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The Bat Grid Inventory and Monitoring Project: A Regional Approach to Inventorying and Monitoring Bat Populations 2008 Inventory Report

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DoD Legacy Bat Grid 2008 Inventory Report

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Background

Globally, bats (Order Chiroptera), are acknowledged as one of the most diverse and threatened Orders of mammals in the world. Threats to bats range from habitat destruction to disturbance during critical periods, such as hibernation. 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 it has not been systematically collected. The need for inventory and monitoring efforts have been identified in both Oregon and Washington State Comprehensive Plans and both states have identified several bat species with a status of S-1 or S-2 and the recently released Oregon Sensitive Species List included 1 “critical” and 7 “vulnerable” bat species. Furthermore, the interagency Northwest Forest Plan addressing forest management on federal lands in western Oregon and Washington, northern California identified bats as a taxon lacking in baseline information.

Since its initiation in 2002, the Bat Grid Inventory and Monitoring Project has evolved as a richly collaborative strategy to inventory and monitor bat species across Oregon and Washington with unprecedented geographic and scientific resolution. 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. The survey efforts in 2008 continued the implementation of a wall-to-wall sampling grid for inventorying and monitoring bat species across the Pacific Northwest specifically incorporating lands associated with DoD facilities and neighboring partners. The project provided 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. 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

Historical data on species distribution in the Pacific Northwest (PNW) has been based on species identification primarily using morphometrics. More recent testing of methods for identification has shown that this alone is not reliable for all species of bats, and acoustic and genetic data also are important for accurate identification of species. Without accurate species identification it is difficult to discern distribution and habitat associations that are essential for completing effective conservation plans. When all 3 methods of species identification are used along with a standardized sampling strategy, a reliable distribution of species can be mapped and data can be used for status assessments and conservation plans.

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 taxa 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**).

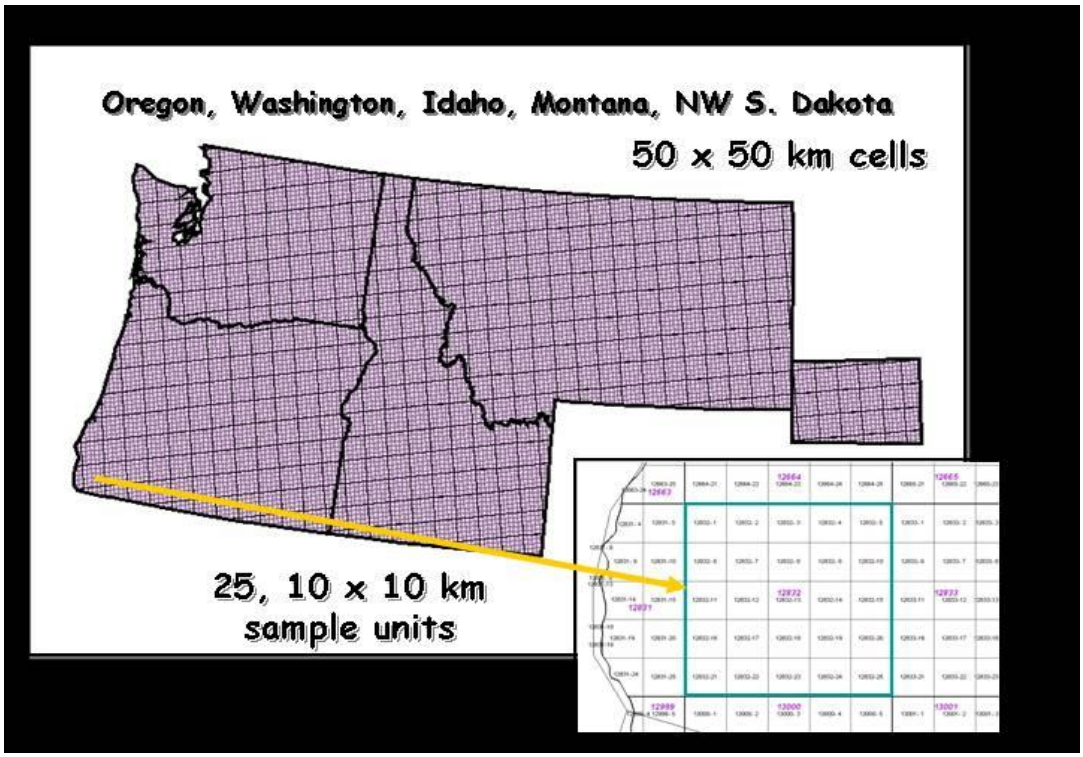

Figure 1. *Geographic display of The Bat Grid Sampling Frame of 50 x 50 km grid cells, each comprised of 25, 10 x 10 km sample units.*

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 contacted to participate in the 2008 Bat Grid surveys. Fort Lewis did not respond and after consultation with the Resource Specialist for Boardman Naval Facility, we determined that drought conditions and fire precluded this facility as a candidate for conducting surveys. Seven Washington DoD Facilities were incorporated into the Bat Grid during 2008 included: Indian Island and Bangor Naval Bases, Whitbey Island AFB, Yakima Training Center, McChord Air Force Base, Fairchild AFB, Jim Creek Naval Station, and Bangor Submarine Base. 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 2 mistnet and 2 acoustic surveys were conducted between dusk and 01:00 hrs. Three or more individuals from the US Forest Service, BLM, Bats Northwest, and other partners conducted surveys in collaboration with DoD Facility personnel at the 7 facilities. In most cases, DoD personnel were required to escort surveyors 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 et al.) 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.

Additional sampling

Additionally, remote acoustic surveys were conducted weekly in fall (September – October) at the Yakima Training Center (YTC). Lands adjacent to the YTC are productive wind energy farms and the YTC is considering wind development as a future option at their facility. The fall surveys were added to provide information about migrant bat species that may be using the area (*Lasiurus cinereus* (hoary bat), *Lasionycterus noctivagans* (silver-haired bat), and possibly *Tadarida brasiliensis* (Mexican free-tail bat)) and that are negatively affected by wind turbines. On-the-job training, site selection, and equipment were provided to YTC personnel so that they could independently conduct the surveys.

Monitoring

Our monitoring strategy was developed in 2006 and included consultation with Darryl MacKenzie, Ted Weller, and Christina Vojta to develop a pilot approach for monitoring bats across the PNW. In 2008, forty sample units were randomly selected across Oregon and Washington as described above and 6 surveys (3 mist net/acoustic and 3 remote acoustic surveys) were targeted for each sample unit with a single visit to each site. Additionally, 2 roost surveys were conducted in each sample unit when roost structures were present. Data collected at DoD facilities also is being incorporated into the monitoring analysis (see separate monitoring report).

Training

Two training sessions were conducted and included material for returning surveyors who wanted a refresher on survey techniques and updates to the techniques or protocol. Training of field personnel to conduct surveys was completed 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).

Although training was specific to The Bat Grid Project, basic techniques on capture and species 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, Pat Ormsbee, 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 4^{th} and 5^{th} 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 detectors (http://www.batsound.com/). Calls collected from captured bats were recorded using a tether or zipline 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. 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 MSAccess 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 46 participants (affectionately known as "Gridders") attended the 2 training sessions in Ephrata, WA, and in Burns, OR, including 4 DoD employees representing McChord Air Force Base, WA; US Army Corps of Engineers - Willamette Valley Projects, OR; and U.S. Army Dugway Proving Ground, UT. Additional attendees represented 12 Federal or State Agencies, organizations, or universities, Burns-Paiute Confederated Tribes, US Forest Service, Bureau of Land Management, The Nature Conservancy, Oregon State University, Bats Northwest, Oregon and Washington Dept. of Fish and Wildlife, Hanford Nuclear Site, and citizen volunteers. A field class from Central Washington University of about 1 dozen students joined us for an evening field session.

On-the-job-training was provided for 10 DoD employees or contract biologists at Fairchild AFB, Yakima Training Center, McChord AFB, Jim Creek Naval Station, and Bangor Submarine Base. A student employee with US Army Corps of Engineers - Willamette Valley Projects completed a week-long internship, traveling with The Bat Grid Tiger Team to conduct surveys at Indian Island and Bangor Naval Bases and Whitbey Island AFB.

Approximately 128 individuals participated in The Bat Grid Inventory and Monitoring Project in 2008 and an estimated 3790 volunteer or in-kind hours were contributed to conducting Bat Grid surveys or processing data. Table 2 displays in-kind and volunteer hours associated with the 2008 Bat Grid Project exclusive of BLM and USFS paid in-kind hours since they are the lead agencies. Seventeen individuals representing 7 agencies, organizations, or citizen scientists assisted with surveys conducted on DoD facilities and included Bureau of Land Management, U. S. Forest Service, Department of Energy, Washington Dept. of Wildlife, Bats Northwest, and Cascadia Research.

Table 2. *Number of total participants who were paid or volunteered with an agency or group and total volunteer hours for all agencies and groups combined with in-kind hours for other than BLM and USFS personnel associated with The Bat Grid Project in 2008.*

Bat Grid Partners 2008		
Association	***Total number of individuals (paid and volunteer)***	***All Volunteer Hrs and In-Kind Hrs for other than BLM and USFS***
US Forest Service	45	644
BLM	37	276
DoD	16	188
Bats Northwest	5	436
Oregon Dept. F&W	4	120
DOE - Hanford	4	118
Oregon State U	4	112
Burns-Paiute Tribe	3	118
Portland State U	3	1030
Humboldt State U	2	570
TNC	2	10
USFWS	1	60
NPS	1	44
WA Dept of F&W	1	64
Total	***128***	***3790***

Additionally, The Nature Conservancy of Washington donated free housing for training attendees, Washington Department of Natural Resources and Oregon State University Extension Service donated meeting room space for training, 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

A total of 371 surveys were conducted in 2008. Of the 371 surveys, 68 (18%) were conducted on DoD lands. The 2008 survey effort represents approximately 1,527,901 acres [An average of 6 surveys are required to cover a 10 km x 10 km sample unit or 24,710 acres; thus (371 surveys/6 surveys) x 24,710 ac = 1,527,901 ac]. A total of approximately 96 10 km x 10 km sample units were actually surveyed 1 or more times. Of the 96 sample units surveyed 1 or more times, 25 SUs (25%) were associated with DoD facilities.

In 2008, we initiated spring and fall acoustic surveys in Coos Bay and Yakima Training Center, respectfully. These were pilot efforts to test methodology and generate some initial data to determine if future efforts for surveying migrants were warranted. In both cases, calls were collected indicating the presence of migratory bats.

Monitoring effort

Of the 88 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 are being included in some of the analyses on species presence and detection probabilities that are described in the separate monitoring report.

In June of 2008, we worked with Tom Rodhouse to analyze probability of occupancy (psi) and detection probabilities (p) using 2007 Bat Grid capture data for the species, *Myotis evotis* using Presence software. These 2 statistics are fundamental to completing species distribution and trend analyses for monitoring. The purpose of running the test was to see if our sample size and SU size were adequate to get realistic results using Presence. We selected this species because we were confident that the capture data were reliable for accurately distinguishing this species and it is a species that is moderately ubiquitous across Oregon and Washington.

The model testing showed that the best model was one where psi was constant and p varied by survey. Psi (probability of occupancy) was 89% (CI 76-96%) and the p (probability of detection) ranged from roughly 50% to 82%. Since these were basic analyses that lacked covariates, such as weather that might affect detection probabilities, the wide range in values for p was a reasonable outcome. More importantly, there was no indication from the results that our sample size or SU size were an issue for this species. Had sample size been an issue, we would have seen broader CIs and had SU size been an issue, we would have expected psi and p to be closer to "1". While the influence of sample size will have to be assessed species by species, we do not expect SU size to be an issue for any species since it proved adequate for *M. evotis*.

Acoustic data provided for *M. evotis* from the automated call analysis system were spurious and we did not feel the data were robust enough to conduct "psi" and "p" statistics for all species. Further

refinement of the automated tool was required (see "*Acoustics and tool development*" section below for a further explanation.

Additionally, analysis of monitoring data using 2008 data was completed and reported under a separate report.

Genetics and tool development

Two hundred and sixty wing biopsies and 21 guano samples were collected for potential DNA analysis in 2008. In 2008, we distinguished the effectiveness of DNA analysis methods for identifying PNW bat species using a micro-array chip or mitochondrial DNA analyses (Table 2). For species identification using the microarray, it is critical that species-specific probes only illuminate when they come in contact with DNA from a target species so that we avoid false positive results (a species-specific probe illuminates when DNA from that species really isn't there). We were able to do this for all bat species in the PNW except for some *Myotis* species where genetic distinction is an issue regardless of what analysis method is used.

Table 2. *DNA species analysis techniques and their applicability to PNW bat species.*

Species	DNA Sequencing with Mysp1/2 and Mysp 3/4 (16S)	Microarray
Antrozous pallidus	X[1]	X[2]
Corynorhinus townsendii	X	X
Eptesicus fuscus	X	X
Euderma maculatum	X	X
Lasiurus cinereus	X	X
Lasionycteris noctivagans	X	X
Myotis evotis	X[3]	X[3]
Myotis thysanodes	X[3]	X[3]
Myotis keenii	X[3]	X[3]
Myotis lucifugus carissima	X[3]	X[3]
Myotis lucifugus lucifugus	X	X
Myotis lucifugus alescensis	X	X
Myotis californicus	X[4]	X[4]
Myotis cilliolabrum	X[4]	X[4]
Myotis volans	X	X
Myotis yumanensis	X[5]	X[6]
Tadarida brasiliensis	X	X

1. Works well for subspecies in Pacific Northwest, but with variable success in the southwestern US.
2. Successful in both the northwest and southwest US
3. This species is part of a species group that cannot be resolved: *Myotis evotis, Myotis thysanodes, Myotis keenii, Myotis lucifugus carrisima,* and *Myotis auriculus*
4. This species is part of a species group that cannot be resolved: *Myotis cilliolabrum, Myotis californicus,* and *Myotis leibii*
5. *Myotis yumanensis* from the northwest are distinct from all other species. In the southwestern US, samples that have been identified in the field as either *Myotis yumanensis* or *Myotis velifer* cannot be resolved from each other, although they are different from the northwestern *Myotis yumanensis*.
6. The *Myotis yumanensis* probes on our microarray successfully identified *Myotis yumanensis* as part of mixed-species guano sample collected under field conditions in Arizona.

To explore the potential to distinguish genetically ambiguous species groups, we have begun looking at multiple detection methods for confounding species of the *Myotis* genus, specifically the long-eared *Myotis* and *M. lucifugus* group. Currently we are working with micro-satellite data from 6 loci as well as mitochondrial sequence data sampled from 277 *M. evotis*, 88 *M. thysanodes*, and 120 *M. lucifugus*. Additionally, we have acoustic data associated with genetic data for 71 *M. evotis*, 8 *M. thysanodes*, and over 100 *M. lucifugus*. The acoustic data serves as a standard for species identification with this group, as acoustic calls between these species are distinct. To date, 3 distinct genetic groups have been identified, lending support for the occurrence of 3 distinct species. PSU is also doing the genetic work for the Bristish Columbia samples of *M.keenii* and we are working collaboratively with them to better identify this species and eventually combine our data sets for analyses and publication.

Acoustics and tool development

In 2008, we received 15,000 results from the automated acoustic analysis program from Joe Szewczak at Humboldt State University. We conducted a beta test of the results by comparing the acoustic results to Bat Grid capture data. In many cases, the call analysis results were characterized to a species group (eg *Antrozous pallidus/Eptesicus fuscus/Laciurus cinereus*) as opposed to a specific species. We met with Joe and his assistant Aaron in October, 2008 and discussed the results and the beta testing. Based on that meeting, further refinements of the model were applied. In July, 2009 we received a second run of the 2008 acoustic analysis results. Again we reviewed the data set manually and returned feedback to Joe that he applied to further refinement of the tool. At this point we decided to extract data from the 2008 call files for 2 species: *Myotis evotis* and *Myotis thysanodes* so we could begin the monitoring data analysis with Tom Rodhouse, and also for all calls collected on DoD facilities so we could complete this report. We continue to work with Joe Szewczak to refine the automated system so we can include the call data for all species in our outputs and analyses.

Data records

In 2008, data associated with 1,236 captured bats for 15 confirmed species were entered in to the Bats Access database. One hundred and sixty-five automated acoustic calls for *M.* evotis and *M. thysanodes* that have been manually validated were entered in the database.

Specific DoD Results

This section presents the 2008 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 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 included mist netting and acoustic detection efforts) 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, confirmed using acoustic methods, or suspected using acoustic methods, and whether or not a species would even be expected in the general geographic area. A beta copy of Sonobat 3.0 (Oregon and Washington) was employed to conduct manual analysis of the call files. This unreleased version of Sonobat provides automated assistance for designating species to calls, although final designations are at the user’s discretion. Species were confirmed acoustically only if calls were of high quality (harmonics present, strong call, minimal background noise) and the diagnostic characteristics specifically needed to identify a species were present (See Attachment 1). Calls that had strong evidence towards a species, but lacked call quality, were designated as suspected. While acoustically confirmed species can be treated as present, acoustically suspected species would require further quality acoustic or capture surveys to confirm presence.

A brief discussion of the implications of results is provided for each facility. Implications also include any recommendations appropriate for the findings.

Fairchild AFB

Fairchild Air Force Base is located approximately 10 miles west of Spokane, adjacent to The Spokane Airport. It covers approximately 4,200 acres at a general elevation of 2418 with little elevational gradient. The base is characterized by urban development, the flight line, undeveloped grasslands interspersed with ponderosa pine (*Pinus ponderosa*) stands, and residual wetlands. About a third of the base is undeveloped.

Bat Grid Surveys were conducted August 12 and 22, 2008. A total of 6 acoustic and mist net surveys were conducted (2 mistnet and 4 remote acoustic surveys). Survey sites included ponds and wetlands dispersed across the undeveloped portions of the base (See **Figure 2**.).

Two bat species were acoustically confirmed at Fairchild AFB and 2 others were suspected. Nine additional species could be expected in the area, although they were not detected during these surveys. All detections were acoustic as no captures occurred (see **Table 3**.).

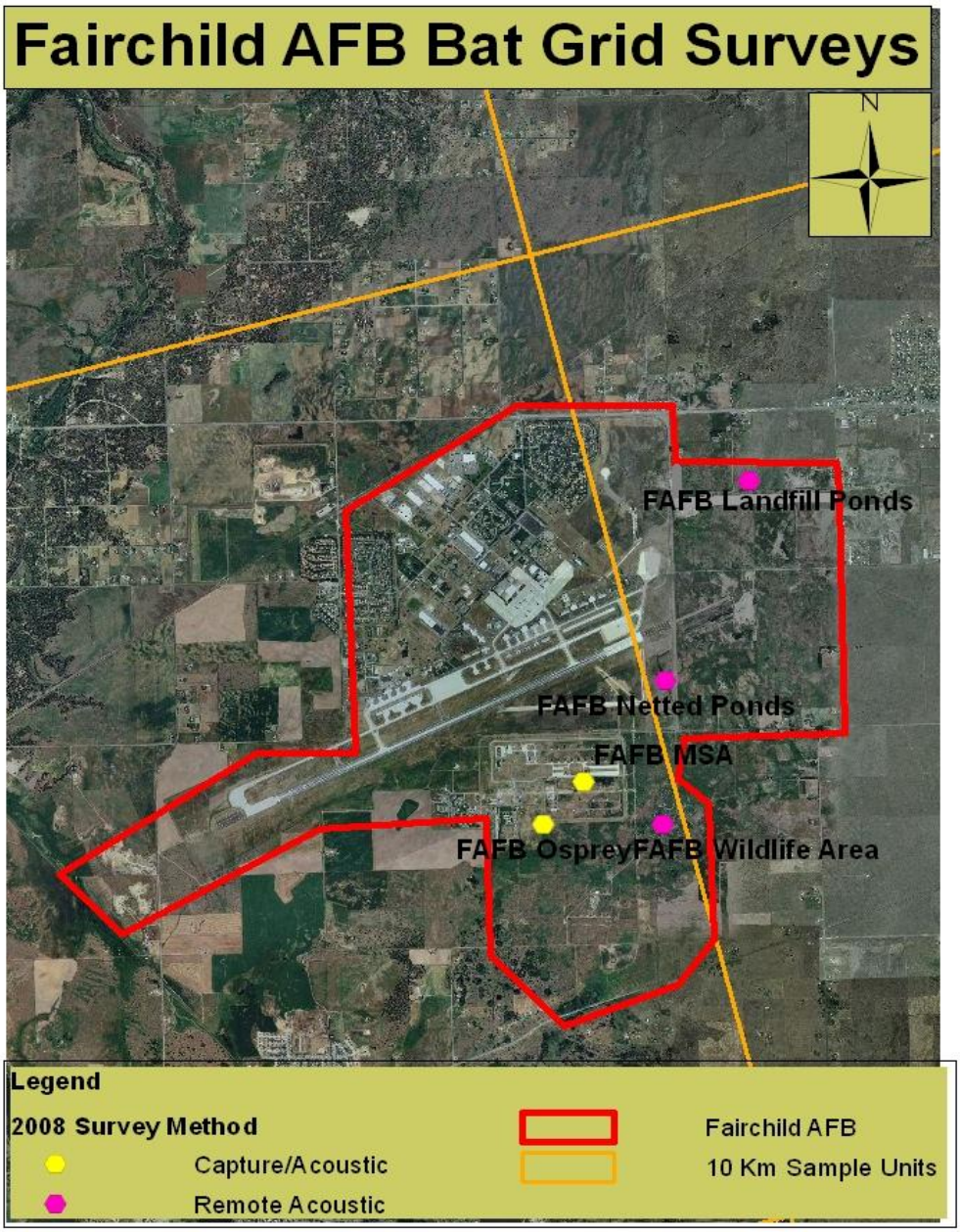

Figure 2. Geographic display of Fairchild AFB Bat Grid survey sites, for surveys conducted August 12 and 22, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. No historic survey data were available for mapping at Fairchild AFB.

Table 3. *Bat species detected during the 2008 Bat Grid Project at Fairchild AFB. Acoustic detections were assessed manually with automated assistance from Sononbat 3.0. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm them to species with full confidence. Species that would be expected in eastern Washington and associated with habitats present at Fairchild are identified under "Generally Expected".*

Fairchild AFB Species Detections					
Species	**Capture**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**			FAFB Landfill Ponds		**X**
Myotis lucifigus **(little brown bat)**		FAFB Landfill Ponds			**X**
Myotis evotis **(western long-legged myotis)**				**X**	**X**
Eptesicus fuscus **(big brown bat)**			FAFB Netted Ponds		**X**
Myotis yumanensis **(Yuma myotis)**				**X**	**X**
Myotis californicusi **(California myotis)**				**X**	**X**
Myotis keenii **(Keen's myotis)**				**X**	
Myotis ciliolabrum **(western small-footed myotis)**				**X**	**X**
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**				**X**	
Lasionycterus noctivagans **(silver-haired bat)**		FAFB Netted Ponds, FAFB Wildlife Area			**X**
Lasiurus cinereus **(hoary bat)**				**X**	**X**

Implications – Since 2 of 11 potential bat species were confirmed at Fairchild AFB, additional surveys are likely to improve species detections. One of the species detected, *Lasionycteris noctivagans* (silver-haired bat), is a migratory species and uses snags as summer roost sites. Insuring snag habitat on or adjacent to Fairchild AFB could enhance habitat resources for this species as well as other bat species expected in the general area. 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.

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 July 11th-13th and September 22nd-23rd. A total of 18 acoustic and mist net surveys were conducted (3 mist net and 15 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across both developed and undeveloped portions of the installation (See **Figure 3.**). Twenty-four remote acoustic surveys were conducted between October 6th and November 25th to inventory for potential migratory bat species. Additionally, a roost survey was conducted at an abandoned mine tunnel in the NE corner of the base. A single *Myotis* species was observed but was too distant to identify to species.

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 4.**).

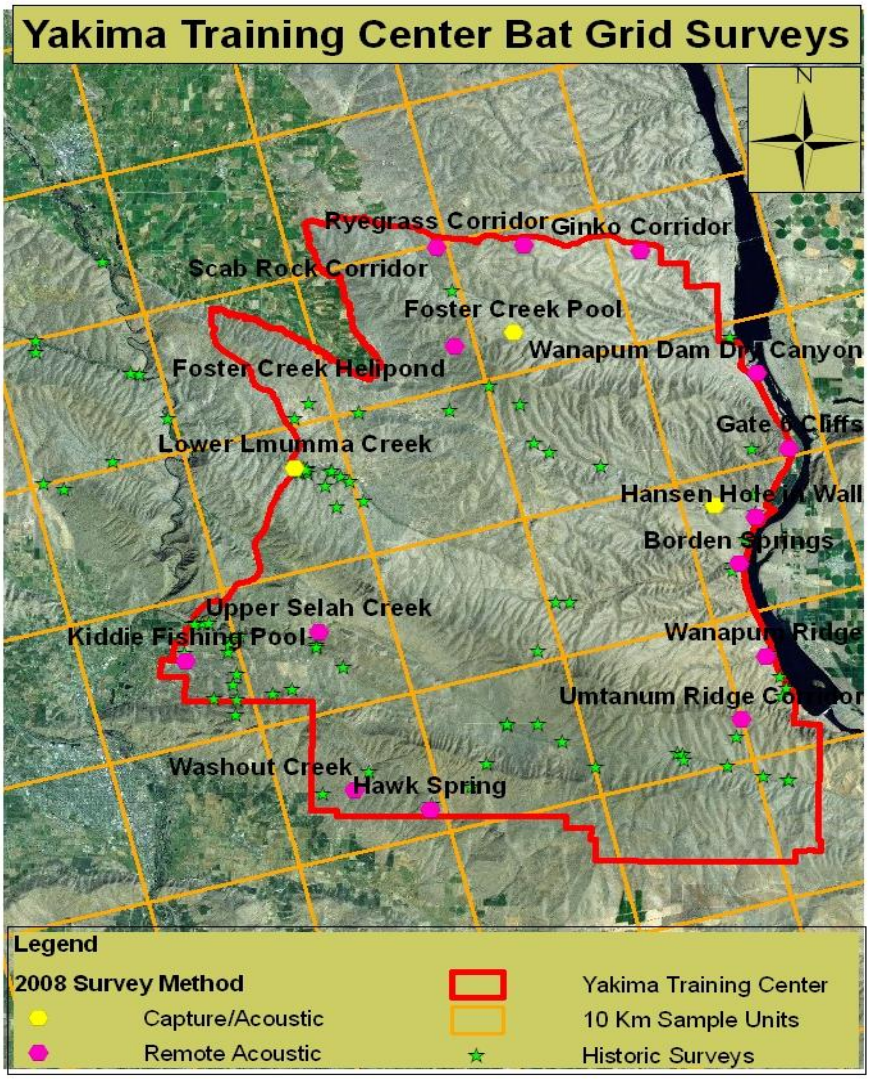

Figure 3. Geographic display of Yakima Training Center Bat Grid survey sites, for surveys conducted July 11th-13th and September 22nd-23rd, 2008 and remote acoustic surveys that were conducted between October 6th and November 25th. Sites where a combination of mistnet captures and acoustic detections 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 4. *Bat species detected during the 2008 Bat Grid Project at YTC. Acoustic detections were assessed manually with automated assistance from Sononbat 3.0. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm them to species with full confidence. Species that would be expected in eastern Washington and associated with habitats present at YTC are identified under "Generally Expected".*

Yakima Training Center Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**Not detected**	**Generally Expected**
Corynorhinus townsendii **(Townsend's big-eared bat)**				**X**	**X**
Antrozous pallidus **(Pallid bat)**	Lower Lmumma Creek		Kiddie Fishing Pool		**X**
Euderma maculatum **(Spotted bat)**				**X**	**X**
Myotis thysanodes **(fringed myotis)**				**X**	**X**
Myotis volans **(long-legged myotis)**			Hansen Hole in Wall		**X**
Myotis lucifigus **(little brown bat)**		Lower Lmumma Creek, Hansen Hole in Wall	Foster Creek Pool, Upper Selah Creek		**X**
Myotis evotis **(western long-legged myotis)**		Hansen Hole in Wall			**X**
Eptesicus fuscus **(big brown bat)**	Lower Lmumma Creek	Lower Lmumma Creek, Hawk Spring, Gate 6 Cliffs	Washout Creek, , Upper Selah Creek		**X**
Myotis yumanensis **(Yuma myotis)**		Borden Springs, Hansen Hole in Wall, Scab Rock Corridor			**X**
Myotis californicusi **(California myotis)**	Lower Lmumma Creek		Ginko Corridor		**X**
Myotis keenii **(Keen's myotis)**				**X**	
Myotis ciliolabrum **(western small-footed myotis)**	Lower Lmumma Creek	Foster Creek Pool, Upper Selah Creek, Wanapum Dam Dry Canyon, Gate 6 Cliffs, Borden Springs, Hansen Hole in Wall			**X**
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**		Lower Lmumma Creek, Borden Springs			**X**
Lasionycterus noctivagans **(silver-haired bat)**	Lower Lmumma Creek	Washout Creek, Upper Selah Creek, Hawk Spring, Gate 6 Cliffs, Ginko Corridor, Umtanum Ridge Corridor	Hansen Hole in Wall		**X**
Lasiurus cinereus **(hoary bat)**		Upper Selah Creek, Wanapum Ridge, Scab Rock Corridor, Umtanum Ridge Corridor			**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) and *Myotis volans* (long-legged 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.

McChord Air Force Base

McChord AFB is located approximately 7 miles south of Tacoma. It covers 4600 acres at a general elevation of 300 feet with little elevation gradient. The base is characterized by urban development, parks, and a golf course with residual natural oak woodland and coniferous forest.

Bat Grid Surveys were conducted on July 15th-16th. A total of 11 acoustic and mist net surveys were conducted (2 mist net and 9 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across both developed and undeveloped portions of the base (See **Figure 4.**).

Eight bat species were captured and/or confirmed acoustically. Three additional species of bats could be expected in western Washington associated with habitats found on McChord AFB but were not detected (**Table 5.**).

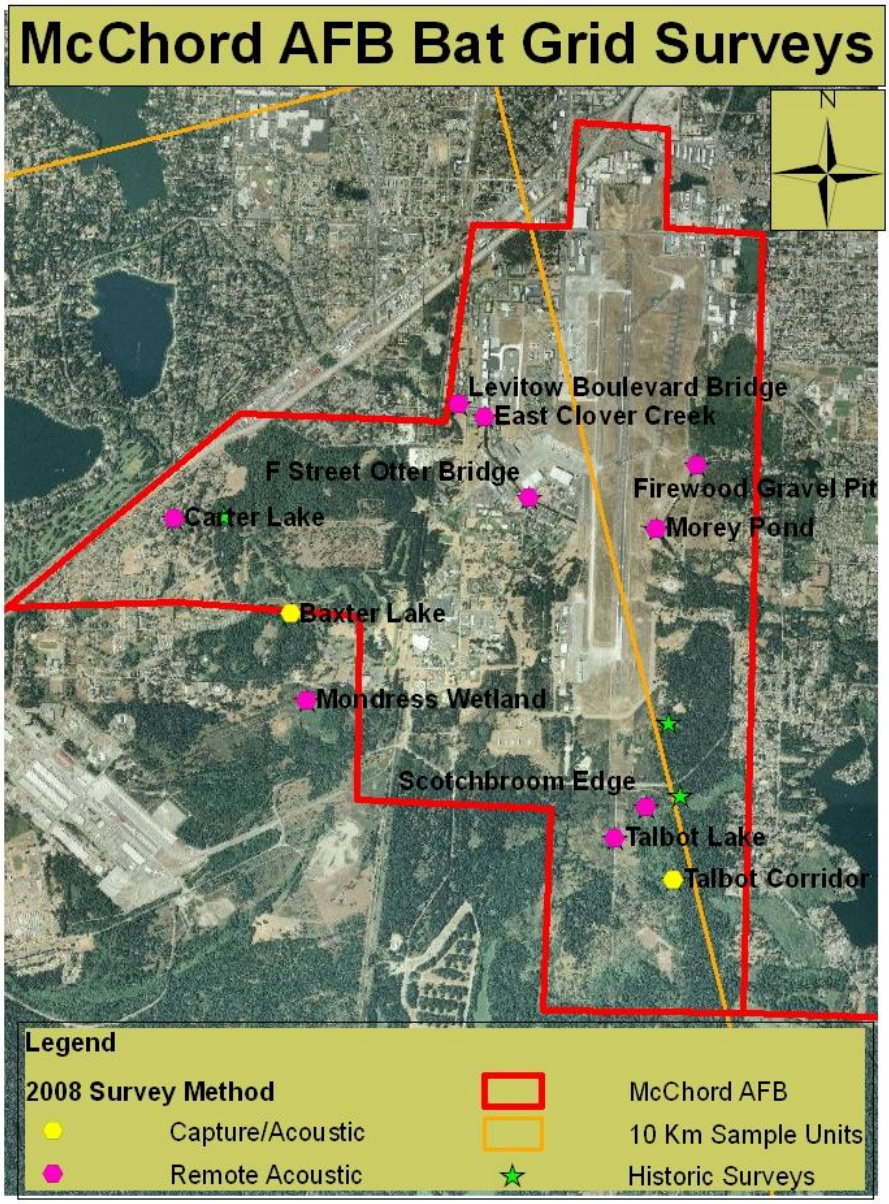

Figure 4. Geographic display of McChord AFB Bat Grid survey sites, for surveys conducted July 15th-16th, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. Historic locations of bat surveys conducted prior to The Bat Grid also are presented.

Table 5. *Bat species detected during the 2008 Bat Grid Project at McChord AFB. Acoustic detections were assessed manually with automated assistance from Sononbat 3.0. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm them to species with full confidence. Species that would be expected in western Washington and associated with habitats present at McChord are identified under "Generally Expected".*

McChord AFB Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**	Baxter Lake		Carter Lake, Morey Pond		X
Myotis lucifigus **(little brown bat)**	Baxter Lake	F Street Otter Bridge, East Clover Creek, Talbot Corridor, Carter Lake, Firewood Gravel Pit, Mondress Wetland, Morey Pond, Talbot Lake, Baxter Lake			X
Myotis evotis **(western long-legged myotis)**		Talbot Lake			X
Eptesicus fuscus **(big brown bat)**	Baxter Lake	F Street Otter Bridge, Mondress Wetland, Talbot Lake	Talbot Corridor, Carter Lake, Morey Pond		X
Myotis yumanensis **(Yuma myotis)**		Mondress Wetland, Morey Pond			X
Myotis californicusi **(California myotis)**		Mondress Wetland, Talbot Lake, Baxter Lake			X
Myotis keenii **(Keen's myotis)**				X	X
Myotis ciliolabrum **(western small-footed myotis)**				X	
Tadarida brasilliensis **(Mexican free-tailed bat)**				X	
Parastrellus hesperus **(canyon bat)**				X	
Lasionycterus noctivagans **(silver-haired bat)**		Scotchbroom Edge, Carter Lake, Firewood Gravel Pit, Mondress Wetland, Morey Pond	Talbot Lake		X
Lasiurus cinereus **(hoary bat)**		Scotchbroom Edge, Carter Lake, Firewood Gravel Pit, Mondress Wetland, Talbot Lake, Baxter Lake			X

Implications – Since 8 of 11 potential bat species were detected at McChord AFB, 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) and *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. It is reasonable to assume that because of the proximity of Fort Lewis to McChord AFB, that bats use habitat on both facilities without regard to administrative boundaries.

Most of the bat species detected on McChord are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat on or adjacent to McChord AFB 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.

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 on August 5th-6th. 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 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 6.**).

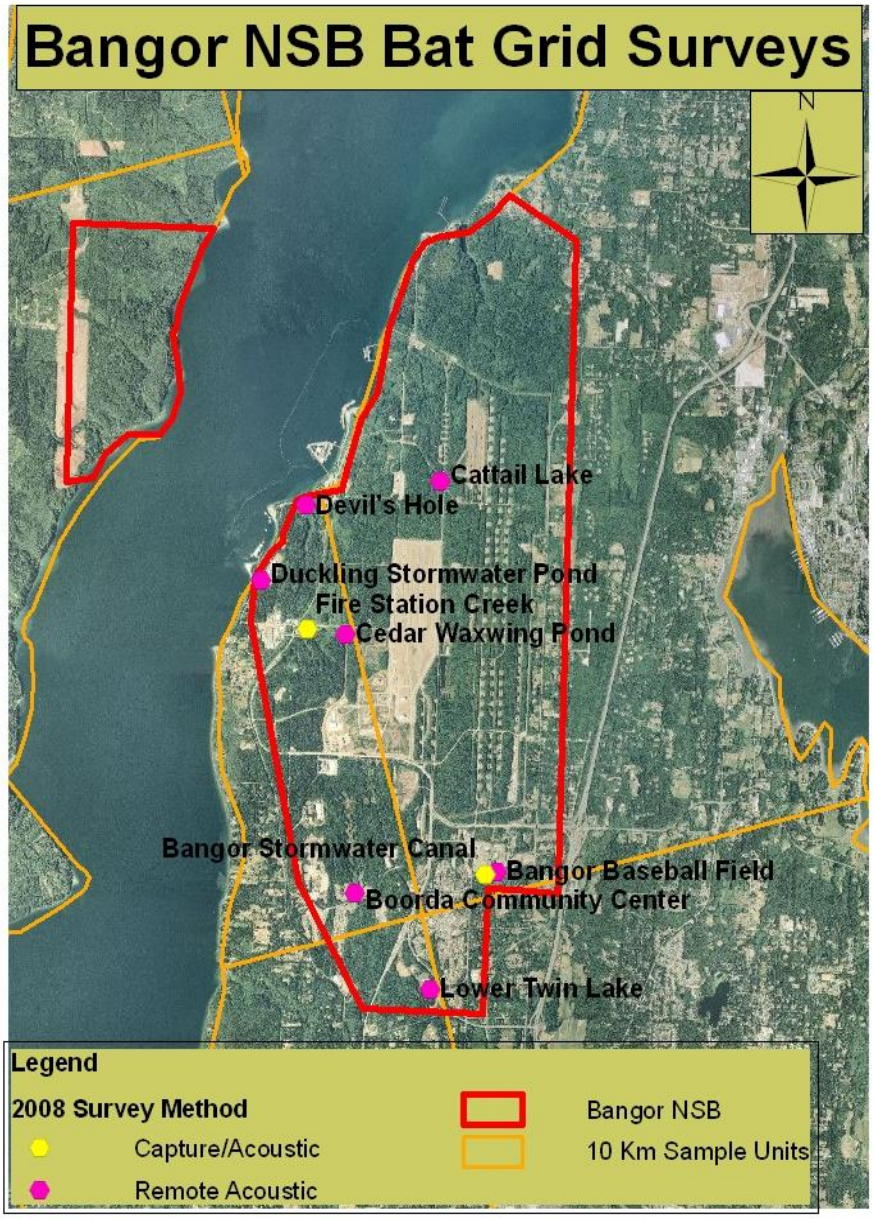

Figure 5. Geographic display of Bangor NSB Bat Grid survey sites, for surveys conducted August 5th-6th, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. No historic surveys are known for this area.

Table 6. *Bat species detected during the 2008 Bat Grid Project at Bangor NSB. Acoustic detections were assessed manually with automated assistance from Sononbat 3.0. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm them to species with full confidence. Species that would be expected on the Olympic Peninsula, Washington and associated with habitats present at Bangor are identified under "Generally Expected".*

Bangor NSB Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**		Bangor Stormwater Canal		**X**	**X**
Myotis volans **(long-legged myotis)**		Bangor Stormwater Canal	Boorda Community Center, Cattail Lake, Duckling Stormwater Pond, Devil's Hole		**X**
Myotis lucifigus **(little brown bat)**	Bangor Stormwater Canal	Bangor Stormwater Canal, Boorda Community Center, Cattail Lake, Duckling Stormwater Pond, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake			**X**
Myotis evotis **(western long-legged myotis)**		Bangor Stormwater Canal, Boorda Community Center, Cedar Waxwing Pond, Lower Twin Lake			**X**
Eptesicus fuscus **(big brown bat)**		Duckling Stormwater Pond, Cedar Waxwing Pond, Devil's Hole	Bangor Stormwater Canal, Boorda Community Cente, Lower Twin Laker		**X**
Myotis yumanensis **(Yuma myotis)**		Bangor Stormwater Canal, Boorda Community Center, Cattail Lake, Duckling Stormwater Pond, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake			**X**
Myotis californicusi **(California myotis)**	Bangor Stormwater Canal	Bangor Stormwater Canal, Boorda Community Center, Cattail Lake, Duckling Stormwater Pond, Cedar Waxwing Pond, Devil's Hole, Lower Twin Lake			**X**
Myotis keenii **(Keen's myotis)**				**X**	**X**
Myotis ciliolabrum **(western small-footed myotis)**				**X**	
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**				**X**	
Lasionycterus noctivagans **(silver-haired bat)**		Bangor Stormwater Canal, Boorda Community Center, Duckling Stormwater Pond, Cedar Waxwing Pond, Bangor Baseball Field, Devil's Hole, Lower Twin Lake			**X**
Lasiurus cinereus **(hoary bat)**		Boorda Community Center, Lower Twin Lake			**X**

Implications – Since 9 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 on August 1st-2nd. 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 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 7.**).

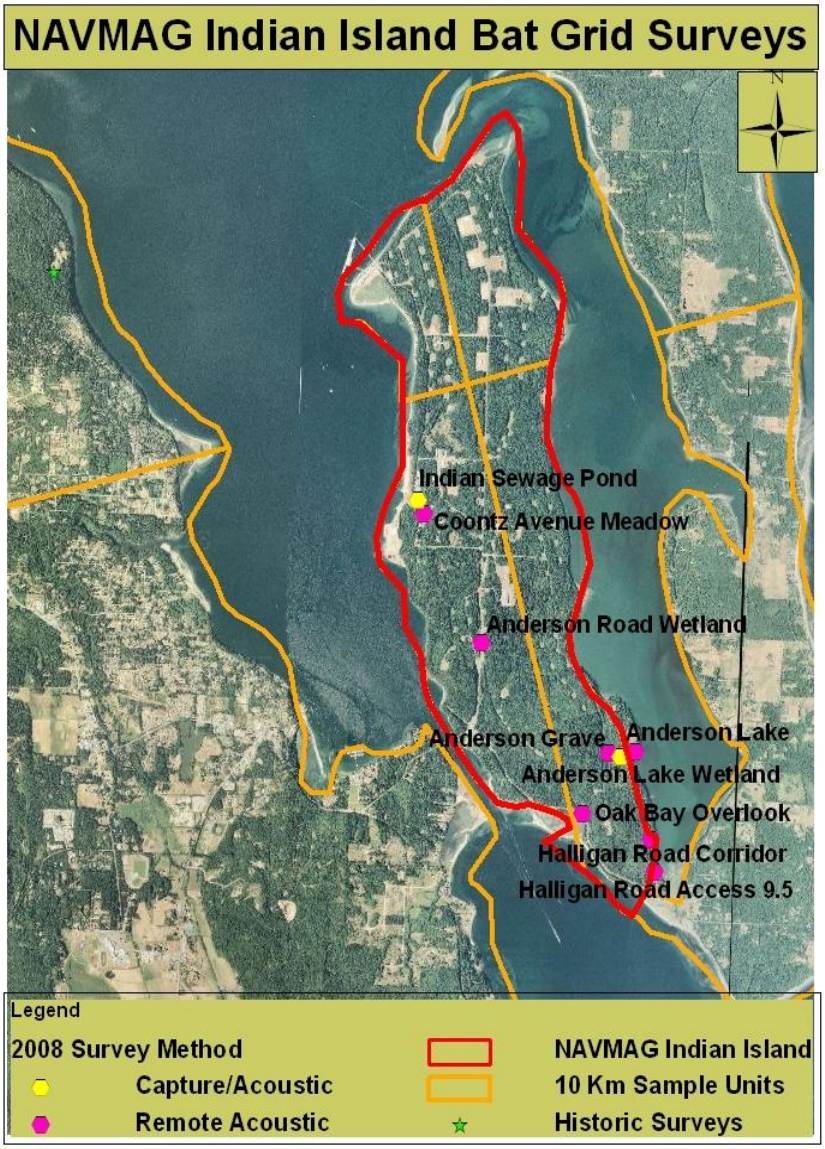

Figure 6. Geographic display of NAVMAG Indian Island Bat Grid survey sites, for surveys conducted August 5th-6th, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. One known historic survey, northwest of Indian Island is also presented.

Table 7. *Bat species detected during the 2008 Bat Grid Project at NAVMAG Indian Is NSB. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm species with full confidence. Species that would be expected on the Olympic Peninsula, Washington and associated with habitats present at Indian Is are identified under "Generally Expected".*

NAVMAG Indian Is Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**		Anderson Lake			**X**
Myotis volans **(long-legged myotis)**			Halligan Rd Access 9.5, Halligan Rd Corridor, Oak Bay Overlook, Anderson Lake Wetland, Indian Sewage Pond, Anderson Lake		**X**
Myotis lucifigus **(little brown bat)**	Indian Sewage Pond, Anderson Lake	Anderson Grave, Halligan Rd Access 9.5, Halligan Rd Corridor, Oak Bay Overlook, Anderson Lake Wetland, Indian Sewage Pond, Anderson Lake			**X**
Myotis evotis **(western long-legged myotis)**	Indian Sewage Pond	Anderson Grave, Halligan Rd Access 9.5, Indian Sewage Pond, Anderson Lake			**X**
Eptesicus fuscus **(big brown bat)**	Indian Sewage Pond	Indian Sewage Pond, Anderson Lake	Halligan Rd Corridor, Coontz Ave Meadow, Anderson Lake Wetland		**X**
Myotis yumanensis **(Yuma myotis)**	Indian Sewage Pond, Anderson Lake	Halligan Rd Access 9.5, Halligan Rd Corridor, Oak Bay Overlook, Anderson Lake Wetland, Indian Sewage Pond, Anderson Lake			**X**
Myotis californicusi **(California myotis)**	Indian Sewage Pond	Anderson Grave, Halligan Rd Access 9.5, Halligan Rd Corridor, Anderson Lake Wetland, Indian Sewage Pond			**X**
Myotis keenii **(Keen's myotis)**				**X**	**X**
Myotis ciliolabrum **(western small-footed myotis)**				**X**	
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**				**X**	
Lasionycterus noctivagans **(silver-haired bat)**		Coontz Ave Meadow, Oak Bay Overlook, Anderson Lake Wetland, Indian Sewage Pond	Anderson Rd Wetland, Anderson Lake		**X**
Lasiurus cinereus **(hoary bat)**		Anderson Grave, Halligan Rd Access 9.5, Coontz Ave Meadow, Anderson Lake Wetland, 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.

Whidbey Naval Air Station

Whidbey NAS is located approximately 2 miles north and east of Oak Harbor, WA on Whidbey Island. It covers approximately 7,000 acres at a general elevation of 50 feet with little elevation gradient. The base is characterized by urban development, parks, and a golf course with some residual hardwood and coniferous woodlands and wetland areas.

Bat Grid Surveys were conducted August 3rd and 4th. A total of 11 acoustic and mist net surveys were conducted (3 mist net and 8 remote acoustic surveys). Survey sites included ponds and wetlands dispersed across both developed and undeveloped portions of the base (See **Figure 7**). Additionally, 2 roost surveys were conducted, 1 at the Cresent Harbor Bridge and 1 external survey only at the abandoned building between Penfold Pond and Cresent Harbor bridge. No bats or sign of roosting were detected.

Seven bat species were captured and/or confirmed acoustically and 1 additional species was suspected acoustically. Three additional species of bats could be expected on the San Juan Islands associated with habitats found on Whidbey Island but were not detected (**Table 8.**).

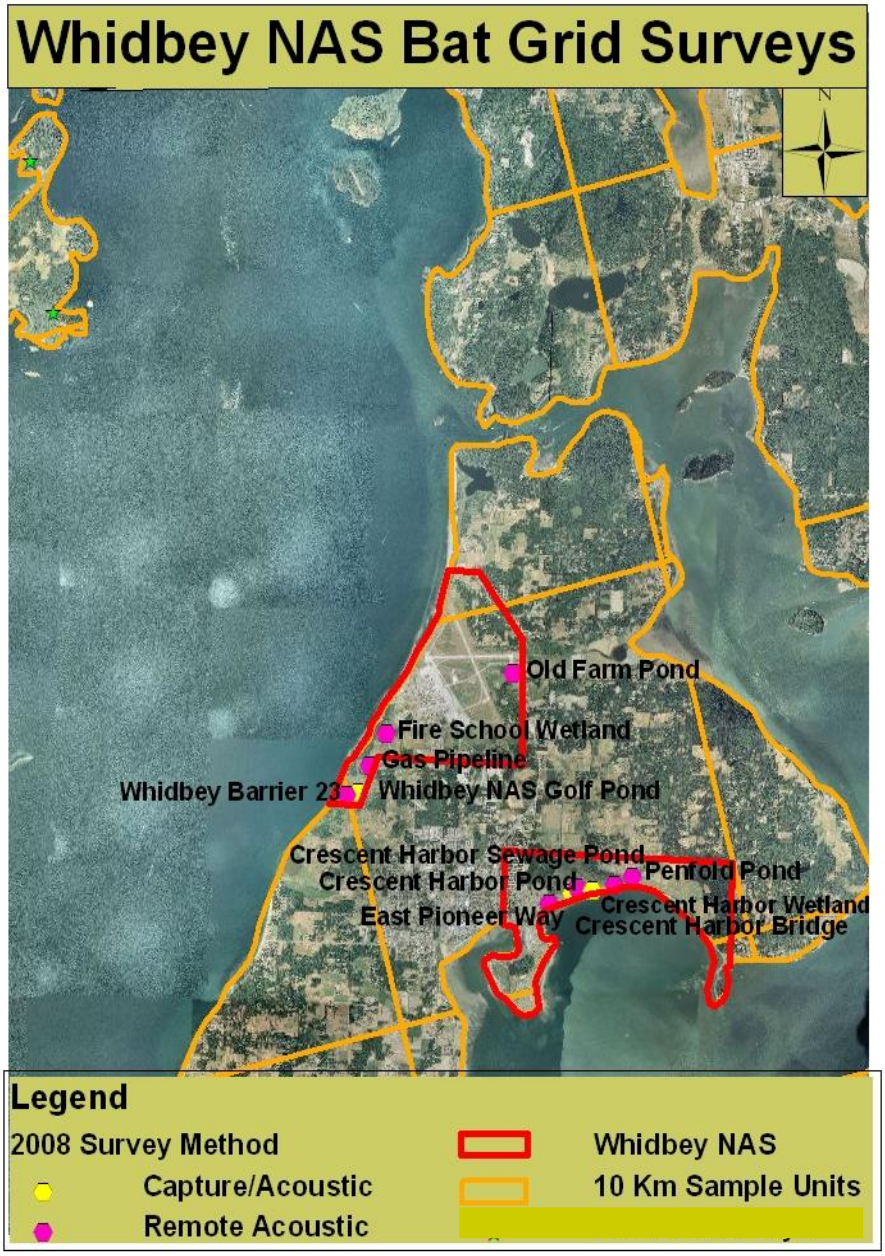

Figure 7. Geographic display of Whidbey NAS Bat Grid survey sites, for surveys conducted August 5th-6th, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. There are no known historic survey sites on Whidbey Island.

Table 8. *Bat species detected during the 2008 Bat Grid Project at Whidbey NAS Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm species with full confidence. Species that would be expected on Whidbey Island, Washington and associated with habitats present on Whidbey NAS are identified under "Generally Expected".*

Whidbey NAS Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**			Old Farm Pond, Penfold Pond, Golf Pond		**X**
Myotis lucifigus **(little brown bat)**	Golf Pond	Old Farm Pond, Crescent Harbor Sewage Pond, East Pioneer Way, Penfold Pond, Golf Pond, Golf Pond			**X**
Myotis evotis **(western long-legged myotis)**		Old Farm Pond, Golf Pond			**X**
Eptesicus fuscus **(big brown bat)**	Golf Pond	Gas Pipeline. Golf Pond	Old Farm Pond, East Pioneer Way, Crescent Harbor Wetland, Penfold Pond, Whidbey Barrier 23		**X**
Myotis yumanensis **(Yuma myotis)**		Crescent Harbor Pond, Gas Pipeline, Old Farm Pond, Crescent Harbor Sewage Pond, East Pioneer Way, Crescent Harbor Bridge, Crescent Harbor Wetland, Penfold Pond, Whidbey Barrier 23, Golf Pond			**X**
Myotis californicusi **(California myotis)**		Old Farm Pond, Fire School Wetland, East Pioneer Way, Crescent Harbor Bridge, Penfold Pond, Whidbey Barrier 23, Golf Pond			**X**
Myotis keenii **(Keen's myotis)**				**X**	**X**
Myotis ciliolabrum **(western small-footed myotis)**				**X**	
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**				**X**	
Lasionycterus noctivagans **(silver-haired bat)**		Gas Pipeline, Old Farm Pond, Fire School Wetland, East Pioneer Way, Penfold Pond, Whidbey Barrier 23, Golf Pond	Crescent Harbor Wetland		**X**
Lasiurus cinereus **(hoary bat)**		Old Farm Pond, Golf Pond			**X**

Implications – Since 7 of 11 potential bat species were detected at Whidbey NAS, 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), *M. thysanodes* (fringed 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 Whidbey NAS are considered forest-dwelling and rely on trees and snags for roosting. Insuring snag habitat on Whidbey NAS 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 on July 30th and attempted but failed because of rain on July 31st. A total of 4 acoustic and mist net surveys were conducted (1 mist net and 3 remote acoustic surveys). Survey sites included water sources and road corridors dispersed across the undeveloped portions of the base (See **Figure 8**.). A single roost survey was conducted at

Five bat species were captured and/or confirmed acoustically and 2 species were suspected acoustically. Four additional species of bats could be expected in this part of coastal Washington and associated with habitats found on Jim Creek NRS but were not detected (**Table 9.**).

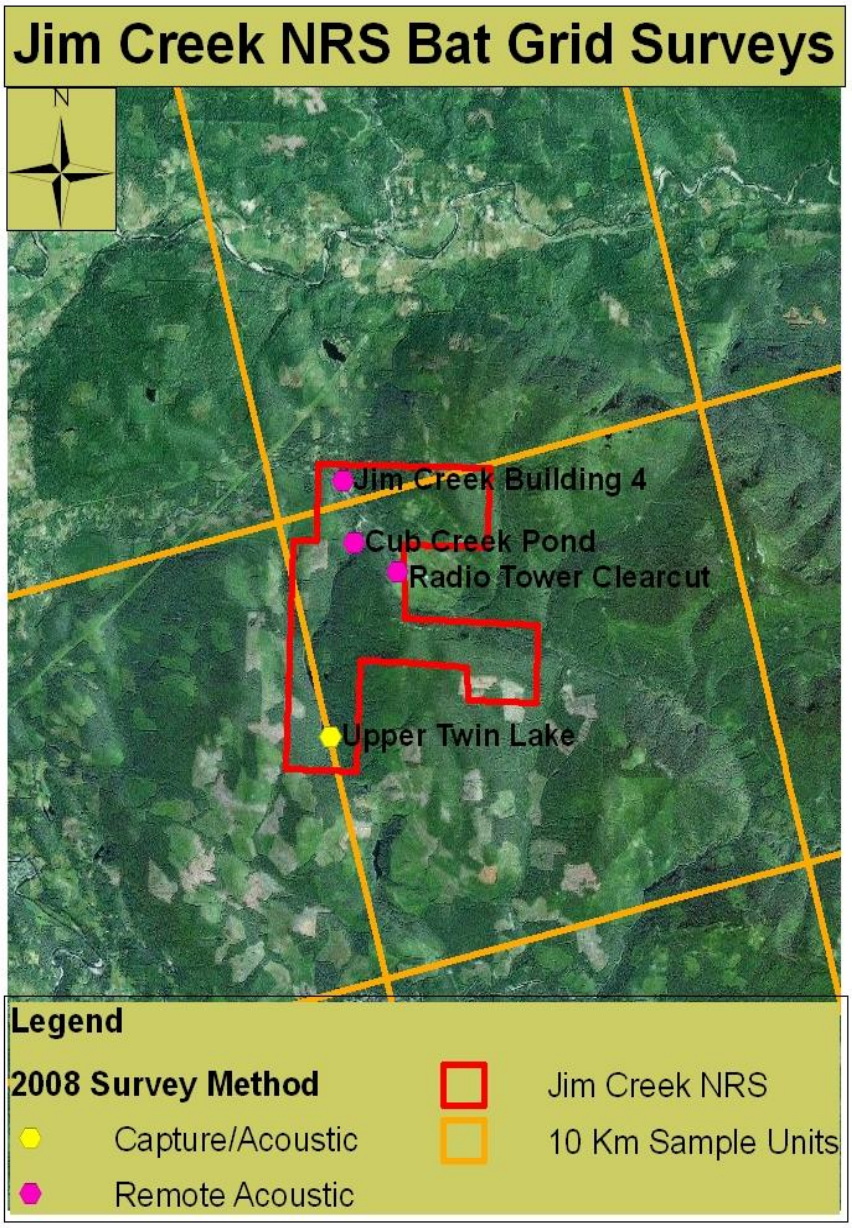

Figure 8. Geographic display of Jim Cr NRS Bat Grid survey sites, for surveys conducted July 30, 2008. Sites where a combination of mistnet captures and acoustic detections were conducted are designated separately from sites where remote acoustic stations were deployed. There are no known historic survey sites on Jim Cr NRS.

Table 9. *Bat species detected during the 2008 Bat Grid Project at Jim Creek NRS. Site locations listed under "Acoustic Confirmed" are those where collected bat calls displayed classic characteristics established for species identification. Locations listed under "Acoustic suspected" are those where collected bat calls lacked quality to confirm species with full confidence. Species that would be expected for western Washington and associated with habitats present at Jim Cr. NRS are identified under "Generally Expected".*

Jim Creek NRS Species Detections					
Species	**Captured**	**Acoustic Confirmed**	**Acoustic Suspected**	**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)**			Upper Twin Lake, Cub Creek Pond		**X**
Myotis lucifigus **(little brown bat)**	Upper Twin Lake (*M. lucifugus/yumanensis, species not confirmed)*	Upper Twin Lake, Cub Creek Pond			**X**
Myotis evotis **(western long-legged myotis)**					**X**
Eptesicus fuscus **(big brown bat)**			Upper Twin Lake, Cub Creek Pond		**X**
Myotis yumanensis **(Yuma myotis)**	Upper Twin Lake (M. lucifugus/yumanensis, species not confirmed)	Upper Twin Lake, Cub Creek Pond			**X**
Myotis californicusi **(California myotis)**		Upper Twin Lake			**X**
Myotis keenii **(Keen's myotis)**				**X**	**X**
Myotis ciliolabrum **(western small-footed myotis)**				**X**	
Tadarida brasilliensis **(Mexican free-tailed bat)**				**X**	
Parastrellus hesperus **(canyon bat)**				**X**	
Lasionycterus noctivagans **(silver-haired bat)**		Cub Creek Pond	Upper Twin Lake		**X**
Lasiurus cinereus **(hoary bat)**		Cub Creek Pond			**X**

Implications – Since 5 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.

2009 work

Data for 2009 has been collected and is being collated in preparation for analysis. In 2009, additional survey effort was conducted at 5 Oregon and 6 Washington DoD facilities.

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 2008 and all indications are that this trend will continue. The training, mentoring, and collaborative surveys appeal to biologists and others who want to hone their field skills and understanding of bat ecology and life history and for some, remember why they got in to the field of biology in the first place. The Bat Grid provides a credible, standardized, and technically supported venue for this type of learning and for building invaluable partnerships that lead not only to the conservation of this taxon, but others 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.

In 2009-2011, the completion of tool development (e.g., automated call analyses) and data analyses products are expected to reflect a culmination of investments of time and money.

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