



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

2014 Status Report

Natural Resource Data Series NPS/UCBN/NRDS—2015/800



ON THE COVER

A western small-footed myotis (*Myotis ciliolabrum*) in Low Tide Cave, Craters of the Moon National Monument and Preserve
Photograph by Allie Konkowski

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Abstract

In the winter of 2014, thirty-four of Craters of the Moon National Monument and Preserve's (CRMO) 400+ known caves were searched for hibernating bats. While most of these caves were apparently empty of bats, 4 new hibernacula were documented (Rio Grande, Low Tide, Ice Lake, and First Chance caves). Additionally, bats were found hibernating in Arco Tunnel, One More Chance and Needles cave which were previously known hibernacula. Bats in the newly discovered hibernacula were identified as Townsend's big-eared bats (*Corynorhinus townsendii*) and Western small-footed myotis (*Myotis ciliolabrum*). A new high count of 38 bats was recorded in Arco Tunnel. Twenty-five of the cave surveys were revisits and 9 caves were checked for the first time. These surveys have doubled the number (to 8) of known hibernacula on CRMO, and added knowledge concerning hibernating bat preference of cave characteristics, including location within caves. To date, about 25% of caves deemed suitable for hibernation have been occupied.



Figure 1. CRMO Wildlife Biologist Todd Stefanic squeezes through a tight passage to reach another room in Needles Cave.

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Figure 2. CRMO Wildlife Biologist Todd Stefanic climbs up to Allie's Attic in Surprise Cave to check it for hibernating bats.

Introduction

In 2007 bats were chosen as one of Craters of the Moon National Monument's (CRMO) "vital signs", as part of the Upper Columbia Basin Network (UCBN) inventory and monitoring program (I&M; Garrett et al. 2007). This vital sign status combined with the looming threat of the bat fungal disease known as white-nose syndrome has stimulated a renewed effort by park and I&M program staff to regularly survey caves for bat use during winter. 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. However, anthropogenic disturbances in caves can disrupt hibernation and cause bats to burn through energy very quickly. White-nose syndrome, which is devastating bat populations in the eastern US and Canada and spreading westward, also causes bats to starve and dehydrate during hibernation (Blehert 2012). The fungus that causes white-nose syndrome was introduced into the northeastern US from Europe (Blehert 2012), and together these two novel stressors present serious threats to CRMO bats over the coming decades. An additional stress, accelerated climate change, is also expected to affect bats across the western US as thermal profiles of caves change (Humphries et al. 2002) and as drought conditions reduce the availability of free water to lactating bats (Adams 2010). Regular monitoring of winter cave use by bats will enable CRMO staff to better manage cave resources, and will contribute to a regional description of bat population trends over time.

Very little is known about where and how many bats hibernate in caves in CRMO. In fact, while Craters has hundreds (if not thousands) of caves scattered over the vast lava flows (roughly the size of Rhode Island), only one hibernaculum, Arco Tunnel, had been verified and surveyed on a regular basis prior to 2012. 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 white-nose syndrome fungal decontamination procedures (USFWS 2012). In 2013, surveys were conducted in 41 caves, including 6 revisits of caves surveyed in 2012. In 2014 surveys were conducted in 34 caves (25 revisits, 9 new caves). Accessing caves in CRMO during winter is an extremely challenging endeavor, sometimes requiring snowshoeing several miles across snow covered sagebrush and lava fields to reach cave entrances. These efforts were sometimes in vain as caves turned out to be unsuitable for hibernating bats, but they have expanded the knowledge of winter bat use in Craters' caves and will allow biologists to better focus efforts in the future.

Methods

Identification of Caves to Survey

The CRMO cave database and paper files were searched to find caves which might provide the necessary elements for proximity, safe access and suitability as habitat for hibernating bats. The first constraint was that caves had to be close enough to gain access, survey, and return to the office within a single work day. Caves that would require specialized skills or equipment for safe entry were excluded. This eliminated vast areas of the Monument and Preserve south of the loop road from consideration as well as known hibernacula including South Grotto, Creon's Ice Cave, and Crystal Ice Cave (Earle and Earle 2002) because of the unsafe conditions and the specialized skills required to repel into these deep pit-rift entrances. The farthest afield surveyors traveled to conduct a survey involved a 3.75 mile snowmobile ride followed by a 4.5 mile snowshoe hike out to The Watchman Cave. All of the caves surveyed were on the north end of the park in the original Monument (Figure 1).

Several cave features were also considered during search deliberations. One of the first considerations was whether cave length was sufficient to provide a dark zone for hibernating bats (generally not less than 100 feet). Entrance size was also considered. Generally, small entrances or some other constriction is beneficial for separating the interior of the cave from outside light and climate conditions. This allows the interior of the cave to maintain a steady climate throughout winter. The third consideration is the number of skylights and entrances. Caves with numerous entrances and/or skylights generally do not make good hibernaculum, as light and outside temperature extremes influence large portions of the cave interior.

Selection of caves was often not a precise exercise due to incomplete or inaccurate cave data and maps. Some caves have highly detailed, professionally surveyed maps (e.g., Figure 2), but most have much less reliable information. Many cave files have no maps or only crude hand-drawn maps with approximated cave dimensions. Some caves were completely unexplored and the only information we could obtain ahead of time were GPS coordinates of one of the cave entrances. Often, hand drawn maps did not include information pertinent to bat use (skylights, number of entrances etc.) which led to some wasted effort as surveyors trekked out across lava on snowshoes only to enter a cave to find it well lit by skylights or otherwise unsuitable for hibernating bats. Following the recommendation of the 2012-2013 report, starting in the summer of 2013 an effort had been made to survey caves in the summer to determine their suitability for winter bat use before including them in winter survey efforts. In the summer of 2013 several potential hibernacula caves were visited which lead to the inclusion of 4 caves (Guano, Rio Grande, West Teepee, Buffalo) into 2014 surveys. Efforts in the summer of 2014 added 7 new caves to the list of caves to be surveyed in the winter of 2015 and removed 17 others from consideration. Although not the main focus of this effort, cave maps and data were updated as surveyors encountered inaccuracies. Previously unexplored areas were added to current maps and sometimes entirely new maps were drawn. Cave passage lengths and heights were corrected. Skylights and other missing features were added to maps.

Survey Methods

All surveys were conducted between January 16 and February 26 in 2014. Caves of sufficient length were divided into zones based on natural features or breaks in the cave. Air temperature and/or cave ceiling/wall temperature and humidity were recorded one to three times per zone. Air temperature and humidity were taken with Kestrel 3000 Pocket Weather Meters. Ceiling/wall temperatures were taken using a UEI INF 156 Infrared thermometer (newly acquired instruments for 2014 surveys). Temperature and humidity data was not taken if, upon entering a cave, it was deemed to be unsuitable for hibernacula. If bats were found, temperatures were taken as close to the bats as possible. Limiting disturbance to bats was prioritized over species identification and no bats were handled or measured during surveys. All hibernating bats were photographed to aid in identification and for use in counting bat clusters back in an office setting. Bat expert and wildlife biologist Bill Doering, Power Engineers Inc., was enlisted to identify species from photos. Even with photos, bat identification is imprecise and some bats had to be classified as *Myotis* spp. or simply “unknown bat”.



Caves of Craters of the Moon

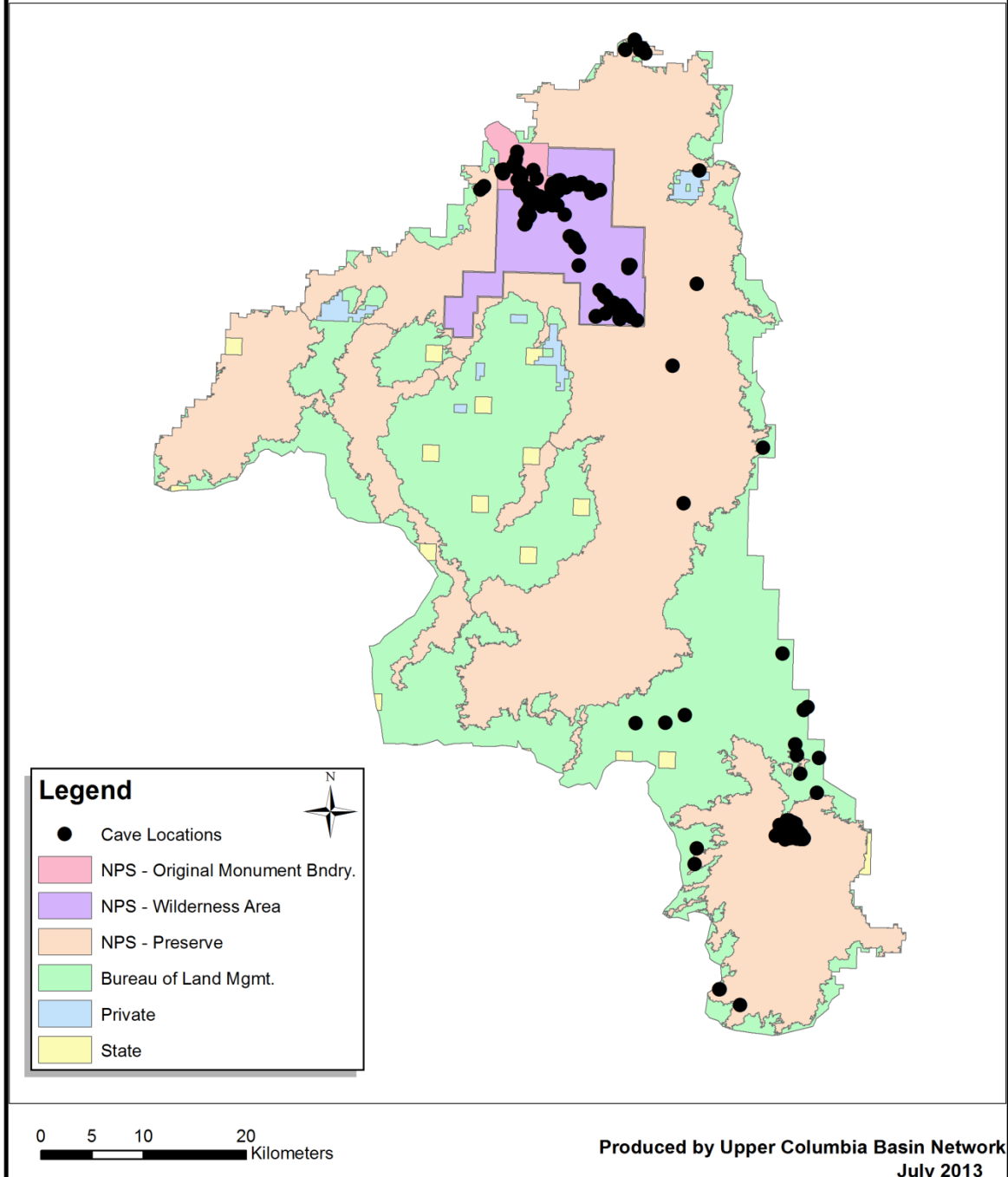


Figure 3. Map of the known caves and land ownership patterns in Craters of the Moon National Monument and Preserve.

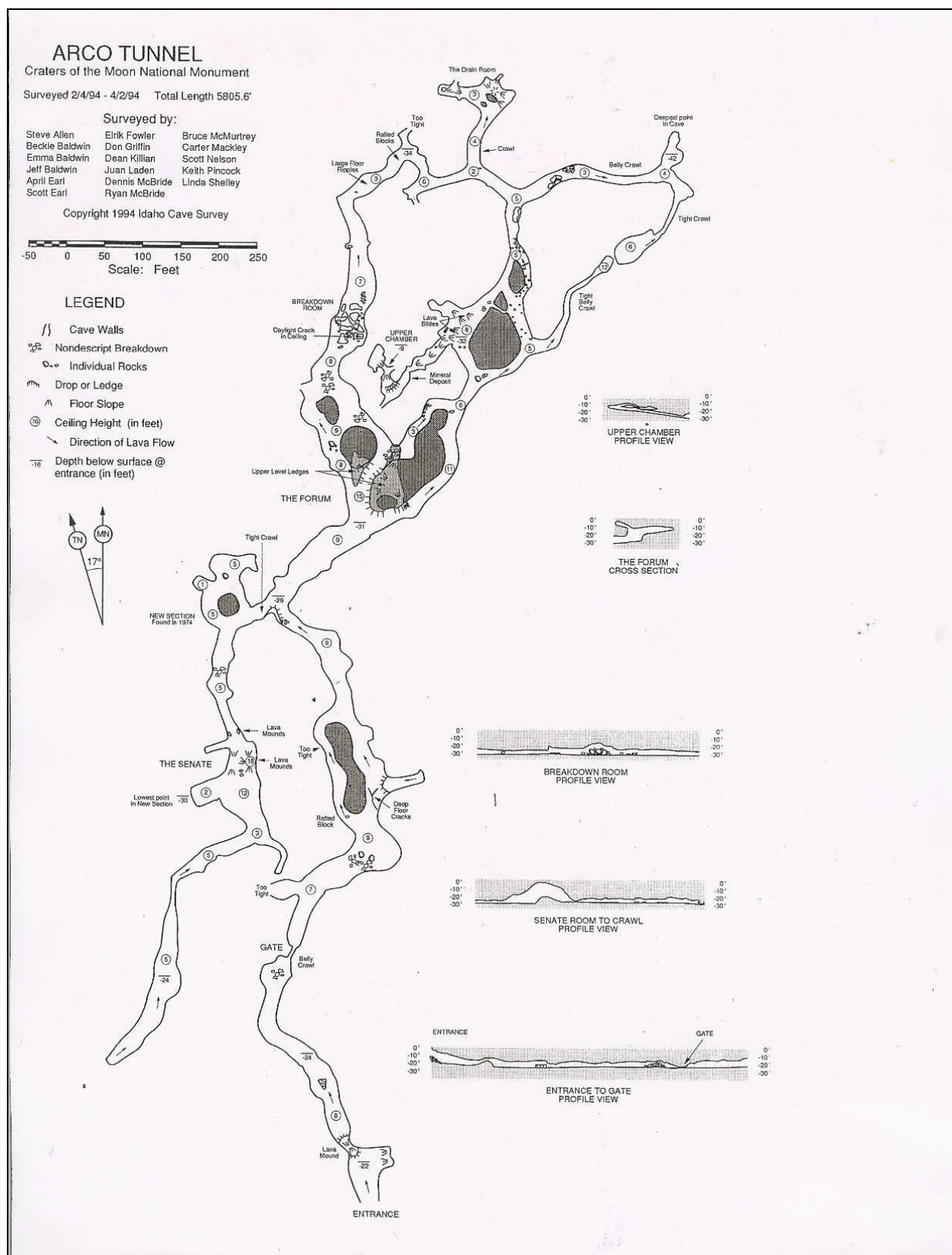


Figure 4. Map of Arco Tunnel cave in Craters of the Moon National Monument and Preserve.

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 has a unique situation where there can be multiple cave entrances within very short distances, and sometimes multiple cave entrances can be within the same breakdown pit. Therefore, decontamination after every cave visit was seen as excessive and unwarranted. Previous versions of the protocols used a 10 mile radius before decontaminating was required. The author brought up these concerns on a National WNS conference call when the protocols were initially changed from the 10 mile rule to every cave visit in winter 2012. There were no concerns or objections from the USFWS or other biologists on the call to modify the decontamination procedures for this particular situation. Therefore CRMO surveyors used a modification of the protocols in which cave gear was kept separated from all other gear and packs to the extent possible until full decontamination could be completed after visiting the last cave on any given day of cave searches. Using this method, surveyors never entered caves on the same day that were more than a mile apart.

Surveyors learned from their experiences with decontamination procedures in 2013 when dealing with winter conditions and surveying in remote locations. Tyvek suits often ripped on jagged rocks and lava stalagmites when crawling through smaller passages and thus were abandoned for heavy-duty coveralls in 2014. Hand warmers taped to the disinfectant (Formula 409 All-Purpose Cleaner or disinfecting wipes) kept it from freezing solid and becoming unusable. The most effective measure proved to be lining the compartment of a backpack with a sturdy plastic garbage bag and storing any gear that entered a cave in the bag between surveys. Upon returning to the office all submersible gear could be submerged in hot water ($> 122^{\circ}\text{F}$ for 20 minutes) and non-submersible gear could be wiped down. Decontamination of snowshoes continues to be an area of concern for cavers as snowshoes are neither submersible or easily wiped down. Surveyors disinfected boots upon exit of caves before strapping snowshoes back on to minimize any potential of infecting snowshoes.



Figure 5. Surveyors suit up in safety and WNS decontamination gear before entering Chapel Cave.

Acoustic Monitoring and Driving Transects

Acoustic monitoring of Arco Tunnel, or any cave entrances in CRMO, was not conducted in 2014 due to the absence of Petterson D500x bat detectors (on recall). Acoustic monitoring may be used in the future to detect emergence activity from Arco Tunnel, or to detect bat activity in possible hibernacula not yet included in the survey (eg., caves difficult to survey, caves of questionable quality).

CRMO staff participated in the South East Idaho Bat Working Group's pilot season of a driving transect survey in 2014. Two driving routes were designed (out of 30+ routes throughout SE Idaho) that would at least partially cross CRMO. Routes were driven once per month throughout the summer. Data was collected and submitted to Becky Abel at the Idaho Department of Fish and Game for analysis. If these summer surveys continue, the goal would be to detect migratory bats and their possible pathways.

Results and Discussion

Thirty-four caves were visited in 2014, including 25 revisits (Table 1). Four new hibernacula were documented during 2014 surveys (Table 1). This brings the number of known hibernacula on CRMO to 8. Bats seen in the new hibernacula included Townsend's big-eared bats (*Corynorhinus townsendii*), Western small-footed myotis (*Myotis ciliolabrum*) and one unidentified myotis species. One cave visited was considered too light for hibernating bats and two caves were considered unlikely for hibernation due to their smaller size (Table 1). On two occasions (Low Tide and First Chance caves) hibernating bats were found nearly in the light zone of a cave (35-50 feet from a cave entrance). This led surveyors to reconsider what might be a suitable cave for hibernation. As a result, 3 caves listed in the 2012-2013 report as either unlikely for or not suitable for hibernation were changed to "possible". These 3 caves were surveyed in 2014 despite the original call on suitability and put back into the annual survey list (Table 1). To date, approximately 24% of caves visited and deemed suitable for hibernation have contained hibernating bats. Bats were found in 2 caves that were negative for bats in 2013 surveys (Ice Lake and First Chance caves). In one case (Low Tide Cave) bats were found in a cave which had been surveyed all three years but was negative for bats in 2012 and 2013. One other cave (Beauty) was negative for bats after having been used for hibernation in 2013. These results indicate that bats move from one cave to another (either from year to year or within year). The survey of Arco Tunnel resulted in a record high count of 38 bats. Arco Tunnel remains the largest confirmed hibernacula in CRMO, although 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). None of these have been surveyed yet due to remoteness, hazards and specialized skills required to descend into these caves.



Figure 6. One of two clusters of bats in Arco Tunnel found during the 2014 survey.

Cave Climate Conditions at Hibernacula Sites

Cave temperature data has been collected as close to hibernating bats as possible for two winter hibernacula survey seasons (2013-2014). In 2013 only Kestrel 3000 Pocket Weather meters were employed to collect air temperature. Starting in 2014 CRMO acquired UEI INF 156 Infrared thermometers. These instruments were purchased for several reasons: for high-ceilinged caves so that temperatures could be taken as close to hibernating bats as possible, because of the instantaneous nature of the data (whereas Kestrels often need a few minutes to acclimate to the cave environment), and lastly because Kestrels are easily influenced by the surveyor's body heat and respiration (especially in small cave passages). However, it quickly became apparent that the infrared thermometers often differed from air temperature readings taken by the Kestrels at the same location. Once this issue was noticed, surveyors began carrying both instruments and taking both air and ceiling temperatures whenever possible. The two types of instruments never agreed exactly and differences ranged from as little as 2.5°C to as much as 22°C (with the infrared thermometers always reading cooler). The reason for these discrepancies is unknown but may be due to differences in the emissivity of lava tube cave ceilings and walls on CRMO or due to exceeding the lower limit of the unit's operating range (0°C) during travel to and from the cave. This is an area that needs to be further explored in 2015 surveys. Discussions about this issue with other biologists working with bats in cave environments has to this point been fruitless, as they have generally employed only infrared thermometers and have not noted a substantial difference with air temperatures. For the purposes of this report we will present only the air temperature findings as they are most in line with what we expect from hibernating bats (many of the infrared temperatures were far colder than the expected temperature) and we have 2 years of data collected with the Kestrel units versus one season of use with the infrared thermometers.

Initially, it was not deemed necessary to collect humidity data during cave surveys as the general consensus of the literature indicated that bats only hibernate in high (60 -100 %) humidity conditions in order to maximize energy savings and reduce evaporative water loss during winter (Perry 2013). Field data sheets did not have a place to record humidity. Despite this, surveyors did collect some humidity data in 2013. Looking at this data, it became apparent that bats were found hibernating in a wide range of humidity conditions including caves with humidity as low as 42%. Therefore, in 2014, surveyors often recorded humidity levels on maps or under "comments" on field forms. In future years, humidity data should become a routine part of protocols. This will further our knowledge of humidity conditions in hibernacula within CRMO caves, potentially better describe humidity preferences of species, and help predict which caves may be more susceptible to hosting the fungus *Pseudogymnoascus destructans* which is presumed to grow best at high levels of humidity (Grieneisen 2013).

For the two winter survey seasons (2013-2014) bats were found hibernating in CRMO caves within an air temperature range of -0.9°C to 9.2°C. In comparison to caves used as hibernacula on the Idaho National Laboratory (INL), which is immediately adjacent to CRMO, the normal range in most of their caves is -1.6°C to 3°C (Whiting 2013, using UEI INF 156 Infrared thermometer). Both of these ranges' lower limits is colder than reported by Perry (2013) for most temperate vespertilionid bats in North America, which select caves with temperatures between 2 and 10 °C. Given that the fungus

that causes WNS (*Pseudogymnoascus destructans*) thrives best between 5°C and 14°C (Blehert et al. 2009) the temperature data collected during CRMO hibernacula surveys confirms that CRMO caves and bats are at risk.



Figure 7. A Townsend's big-eared bat found hibernating in Needles Cave (with one ear down and one ear curled up) during the 2014 survey.

The humidity data presented here is very preliminary as the sample size is too small to make any solid inferences on, and was not collected uniformly for every bat location (we may have only one humidity data point per zone or per cave). Speaking generally however, Townsend's big-eared bats (*Corynorhinus townsendii*) seem less selective for humidity (found between 42-90%). *Myotis* species were not found in humidity lower than 59% and those suspected to be Yuma myotis were only found in the highest humidity conditions (>89%).

Table 1. List of 49 caves surveyed for winter bat use during winters of 2012-2014 in Craters of the Moon National Monument and Preserve.

Cave	Surveyed			Suitable for Hibernacula	Bats (High Count)
	2012	2013	2014	(judgment of surveyors)	
Sand Trap	Y	Y	Y	possible	0
Two-Step	Y	Y	Y	possible	0
Fire-Ring	Y	Y	Y	possible	0
Bloody Knees	Y	Y	Y	possible *	0
Low Tide	Y	Y	Y	confirmed	2
Pond	Y	N	-	no - too small	-
Three Room	Y	N	-	no - too short and light	-
Skelebat	Y	Y	Y	possible	0
Open Dome		Y	Y	Unlikely – too light (skylight on far end)	0
Screaming Jaws of Death		Y	Y	Yes	0
Spongy Floor		Y	Y	Possible	0
Antelope		Y	-	no - too short and light	-
Ice Lake		Y	Y	confirmed	1
Prickly Pear		Y	N	unlikely – short and too light	0
Karate		Y	-	no - too short and light	-
Girl Scout		Y	-	no - too light (skylights/multiple entrances)	-
Lobe 1		Y	-	no- too small	-
Lobe 2		Y	-	no- too small	-
Chimney		Y	Y	possible	0

*changed from “unlikely - too short and/or too light” to “*possible*” based on further cave exploration and findings from 2014 surveys where hibernating bats were found nearly in the light zone of nearby caves

Table 1 (continued). List of 49 caves surveyed for winter bat use during winters of 2012-2014 in Craters of the Moon National Monument and Preserve.

Cave	Surveyed			Suitable for Hibernacula	Bats (High Count)
	2012	2013	2014	(judgment of surveyors)	
Cathedral		Y	-	no - too short and light	-
Big Craters Tunnel		Y	-	no – too light (skylights)	-
Chapel		Y	Y	Yes	0
Rope Floor		Y	-	no - too short and light	-
Arched Pit		Y	-	no - too short and light	-
Green Crystal		Y	-	no - too short and light	-
Indian Tunnel (west passage)		Y	Y	unlikely (no constriction point)	0
Dewdrop		Y	-	no - too short and light	-
Beauty		Y	Y	confirmed	2
Boy Scout		Y	Y	unlikely – too light	0
Arco Tunnel		Y	Y	confirmed (known since 1985)	38
Hidden		Y	Y	Yes	0
Hidden II		Y	Y	Possible*	0
First Chance		Y	Y	confirmed	1
Needles		Y**	Y	confirmed	3
Tom Thumb		Y	-	no – too light	-
Last Chance		Y	Y	possible in farthest reaches of cave	0

** changed from “no - too short and light” to “possible” based on findings from 2014 surveys where hibernating bats were found nearly in the light zone of caves

*about 50 feet of cave not thoroughly searched as surveyors felt it unlikely they could get past the bat without disturbing it

Table 1 (continued). List of 49 caves surveyed for winter bat use during winters of 2012-2014 in Craters of the Moon National Monument and Preserve.

Cave	Surveyed			Suitable for Hibernacula	Bats (High Count)
	2012	2013	2014	(judgment of surveyors)	
Lava River Natural Bridge		Y	Y	possible	0
Surprise		Y	Y	Possible*	0
East Teepee		Y	Y	possible	0
One More Chance		Y	Y	confirmed	2
Buffalo Caves			Y	possible	0
East Hidden			Y	possible	0
Fool Killer			Y	No - too light	-
Guano			Y	Possible	0
Hornito Cone Moat			Y	Unlikely - too small	0
Rio Grande			Y	Confirmed	4
The Watchman			Y	Yes	0
West Hidden			Y	Unlikely - too small	0
West Teepee			Y	Yes	0

* changed from "*unlikely - too light*" to "*possible*" based on further cave exploration and findings from 2014 surveys where hibernating bats were found nearly in the light zone of caves

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