



Bat Hibernacula Surveys in Craters of the Moon National Monument and Preserve

2016 Status Report

Natural Resource Report NPS/UCBN/NRR—2016/1333



**ON THIS PAGE**

Wildlife Biologist Todd Stefanic exiting West Hidden Cave in February, Craters of the Moon National Monument and Preserve. Photograph by K.Slocum.

ON THE COVER

Three Townsend's big-eared bats (*Corynorhinus townsendii*) in Arco Tunnel, Craters of the Moon National Monument and Preserve. Photograph by A. Konkowski.

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November 2016

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Slocum, K., A. Millet, T. Stefanic, and T. J. Rodhouse. 2016. Bat hibernacula surveys in Craters of the Moon National Monument and Preserve: 2016 status report. Natural Resource Report NPS/UCBN/NRR—2016/1333. National Park Service, Fort Collins, Colorado.

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Abstract/Executive Summary

Between January and March of 2016, twenty-seven of Craters of the Moon National Monument and Preserve's (CRMO) 400+ known caves were surveyed for hibernating bats. This is the fourth year of annual bat hibernation surveys at CRMO. Bats in Arco Tunnel and other hibernacula were identified as Townsend's big-eared bats (*Corynorhinus townsendii*), undifferentiated species of *Myotis*, and several were not identifiable to genus. Temperature and humidity readings were recorded throughout caves and in the immediate space of hibernating bats. Snow conditions limited the ability of staff to survey as many caves in 2016 as they have in other years.

Acknowledgments

Jim Bromberg, Sandra Gladish, Alex Riggins, and Ross Winton assisted with field work. Idaho Fish and Game also provided HOBO detectors. Jim Bromberg and Paulina Starkey reviewed and edited the report.

Introduction

Very little is known about where, when, and how many bats use the caves managed by Craters of the Moon National Monument and Preserve (CRMO). While CRMO has potentially thousands of caves scattered through its vast lava flows, only Arco Tunnel (first documented in 1958) had been verified as a hibernacula and surveyed occasionally prior to 2012. The first record of bats at CRMO is from a 1926 museum specimen, simply labeled as being from “Craters of the Moon National Monument,” and the first hibernating bat was recorded in 1985 in Arco Tunnel (Genter 1986). Though nearby locations such as the Idaho National Laboratory (INL) had frequent surveys of well-known hibernacula through the 80s and 90s (Whiting 2011), there was little impetus to survey bats at CRMO until the devastating spread of the bat fungal disease white-nose syndrome (WNS) stimulated cave surveys for bat use during winter. In 2007 bats were chosen as one of CRMO’s “vital signs,” an indicator of overall ecosystem health by the Upper Columbia Basin Network Inventory and Monitoring Program (I&M; Garrett et al. 2007). CRMO has at least one species, the little brown bat (*Myotis lucifugus*), which has been confirmed as susceptible to WNS (Bleher et al. 2009). This is the fourth year of hibernacula surveys, which are intended to give baseline knowledge of what species are present in winter, where they choose to hibernate within the extensive cave environment, and population trends.

Increasing awareness of the threats bat populations face has shown the need for better information and proper management concerning local bat populations in recent years, particularly in the west (Miller 2001, Hendricks 2012, Whiting et al. *forthcoming*). Winter hibernation is a critical time for bats; adult mortality is typically very low during winter (Barclay and Harder 2003), and energy savings made during winter enable female bats to raise pups during summer (Adams 2003). Historically, anthropogenic disturbances from recreational cavers and researchers have caused high rates of mortality, though the disturbance to torpid bats may not be immediately apparent (Pierson et al. 1999). Bats infected with WNS rouse from torpor more frequently than uninfected bats, causing starvation and dehydration (Bleher 2012). As of March 2016, Washington State confirmed the presence of the WNS-causing fungus *Pseudogymnoascus destructans*. Additional stress from accelerated climate change is also expected to affect bats across the western US as thermal profiles of caves change (Humphries et al. 2002). Finally, bat populations in southeast Idaho and other areas are seriously threatened by increasing wind-energy development, and mortality rates from wind turbines could already have lasting effects on populations (Kunz et al 2007, Cryan and Barclay 2009). All of these factors pose large threats to CRMO bat populations now and in the coming decades.

In 2012, CRMO and I&M staff visited eight easily accessible caves to pilot test a winter cave survey protocol (Rodhouse et al. *forthcoming*) and to test WNS decontamination procedures (USFWS 2012). Initially, 33 caves were chosen for yearly monitoring, but due to the hazardous winter conditions, generally small yield per survey effort, and small staff of CRMO, the protocol was revised in 2015 to only monitor Arco Tunnel (Rodhouse et al, *forthcoming*). However, other caves are also surveyed by the same methods when there are time and resources to do so. These efforts have not only expanded the Monument’s knowledge of how bats use CRMO, but also of the cryptic landscape. Regular monitoring of winter cave use by bats will enable CRMO staff to make more

informed management decisions, and will contribute to regional knowledge of bat population trends over time. These surveys also provide opportunities to document CRMO's unique geologic resources.

Methods

Study Area

Craters of the Moon National Monument and Preserve is located on the northern edge of the Snake River Plain in south central Idaho and spans portions of Blaine, Butte, Lincoln, Minidoka, and Power counties. It was designated as a national monument in 1924 to preserve the geologically unique and diverse volcanic landscape caused by the Great Rift, a 50-mile long volcanic rift zone formed from crustal extension and decompression melting. The rift is 1-5 miles wide and is expressed as a series of open cracks, fissures, cones, vents, and shield volcanoes, which have formed from periodic eruptions between 15,000 and 2,000 ya. Three distinct lava fields have been created from ~60 flows: Craters of the Moon, Kings Bowl, and the Wapi. The northern terminus of the rift starts in the Pioneer Mountains (7729'), and trends south through the Wapi (5330'). The monument is co-managed by the National Park Service (NPS) and the Bureau of Land Management (BLM). The NPS manages 465,047 of the 753,334-acre monument, which is almost entirely comprised of the three young lava fields. The BLM-managed portion is also of volcanic origin, but is considerably older (~300,000 ya) and heavily vegetated by sagebrush steppe (National Park Service 2007, Madison et al. 2009). Summers in the region tend to be hot and dry, while the majority of precipitation falls during the cold winters and spring as snow or rain (Genter 1986, Wackenhut 1990).

There are currently 497 known caves in CRMO. The most common types of caves are lava tubes, though 6 other cave types are present in the landscape. Lava tubes created by large pahoehoe flows originating from the rift are the most common. Two have more than a mile of connected passages (Indian Tunnel, Arco Tunnel). All other known lava tube caves are much smaller, usually under 100' total of passage. Blister caves from gas expansion and caves created from differential weathering of cinder layers are also present, but are generally not suitable for hibernation. Large lava tubes from much older volcanic activity are also found in the BLM-managed monument. Some of them have contained hibernating colonies of bats in past surveys (Lewis et al. 1996), but they were not surveyed as part of this study.

Eleven of the 16 bats known to Idaho have been recorded as using the CRMO landscape during the year. Townsend's big-eared bat (*Corynorhinus townsendii*) is the most common bat species found overwintering in lava tubes (Stefanic 2015). Other species also use the cave resource in winter, such as several species of *Myotis* and potentially big brown bats (*Eptesicus fuscus*) (Genter 1986, Stefanic 2015). Because bats are not handled during the winter surveys, current surveys do not attempt to identify myotids to species.

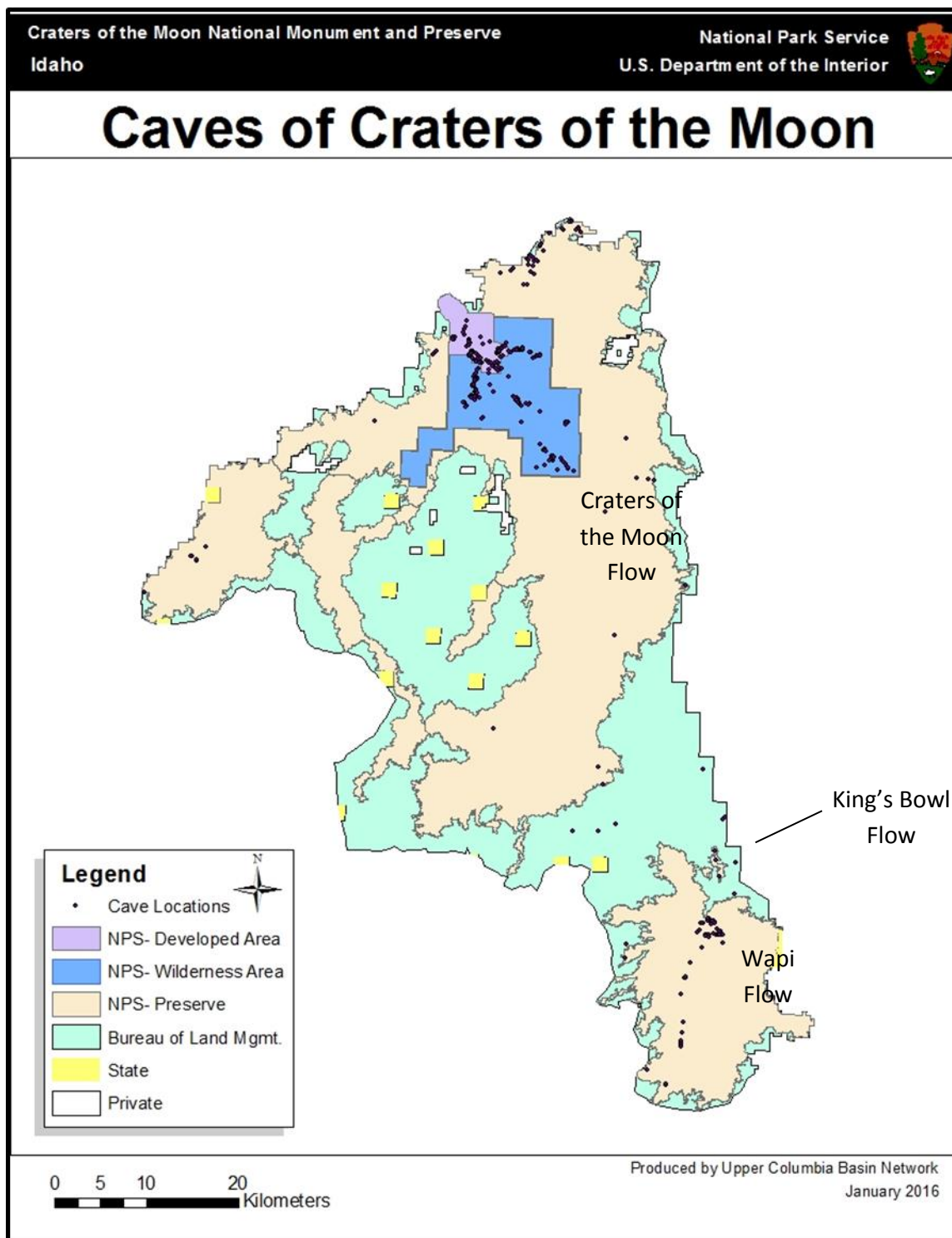


Figure 1. Map of the known caves and land ownership in Craters of the Moon National Monument and Preserve.

Survey Methods

The protocol (Rodhouse et al. forthcoming) was followed for all surveys performed. Arco Tunnel was surveyed on February 11. All auxiliary hibernacula surveys were conducted between January 13 and February 19 in 2016. Air temperature, humidity, and cave ceiling/wall temperature were recorded one to three times per zone. Air temperature and humidity were measured with Kestrel 3000 Pocket Weather Meters. Ceiling/wall temperatures were taken using a UEI INF 156 Infrared thermometer. When bats were found, temperatures were taken as close to the bats as possible without disturbing them.

Each survey was conducted with a crew leader and one or more assistants. Crew leaders were professional wildlife biologists, one of whom has been surveying since 2012. Surveyors used flashlights to locate bats, which were then identified and recorded by the crew leader and assistant, respectively. Bats found in direct contact with another bat were recorded as a cluster, and all other bats not in direct contact with another bat were counted as individuals. Bats were not handled during the survey, which limited disturbance but also the accuracy of identifying myotis and other species. Clusters of bats were photographed to aid in counting. It is also assumed that some myotis were overlooked due to their selection of small cracks and crevices to hibernate in, making them less visible than Townsend's big-eared bats and easier to miss (Genter 1986, Wackenhut 1990, Whiting et al. forthcoming).

White-nose Syndrome Decontamination

The National White-nose Syndrome Decontamination Protocol version 06.25.2012 (USFWS 2012) was followed with the exception of the requirement to decontaminate after every cave visit. Craters of the Moon National Monument and Preserve has a unique situation where multiple cave entrances can be within very short distances, sometimes within the same breakdown pit. With the large number of caves within a season in an extreme and challenging environment, decontamination after every cave visit was seen as excessive and unwarranted. These concerns were discussed on a national WNS conference call when the protocol was initially changed from no decon action for caves within 10 miles rule to every cave visit in winter 2012. There were no objections from the USFWS or other biologists to having CRMO modify its decontamination procedures to better suit the environment. CRMO procedures allow for multiple cave visits without decontamination if the entrances are within a 1 mile radius.

Tyvek suits were used initially in 2012 and 2013, but were abandoned for heavy-duty coveralls in 2014 due to the tight and extremely sharp nature of many caves. Formula 409 All-Purpose Cleaner was used to decontaminate shoes before putting on snowshoes. Other gear brought into the caves was put into a garbage bag until returning to the office where all gear could be properly decontaminated (USFWS 2012, Shelley et al. 2013). This work was done before the release of the 2016 decontamination protocol (USFWS 2016).

Acoustic Monitoring

In order to assess the end of hibernation, we deployed a Pettersson D500X detector at the entrance of Arco Tunnel in early March, but due to equipment failure we were unable to monitor when bats roused from torpor this season. In 2015 the detector was deployed between March 3 and April 23.

Calls were processed using Sonobat 3.2.1 with Great Basin classifiers. A total of 13 calls were recorded between March 3 - April 16. On the 16th, 344 calls were recorded, and between ~1,000-5,000 calls per night were recorded for the following 13 days (Slocum et al. 2016). Year-long acoustic sampling is planned to start in fall of 2016.

CRMO is contributing acoustic monitoring data to two large-scale projects, the North American Bat Monitoring Project (NABat, Loeb et al. 2015) and the East Idaho Bat Collaborative. The NABat survey season is timed to capture bat activity after young bats became volant. Three stationary Anabat SD2 detectors were deployed in CONUS_10k cell 97787 for the nights of August 1-4, 2016. Detectors started recording 15 minutes before sunset and stopped recording 15 minutes before sunrise. The data collected was entered into the NPS Bats Acoustic Survey Database v1.7, then uploaded to the Integrated Resource Management Applications portal (<https://irma.nps.gov/DataStore/Reference/Profile/2233491>).

Mobile acoustic surveys were conducted monthly from May through October to collect data for the East Idaho Bat Collaborative. There are 32 routes between 40-60 km throughout eastern Idaho, and CRMO is responsible for two. Mobile transects are conducted using an Anabat SD2 detector with an external roof-mounted microphone. Routes are driven at 20 mph and surveys begin 30 minutes before sunset. Data collected is submitted Idaho Department of Fish and Game for analysis.

Results

Arco Tunnel was surveyed on February 11, 2016 by six surveyors. Three had previous experience with winter bat surveying at CRMO, and the entire survey was completed in 3 h 42 m. Thirty-two bats were found (Table 1, Figure 2). Between January 13 and February 19 twenty-six auxiliary caves were surveyed (Table 1, Appendix A). A total of 21 bats were found, 11 hibernating individually, and 10 that were found in 4 clusters. A cluster was defined as bats having physical contact with one another. Two clusters were comprised of myotids and two clusters were comprised of Townsend's big-eared bats. The four clusters were all found in Arco Tunnel. Figures 3-5 show average humidity, average temperature, and a hibernating cluster of myotids in Arco Tunnel, respectively.

Table 1. Cave conditions associated with bats found during the 2016 survey season by cave.

Cave Name	Bat Species	# of bats	Temp (°C)	Rel. Hum (%)
Arco Tunnel	COTO	20	-3.0 – 5.1	52.7 – 65.2
	MYSP	10	4.3 – 11.5	67.8 – 82.2
	UNKN	2	6.1 – 10.4	64.5 – 73
Beauty Cave	COTO	2	1.0 – 1.1	75 – 80
Needles Cave	COTO	3	4.3	96.9 – 100
Rio Grand	COTO	3	1.3 – 3.1	67.9 – 82.6
Two Step	COTO	3	3.2	62.7 – 67.7

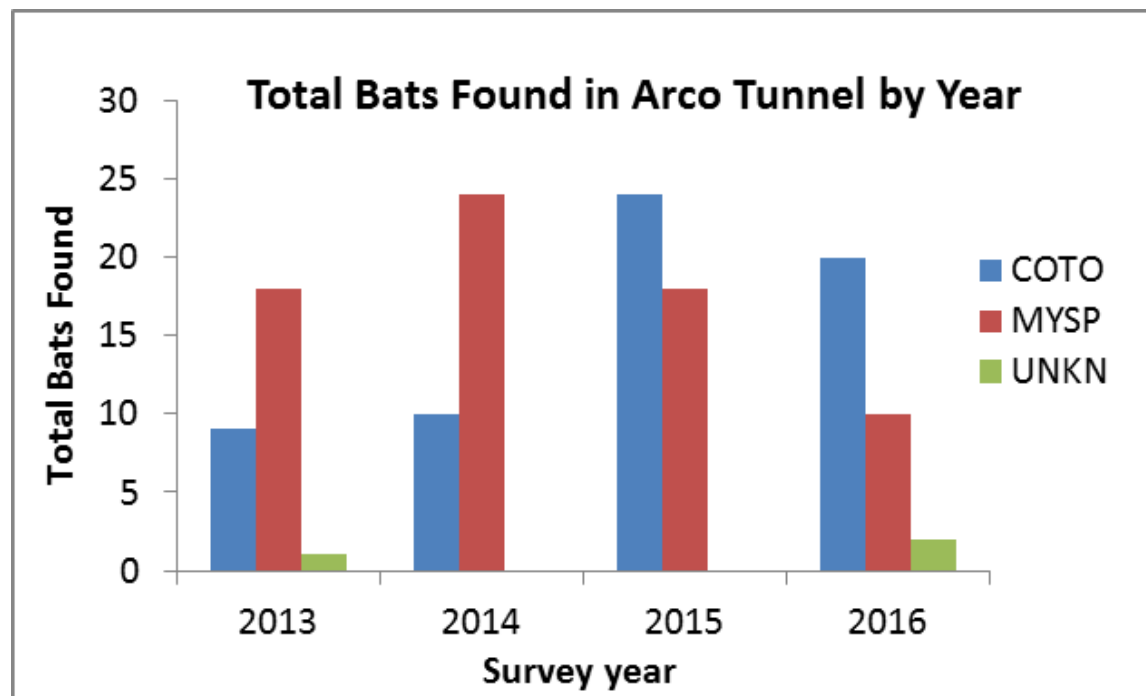


Figure 2. Total number of bats found in Arco Tunnel by year of survey.

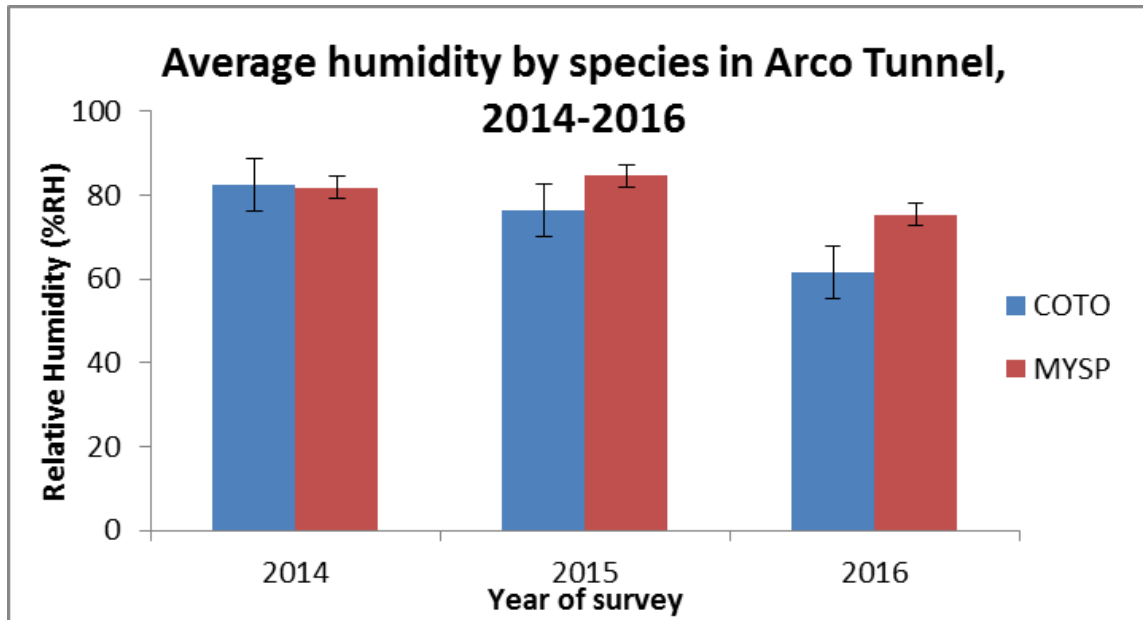


Figure 3. Average humidity and standard deviation in the immediate space of hibernating bats, by species between 2014-2016.

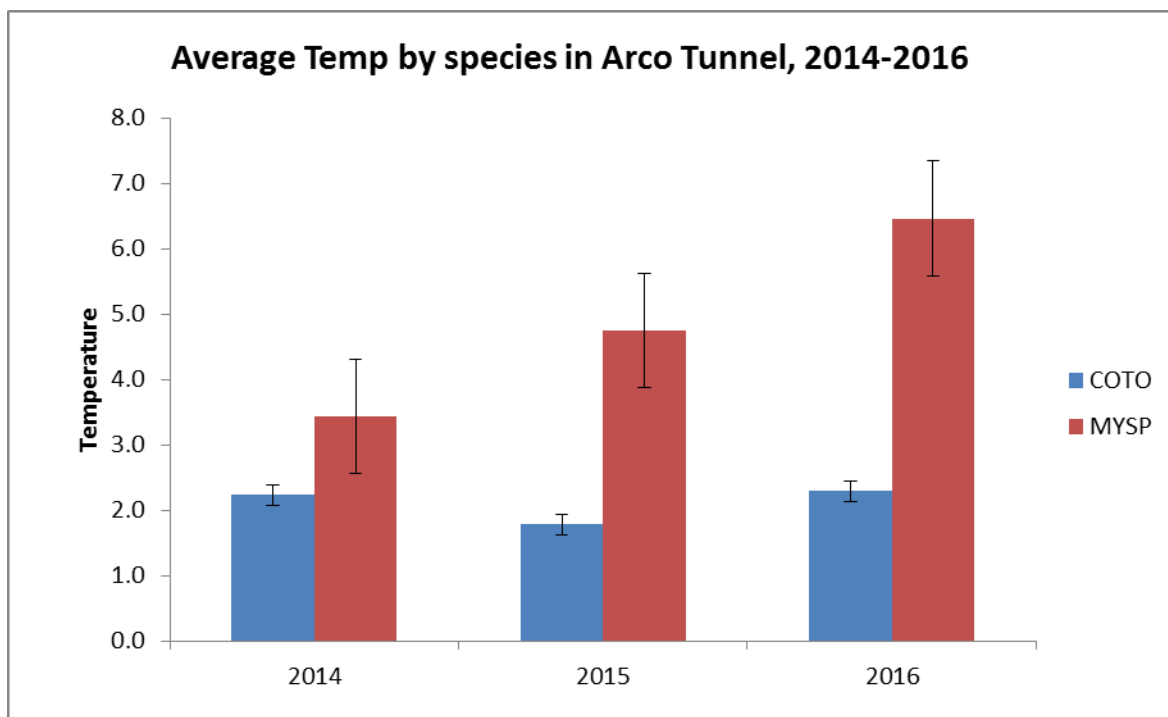


Figure 4. Average temperature and standard deviation in the immediate space of hibernating bats by species from 2014-2016.



Figure 5. A hibernating cluster of myotids in Arco Tunnel, 2016 (photo by A. Millet).

Discussion

This is the fourth annual survey of hibernacula at Craters of the Moon. Bats were found mostly individually and in relatively small numbers per cave, characteristic of other hibernacula at CRMO and elsewhere in the west, particularly for Townsend's big-eared bats (Hendricks 2012, Pierson et al. 1999). In Arco Tunnel we found 2 clusters of myotis (2 and 3 bats/cluster) and two clusters of Townsend's big-eared bats (2 and 3 bats/cluster). In the three previous surveys, there have been larger clusters of myotis (6-12 individual/cluster). For a complete list of winter surveys and species found, see Appendix A.

This year's data appears to be congruent with data from previous surveys, in that Townsend's big-eared bats have different microclimate preferences than myotis. The only other information on humidity and temperature selection of hibernating bats in CRMO is from Genter (1986). Genter's information is from 8 caves on the INL, but also includes the first survey of Arco Tunnel in which he only found 3 western small-footed bats (documented as *M. leibii*, now considered *M. ciliolabrum*). Genter found that western small-footed bats occupied a slightly smaller, but not significantly different range of humidity than Townsend's big-eared bats. Genter also found that Townsend's big-eared bats occupied warmer regions of caves than western small-footed bats. While our data supports some of these findings, more years of data are needed to properly analyze our findings; the protocol was not followed in 2013 and part of 2014 in regards to temperature and humidity readings. The typical temperature range of hibernacula on the INL is -1.6°C to 3°C (Whiting 2013, using UEI INF 156 Infrared thermometer). CRMO has an average hibernacula temperature of 4.66°C, and only two records of bats hibernating below 0°C. Both CRMO's and INL's hibernacula temperature ranges are similar to the range reported by Perry (2013) for most temperate vespertilionid bats in North America, which select caves with temperatures between 2 and 10 °C. The WNS-causing fungus *Pseudogymnoascus destructans* is known to thrive best between 5°C and 14°C (Blehert et al. 2009) and at relatively high levels of humidity (Grieneisen 2011). Our data suggests that CRMO and surrounding caves are able to host *P. destructans* and also contain susceptible bat populations.

In 2013 only Kestrel 3000 Pocket Weather meters were employed to collect air temperature, and later humidity. Starting in 2014 CRMO acquired UEI INF 156 Infrared thermometers, which is the sole instrument used in regional surveys done by the INL and Idaho Fish and Game (Whiting 2013). The instant infrared thermometers, which measure surface temperature, were used alongside the Kestrel units in all 2015 surveys. However, there were discrepancies in temperature readings between the two units, which could be as much as 20°C different when measuring temperature at a location.

Both the INL and the BLM managed portion of CRMO have significant hibernacula, with caves containing 400 or more bats (Lewis et al. 1996, Whiting and Bybee 2011). Those hibernacula are within a 40-50 miles radius of Arco Tunnel and the other caves surveyed in the NPS managed portion of CRMO. A recent Bat Conservation International study found a combination of constriction, mean cave ceiling height, and distance from an ephemeral water source could predict winter occupancy of lava tube caves by Townsend's big-eared bats in caves in southeast Idaho (Gillies et al. 2014). While CRMO shares a recent (600,000 ya) volcanic history with these caves,

CRMO has continued to be active as recently as 2000 ya, yielding a much wider variety of features considered caves, and a wider selection of potential hibernacula. While CRMO is suspected to have large hibernacula due to the abundance of the cave resource, efforts to date have not revealed any. Whether large hibernacula exist on CRMO and we simply haven't looked in the right place yet or whether CRMO lacks these large hibernacula altogether is unknown. The lack of large hibernacula could be the result of differences in geomorphology and/ or environmental conditions compared to caves on the INL and BLM. Their thicker covering of soil and vegetation, and relatively large size in comparison to CRMO caves could provide a more stable climate. These factors could speak to why some CRMO caves have varying occupancy, though studies from the INL show that cave fidelity could be variable for regional caves as well; Wackenhut found 14-60% of banded Townsend's big-eared bats returned the following winter to their banding cave on the INL, and 11-52% in nearby counties (1990).

Anecdotal reports suggest there may be other large hibernacula in Crystal Ice Cave, South Grotto, and Creon's cave in the King's Bowl complex (Earle and Earle 2002). While these caves have been entered regularly in the last decade for mapping, they have not been surveyed by park staff or affiliates due to remoteness, unstable and frequent rock fall in the rift zone, as well as specialized skills required for entering these caves.

This year there were no bats found hibernating within zones impacted by light. In the 2015 surveys, 6 bats were found to be in the light zone of hibernacula at the time of survey. This year there was significantly more snow on the ground than last year. At the time of the Arco Tunnel survey in 2016, there were over 90 cm of snow on the ground at CRMO headquarters, while in 2015 there was under 50 cm of snow. In 2015 the snow had mostly melted by late February, which could have accounted for some of the bats found within the light zone if snow had initially covered the entrances at the beginning of hibernation. Bats affected with WNS have been shown to move closer to entrances over the course of a season (Locke 2008). To document this caves would need to be revisited within a survey season, which is not currently part of the CRMO protocol. However, revisions are going to be considered in light of *P. destructans* being found in western Washington, and as it moves closer to CRMO in the coming years.

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Appendix A

Table 2. Comprehensive list of caves surveyed by year, hibernacula status, and associated species.

Cave	Years Surveyed				Used as Hibernacula	Species Found
	2013	2014	2015	2016		
Antelope	0					
Arched Pit	0					
Arco Tunnel	33	38	42	32	Confirmed	COTO, MYCI, MYYU, MYSP, UNKN
Baker Cave III		3				
Beauty	2	0	0	2	Confirmed	COTO
Big Craters Tunnel	0					
Bloody Knees	0	0	6	0	Confirmed	COTO
Boy Scout	0	0	0	0		
Buffalo Caves		0	0	0		
Cathedral	0		0			
Chapel	0	0	0			
Chimney	0	0	0			
Dewdrop	0					
East Hidden		0	0	0		
East Teepee	0	0	0	0		
Expedition (North)			0			
Expedition (South)			6		Confirmed	COTO, MYCI
Fire-Ring	0	0	0	0		
First Chance	0	1	1	0	Confirmed	COTO
Fool Killer		0				
Freaky Steam			0			
Girl Scout	0					
Green Crystal	0					
Guano		0	0	0		
Hidden	0	0	0	0		
Hidden II	0	0	0	0		
Hornito Cone Moat		0	0			
Ice Lake	0	1	0	0	Confirmed	MYSP
Incognito			0			
Indian Tunnel (west passage)	0	0	1	0	Confirmed	MYCI
Karate	0					

Table 2 (continued). Comprehensive list of caves surveyed by year, hibernacula status, and associated species.

Cave	Years Surveyed				Used as Hibernacula	Species Found
	2013	2014	2015	2016		
Lariat	6				Confirmed	COTO
Last Chance	0	0	0			
Lava River			1		Confirmed	COTO
Lava River Natural Bridge	0	0	0			
Lobe 1	0					
Lobe 2	0					
Lost Light			0			
Low Bridge Tunnel			0			
Low Tide	0	2	1	0	Confirmed	COTO, MYCI
Needles	1	3	7	3	Confirmed	COTO, MYCI
Nick Cave			5	0	Confirmed	MYSP
One More Chance	2	1	2		Confirmed	COTO
Open Dome	0	0	0	0		
Painful Snack			0			
Pond						
Prickly Pear	0					
Rio Grande		4	4	3	Confirmed	COTO
Rope Floor	0					
Sand Trap	0	0	0	0		
Screaming Jaws of Death	0	0	1	0	Confirmed	COTO
Skelebat	0	0	0	0		
Sky-Bridge Hollow			0			
Snowball's Chance			0			
Snowball's Little Friend			0			
Sorcerer Cavern			0			
Spongy Floor	0	0	0	0		
Surprise	0	0	0	0		
Surprise Bat			0			
Three Room	0					
Tom Thumb	0					
Two-Step	0	0	1	0	Confirmed	COTO
Watchman		0	0			

Table 2 (continued). Comprehensive list of caves surveyed by year, hibernacula status, and associated species.

Cave	Years Surveyed				Used as Hibernacula	Species Found
	2013	2014	2015	2016		
West Hidden		0	0	0		
West Teepee		0	0	0		
Wile E. Coyote			6		Confirmed	COTO

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 131/135009, November 2016

National Park Service
U.S. Department of the Interior



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2016

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