2008 Bat Inventory: A Pilot Study

Klondike Gold Rush National Historical Park

Photo: Little Brown Myotis on Moore House Shed

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Abstract

Few studies have been done on species distribution, phenology, and the natural history of bats in Alaska. Existing records show the greatest species diversity exists in the southeast where five species are likely to occur regularly. This study provides a first look at bat activity in Klondike Gold Rush National Historical Park and its vicinity, using passive acoustic monitoring techniques that are commonly employed in species surveys. Detections can be attributed to at least one of four *Myotis* species, as well as a non-Myotis species newly recorded in 2008, but identification beyond the genus level was not possible with the resources available. The continuation of this study would be more comprehensive with the addition of mist-netting efforts and active acoustic monitoring to more accurately define the species present.

Key Words

Bats, Passive Bioacoustic Monitoring, Anabat Detector, Mammals, Inventory, Klondike Gold Rush National Historical Park, Alaska

Contents

Abstract.......... ii
Key Words.......... ii
Introduction.......... 1
Sites.......... 2
Methods.......... 2
Results.......... 4
Discussion.......... 4
Recommendations.......... 5
Acknowledgements.......... 5
Literature Cited.......... 6

Figures

Figure 1. Bat Activity Rates: Nelson Slough Pond, April 20 – October 9, 2007 7
Figure 2. Bat Activity Time: Nelson Slough Pond, March 11 – October 9, 2007..........8

Appendices

A. Range Maps..........9
B. Installation and Management of the Anabat Detector..........10
C. Mist Netting Proposal..........11
D. Nelson Slough Detector Location Map..........13

Introduction

An acoustic monitoring pilot study was initiated in the summer of 2007 to inventory the bat species occurring in Klondike Gold Rush National Historical Park (KLGO). Of the six species with ranges that most nearly approach Skagway, the little brown Myotis (*Myotis lucifugus*) has the greatest likelihood of occurring in the park. It has the widest range of all bat species occurring in Alaska with sightings as far north as Fairbanks, and extending to King Salmon and Kodiak Island in the southwest. Specimens of the little brown Myotis have been collected throughout southeast Alaska, from Ketchikan to Yakutat, as well as in Atlin, BC, and throughout the southern Yukon Territory. The other five species that may occur in the park are the Keen's Myotis (*Myotis keenii*), California Myotis (*Myotis californicus*), long-legged Myotis (*Myotis volans*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*) (see Appendix C for range maps of all six candidate species). Only one specimen of the big brown bat has ever been collected in Alaska (Parker 1997), located in a building in the interior where it is thought to have been incidentally transported by humans. A study of bat species distribution in Southeast Alaska by Parker in 1997 did not produce any recordings of the big brown bat in their echolocation surveys.

The presence of the silver-haired bat in KLGO was confirmed this season by an echolocation recording. Previously, the Taku River had been the northernmost site of documentation, 120 km to the southeast. Other reports from as far north as Prince William Sound have not been substantiated. Several more recordings from this year can only be attributed to the silver-haired bat or the big brown bat, but because these two species share call types that are nearly indistinguishable, it is unknown which species the recordings belong to.

The regular occurrence of the Keen's Myotis, California Myotis, and long-legged Myotis in Southeast Alaska is substantiated by several specimens of each species that were collected throughout the region. While Skagway would be the northernmost location in Alaska to find evidence of these species, their seasonal or permanent residence in the area is well within the realm of possibility. The long-legged Myotis has been found at a comparable latitude in Atlin, BC, the Keen's Myotis has been found within 160 km to the south, and the California Myotis occurs as close as the northern tip of Prince of Wales Island, approximately 375 km southeast of Skagway (Parker 1997).

The method of bat detection used in this study was passive acoustic monitoring. It calls for the installation of a bat detector in a location where it records ultrasound for a predetermined range of hours during the day. The detectors in this study were set to begin and end recording at approximately sunset and sunrise, respectively, these being the hours of the day when the bats will be actively hunting and flight activity will be at its highest. While bats are not the only source of ultrasound in the natural environment, their echolocation calls are distinguishable from the ultrasound produced by insects and weather events, which are the two other sources most likely to be recorded.

As with any bat survey methodology, there are advantages and disadvantages to using passive acoustic monitoring as a means of inventorying bat species and their relative frequency of occurrence. When compared with active monitoring, its greatest benefit is in the time saved by unattended recording. It requires only installation, periodic data maintenance, and a reliable source of power.

On the other hand, passive acoustic monitoring can result in a large quantity of extraneous "noise" files in the data, which often demands a significant amount of processing time in the office in order to sift out the relevant echolocation recordings. The greatest disadvantage of passive monitoring is the lack of on-site visual observation that can be extremely useful, and is often necessary, in making accurate species identification. Passive monitoring by itself is also unable to collect the data needed to accurately gauge species abundance, because there is no way of knowing how many echolocation recordings belong to each individual bat that passes the detector. However, it would be possible to develop an activity index.

Sites

This year, monitoring took place only at the Nelson Slough site established in 2007. It is an aquatic habitat where slough water collects in a pond, and then continues to drain through a channel of wetland that forms a short flying corridor. The slough contains primarily grasses and sweet gale, and is bounded by young Sitka spruce. Large numbers of insects and an unobstructed flying space are conducive to high levels of bat activity in the area. The site was selected for ease of access and high levels of bat activity found in 2007, and for continuity with last year's data.

Methods

This pilot study used passive monitoring techniques to count passes and identify species using the echolocation calls emitted by flying bats. The detection equipment used in this study consisted of a single Anabat 2 detector (Titley Electronics, Sydney, Australia) paired with an Anabat ZCAIM recording unit. An Anabat SD1 with built-in ZCAIM function failed to perform properly in the field and was not used successfully this year. The Anabat 2 apparatus was installed in a single location for the full extent of the study period, where it was placed inside weatherproof housing and then attached to a small Sitka spruce using nylon utility straps. This allowed for a low profile, unintrusive design that was quick to deploy and maintain.

Figure 1. Nelson Slough bat detector

The weatherproofing of the detectors was based on a design suggested by Chris Corben, the bat biologist responsible for engineering the Anabat (http://users.lmi.net/corben/). The general concept is to keep the detector body and microphone head clear of harmful debris and rain while minimizing the impact on its capacity to detect ultrasound. This is achieved by orienting the microphone directly down and placing a plastic board beneath it to reflect ultrasonic calls up into the microphone. Placing the reflector at a 45 degree angle over level ground effectively makes the area of detection the same as if the microphone were facing a direction parallel to the ground. The main disadvantage of this design is the extra ultrasonic noise produced when rain or debris hits the reflector. The body of the detector was placed in plastic housing along with foam for cushioning. An external 12V gel cell battery was placed on the ground beneath each detector and supplied sufficient power for 9 to 14 days of passive monitoring.

Passive recording began in March when there was a considerable amount of snow around the site, and it is scheduled to end in mid-October when the number of call recordings per night has dropped to zero. This will ensure that the arrival and departure of migrating bats, or the initiation of and arousal from hibernation, is fully documented. The detector was set to begin recording 30 minutes before official sunset and end 30 minutes after official sunrise.

The detector unit used a 512 MB CF storage card to store the call data for analysis at a later time. The card was checked and deleted no less frequently than once every two weeks to ensure that the memory was never entirely filled. The calls were converted into Analook sequence files by the AnalookW program, which automatically separates each call sequence into an individual file (see Appendix B for full details on data management).

Recordings were manually filtered by eye to quantify the number and quality of bat detections. First, the noise files were separated from those that were recognizable as having originated from a bat, regardless of their clarity. This was performed subjectively, using a combination of recording length, pixel density and group shape, and time intervals between pixels. The bat call files were then categorized as either of sufficient quality to be used in species identification (minimum temporal length of 1,000 cycles), or poor quality and of no use for identification purposes. This process, too, was necessarily subjective without an electronic means of filtration. Due to the interspecific similarities and intraspecific variation in echolocation calls between certain bat species in other geographic regions, which can result in misidentification of call sequences (Betts, 1998; Barclay, 1999), the six possible species were divided into two groups according to the minimum frequencies of their calls. The little brown Myotis, California Myotis, long-legged Myotis, and Keen's Myotis were placed in a 40 kHz Minimum Frequency Group (MFG), while the big brown bat and silver-haired bat were placed in a 25 kHz MFG.

Discriminant function analysis is often needed for identification of calls to the species level, notably within the Myotis genus. This process sorts the calls into defined categories based on input parameters such as sweep range, minimum frequency, maximum frequency, characteristic frequency, and characteristic slope. The parameter values should be based on those found in the calls of a reference library for the geographic region. There is currently no reference library available for the park's geographic region, and rectifying this should be a priority in the future. The park is also currently without a discriminant function analysis program, so the call recordings from this season could only be identified to the frequency group level.

Results

Bats species from both MFGs outlined above were represented in this year's recordings. There were a total of 2,111 recordings, 1,862 of which were recognizable as being produced by a bat, and 1,551 of which were considered of high enough quality for use in species identification (**Table 1**). Nineteen calls belonged to the 25 kHz MFG, and the remaining 1,843 calls were classified as members of the 40 kHz MFG. All but one call could not be positively identified beyond the genus level due to the limitations of analysis tools and reference datasets available to the park. The one identifiable call (file I5210116.36#) belonged to a silver-haired bat, a new record for the park and an extension to the bat's northern range as shown in Appendix A. The identification was made by Cori Lausen, a bat research biologist of British Columbia (personal communication, October 2, 2008).

Beyond the overlap in call parameters within the two frequency groups, there are further complications such as directionality, attenuation, and Doppler shift that can cause calls from the same individual in the same habitat to appear differently in the recordings. This, in combination with the potential for variation in an individual's call due to habitat, reinforces the need for mist-netting, reference dataset development, and discriminant function analysis in order to make consistently accurate identification to species level.

There were two spikes in the quantity of calls recorded during the season, one in mid-July (n=66), and one in late August (n=96). From the first call recorded on April 20 to the last call recorded on October 5, the mean number of calls per night was 11.

The abundance of bats in the park could not be calculated with a strong degree of accuracy from the data gathered. However, it is apparent from the number of recordings collected that bats occur regularly in and around the park from March to mid-October, and that there is at least one non-Myotis species that occurs regularly in the area. The last call was recorded on October 5, which suggests either a seasonal shift in habitat use or the initial stages of hibernation.

With no recordings after October 18 in 2007, and no reported sightings from the community, there is currently no evidence of bats overwintering in the park.

Discussion

The significance of this pilot study is primarily the confirmation of the regular occurrence of at least two bat species in and around the park. Without investing in more sophisticated analysis tools and mist-netting efforts to develop a call reference library, it will not be possible to satisfactorily identify the species that make regular use of park land. However, it may be feasible to gain a general idea of the habitats that harbor the greatest bat activity and use those to estimate the relative abundance of bats in different areas of the park throughout the year.

While only one of the recordings could be positively identified to species, it is very likely that the majority of those in the 40 kHz MFG belonged to the little brown bat, based on the range, common occurrence, and typical call frequency of that species. The California Myotis, which is known to produce an echolocation call with a minimum frequency of 50 kHz, is distinguishable from the other three Myotis species in its frequency category. No

recordings exhibited this feature, however, and the presence of this species could not be verified.
The unidentifiable calls in the 25 kHz MFG most likely belong to the silver-haired bat, based primarily on the fact that the only published specimen record of the other non-Myotis species collected in Alaska, the big brown bat, was from the Alaskan interior and may have been an accidental occurrence. In the 25 kHz MFG, there is a single call that can be used to distinguish the silver-haired bat from the big brown bat if an Anabat detector is used as the recording device (C. Lausen, personal communication, May 31, 2008).

The number of monitoring sites was reduced to one this year due to a reduction in resources. While it takes minimal effort to maintain the Nelson Slough site, little can be learned about the habitat use and distribution of bats in the park without sampling a variety of sites. The discovery of at least a second bat species in the park should further encourage the revamping of monitoring efforts initiated in 2007.

Recommendations

Due to the difficulty and unreliability of species identification using only echolocation calls for the candidate bat species in the park, it is highly recommended that a mist-netting effort be made in the continuation of this study, along with the use of passive acoustic monitoring in a broader range of habitats. Active acoustic recording should accompany each instance of mist-netting so that a call library can be established for use in identifying the calls collected in passive acoustic monitoring.

The results from the past two seasons concur with the literature on the finding that the number of calls recorded near water and open spaces is greater than in heavily wooded areas where high clutter occurs. This suggests that recording and mist-netting be concentrated near water and open flyways where the capture rate should be higher, and the likelihood of recording all bat species in the area will be greatest, due simply to a greater number of active bats in the area. (See Appendix C for mist-netting project budget.)

Acknowledgements

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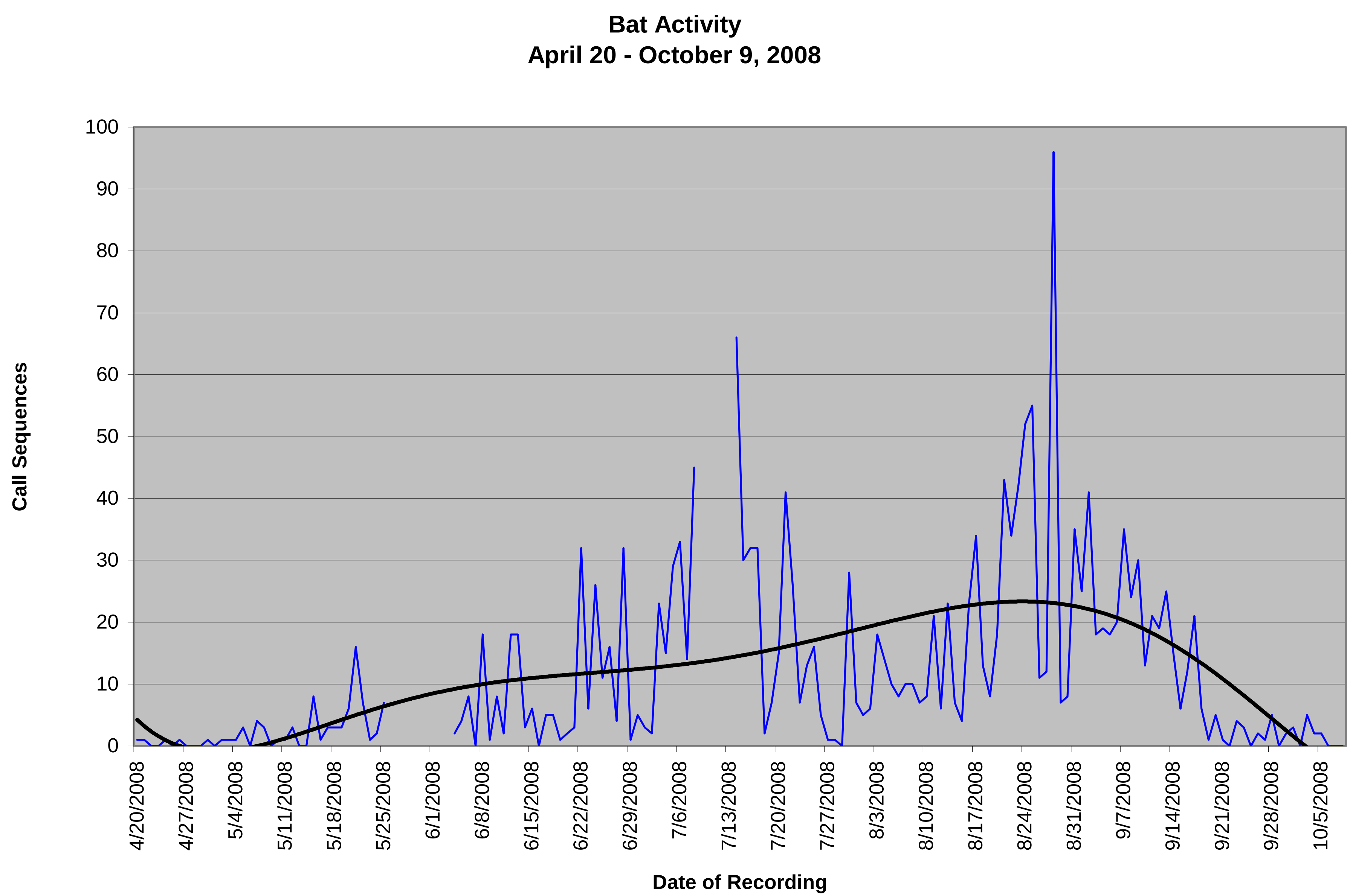


Figure 1. This graph represents the change in bat activity at the Nelson Slough Pond site during the span of the study period.

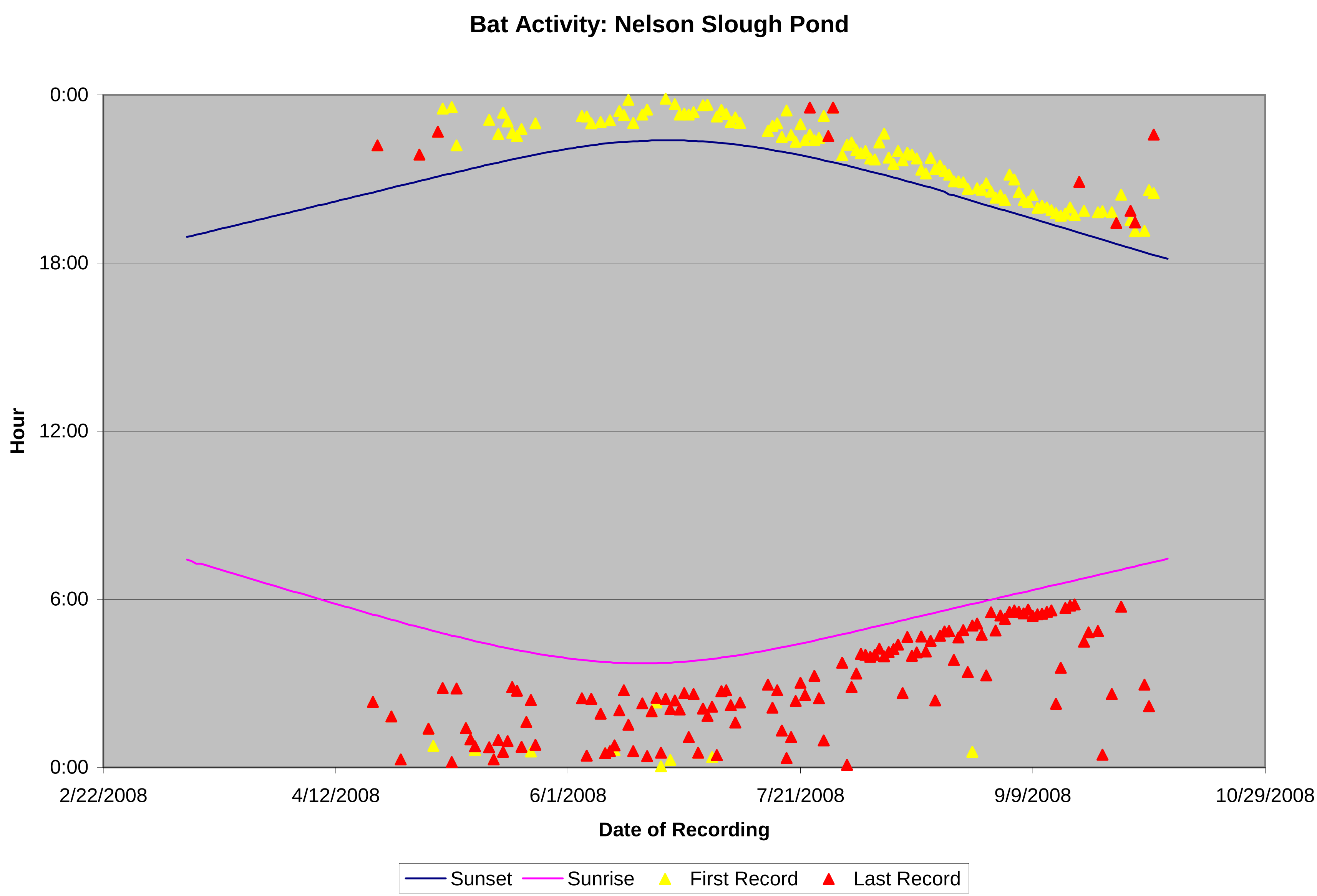
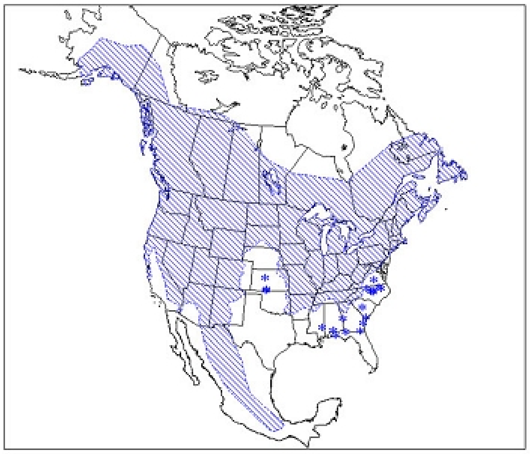


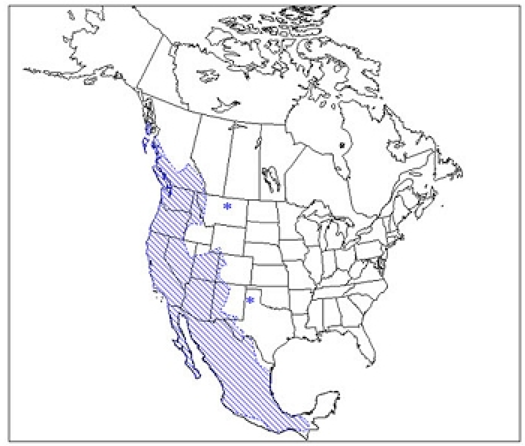
Figure 2. This graph represents the times of bat activity at the Nelson Slough Pond site during the span of the study period.

Appendix A – Range Maps (Bat Conservation International 2008)

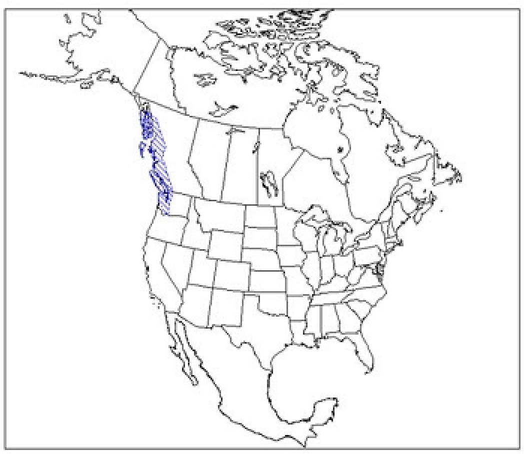
Little Brown Myotis



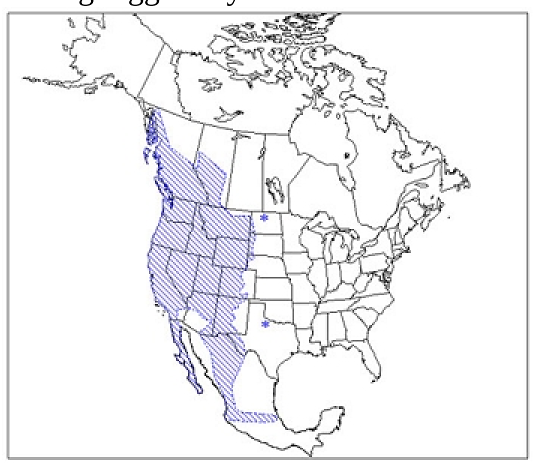
California Myotis



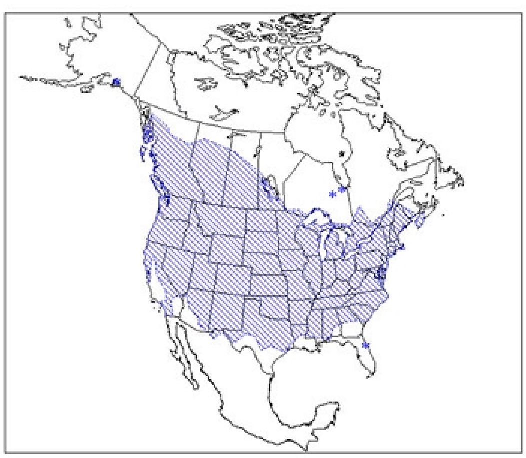
Keen's Myotis



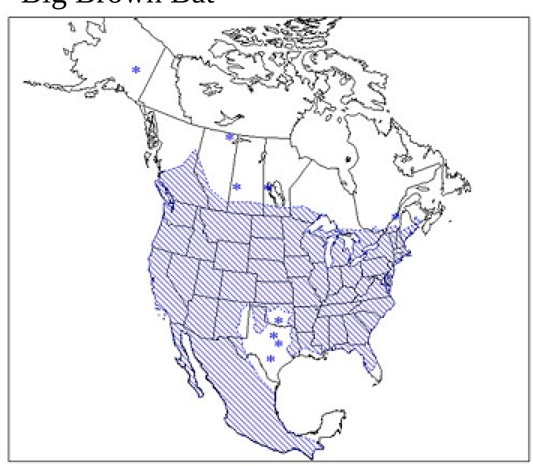
Long-legged Myotis



Silver-haired Bat



Big Brown Bat



Appendix B – Installation and Management of the Anabat Detector

<u>CF Card Initialization</u>

A CF card is used to store the call data. It must first be formatted to FAT in My Computer, then initialized for use by the Anabat in the CFCREAD program. The recording times should then be set in CFCREAD before insertion into the Anabat detector. Consult the CFCREAD instruction manual for details (T:\NRM\Mammals\Bats\Anabat\CFCread Instructions).

<u>Anabat SD1 and ZCAIM Preparation</u>

The local time must be checked and set in CFCREAD before deployment to ensure temporal accuracy and consistency with daylight savings time changes. Consult the CFCREAD instruction manual for details.

<u>Data Management</u>

Using a 512 MB CF card should be sufficient for at least one week, and likely as long as two weeks, of data storage before the card fills to maximum capacity, depending upon bat activity levels. It is recommended that the card be checked weekly to ensure no loss of data. To download the recordings, use a CF card reader and the download function in the CFCREAD program. The “Make ZCA file” box should be checked and the Raw option should be selected. The “Save Data File” and “Interpret Data” boxes should also be checked and the Division Ratio set to 16. The rest of the default settings should be fine.

After a successful download, make sure the begin and end times for recording are correct in the CFCREAD window and then use the Erase function.

The recording files should be transferred to a new folder in T:\NRM\Mammals\Bats, and should include sequence files (e.g., .58#), ZCA files, a RAW data file (unaltered copy of the original recordings before download), and a text file of the download.

<u>Data Analysis</u>

The data can be viewed in Windows using the program AnalookW. Sequence files default to open in AnalookW. Once opened, they can be viewed on different timescales by selecting from F1-F10. They can also be condensed or expanded using the DPP1-DPP4 buttons. The arrow keys on the keyboard will shift the viewing frame along the call sequence. The Q and W keys on the keyboard will move from one sequence file to the next within the open folder. If there is a computer set for DOS use only, the data can be viewed there using the DOS version of Analook.

<u>Deployment</u>

The detector apparatus should be installed vertically, usually against a tree, such that the microphone faces the ground. The reflector should be placed at an angle of approximately 45 degrees to the tree so that the microphone, in effect, is facing towards the area of bat activity.

Appendix C – Mist Netting Proposal

Equipment

6 mist net poles (enough for a single high mist net setup) = $99.00 (www.batmanagement.com)

Forest Filter Mist Net System = $650.00 (www.batmanagement.com)

Harp Trap 3' Cave Catcher = $650.00, 6' Forest Strainer = $950.00, Catch Bag = $65.00 (www.batmanagement.com)

Avinet 2.6x2.6m = $80, 2.6x6m = $100, 2.6x9m = $130, 2.6x12m = $145, 2.6x18m = $210 (Alana ecology)

6 mist net poles (26mm) = $280 (Alana ecology)
6 mist net poles (19mm) = $240 (Alana ecology)

Procedure

Open nets 30 minutes before sundown and leave up for at least three hours. It has been suggested that mist nets be checked continuously to achieve optimum capture rate, and no less frequently than every 10 minutes to minimize injury to bats. Also, it is recommended that four infrared lights be used per net to maximize detection of captured bats.

Between 30 and 200 reference calls should be used in Discriminant Function Analysis. If one bat of each resident species were successfully caught and processed on each netting effort, the total mist-netting efforts should be 30.

6 sites x 7 hours (4 for netting, 3 for travel and setup) x 5 nights x $21/hour = $4410

Passive monitoring will take place at six sites for approximately one month per site.

6 sites x 4 hours (3 for travel and site choice, 1 for setup) x $21/hour = $504

Data Management and Analysis
Discriminant Function Analysis software is needed for species identification. STATA 10 SE costs $1550 with the base manual (add $275 for complete set of manuals).

Hours per CF card download: 3 (1 for travel, 2 for analysis) x 25 x $21 = $1575
Hours on DFA: 20 x $21 = $420
Hours on miscellaneous tasks: 20 x $21 = $420
Management Total: $2415

Safety

Those persons handling bats should receive full rabies prevaccinations at least one month prior to handling. It is also recommended that thick leather gloves be used in handling whenever possible, namely on the hand being used to hold the bat.

Resource	**Cost**
Mist Net Components (2x6m, 2x9m, 2x12m, 24 26mm poles)	$1870
Biotech Mistnetting	$4410
Biotech Passive Monitoring	$504
Biotech Data Management	$2415
Discriminant Function Analysis Software (STATA 10 SE)	$1550
Leather Gloves (3 pairs)	$60
Rabies Prevaccination	$250
Total	**$11,059**

Nelson Slough Bat Detector

Klondike Gold Rush National Historical Park

Department of the Interior
National Park Service

● Detector Location

Appendix D

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0 150 300 600 Meters