

A SURVEY OF DAY ROOSTING BY PLECOTUS TOWNSENDII IN LAVA-TUBE
CAVES AT CRATERS OF THE MOON NATIONAL MONUMENT,
BUTTE COUNTY, IDAHO

FINAL REPORT

RESEARCH CONTRACT

NATIONAL PARK SERVICE
CRATERS OF THE MOON NATIONAL MONUMENT
P.O. BOX 29
ARCO, IDAHO 83213

Barry L. Keller
and
Richard T. Saathoff

Idaho Museum of Natural History
Idaho State University
Pocatello, Idaho 83209

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SCOPE OF THE REPORT

This report summarizes nursery and day roost use of lava-tube caves by Plecotus townsendii (Townsend's big-eared bat) at Craters of the Moon National Monument. Forty-six of the 84 known caves at the Monument were examined during a warm season survey by Saathoff, who conducted assessments aimed at creating minimal disturbance during daylight hours. All single internal roost surveys were completed during the period 29 June until 22 August, 1994. No night-roost capture surveys were undertaken. Two nursery colonies were located and the caves containing them are recommended for further study.

INTRODUCTION

Plecotus townsendii, a species federally listed as C-2 and a species of special concern (SSC) in Idaho (Conservation Data Center, 1994) roosts in caves, mines, buildings. In Idaho, colonies hibernate during winter in lava-tube caves (Genter, 1986) near sites used as roosts during the summer (Keller, et al., 1993). The main diet of big-eared bats consists of small moths. Individuals supplement moisture from their food with water from streams, lakes, ponds, or temporary pools of free-standing water. Nursery colonies consist of clusters of 25 to 50 individuals. Clustering is assumed to preserve energy of young, enabling them to grow rapidly and store sufficient amounts of fat to survive their first winter of hibernation (Kunz, 1982). Nursery colonies typically occur in warmer parts of caves, mines, and buildings (Zeweloff, 1988), but temporal changes in the thermal envelope that is occupied by a cluster of individuals in a nursery colony remains to be investigated. During summer, males are usually solitary and roost alone or in groups of up to six bats (Nowak, 1991). A mammalian species account is available for this species (Kunz and Martin, 1982).

Vicki Snitzler-Neeck, Resource Manager at Craters of the Moon, has corroborated that the Crater's population of Plecotus townsendii has not been investigated by Monument employees historically. Until the summer of 1993, largely anecdotal evidence was available about bats species within the boundary of the area now designated as the Monument. Voucher specimens of bats collected from a variety of Monument locations, including specimens of big-eared bats, are on deposit at the U.S. National Museum, Berkeley Museum of Vertebrate Zoology, the Idaho Museum of Natural History, the Field Museum of Natural History, and the Texas A&M Museum as a result of historical surveys. The bulk of the specimens on deposit at IMNH were collected by Rick Carron during July and August 1969, but Davis (1939) collected some Craters bats prior to publishing his treatment of Idaho mammals. In May 1989, Keller and Wackenhut investigated a reported nursery colony site on the Monument, but failed to find bats. In 1993, a Monument employee discovered a probable nursery colony at Antelope Cave. In

1993, Bill Bosworth and Bill Doering, graduate students at Idaho State University, confirmed the presence of a nursery colony in Two-step Cave. This cave subsequently was closed to prevent disturbance to the nursery colony. The present study was initiated to locate Monument sites requiring management conservation efforts. Because the Monument contains extensive bat hibernacula, a major study, conducted over a period of years, is needed as a result of the status of big-eared bats. Early in 1995, a Habitat Conservation Assessment (HCA) and Conservation Strategy (CS) will be available that details status, life history and current and known threats for this species in the western states.

METHODS

Study Area

Accessible caves were surveyed at Craters of the Moon National Monument, Butte County, Idaho beginning in late June 1994, in the **North End Caves Area** north-northwest of Grassy Cone (see Fig 1). This area was selected initially as a result of previous observations of a nursery colony at Two-Step Cave, a situation suggesting potential for a high concentration of bats in adjacent caves. Survey work on the 11 northern caves was completed by July 7, 1994. Because 84 caves are known to exist in the Monument, a set of subjective criteria were used to selectively eliminate caves that likely would not yield significant data and would negatively impact the efficiency of completing a survey in the two month period available for this study. The criteria included:

- 1) If the caves had many skylights that provided excessive light, they were removed from the survey list.
- 2) If the cave ceiling was low, the passage limited, or if the cave appeared to contain dangerous conditions that impacted safety considerations, it was excluded from the survey list.
- 3) If the cave was used by visitors on a daily basis, it was removed from the survey list because of the likely exclusion of day-roosting individuals as a result of frequent disturbance.
- 4) If the distance between a cave and the nearest road was excessive, requiring over a day of cross country hiking, it was removed from the survey list.

Caves eliminated from survey were evaluated on the basis of reports and maps in the archives of the Monument. Thirty-five caves were eliminated from the list. Two caves which could be surveyed were overlooked until the end of August, at which point it was decided to wait to survey them until a subsequent summer. Out of 35 caves, 15 that were located in the southern **Wilderness Area** were eliminated because they required over a day of cross-country hiking to reach them. Six caves in the **Caves Area** were eliminated

because of high visitor use, four were considered too dangerous, three were too small, four were too light, and the remaining three were excluded as a result of miscellaneous problems.

Surveying Caves

When caves were surveyed, caution was exercised because of the Hantavirus carried by rodents, although infection has not been documented on Craters. Many of the caves contained nests or visually sighted Peromyscus maniculatus and Neotoma sp. populations, known primary reservoirs for hantavirus infection. Because death almost always results from infections of humans by this virus (Center for Disease Control, 1993), and because the virus is known to occur in Idaho (Hjelle, et al. 1994) in areas immediately adjacent to Craters, caution was exercised in small caves as a result of assumed limited air-flow exchange, a condition permitting potential aerosol infection of individuals. Consequently, when deemed appropriate, masks that filter out the dust particles on which the virus could be carried, were worn in caves that had a dirt floor and/or those not well ventilated. Caves that could be surveyed, were traversed slowly by one or two individuals on foot with the aid of flashlights. Occasionally, one Park service employee waited outside the opening. When bats were located, individuals were visually examined for colored wing bands used in winter studies by Wackenhut (1990), Bosworth (1994) and Doering (in prep.) during studies on the Idaho National Engineering Laboratory. Caves that contained free water pools were surveyed exceptionally carefully as a result of the need for water by bats in this desert area. After the initial survey inside a cave, it was sometimes useful to wait outside of the entrance for 15 minutes to determine if bats, not visually detected but present, attempted to exit or "light test" the mouth of the cave and return. A summary of 46 visited sites, detailed further in Table 1, is presented below.

Field Research Sites

1. Cave name: Binky
Cave location: T1N R24E sec 12 NW1/4
Comments: No bats, too light and short
2. Cave name: Button
Cave location: T1N R24E sec 12 NW1/4
Comments: No bats
3. Cave name: Flow Throat
Cave location: T1N R24E sec 11 NE1/4
Comments: No bats

4. Cave name: Moonshine
Cave location: T1N R24E sec 11 NE1/4
Comments: One Plecotus townsendii flying near the entrance,
pond in the SE side
5. Cave name: Skylight
Cave location: T1N R24E sec 11 NE1/4
Comments: No bats
6. Cave name: West Moonshine
Cave location: T1N R24E sec 11 NE1/4
Comments: No bats
7. Cave name: White Bone
Cave location: T1N R24E sec 11 NE1/4
Comments: No bats, Too open and short
8. Cave name: Buffalo
Cave location: T1N R24E sec 12 SE1/4
Comments: No bats
9. Cave name: Shelf
Cave location: T1N R25E sec 07 SW1/4
Comments: No bats according to a park employee
10. Cave name: Arco Tunnel
Cave location: T1N R25E sec 06 NE1/4
Comments: No bats
11. Cave name: Dry Well
Cave location: T1N R25E sec 06 SW1/4
Comments: One Plecotus townsendii flying from the rear of
the cave
12. Cave name: Lunch
Cave location: T1N R25E sec 06 SW1/4
Comments: No bats, too open and light
13. Cave name: North Fork
Cave location: T1N R25E sec 06 NE1/4
Comments: No bats
14. Cave name: Rock Wall
Cave location: T1N R25E sec 06 W1/2
Comments: No bats
15. Cave name: Roomy
Cave location: T1N R25E sec 06 SW1/4
Comments: No bats
16. Cave name: Tube Tube (Partition Cave, Skonier 1982)
Cave location: T1N R25E sec 06 S1/2
Comments: No bats, too light and warm

- 17.Cave name: Underfoot
Cave location: T1N R25E sec 06 SW1/4
Comments: No bats
- 18.Cave name: White Powder
Cave location: T1N R25E sec 06 NE1/4
Comments: No bats
- 19.Cave name: Lava Pool
Cave location: T1N R24E sec 02 NW1/4
Comments: No bats, too small
- 20.Cave name: Small
Cave location: T1N R24E sec 02 N1/2
Comments: No bats, too small
- 21.Cave name: Three Room
Cave location: T2N R24E sec 35 SW1/4
Comments: No bats
- 22.Cave name: Antelope
Cave location: T2N R24E sec 34 SW1/4
Comments: One Plecotus townsendii flying near the north entrance
- 23.Cave name: Bloody Knees
Cave location: T2N R24E sec 34 SW1/4
Comments: No bats
- 24.Cave name: Coyote Hole Blister
Cave location: T2N R24E sec 35 NW1/4
Comments: No bats
- 25.Cave name: Fire Ring
Cave location: T2N R24E sec 34 SW1/4
Comments: No bats
- 26.Cave name: Ice Lake
Cave location: T2N R24E sec 34 SW1/4
Comments: One dead frozen bat in the ice, could not identify species. Water on the surface of the ice
- 27.Cave name: Low Tide
Cave location: T2N R24E sec 34 SW1/4
Comments: No bats
- 28.Cave name: Sand Trap
Cave location: T2N R24E sec 34 SW1/4
Comments: No bats

- 29.Cave name: Screaming Jaws of Death
Cave location: T2N R24E sec 34 SW1/4
Comments: Approximately ten Plecotus townsendii in the rear of the cave
- 30.Cave name: Shelter
Cave location: T2N R24E sec 27 SE1/4
Comments: No bats
- 31.Cave name: Tunnel
Cave location: T2N R24E sec 34 S1/2
Comments: No bats, too open and light
- 32.Cave name: Two-Step
Cave location: T2N R24E sec 34 SW1/4
Comments: Plecotus townsendii nursery colony
- 33.Cave name: Arched Pit
Cave location: T1N R25E sec 07 NE1/4
Comments: No bats
- 34.Cave name: Chapel
Cave location: T1N R25E sec 07 NE1/4
Comments: No bats
- 35.Cave name: Great Owl Cavern
Cave location: T1N R24E sec 14 NE1/4
Comments: No bats
- 36.Cave name: Monument
Cave location: T1N R24E sec 12 SW1/4
Comments: One bat flew into cave but could not be identified. Saathoff was only able to see it momentarily.
- 37.Cave name: White Roof
Cave location: T1N R24E sec 14 NE1/4
Comments: No bats
- 38.Cave name: First Chance
Cave location: T1N R25E sec 05 NE1/4
Comments: No bats
- 39.Cave name: Hidden I
Cave location: T1N R25E sec 05 W1/2
Comments: No bats
- 40.Cave name: Hidden II
Cave location: T1N R25E sec 05 W1/2
Comments: No bats, looks like good bat habitat

41. Cave name: Horseshoe
Cave location: T1N R25E sec 05 NE1/4
Comments: No bats
42. Cave name: Last Chance
Cave location: T1N R25E sec 04 NW1/4
Comments: No bats
43. Cave name: Lava River
Cave location: T1N R25E sec 04 NW1/4
Comments: No bats
44. Cave name: Needles
Cave location: T1N R25E sec 05 NE
Comments: Plecotus townsendii nursery colony
45. Cave name: Spatter Cone Moat
Cave location: T1N R25E sec 05 N1/2
Comments: No bats
46. Cave name: Tom Thumb Tunnel
Cave location: T1N R25E sec 05 NE1/4
Comments: No bats, too open and light

No random netting surveys detailing night-roosting habits of Monument bats was undertaken during the summer, 1994, a condition that should be immediately rectified in subsequent work. Potential free standing water sites also were reviewed for possible summer netting. Two proposed netting sites, selected on the basis of water availability, accessibility for transport of equipment, and the abundance of bats in the area were located. These two sites are in the very northern section of the Monument and are fairly close together (Fig. 1). Pools of water on the Monument are largely absent. The two located sites likely contain water as a result of the Pioneer Mountains which contain snow pack until summer. During the study period free-standing water was present until July, a condition leading to expanded utilization of the area by bats. Exact locations include:

1. Site name: Little Cottonwood Creek by Martin Mine
Site location: T2N R24E sec 22 W1/2
Comments: A bat detector was used at 80khz on July 7, 1994. The creek was moist and bats were detected fairly consistently. Trees and shrubs are present.
2. Site name: Creek at "Research Camp"
Site location: T2N R24E sec 27 NW1/4
Comments: The site was checked on August 23, 1994. The creek had water in it about 50 meters from the work station. The site contains many trees and shrubs. A bat detector was not used.

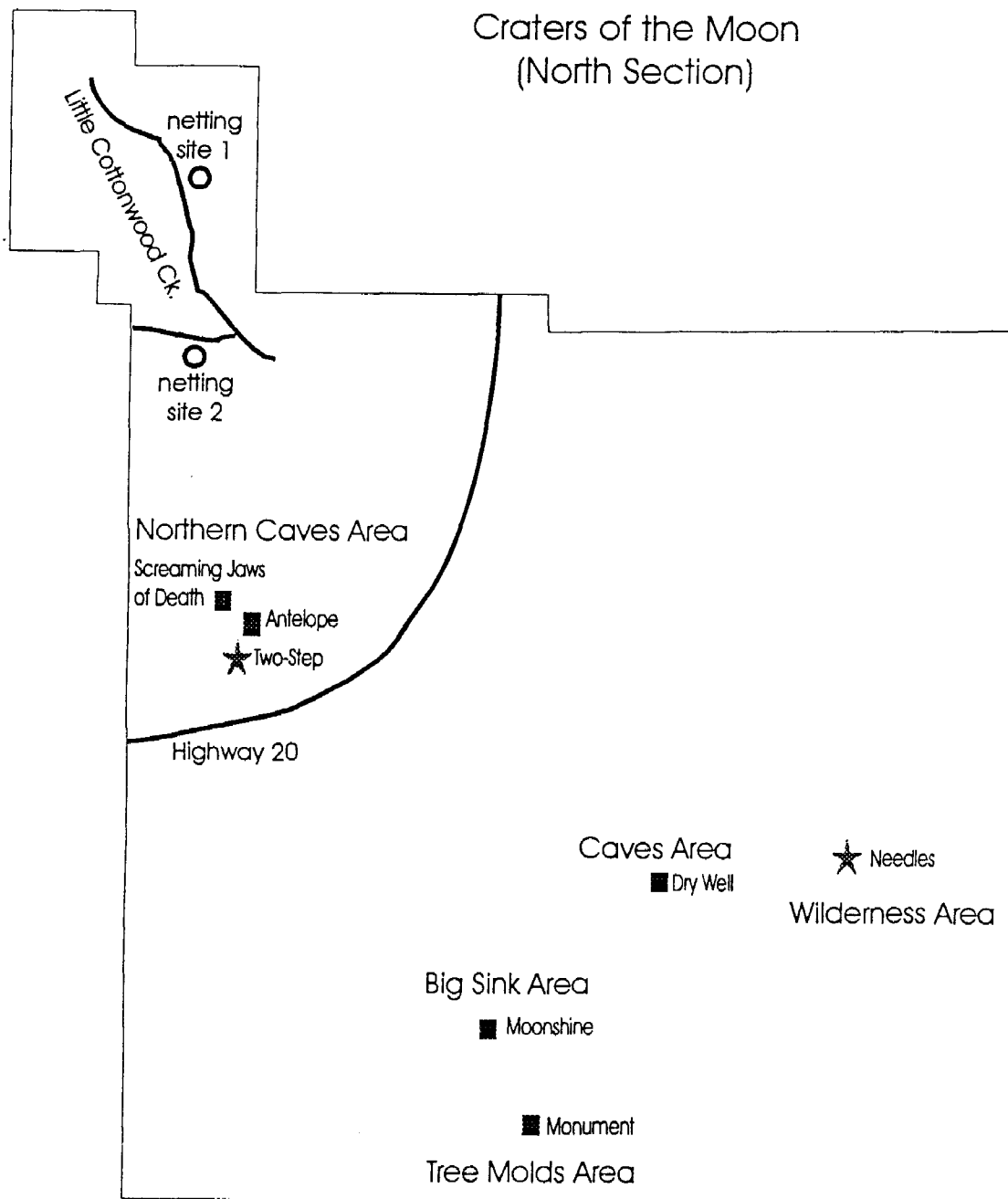


Figure 1. Map of bat locations and netting sites within Craters of the Moon

3 Km

Table 1. Craters of the Moon cave summary for the Summer of 1994. Approximate length of cave is in meters and NA = not available.

Name of Cave	Date	Comments	Approximate Length of Cave	Location
BIG SINK AREA				
Binky	08/08/94	No bats, too light and short	14m	T1N, R24E, Sec12, NW
Button	08/08/94	No bats	6m	T1N, R24E, Sec12, NW
Cone		Too small	8m	T1N, R24E, Sec12, NW
Crystal Pit		Closed due to fragile crystals, 90ft rapel	24m	T1N, R24E, Sec12, NW
Deep Crack		Dangerous	46m	T1N, R24E, Sec12, NW
Flow Throat	08/08/94	No bats	5m	T1N, R24E, Sec11, NE
Holiday		2ft high ceilings, too small	NA	T1N, R24E, Sec12, NW
Lava Cascades		Too small	18m	T1N, R24E, Sec12, NE
Manhole Shaft		30ft rapel	NA	T1N, R24E, Sec12, NW
Moonshine	08/08/94	One <u>Plecotus townsendii</u> flying near entrance Pond in SE side	6m	T1N, R24E, Sec11, NE
Rolling Rock		30ft rapel, unstable	16m	T1N, R24E, Sec02, SE
Skylight	08/08/94	No bats	6m	T1N, R24E, Sec11, NE
West Moonshine	08/08/94	No bats	5m	T1N, R24E, Sec11, NE
White Bone	08/08/94	No bats, too open and short	6m	T1N, R24E, Sec11, NE
BUFFALO AREA				
Buffalo	08/08/94	No bats	NA	T1N, R24E, Sec12, SE
Shelf	08/14/94	No bats according to a park employee	17m	T1N, R25E, Sec07, SW

CAVES AREA

Arco Tunnel	07/12/94	No bats	1771m	T1N, R25E, Sec06, NE
Beauty		Visitor Cave	288m	T1N, R25E, Sec06, NE
Boy Scout		Visitor Cave	142m	T1N, R25E, Sec06, NW
Dewdrop		Visitor Cave	73m	T1N, R25E, Sec06, W
Dry Well	07/12/94	One <u>Plecotus townsendii</u> flying from rear of cave	22m	T1N, R25E, Sec06, SW
East Teepee		Dangerous entrance	NA	T2N, R25E, Sec31, SE
Grotto (Boy Scout II/ Boy Scout Back Door)		High visitor use	31m	T1N, R25E, Sec06, NW
Indian Tunnel		Visitor Cave	666m	T1N, R25E, Sec06, SW
Lava Column		Too light	14m	T2N, R25E, Sec31, SE
Lunch	07/12/94	No bats, too open and light	18m	T1N, R25E, Sec06, SW
North Fork	07/12/94	No bats	NA	T1N, R25E, Sec06, NE
Rock Wall	07/12/94	No bats	14m	T1N, R25E, Sec06, W
Roomy	07/12/94	No bats	13m	T1N, R25E, Sec06, SW
Smooth Stone		Too light	31m	T1N, R25E, Sec06, NE
Surprise		Visitor Cave	99m	T1N, R25E, Sec06, NW
Tube Tube (Partition Cave)	07/12/94	No bats, too light and warm	18m	T1N, R25E, Sec06, S
Underfoot	07/12/94	No bats	24m	T1N, R25E, Sec06, SW
West Teepee		Dangerous entrance	NA	T2N, R25E, Sec31, SE
White Powder	07/12/94	No bats	9m	T1N, R25E, Sec06, NE

NORTH CRATER AREA

Lava Pool	08/01/94	No bats, too small	6m	T1N, R24E, Sec02, NW
Open Dome		Too light	20m	T2N, R24E, Sec35, SW
Small	08/01/94	No bats, too small	7m	T1N, R24E, Sec02, N
Three Room	08/01/94	No bats	17m	T2N, R24E, Sec35, SW

NORTHERN CAVES AREA

Antelope	06/29/94	One <u>Plecotus townsendii</u> flying near the north entrance	14m	T2N, R24E, Sec34, SW
Bloody Knees	07/07/94	No bats	NA	T2N, R24E, Sec34, SW
Coyote Hole Blister	07/07/94	No bats	9m	T2N, R24E, Sec35, NW
Fire Ring	07/07/94	No bats	41m	T2N, R24E, Sec34, SW

Ice Lake	06/29/94	One dead frozen bat in the ice, could not identify species. Water on the surface of ice	35m	T2N, R24E, Sec34, SW
Low Tide	06/29/94	No bats	70m	T2N, R24E, Sec34, SW
Sand Trap	06/29/94	No bats	18m	T2N, R24E, Sec34, SW
Screaming Jaws of Death	06/29/94	Approximately ten <u>Plecotus townsendii</u> in the back of cave	NA	T2N, R24E, Sec34, SW
Shelter	07/07/94	No bats	17m	T2N, R24E, Sec27, SE
Tunnel	07/07/94	No bats, too open and light	10m	T2N, R24E, Sec34, S
Two-Step	06/29/94	<u>Plecotus townsendii</u> Nursery Colony	NA	T2N, R24E, Sec34, SW
	07/08/94	Nursery Colony		
	08/23/94	No bats		
ORANGE SINK AREA				
Arched Pit	08/22/94	No bats	61m	T1N, R25E, Sec07, NE
Chapel	08/22/94	No bats	13m	T1N, R25E, Sec07, NE
Rope Floor		3ft high loose ceiling	11m	T1N, R25E, Sec07, NE
SOUTHERN WILDERNESS AREA				
Amphitheater		14mi round trip	92m	T1N, R25E, Sec36, NW
Bearsden Waterhole		6mi round trip	14m	T1N, R25E, Sec29, NE
Bridge of Tears		14mi round trip	26m	T1N, R25E, Sec36, NW
Dirt Slide		14mi round trip	9m	T1N, R25E, Sec36, NW
Five Rift Ice		22mi round trip	NA	T1N, R25E, Sec24, NE
Little Prairie Waterhole		6.5mi round trip	NA	T1N, R25E, Sec29, NE
Moss		14mi round trip	32m	T1N, R25E, Sec36, NW
Packrat		14mi round trip	57m	T1N, R25E, Sec36, NW
Sentinel M		8mi round trip	14m	T1N, R25E, Sec33, NW
Sentinel P		8mi round trip	4m	T1N, R25E, Sec33, NW
Sheeptrail Butte		18mi round trip	17m	T1N, R25E, Sec14, NW
Subway		14mi round trip	55m	T1N, R25E, Sec36, NW
Twin Ice Waterholes		20mi round trip	11m	T1N, R25E, Sec13, SW
Two Point		22mi round trip	9m	T1N, R25E, Sec23, NW
Vertical Ice		20mi round trip	NA	T1N, R25E, Sec14, SE

RESULTS

Out of the 46 caves surveyed during daylight hours, seven caves contained bats. Two of the seven caves contained a nursery colony, one held approximately ten big-eared bats, and four each contained one bat. Figure 1 depicts the location of caves containing bats in Craters of the Moon. Stars represent location of a nursery colony of big-eared bats, squares, locations where bats were found, but not nursery colonies. The figure shows that three caves north of the highway in the Northern Caves area are very close together and close to a potential netting sites where water is present. One of these caves, Two-Step, had a nursery colony in it, Screaming Jaws of Death contained 10 bats, and Antelope had one bat in it. This area by far has the highest concentration of day-roosting bats and should be studied during subsequent summers. The four caves south of the highway are widely dispersed. Only Needles Cave contained more than one bat, but this cave did contain a nursery colony.

Table 1 summarizes caves surveyed on the Monument by name, the date surveyed, comments on the cave, approximate length of the cave in meters, and the location of the cave, organized alphabetically.

Needles Cave, which is approximately 49 meters in length, is located in the **Wilderness Area** and, on July 8, 1994, contained a nursery colony near the middle about 27 meters from the entrance. Approximately 40 to 50 Plecotus townsendii were present in a cluster on the ceiling. No bands were observed on any of the bats in the cave and by August 22, when the cave was re-entered, the colony had dispersed.

Two-Step Cave in the **North End Caves Area** contained a nursery colony at the mouth of the cave. The nursery colony was located on the ceiling just above the floor at a point reached when descending down the 2-meter deep entrance. This nursery colony was present in July 1993 as confirmed by Bill Bosworth and Bill Doering in the same location as during 1994. Approximately 40 Plecotus townsendii were present in a cluster on the ceiling. They were easily disturbed when they were observed. A few would fly towards the rear of the cave while they were watched. No bands were observed on any of the bats in the cave. The nursery colony was observed on June 29, 1994, and July 08, 1994. No nursery colony was observed on August 23, 1994. The length of the cave is unknown (Table 1).

Screaming Jaws of Death in the **North End Caves Area** contained approximately ten Plecotus townsendii flying in the rear of the cave on June 29. No bands were observed on the bats, but bands may have been missed because the bats were flying. In July 1993 a nursery colony was observed but not confirmed. The length of the cave is unknown (Table 1).

Antelope Cave in the North End Caves Area contained one Plecotus townsendii flying near the northern entrance. No band was observed on the bat. A nursery colony was observed in 1992, but not in July 1993, but the status of the colony was not confirmed. The single bat was observed on June 29, 1994. The length of the cave is 14 meters (Table 1).

Moonshine Cave in the Big Sink Area contained one Plecotus townsendii flying near the entrance on August 8, 1994. No band was observed on the bat. The bat flew out of the cave to an unknown location after flying around the entrance of the cave for several minutes. A small pond was reported in the southeast side of the cave in July 1993. This pond was not located when the cave was surveyed in 1994, but it may be down a small breakdown shaft that was not entered. The length of the cave is 6 meters (Table 1).

Dry Well Cave in the Caves Area contained one Plecotus townsendii in the rear of the cave on July 12. The bat flew past Saathoff when he was about 20 meters into the cave. No band was observed. The entrance is one and a half meters deep. The length of the cave is 22 meters (Table 1).

Monument Cave in the Tree Molds Area contained one bat that flew into it as Saathoff was removing his field equipment. The species could not be determined. This bat was observed on August 11, 1994. The length of the cave is 32 meters (Table 1).

RECOMMENDATIONS

The following recommendations are ordered in priority. The type of effort needed on the Monument can not be completed with the level of funding provided during the past year. The most efficient way to complete this task would be to provide a research grant with funding for a graduate student seeking a degree at Idaho State University. One option might include requiring procurement of some matching funds from a non-federal source. Ph.D. student research assistantships are funded at a level of \$10,000.00 per year at Idaho State. If incremental funding is made available, recommendations numbers 3 and 4 could be completed before a major study was initiated.

1. Caves known to contain nursery colonies should be placed off limits to any human intrusion until a full study plan is prepared and submitted to the Monument.
2. The hibernacula supporting nursery colonies should only be entered by individuals qualified to undertake bat research. For any subsequent research on the Monument, it is recommended that red light be used to count individuals and that counts only be undertaken in early July on a single occasion. The caves should be mapped and photographed, preferably by the Idaho Cave Survey with

techniques developed for research at Idaho National Engineering Laboratory (Keller, et. al., 1993) during a single day in mid September only. Both caves could be electronically prepared for measurement of the thermal envelope area, where the nursery colonies were previously observed, with data-logger systems (Omega Engineering Inc., Stamford, CT) secured outside of the cave opening during this mapping. The microprocessor for the system would require field personnel to "download" temperature information for computer analysis at 30-day intervals as a result of the limit of the memory of the microprocessors used in our laboratory, but adequate funding might permit the transmission and reception of data sets via radio signal transmitted from each location to a central processing area (Idaho State University) relayed via NOAA satellite. Thermal profiles should be monitored continuously for 1 year with the system employed. The use of microprocessors to store data on thermal profiles of caves is not in print. At present, the system is unique to research studies on bats developed at Idaho State University. If bats are to be managed on the Monument, a description of the thermal envelope in areas where nursery colonies occur must be known. No studies are available to provide these data.

3. A selected series of caves should be sampled for night-roost activity during the summer of 1995. Voucher specimens, excluding Plecotus because this species is already on deposit, should be prepared for all bat species on the Monument. A key to these species should be prepared for the Monument only, and a full plan to develop and implement preparation of a brochure for Monument visitors considered.

4. Night activity in caves containing water should be monitored using red light observation and night vision devices for several evenings to determine patterns of use.

5. Funding should be secured to helicopter two researchers to caves not readily accessible by foot. The team should be left on location at each site to assess night-roost activity before being moved to the next location.

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