

Submitted to: Michael A. Bogan, U.S. Geological Survey, Fort Collins Science Center, Arid Lands Field Station, Albuquerque, New Mexico

November 2005

Prepared by: Shauna Haymond, Holistic Wildlife Services NM, LLC, 112 Hampton Roads Avenue, Hampton, Virginia 23661.



Introduction

Holistic Wildlife Services NM, LLC, conducted acoustic surveys for bats at Canyonlands National Park (CANY). Efforts were part of a larger bat inventory effort being conducted by the U.S. Geological Survey, Fort Collins Science Center, Arid Lands Field Station and Natural History Associates (Bogan and Mollhagen 2005) for the National Park Service (NPS) Northern Colorado Plateau Network (NCPN). The NPS was engaged in a nationwide program to inventory vascular plants and vertebrates on park lands.

A variety of sampling methods (e.g. mist netting combined with roost and acoustic surveys) are effective for assessing the status of bats because of their mobile nature (Hayes et al. in press; Kunz and Kurta 1988). Mist netting is often used to capture bats drinking from or feeding over sources of water. Acoustic surveys for bats are useful when no water is available over which to net or when water is too ample to effectively concentrate bats over a small enough area for capture. They can also be helpful in detecting species that are not easily captured in mist nets. Extensive mist netting was conducted on some areas of CANY in 2004 (Bogan and Mollhagen 2005), however not all areas were inventoried because of a lack of suitable net sites.

The objectives of this investigation were to inventory and document the presence of bat species using acoustic surveys in areas that were difficult to inventory with mist nets and to document bat species which were expected to occur within CANY but had not been captured with mist netting efforts. Activity of bats and relative abundance was also assessed.

Study Area

Efforts focused on the Island in the Sky and Needles districts of CANY. No mist netting had been undertaken in Island in the Sky therefore, a complete inventory of the district was needed. Island in the Sky is a sandstone mesa that rises approximately 1,000 feet above the surrounding terrain and lacks substantial or accessible perennial sources of water.

Extensive mist netting for bats had previously occurred throughout Needles (Bogan and Mollhagen 2005). Consequently acoustic sampling was employed to document species that had not been captured, but were expected to be present. Sandstone spires and narrow canyons characterized the Needles district.

Methods

Four sampling sites were selected within Island in the Sky: Willow Flat Campground, Syncline Loop, Neck Spring, and Cabin Spring (Table 1). Willow Flat Campground was a developed campground situated on the mesa top amidst piñon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and sagebrush. The Syncline Loop sampling site was located near a small pothole of water on the north side of the loop. The drainage included a riparian area with intermittent pools of water. Vegetation included piñon pine and Utah

juniper with occasional salt cedars (*Tamarix ramosissima*), and willows. The understory included ricegrass (*Stipa hymenoides*), four-wing saltbush (*Atriplex canescens*), and Mormon tea (*Ephedra viridis*). The Neck Spring sampling site was situated in a small, narrow canyon near several small pools of water. The Cabin Spring sampling site was in a small, narrow canyon near a large pool of water and several smaller pools. Vegetation around the Neck Spring and Cabin Spring sampling sites consisted of mesic vegetation including Gambel oak (*Quercus gambeli*), maidenhair fern (*Adiantum capillus-veneris*), and various grasses. One additional site located in the Big Mesa camping area on Bureau of Land Management (BLM) land 15.9 km north of Island in the Sky was sampled. This site was sparsely vegetated with junipers and sagebrush.

Two sampling sites were selected at Needles: Big Spring and the Gray Water facility. The sampling site at Big Spring Canyon was situated below the trailhead at the spillway above a large pool of water. Vegetation primarily consisted of cottonwoods (*Populus* sp.), willows, salt cedar and four-wing saltbush. The Gray Water facility was a man-made holding pond surrounded by salt cedar and four-wing saltbush.

Acoustic surveys entailed the use of a bat detector and compact flash storage zero-crossing analysis interface module (Anabat II bat detector, Anabat CF ZCAIM, and associated hardware; Titley Electronics, Ballina, New South Wales, Australia) that recorded echolocation calls at a division ratio set at 16. One bat detector-ZCAIM recording system was positioned at each sampling point for 1 to 2 nights. Bat detectors were either placed on the ground or attached to a tripod extended about 0.5 m. Bat detector microphones were positioned at approximately 45 degrees to the horizon and trained at areas of interest (eg. water sources, flight corridors) and away from areas of high clutter (eg. dense vegetation; Sherwin et al. 2000). Systems were programmed to begin passively recording approximately 30 minutes prior to sunset and terminate recording approximately 30 minutes prior to sunrise. Sensitivity of detectors was set to 6.

A bat detector produces audible output from the ultrasonic calls emitted by echolocating bats. The ZCAIM interfaced the audio-frequency signal from the detector to a memory card. Files were then converted to a frequency (kHz)-time (ms) display using Anabat software (Analook). Displays were used to identify species based on qualitative analysis of call parameters (eg. shape, minimum frequency of calls, maximum frequency of calls, body of calls, change in slope, time between calls) compared to reference calls from known individuals.

The location and elevation of each sampling site were recorded in UTMs (NAD27 datum) using a Garmin GPSmap 76S Global Positional System unit.

Number of call sequence files recorded, percent of call sequence files that were identifiable to species, level of activity for each sampling site (number of files recorded per hour), and relative abundance of each species (percent of all call sequence files recorded) were determined. A tally of sampling-hours (number of hours of recording) was also generated.

Results

Fieldwork was conducted 13-20 June 2005, and consisted of 77.5 sampling hours (Table 2). Efforts resulted in recording 3,622 call sequence files of which 93.2% contained identifiable call sequences. Eleven species were detected (Tables 3 and 4) and all species were detected in both districts except long-legged myotis (*Myotis volans*), which was detected only in Island in the Sky, and western small-footed myotis (*M. ciliolabrum*), which was detected only in the Needles district. California myotis (*M. californicus*; 51.0%) and Western pipistrelle (*Pipistrellus hesperus*; 41.7%) generated more than 90% of all recorded call sequence files (Table 5). California myotis, western pipistrelle, and big brown bat (*Eptesicus fuscus*) where recorded at all sampling sites. For the four sampling sites in Island in the Sky, eight species were recorded at Cabin Spring, five at Neck Spring, five at Syncline Loop, and seven at Willow Flat. Five species were also recorded at Big Mesa on BLM land. For the two sampling sites in Needles eight species were recorded at the Gray Water facility and five were recorded at Big Spring.

Not all bat species have equal probability of detection with acoustic surveys (Gannon et al. 2003). Bats that fly slowly and produce quiet, low-intensity calls, such as Townsend's big-eared bat (*Corynorhinus townsendii*), can be more difficult to detect with passive recording efforts than species with louder, higher-intensity calls, such as the western pipistrelle, especially when activity of the latter is great in the area of interest. Additionally, while using a division ratio of 16 is ideal for recording the majority of species expected in this study area using the Anabat system, some species produce a call that is more suited to recording at a different division ratio. For example, echolocation calls of the spotted bat (*Euderma maculatum*) would be more suited to recording at a lower division ratio because of the low frequency of the calls.

The average number of call sequences recorded per hour was 46.7 however, level of activity varied greatly among sampling sites. Level of activity was greatest at Gray Water (Needles district) where 78.2 calls sequence files were recorded per hour (Table 6). Level of activity was lowest at Big Mesa (BLM district) where level of activity was 1.1 call sequence files per hour and Willow Flat (Island in the Sky) where level of activity was 7.0 call sequence files per hour. Low activity levels at these two sites could most likely be attributed to the absence of water.

Bear in mind that level of activity quantified by acoustic sampling with bat detectors does not indicate an absolute measure of abundance or density of bats because a single bat repeatedly flying within the detectable range of the microphone cannot be discerned from multiple bats (Hayes 2000). Level of activity may also vary considerably temporally and spatially, as bats are dynamic in nature (Gannon et al. 2003; Sherwin et al. 2003). Hence, these results indicate presence of species and are a measure of the amount of bat use of an area at a specific point in time.

Acoustic surveys provide important information for an inventory of bat species and can also be valuable for obtaining data for long-term monitoring of local bat populations for the purpose of conservation management. A well-designed study addressing spatial and

temporal fluctuations (seasonally and nightly) of bats can provide statistically defensible information on habitat associations, species distribution, and population trends (Hayes et al. in press; Walsh et al. 2002). Monitoring efforts would entail creating a detailed echolocation call library from hand-released local species, randomly selecting multiple monitoring sites within a variety of habitats, and conducting concurrent sampling at all monitoring locations across multiple years.

Literature Cited

Bogan, Michael A., and Tony R. Mollhagen. 2005. Inventory for bats (Chiroptera) at Canyonlands National Park, Utah. Unpublished report to Northern Colorado Plateau Network, Moab, UT. 19 pp.

Gannon, W. L., R. E. Sherwin, and S. Haymond. 2003. On the importance of articulating assumptions when conducting acoustic studies of habitat use by bats. Wildlife Society Bulletin, 31: 45-61.

Hayes, J. P. 2000. Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. Acta Chiropterologica, 2: 225-236.

Hayes, J. P., H. K. Ober, and R. E. Sherwin. In press. Survey and monitoring of bats. In: Ecological and behavioral methods for the study of bats second edition (T. H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C.

Kunz, T. H., and A. Kurta. 1988. Capture methods and holding devices. Pages 1-29 in: Ecological and behavioral methods for the study of bats (T. H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C.

Sherwin, R. E., W. L. Gannon, and S. Haymond. 2000. The efficacy of acoustic techniques to infer differential use of habitat by bats. Acta Chiropterologica, 2: 145-153.

Sheriwn, R. E., Gannon, W. L., and J. S. Altenbach. 2003. Managing complex systems simply: understanding inherent variation in the use of roosts by Townsend'sbig-eared bat. Wildlife Society Bulletin, 30: 97-100.

Walsh, A. L., R. M. Barclay, and G. F. McCracken. 2004. Designing bat-activity surveys for inventory and monitoring studies at local and regional scales. Pages157-165 in: Bat echolocation research: tools, techniques and analysis (R. M. Brigham et. al., eds). Bat Conservation Internation. Austin, Texas.

Table 1.—Acoustic bat inventory sampling sites visited during 2005, in and near Canyonlands National Park.

Name	District	Easting	Northing	Elev. (m)	Vegetation	Full Locality Description
Big Mesa Campground	BLM	0604051	4276677	1623	Desert shrubland	Utah: Grand Co., Bartlett Flat, 5325’
Syncline Loop pothole	Island in the Sky	0594409	4255647	1632	Desert riparian	Utah: San Juan Co., Canyonlands NP, Upheaval Dome, 5354’
Willow Flat Campground	Island in the Sky	0597168	4248848	1864	Piñon-juniper	Utah: San Juan Co., Canyonlands NP, Willow Flat, 6115’
Cabin Spring	Island in the Sky	0601381	4255323	1720	Mesic woodland	Utah: San Juan Co., Canyonlands NP, Grays Pasture, 5643’
Neck Spring	Island in the Sky	0602616	4255370	1730	Mesic woodland	Utah: San Juan Co., Canyonlands NP, Grays Pasture, 5676’
Gray Water Facility	Needles	0607595	4223167	1531	Desert shrubland	Utah: San Juan Co., Canyonlands NP, SE flank Squaw Butte, 4995’
Big Spring	Needles	0603466	4226034	1471	Desert riparian	Utah: San Juan Co., Canyonlands NP, Big Spring Canyon, 4826’

Table 2.—Field schedule for 2005 acoustic bat inventory at Canyonlands National Park and adjacent area, in chronological order, indicating dates, sampling site, district and sampling hours (number of hours spent recording).

Dates	Sampling Sites	District	Sampling Hours
13 June	Big Mesa Campground	BLM	9.0
14 June	Willow Flat Campground; Syncline Loop	Island in the Sky	10.0; 11.0
15 and 16 June	Neck Spring; Cabin Spring	Island in the Sky	9.5; 9.5
17 June	Willow Flat Campground	Island in the Sky	9.5
18 and 19 June	Gray Water Facility; Big Spring	Needles	9.5; 9.5
	Total		77.5

Table 3.—List of bat species detected during 2005 acoustic inventory and sampling site(s) where detected at Island in the Sky district and adjacent areas, Canyonlands National Park.

Common Name	Scientific Name	Sampling Site
California myotis	*Myotis californicus*	Big Mesa (BLM), Cabin Spring, Neck Spring, Syncline Loop, Willow Flat
Fringed myotis	*M. thysanodes*	Neck Spring
Long-legged Myotis	*M. volans*	Cabin Spring
Yuma myotis	*M. yumanensis*	Cabin Spring, Willow Flat
Western pipistrelle	*Pipistrellus hesperus*	Big Mesa (BLM), Cabin Spring, Neck Spring, Syncline Loop, Willow Flat
Big brown bat	*Eptesicus fuscus*	Big Mesa (BLM), Cabin Spring, Neck Spring, Syncline Loop, Willow Flat
Allen's big-eared bat	*Idionycteris phyllotis*	Cabin Spring
Pallid bat	*Antrozous pallidus*	Big Mesa (BLM), Cabin Spring, Neck Spring, Syncline Loop, Willow Flat
Brazilian free-tailed bat	*Tadarida brasiliensis*	Big Mesa (BLM), Cabin Spring, Syncline Loop, Willow Flat
Big free-tailed bat	*Nyctinomops macrotis*	Willow Flat

Table 4.—List of bat species detected during 2005 acoustic inventory and site(s) where detected at Needles district, Canyonlands National Park.

Common Name	**Scientific Name**	**Sampling Site**
California myotis	*Myotis californicus*	Big Spring, Gray Water
Western small-footed myotis	*M. ciliolabrum*	Big Spring
Fringed myotis	*M. thysanodes*	Gray Water
Yuma myotis	*M. yumanensis*	Gray Water
Western pipistrelle	*Pipistrellus hesperus*	Big Spring, Gray Water
Big brown bat	*Eptesicus fuscus*	Big Spring, Gray Water
Allen's big-eared bat	*Idionycteris phyllotis*	Gray Water
Pallid bat	*Antrozous pallidus*	Big Spring
Brazilian free-tailed bat	*Tadarida brasiliensis*	Gray Water
Big free-tailed bat	*Nyctinomops macrotis*	Gray Water

Table 5.—Relative abundance (% of all sequence files recorded) for each bat species detected during 2005 acoustic inventory at Canyonlands National Park.

Common name	Relative abundance (%)
California myotis	51.0
Western small-footed myotis	0.2
Fringed myotis	0.1
Long-legged myotis	0.1
Yuma myotis	0.5
Western pipistrelle	41.7
Big brown bat	0.8
Allen's big-eared bat	0.1
Pallid bat	1.9
Brazilian free-tailed bat	0.3
Big free-tailed bat	0.4

Table 6.—Level of all bat activity (number of call sequence files recorded per hour) at each sampling site as determined during 2005 acoustic inventory Canyonlands National Park and adjacent area.

District	Sampling Site	Level of activity (files recorded/hr)
BLM	Big Mesa Campground	1.1
Island in the Sky	Cabin Spring	21.0
Island in the Sky	Neck Spring	62.6
Island in the Sky	Syncline Loop	14.2
Island in the Sky	Willow Flat Campground	7.0
Needles	Big Spring	13.1
Needles	Gray Water	78.2