda Community Center, Lower Twin Lake		X
Myotis lucifugus **(little brown bat)**	Bangor Stormwater Canal (*M. lucifugus/yumanensis, species not confirmed*)	Bangor Stormwater Canal, Boorda Community Center, Cattail Lake, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake		X
Myotis evotis **(western long-legged myotis)**		Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake		X
Eptesicus fuscus **(big brown bat)**		Cedar Waxwing Pond, Devil's Hole, Bangor Stormwater Canal, Lower Twin Lake		X
Myotis yumanensis **(Yuma myotis)**	Bangor Stormwater Canal (*M. lucifugus/yumanensis, species not confirmed*)	Cattail Lake, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake		X
Myotis californicus **(California myotis)**		Bangor Stormwater Canal, Boorda Community Center, Cattail Lake, Cedar Waxwing Pond, Lower Twin Lake		X
Myotis keenii **(Keen's myotis)**			X	X
Myotis ciliolabrum **(western small-footed myotis)**			X	
Tadarida brasiliensis **(Mexican free-tailed bat)**			X	
Parastrellus hesperus **(canyon bat)**			X	
Lasionycteris noctivagans **(silver-haired bat)**		Bangor helipad, Cattail Lake, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake, Boorda Community Center		X
Lasiurus cinereus **(hoary bat)**		Lower Twin Lake, Bangor Helipad, Cattail Lake, Cedar Waxwing Pond		X

Implications – Since 8 of 11 potential bat species were detected at Bangor NSB, additional inventory surveys would be most effective in focusing on areas most likely to support undetected species. Surveys for *Corynorhinus townsendii* (Townsend's big-eared bat) would be best focused on potential roost sites. Surveys for *Myotis keenii* (Keen's myotis) would be best focused on small water features in forest habitat. *Myotis keenii* has not been well described as a species and evidence to differentiate this species from other long-eared *Myotis* (*M. thysanodes, M. evotis*) acoustically, morphometrically, and genetically is weak. Additional data collected on captured long-eared *Myotis* within the range of *M. keenii* will contribute to better understanding species designations within the long-eared *Myotis* group. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits.

Most of the bat species detected on Bangor NSB are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat on or adjacent to Bangor NSB could enhance habitat resources for these species. For all bat species, maintaining perennial clean water sources surrounded by native vegetation, such as wetlands, can provide quality drinking and foraging habitat to support summer and migratory bats.

Naval Magazine Indian Island

NAVMAG Indian Island is located approximately 12 miles south of Port Townsend, WA. It covers 2700 acres with an elevation gradient between 0 and 300 feet. The installation encompasses Indian Island which sits in Puget Sound and is characterized by limited urban development with beaches, parks, and recreation areas. Undeveloped portions of Indian Island represent managed coastal coniferous forests. Fresh water features are limited and include sewage ponds and a large natural pond with adjacent wetlands containing dense aquatic vegetation of reeds, cattails, duckweed, and lilies.

Bat Grid Surveys were conducted August 5th and 6th. A total of 6 acoustic and mist net surveys were conducted (2 mist net and 4 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across both developed and undeveloped portions of the installation (See **Figure 6**).

Eight bat species were captured and/or confirmed acoustically and 1 additional species was suspected acoustically. Two additional species of bats could be expected on the Olympic Peninsula associated with habitats found on Indian Island but were not detected (**Table 4**).

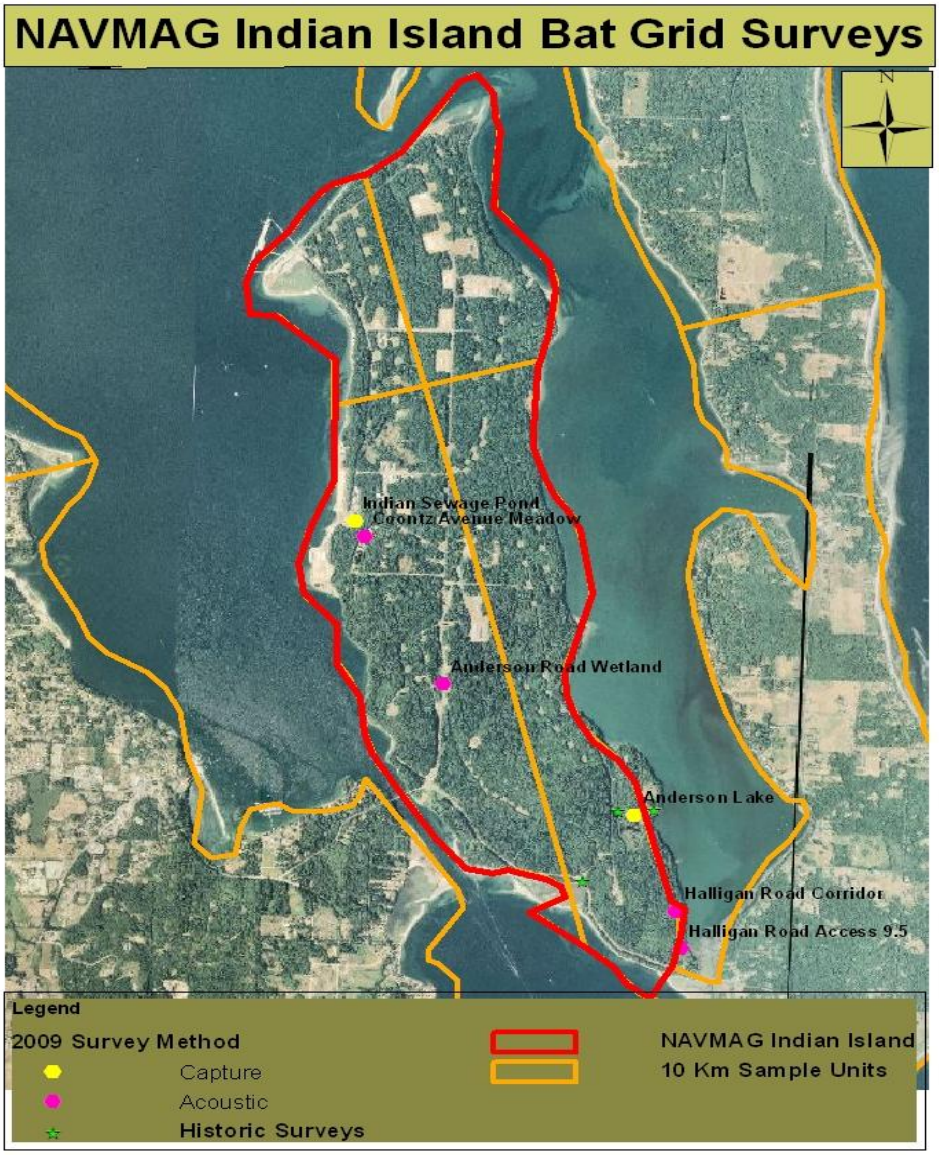

Figure 6. Geographic display of NAVMAG Indian Island Bat Grid survey sites, for surveys conducted August 5th-6th, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic sites include Bat Grid surveys conducted in 2008.

Table 4. *Bat species detected during the 2009 Bat Grid Project at NAVMAG Indian Is NSB. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected on the Olympic Peninsula, Washington and associated with habitats present at Indian Is are identified under "Generally Expected".*

2009 NAVMAG Indian Island species detections				
Species	**Captured**	**Acoustic Confirmed**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**		Halligan Rd Access 9.5		X
Antrozous pallidus **(pallid bat)**			X	
Euderma maculatum **(spotted bat)**			X	
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**			X	X
Myotis lucifugus **(little brown bat)**	Indian Sewage Pond (*M. lucifugus/yumanensis, species not confirmed*)	Halligan Rd Access 9.5, Halligan Rd Corridor, Anderson Lake, Indian Sewage Pond, Anderson Rd Wetland		X
Myotis evotis **(western long-legged myotis)**		Halligan Rd Corridor, Halligan Rd Access 9.5, Anderson Rd Wetland, Coontz Ave Meadow		X
Eptesicus fuscus **(big brown bat)**		Indian Sewage Pond		X
Myotis yumanensis **(Yuma myotis)**	Indian Sewage Pond (*M. lucifugus/yumanensis, species not confirmed*)	Halligan Rd Access 9.5, Anderson Rd Wetland, Indian Sewage Pond		X
Myotis californicus **(California myotis)**		Halligan Rd Access 9.5, Halligan Rd Corridor, Anderson Lake, Indian Sewage Pond		X
Myotis keenii **(Keen's myotis)**			X	X
Myotis ciliolabrum **(western small-footed myotis)**			X	
Tadarida brasiliensis **(Mexican free-tailed bat)**			X	
Parastrellus hesperus **(canyon bat)**			X	
Lasionycteris noctivagans **(silver-haired bat)**		Anderson Lake, Anderson Rd Wetland Halligan Rd Access 9.5, Halligan Rd Corridor		X
Lasiurus cinereus **(hoary bat)**		Halligan Rd Corridor, Coontz Ave Meadow, Anderson Rd Wetland		X

Implications – Since 8 of 11 potential bat species were detected at NAVMAG Indian Island, additional inventory surveys would be most effective in focusing on areas most likely to support undetected species. Surveys for *Corynorhinus townsendii* (Townsend's big-eared bat) would be best focused on potential roost sites. Surveys for *Myotis keenii* (Keen's myotis) and for *Myotis volans* (long-legged myotis) would be best focused on small water features or ponds in forest habitat. *Myotis keenii* has not

been well described as a species and evidence to differentiate this species from other long-eared *Myotis* (*M. thysanodes, M. evotis*) acoustically, morphometrically, and genetically is weak. Additional data collected on captured long-eared *Myotis* within the range of *M. keenii* will contribute to better understanding species designations within the long-eared *Myotis* group. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits.

Most of the bat species detected on NAVMAG Indian Island are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat on Indian Island could enhance habitat resources for these species. For all bat species, maintaining perennial clean water sources surrounded by native vegetation, such as wetlands, can provide quality drinking and foraging habitat to support summer and migratory bats.

Jim Creek Naval Radio Station

Jim Creek NRS is located approximately 25 miles north of Everett, WA on the west slope of the Cascade Range. It covers approximately 5000 acres with an elevation gradient between 700 and 3100 feet. The station is characterized by undeveloped old growth coniferous forest with the exception of a large cleared area associated with the communication tower antennae. There are numerous perennial water features including natural watersheds, and ponds, and a lake with minimal urban development.

Bat Grid Surveys were conducted July 17th and 18th. A total of 9 acoustic and mist net surveys were conducted (2 mist net and 7 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across the undeveloped portions of the base (See **Figure 7**). A single roost survey was conducted at Blue Mountain Shed.

Nine bat species were captured and/or detected acoustically. Two additional species of bat could be expected in this part of coastal Washington and associated with habitats found on Jim Creek NRS but were not detected (**Table 5**).

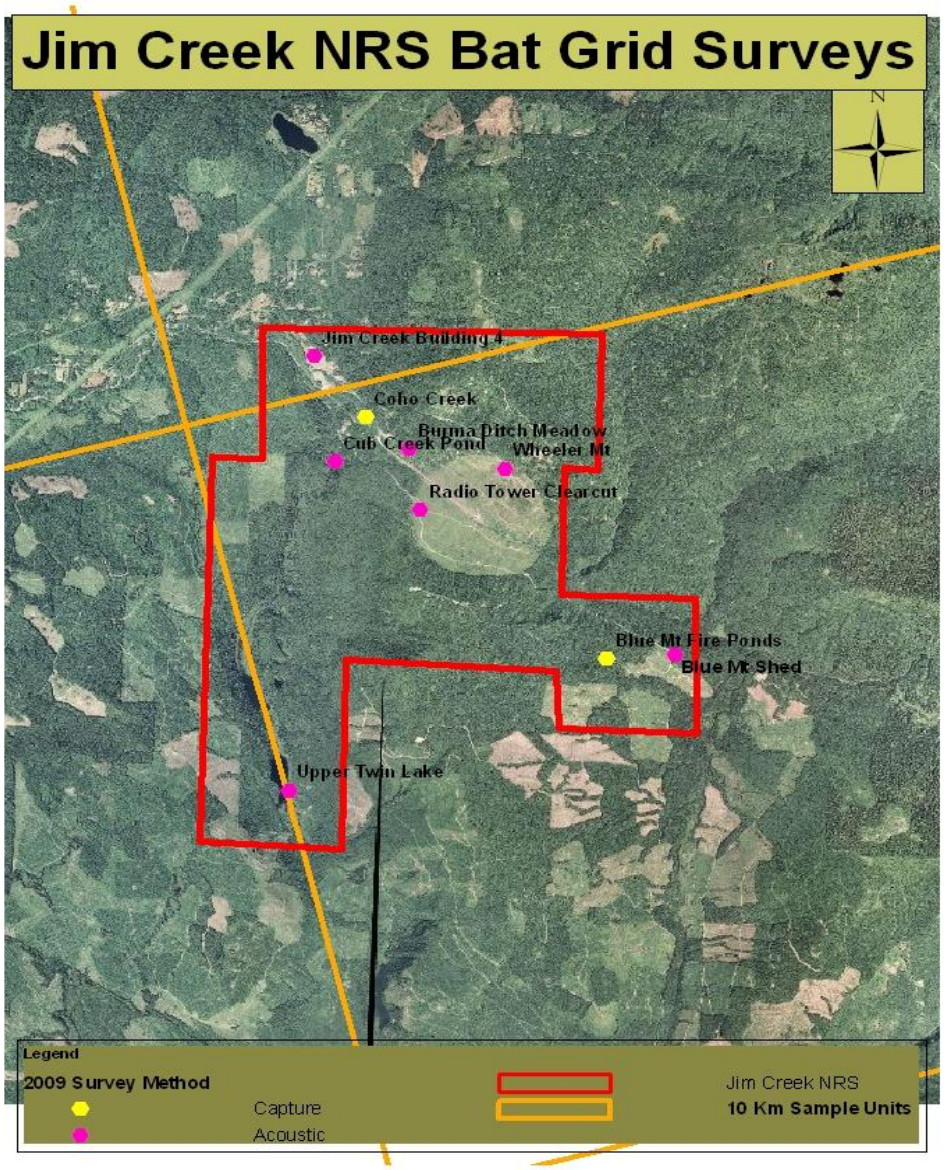

Figure 7. Geographic display of Jim Cr NRS Bat Grid survey sites, for surveys conducted July 17 & 18, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. There are no known historic survey sites on Jim Cr NRS.

Table 5. *Bat species detected during the 2009 Bat Grid Project at Jim Creek NRS. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected for western Washington and associated with habitats present at Jim Cr. NRS are identified under "Generally Expected".*

2009 Jim Creek NRS Species Detections				
Species	**Captured**	**Acoustic Detections**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			**X**	**X**
Antrozous pallidus **(pallid bat)**			**X**	
Euderma maculatum **(spotted bat)**			**X**	
Myotis thysanodes **(fringed myotis)**	Blue Mt Fire Ponds (Myotis species long-eared)			**X**
Myotis volans **(long-legged myotis)**	Coho Cr	Blue Mt Fire Ponds		**X**
Myotis lucifugus **(little brown bat)**	Coho Cr (*M. lucifugus/yumanensis, species not confirmed)*	Blue Mt Fire Ponds, Blue Mt Shed, Coho Cr, Upper Twin Lake, Cub Cr Pond, Building 4		**X**
Myotis evotis **(western long-legged myotis)**		Blue Mt Fire Ponds, Blue Mt Shed, Coho Cr, Cub Cr Pond, Building 4		**X**
Eptesicus fuscus **(big brown bat)**	Coho Cr	Blue Mt Shed, Upper Twin Lake		**X**
Myotis yumanensis **(Yuma myotis)**	Coho Cr (*M. lucifugus/yumanensis, species not confirmed)*	Upper Twin Lake, Cub Cr Pond		**X**
Myotis californicus **(California myotis)**		Upper Twin Lake		**X**
Myotis keenii **(Keen's myotis)**			**X**	**X**
Myotis ciliolabrum **(western small-footed myotis)**			**X**	
Tadarida brasiliensis **(Mexican free-tailed bat)**			**X**	
Parastrellus hesperus **(canyon bat)**			**X**	
Lasionycteris noctivagans **(silver-haired bat)**		Blue Mt Fire Ponds, Coho Cr, Cub Creek Pond, Building 4, Radio Tower Clearcut, Upper Twin Lake		**X**
Lasiurus cinereus **(hoary bat)**		Blue Mt Shed, Cub Cr Pond, Building 4, Upper Twin Lake, Wheeler Mt		**X**

Implications – Since 9 of 11 potential bat species were confirmed at Jim Creek NRS, additional surveys are likely to improve species detections. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits.

Most of the bat species detected at Jim Creek NRS are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat at Jim Creek NRS could enhance habitat resources for these species. For all bat species, maintaining perennial clean water sources surrounded by native vegetation, such as wetlands, can provide quality drinking and foraging habitat to support summer and migratory bats. The presence of intact native forest habitat at Jim Creek NRS provides high quality roosting and foraging habitat for forest-dwelling bat species.

Kingsley Field AFB

Kingsley Field is located on the southwest edge of Klamath Falls, OR. It is a semi-urban environment with agriculture lands, shrub-steppe, and marshlands to the south and west. It covers approximately a square mile representing flat terrain at 4000 feet elevation. The majority of the installation is characterized as developed urban dominated by non-native plant species. Surface water is limited to a canal. Numerous buildings are present that could serve as roosting sites for bats. Although internal roost surveys were not conducted, external surveys resulted in detection of 1 day roost of *M. ciliolabrum/californicus*.

Bat Grid Surveys were conducted August 27th and 28th. A total of 6 acoustic and mist net surveys were conducted (2 mist net and 4 remote acoustic surveys). Survey sites included 4 canals and 2 open areas across both developed and undeveloped portions of the installation (**Figure 8**).

Nine bat species were captured and/or detected acoustically. Six additional species of bat could be expected in this part of eastern Oregon although the urban characteristic of Kingsley could limit bat use of the area (**Table 6**).

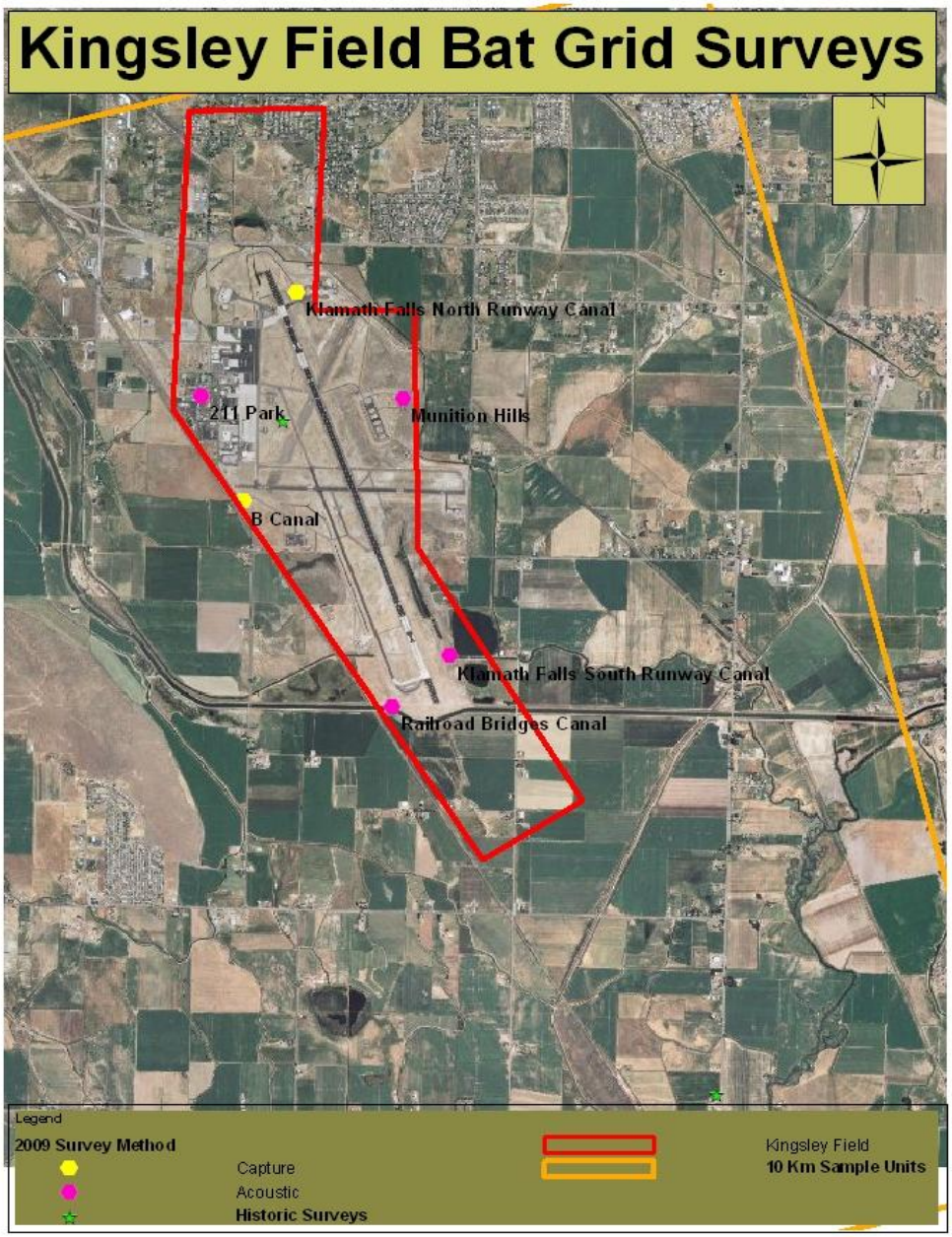

Figure 8. *Geographic display of Kingsley AFB Bat Grid survey sites, for surveys conducted August 27 & 28, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic survey efforts prior to The Bat Grid surveys are included.*

Table 6. *Bat species detected during the 2009 Bat Grid Project at Klamath Falls. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in eastern Oregon and associated with habitats present at or in the vicinity of Kingsley AFB are identified under "Generally Expected".*

2009 Kingsley Field AFB Species Detection				
Species	**Captured**	**Acoustic Detection**	**Not detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(Pallid bat)**			X	X
Euderma maculatum **(Spotted bat)**			X	X
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**			X	X
Myotis lucifugus **(little brown bat)**	B Canal (*M. lucifugus/yumanensis* species not confirmed)	B Canal, K Falls South and North Runway Canals, Munitions Hill, Railroad Bridges Canal		X
Myotis evotis **(western long-legged myotis)**		K Falls North Runway Canal		X
Eptesicus fuscus **(big brown bat)**		211 Park, B Canal, K Falls South Runway Canal, Railroad Bridges Canal		X
Myotis yumanensis **(Yuma myotis)**	B Canal (*M. lucifugus/yumanensis* not determined to species)	K Falls South Runway Canal		X
Myotis californicus **(California myotis)**	211 Park (*M. californicus/ciliolabrum, species not confirmed*)			X
Myotis keenii **(Keen's myotis)**			X	
Myotis ciliolabrum **(western small-footed myotis)**	211 Park (*M. californicus/ciliolabrum, species not confirmed*)			X
Tadarida brasiliensis **(Mexican free-tailed bat)**		211 Park, B Canal, K Falls South and North Runway Canal, Munitions Hill, Railroad Bridges Canal		X
Parastrellus hesperus **(canyon bat)**			X	X
Lasionycteris noctivagans **(silver-haired bat)**		B Canal, K Falls North and South Runway Canal, Munitions Hill, Railroad Bridges Canal		X
Lasiurus cinereus **(hoary bat)**		K Falls South Runway Canal, Munitions Hill, Railroad Bridges Canal		X

Implications – Since 9 of 15 potential bat species were confirmed at Kingsley AFB, additional surveys may or may not improve species detections given the urban nature and limited water of Kingsley. Three migratory bat species, *Tadarida brasiliensis* (Mexican free-tail bat), *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. These species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits in this area.

The remaining bat species detected at Kingsley Field are known to roost and forage in a number of habitat conditions, including urban settings. Many of the bat species detected at Kingsley will readily use buildings and other artificial structures for roosting. Installation of Oregon wedge style bat boxes could provide roost structures for several bat species. Maintaining perennial clean water sources and restoring areas of native vegetation can provide quality drinking and foraging habitat to support summer and migratory bats.

CAMP RILEA

Camp Rilea is located on the Oregon coast 7 miles south of Astoria, OR. It covers approximately 1750 acres with an elevation of 0 – 64 ft. It is characterized by coastal sand dunes, dune grass, coastal herbaceous and shrub species, and introduced pine trees. Fresh water sites include Neacoxie Creek and Pond and a 20 acre fresh-water lake (Slusher Lake). Camp Rilea includes a developed compound of buildings confined to an area adjacent to the camp entrance. Most of Camp Rilea is accessible by unpaved roads.

Bat Grid Surveys were conducted August 18th and 19th. A total of 1 mist net and 3 remote acoustic surveys were conducted. Survey sites included water sources and road corridors dispersed across the undeveloped portions of the camp (See **Figure 9**).

Seven bat species were captured and/or detected acoustically. Three additional species of bat could be expected in this part of coastal Oregon and associated with habitats found at Camp Rilea but were not detected (**Table 7**).

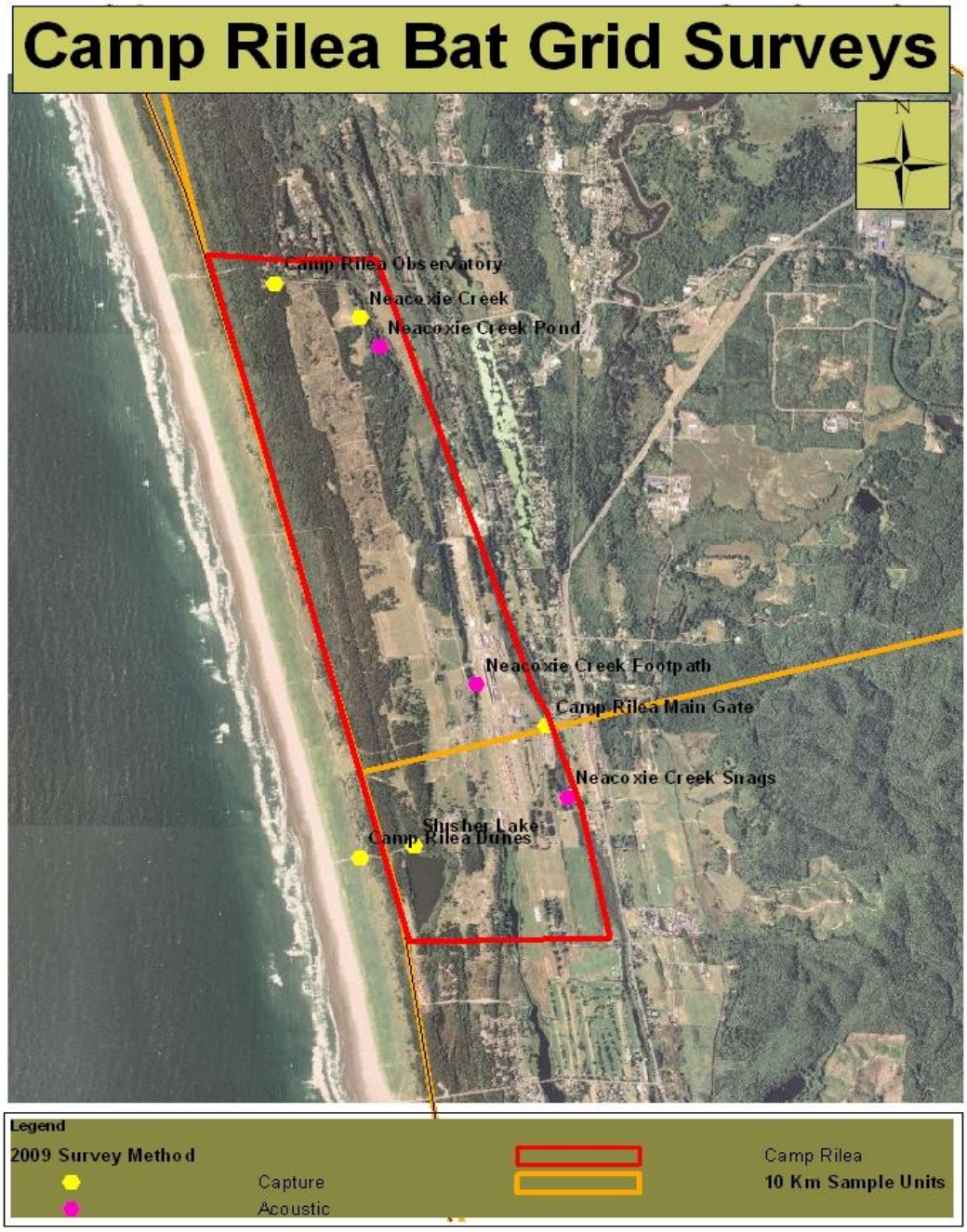

Figure 9. *Geographic display of Camp Rilea Bat Grid survey sites, for surveys conducted August 18 & 19, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. There are no known historic survey efforts prior to the Bat Grid.*

Table 7. *Bat species detected during the 2009 Bat Grid Project at Camp Rilea. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in western Oregon and associated with habitats present at or in the vicinity of Camp Rilea are identified under "Generally Expected".*

2009 Camp Rilea Species Detections				
Species	**Captured**	**Acoustic Confirmed**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(pallid bat)**			X	
Euderma maculatum **(spotted bat)**			X	
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**			X	X
Myotis lucifugus **(little brown bat)**	Slusher Lake	Slusher Lake, Neacoxie Cr, Neacoxie Cr Pond, Neacoxie Cr Snags, Neacoxie Cr Footpath		X
Myotis evotis **(western long-legged myotis)**		Slusher Lake		X
Eptesicus fuscus **(big brown bat)**		Slusher Lake, Neacoxie Cr, Neacoxie Cr Snags, Neacoxie Cr Footpath		X
Myotis yumanensis **(Yuma myotis)**		Slusher Lake, Neacoxie Cr Snags, Neacoxie Cr Footpath		X
Myotis californicus **(California myotis)**	Slusher Lake	Neacoxie Cr Snags, Camp Rilea Observatory		X
Myotis keenii **(Keen's myotis)**			X	
Myotis ciliolabrum **(western small-footed myotis)**			X	
Tadarida brasiliensis **(Mexican free-tailed bat)**			X	
Parastrellus hesperus **(canyon bat)**			X	
Lasionycteris noctivagans **(silver-haired bat)**		Slusher Lake, Neacoxie Cr, Neacoxie Cr Pond, Neacoxie Cr Footpath		X
Lasiurus cinereus **(hoary bat)**	Slusher Lake	Neacoxie Cr Footpath		X

Implications – Since 7 of 10 potential bat species were confirmed at Camp Rilea, additional surveys are likely to improve species detections. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits.

Most of the bat species detected at Camp Rilea are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat at Camp Rilea could enhance habitat resources for these species. For all bat species, maintaining perennial clean water sources surrounded by native vegetation, such as wetlands, can provide quality drinking and foraging habitat to support summer and migratory bats. The maintenance of forest habitat, including growth and retention of large trees and snags, at Camp Rilea will provide high quality roosting and foraging habitat for forest-dwelling bat species.

PORTLAND ANG Base

Portland ANG Base is located within the confines of the Portland International Airport and Port of Portland land holdings. It covers 246 acres with an elevation of 31 ft. It is characterized entirely by urban development with open water limited to 2 sewage ponds. Habitat adjacent to the base where the majority of surveys were conducted includes Port of Portland grasslands and hardwood riparian with a water canal, two private golf courses, and Whitaker County Park with hardwoods and 2 ponds.
Bat Grid Surveys were conducted August 21th and 22th. A total of 2 mist net and 3 remote acoustic surveys were conducted. Survey sites included water sources on and adjacent to the base (See **Figure 10**).

Five bat species were captured and/or detected acoustically. Five additional species of bat could be expected in this part of Oregon although lack of natural habitat in such an urban environment may limit bat use in this area (**Table 8**).

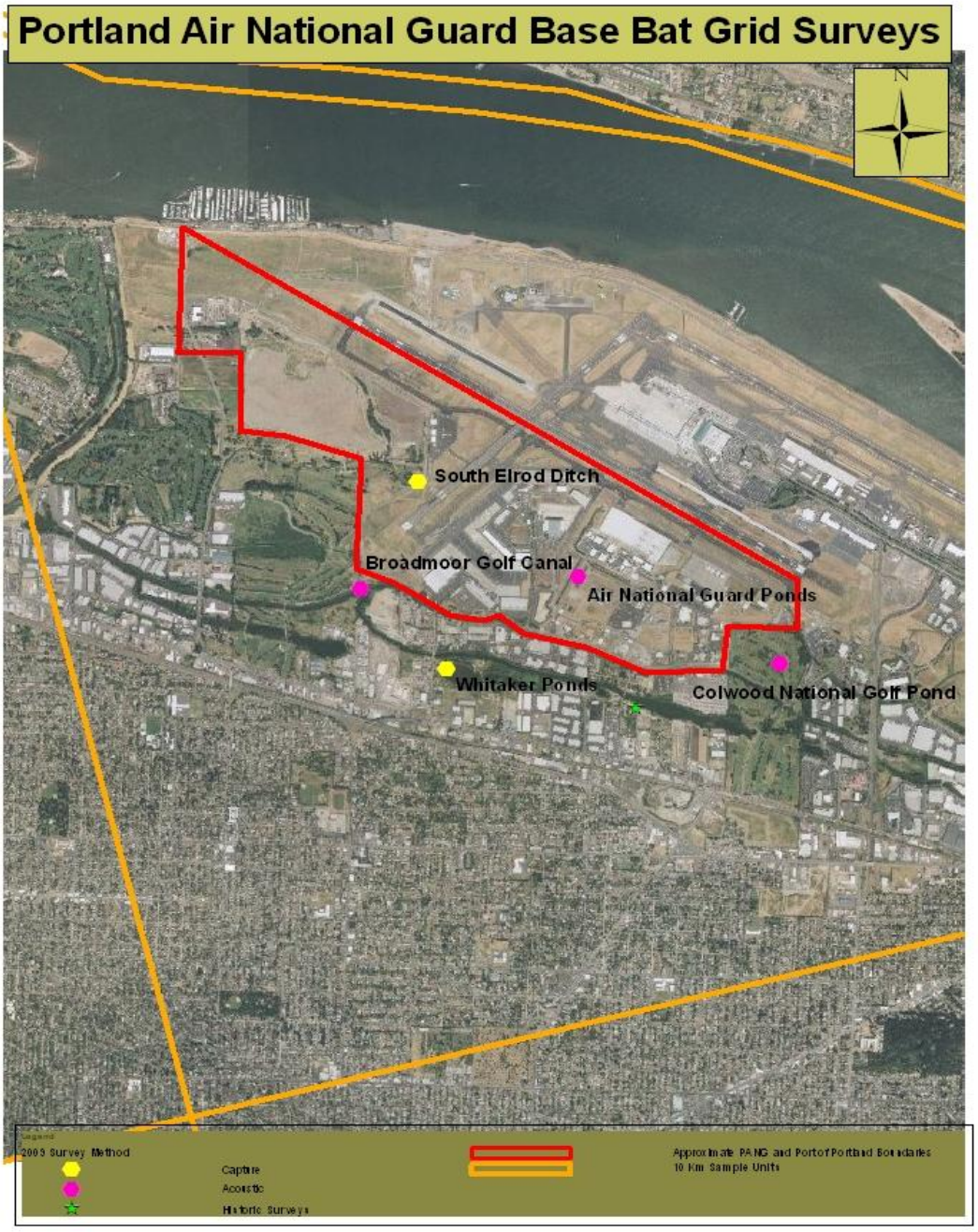

Figure 10. *Geographic display of Portland ANGB Bat Grid survey sites, for surveys conducted August 21 & 22, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic survey sites prior to the Bat Grid also are included.*

Table 8. *Bat species detected during the 2009 Bat Grid Project in relation to Portland ANGB. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in western Oregon and associated with habitats present at or in the vicinity of Portland ANGB are identified under "Generally Expected".*

2009 Portland ANGB Species Detections				
Species	**Captured**	**Acoustic Confirmed**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(pallid bat)**			X	
Euderma maculatum **(spotted bat)**			X	
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**			X	X
Myotis lucifugus **(little brown bat)**	Whitaker Ponds, S. Elrod Radar Ditch	Whitaker Ponds, S. Elrod Radar Ditch, Broadmoor Golf Canal, Colwood National Golf Pond		X
Myotis evotis **(western long-legged myotis)**				X
Eptesicus fuscus **(big brown bat)**		Whitaker Ponds, S. Elrod Radar Ditch, Broadmoor Golf Canal		X
Myotis yumanensis **(Yuma myotis)**	Whitaker Ponds	Broadmoor Golf Canal		X
Myotis californicus **(California myotis)**				X
Myotis keenii **(Keen's myotis)**			X	
Myotis ciliolabrum **(western small-footed myotis)**			X	
Tadarida brasiliensis **(Mexican free-tailed bat)**			X	
Parastrellus hesperus **(canyon bat)**			X	
Lasionycteris noctivagans **(silver-haired bat)**		Whitaker Ponds, S. Elrod Radar Ditch		X
Lasiurus cinereus **(hoary bat)**		Colwood National Golf Pond, Air National Guard Ponds		X

Implications – Five of 10 potential bat species were confirmed on or adjacent to Portland ANGB, primarily on adjacent lands with less urban development and more open water. The majority of bat

species detected, primarily use snags or trees for roosting but are also known to use anthropomorphic structures such as buildings. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits.

Collaborating with the Port of Portland, local golf courses, and Whitaker County Park to manage for tree and snag habitat and to install artificial roost habitat on the base would enhance roosting opportunities for bats. Such collaborative efforts also could be helpful to improve and maintain clean, open water sources that provide quality drinking and foraging habitat to support summer and migratory bats.

CAMP ADAIR

Camp Adair is located about 10 miles north of Corvallis, OR adjacent to the EE Wilson State Wildlife Area, which used to be part of the Camp Adair holdings. Camp Adair covers 500 acres and the EE Wilson Wildlife Area covers 2,000 acres with an elevation of approximately 600 ft. It is within a foothill-valley ecotone and is characterized by oak woodlands and prairie that have been encroached by introduced conifer and fruit trees as well as invasive herbaceous species and agriculture. Oak-grassland restoration efforts have been initiated. There is no accessible open water at Camp Adair although there is open water on the adjacent wildlife refuge.

Bat Grid Surveys were conducted August 15th and 16th. A total of 2 mist net and 6 remote acoustic surveys were conducted. Survey sites included open spaces and road corridors dispersed across the camp (See **Figure 11**).

Ten bat species were captured and/or detected acoustically. No additional species of bat could be expected in this part of western Oregon and associated with habitats found at Camp Adair (**Table 9**).

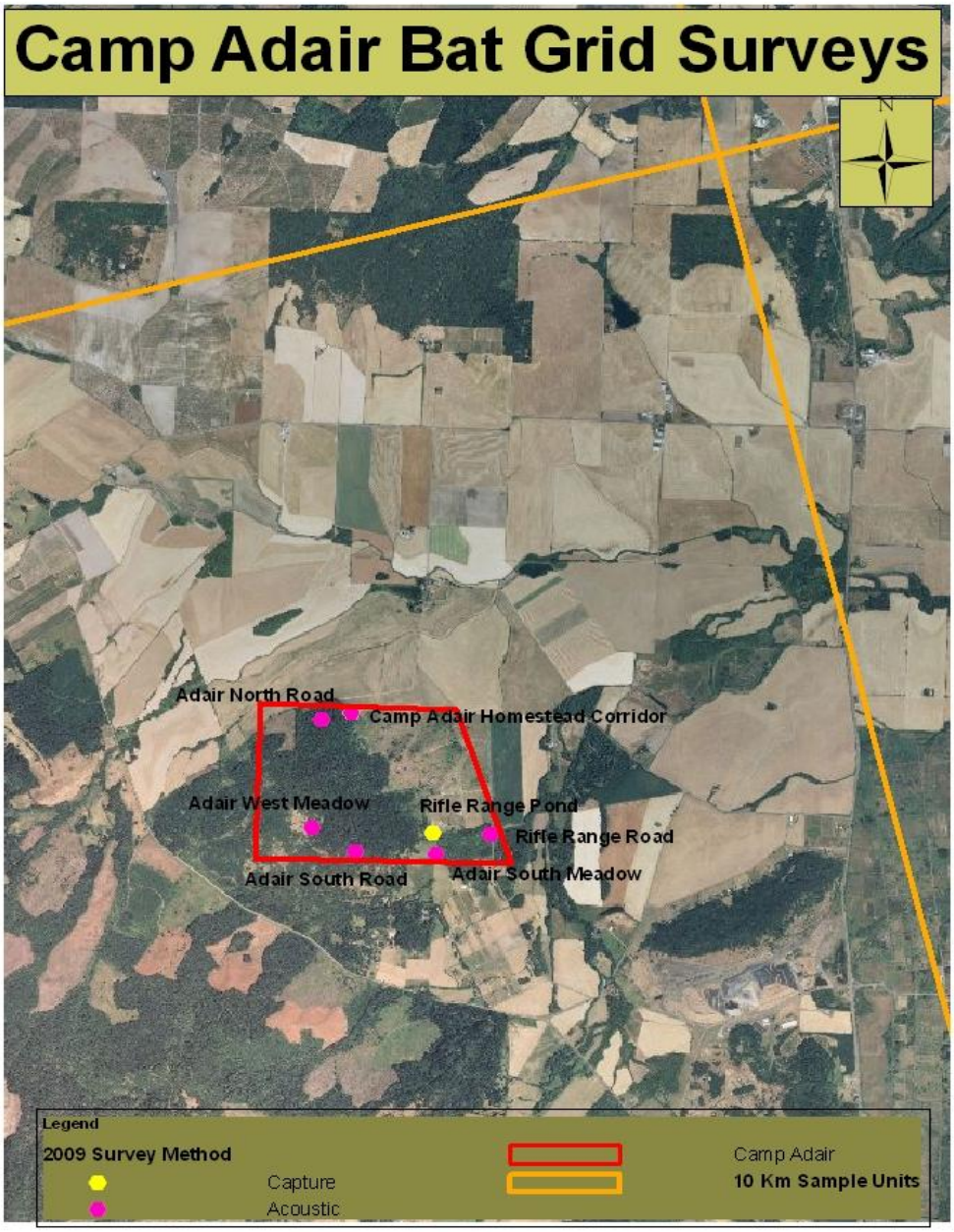

Figure 11. *Geographic display of Camp Adair Bat Grid survey sites, for surveys conducted August 15 & 16, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. There is no record of historic surveys prior to the Bat Grid.*

Table 9. *Bat species detected during the 2009 Bat Grid Project in relation to Camp Adair. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in western Oregon and associated with habitats present at or in the vicinity of Camp Adair are identified under "Generally Expected".*

2009 Camp Adair Species Detections				
Species	**Captured**	**Acoustic Confirmed**	**Not Detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**		Adair West Meadow, Camp Adair Homestead Corridor		**X**
Antrozous pallidus **(pallid bat)**			**X**	
Euderma maculatum **(spotted bat)**			**X**	
Myotis thysanodes **(fringed myotis)**	Rifle Range Pond	Rifle Range Rd, Adair N. Road, Adair S. Meadow		**X**
Myotis volans **(long-legged myotis)**		Rifle Range Rd, Rifle Range Pond, Adair West Meadow		**X**
Myotis lucifugus **(little brown bat)**		Adair S. Meadow, Adair W. meadow, Rifle Range Rd, Camp Adair Homestead Corridor, Adair S. Road		**X**
Myotis evotis **(western long-legged myotis)**		Rifle Range Rd, Rifle Range Pond, Adair West Meadow, Adair S. Meadow, Camp Adair Homestead Corridor, Adair S. Rd.		**X**
Eptesicus fuscus **(big brown bat)**		Adair S. Meadow, Adair W. meadow, Rifle Range Pond, Camp Adair Homestead Corridor, Adair S. Road		**X**
Myotis yumanensis **(Yuma myotis)**		Adair S. Meadow, Rifle Range Road		**X**
Myotis californicus **(California myotis)**		Adair S. Meadow, Adair W. meadow, Rifle Range Pond, Rifle Range Road, Camp Adair Homestead Corridor, Adair S. Road, Adair N. Road		**X**
Myotis keenii **(Keen's myotis)**			**X**	
Myotis ciliolabrum **(western small-footed myotis)**			**X**	
Tadarida brasiliensis **(Mexican free-tailed bat)**			**X**	
Parastrellus hesperus **(canyon bat)**			**X**	
Lasionycteris noctivagans **(silver-haired bat)**		Adair S. Meadow, Adair W. meadow, Rifle Range Road, Camp Adair Homestead Corridor, Adair N. Road		**X**
Lasiurus cinereus **(hoary bat)**	Rifle Range Pond	Camp Adair Homestead Corridor		**X**

Implications – Ten of 10 potential bat species were confirmed at Camp Adair. The majority of bat species detected are considered forest-dwelling and primarily use snags or trees for roosting but some are also known to use anthropomorphic structures such as buildings. Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms during migration and little is known about their migration routes. Surveys for these species May through October will contribute to better understanding of their migration habits. Establishing open water resources and managing for snags on Camp Adair also would enhance bat habitat.

Additionally, there are historical records from the 1970s of *Antrozous pallidus* (pallid bat) roosting in bridges west of Salem. This species is associated with oak woodland-savanna in the foothills of the Rogue and Medford valleys and historically, the southern/mid Willamette Valley. Continued restoration of these habitats at Camp Adair could provide important source habitat for this species if it reoccurs in the area.

Redmond BIAK

Redmond BIAK is located about 3 miles east of Redmond, OR and is actually BLM land designated for military training since World War II. Redmond BIAK covers over 31,300 acres embedded in the Prineville BLM District with an elevation ranging from 2900-3300 ft. It is shrub-steppe habitat with scattered rock outcrops. Open water is limited to a canal and handful of ponds, some of which are ephemeral.
Bat Grid Surveys were conducted August 11th and 12th. A total of 1 mist net and 7 remote acoustic surveys were conducted. Survey sites included a canal, pond, and rock features (See **Figure 12**).

Six bat species were detected acoustically, no species were caught. Eight additional species of bat could be expected in this part of eastern Oregon and associated with habitats found at Redmond BIAK. An acoustic call characteristic of the Mexican free-tail (*Tadarida brasiliensis*) bat was recorded, but species validation would require morphometric verification from a captured individual (**Table 10**).

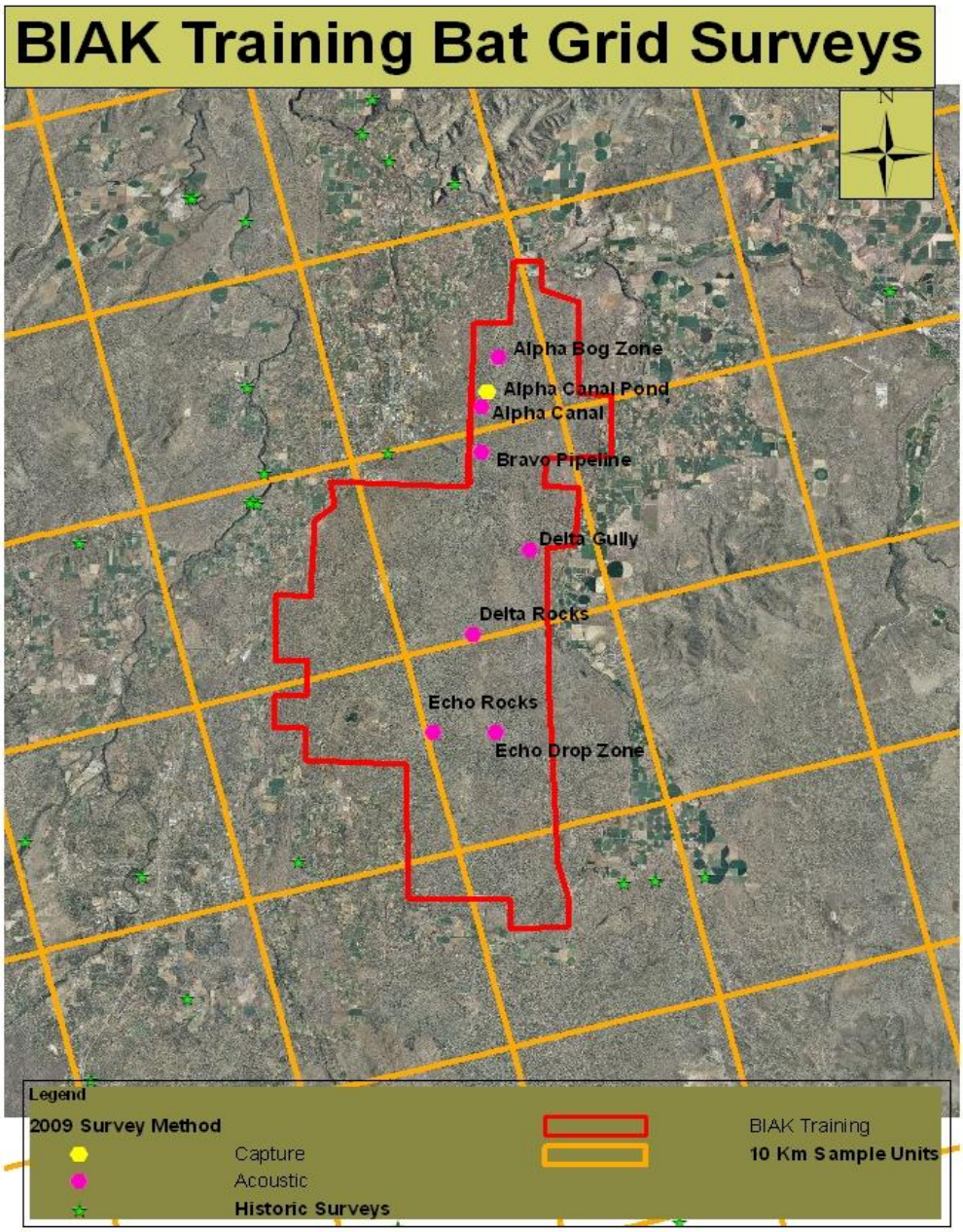

Figure 12. *Geographic display of Redmond BIAK Bat Grid survey sites, for surveys conducted August 11 and 12, 2009. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic locations of bat surveys conducted prior to The Bat Grid also are presented.*

Table 10. *Bat species detected during the 2009 Bat Grid Project on Redmond BIAK. Acoustic detections were a result of Sonobat 3.0 automated analysis with a 95% or greater confidence in species identification. Species that would be expected in eastern Oregon and associated with habitats present at or in the vicinity of Redmond BIAK are identified under "Generally Expected".*

2009 Redmond BIAK Species Detections				
Species	**Captured**	**Acoustic Confirmed**	**Not detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**			X	X
Antrozous pallidus **(Pallid bat)**			X	X
Euderma maculatum **(Spotted bat)**		Alpha Canal Pond, Alpha Canal, Bravo Pipeline		X
Myotis thysanodes **(fringed myotis)**			X	X
Myotis volans **(long-legged myotis)**			X	X
Myotis lucifugus **(little brown bat)**			X	X
Myotis evotis **(western long-legged myotis)**			X	X
Eptesicus fuscus **(big brown bat)**		Alpha Canal Pond, Echo Drop Zone		X
Myotis yumanensis **(Yuma myotis)**		Alpha Canal		X
Myotis californicus **(California myotis)**			X	X
Myotis keenii **(Keen's myotis)**			X	
Myotis ciliolabrum **(western small-footed myotis)**		Alpha Canal, Bravo Pipeline, Echo Drop Zone		X
Tadarida brasiliensis **(Mexican free-tailed bat)**		Suspect call Alpha Canal		
Parastrellus hesperus **(canyon bat)**			X	X
Lasionycteris noctivagans **(silver-haired bat)**		Alpha Canal		X
Lasiurus cinereus **(hoary bat)**		Alpha Canal, Alpha Bog Zone, Delta Rocks, Echo Rocks		X

Implications – Since 6 of 14 potential bat species were detected on Redmond BIAK, additional inventory surveys would be most effective in focusing on areas most likely to support undetected species. Because of the rough terrain on Redmond BIAK and limited survey sites, it might be prudent to use the species list from historical data collected on the Prineville BLM District.

Two migratory bat species, *Lasionycteris noctivagans* (silver-haired bat) and *Lasiurus cinereus* (hoary bat), were detected. Both species can be fatally impacted by wind energy farms. All of the bat species detected on Redmond BIAK rely on rock features, trees, or snags for roosting and reliable, clean, open water sources for drinking. Ephemeral water sources have limited value to bats and are usually dry by mid-summer. Providing perennial clean water sources by developing open guzzlers to augment ephemeral water sources can provide quality drinking and foraging habitat to support summer and migratory bats.

Summary

Participation and support for The Bat Grid Program from USFS, BLM, USFWS, DoD, NPS, Other federal entities, state agencies, and NGO partners continued to grow in 2009. The Bat Grid provides a credible, standardized, and technically supported venue for building invaluable partnerships that lead not only to the conservation of bats, but other taxon as well.

Developing new survey tools in concert with PSU and HSU has been more challenging than we originally planned, yet delays are fairly typical of new technology development. Despite the delays, the acoustic and genetic tools are moving forward and it is important to keep in mind that once finished, they will be invaluable not only to the PNW but will also have global implications that will improve species identification, reduce the use of intrusive survey methods, and increase survey efficiency.

The data set generated by The Bat Grid is globally unique for this taxon in the thoroughness of its content, the extent of its coverage, and the quality and consistency of the data themselves. The original analyses planned for these data, basic occupancy and detection probabilities and standard distribution maps, would provide valuable insight for managing this taxon. The expanded analyses recently agreed to in collaboration with the NPS will improve the reliability and robustness of the statistical models and provide more sophisticated and detailed products for applications of conservation and habitat management. The Bat Grid Program is unique and serves as a model for a growing number of others. USFS Region 1, USFS National Ecology Program, Montana, California, and Utah States have all adopted The Bat Grid or aspects of it as a template or as a reference for developing their own survey systems.

Because of the opportunities for focused learning and skill development, credible standards, tool development, and applicability of the data to conservation and science at local, regional, and national levels, The Bat Grid serves as a valuable conduit for nurturing partnerships and attracting multiple sources of funding. The value of these investments of partnerships and money have been realized in the diverse cadre of trained biologists, a standardized data collection, a region-wide interagency data set, and in survey tool development.

References

KUNZ, T. H., and A. KURTA. 1988. Capture methods and holding devices. Pages 1-30 *in* T. H. Kunz, ed. Ecological and behavioral methods for the study of bats. Smithsonian Institute Press, Washington D. C.

PARSONS, S., AND J.M. SZEWCZAK 2007. Detecting, Recording, and Analyzing the Vocalizations of Bats, *in* Ecological and Behavioral Methods for the Study of Bats, 2nd Edition, T.H. Kunz, ed. Johns Hopkins University Press (*in press*).

SZEWCZAK, J.M. ,2004. Advanced analysis techniques for identifying bat species. Proceedings of the Bat Conservation International Echolocation Symposium, Austin, TX, April, 2002. Published by Bat Conservation International.

ZINCK, J. M., D. A. DUFFIELD, and P. C. ORMSBEE. 2004. Primers for identification and polymorphism assessment of Vespertilionid bats in the Pacific Northwest. Molecular Ecology Notes 4(2):239-242.