# Use of Talus and other Rock Outcrops by Bats in Western Montana

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# Background

Of the 15 bat species present in Montana, four are thought to migrate out of state in the winter. The remaining nine species have been detected acoustically during winter and spring (Montana Natural Heritage Program Acoustic Data 2017), suggesting that these species over winter in Montana. However, few bat species in the state are known to use caves as hibernacula (Montana Natural Heritage Program Cave and Mine Survey Data 2017). To-date there are currently 34 caves in Montana known to have hibernating bats. Of these, Azure Cave in the Little Rocky Mountains holds the largest group (1,700 maximum count) during the winter. In total approximately 4,000 individual bats have been counted across all surveyed caves, but given regular detections away from karst areas and activity levels of non-migratory species in the active season it is reasonable to conclude the orders of magnitude more animals likely overwinter in Montana than are using caves. This suggests that bats that remain in state for hibernation may use other features across the landscape. For example, in Yellowstone National Park, bats have been documented using cracks and crevices in cliffs or talus (rock outcrops) during the active season and within the shoulder seasons (Johnson et al. 2017). In other regions, bats have been tracked using radio telemetry to rock outcrops preceding hibernation (Moosman et al. 2015) and have been found over-wintering in these features (Lamen et al. 2016). Based on these previous studies and our knowledge of the number of bats that do over-winter in Montana's caves, it is apparent that they are using different features across the landscape for hibernation. Perhaps talus or rock outcrops are more prolific across western Montana and provide better quality habitat than caves resulting in more individuals selecting these features as hibernacula.

Although we suspect that talus or rock outcrops provide habitat during the active and hibernation season, we have not yet quantified their use by bats. In order to understand the importance of talus for species of bats over-wintering in western Montana, we conducted surveys using various methods to quantify attributes of these slopes. This would allow us to determine if bats are actively using talus in western Montana and eventually assist in predicting use of these features across the landscape. Furthermore, the data we collect from these surveys can be used as baseline indices of activity during the active season. This becomes especially important for future monitoring efforts detecting White Nose Syndrome (WNS) in 40 kHz bats using non-cave roosts in western Montana. Additionally, these baseline indices can inform future management implications for projects that occur in and around potentially sensitive talus slopes that could support roosting bats during the active season or bats that are over-wintering.

## Methods

To select sites, we used three criteria: 1) Pika (*Ochotona princeps*) presence, 2) distance from roadway < 100 m, and 3) water source in the vicinity. We used the Montana Natural Heritage Program's (MTNHP) Map Viewer tool to find observations for Pika in western Montana. Pika are dependent on talus slopes with certain criteria such as boulder size, interstitial spaces, and subsurface temperature (Hall, 2015), which may be similar to habitat attributes bats require for hibernation. This allowed us to narrow our search using aerial imagery for sites where talus, roadways and water sources intersected.

Surveys were conducted over two 10-day sessions and one 6-day session within three regions of western Montana. From June 20-29 2017, our focus was in the Ravalli, Granite and Deer Lodge Counties including areas around the Burnt Fork Bitterroot River and Rock Creek. Relief in this area is typically dome-topped mountains with large sections of talus and forested stands predominately in the Rocky Mountain Lodgepole Forest type. Sites are generally dry to intermediate with a wide range of seasonal temperatures. Elevations in this area ranged from 1265-1865 m.

From July 5-11 2017, we completed surveys in southwestern Montana along Big Sheep Creek and Pioneer Scenic Bi-way, both located in Beaverhead County. The habitat in the area along Big Sheep Creek includes large limestone cliffs, predominately Montane Sagebrush Steppe and to a lesser extent sections of Rocky Mountain Lodgepole Pine Forest or Rocky Mountain Lower Montane, Foothill, and Valley Grassland. Along the Pioneer Scenic Bi-way, very little area included large sections of talus. The habitat mainly consisted of Montane Sagebrush Steppe and Rocky Mountain Lodgepole Pine Forest with lesser habitat associations of Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, Rocky Mountain Lower Montane, Foothill, and Valley Grassland, Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland, and insect killed forests. Elevations for this region ranged from 1963-2124 m and were some of the highest surveyed.

Our last survey session was from July 18-27 2017. Our focus during this session was in Ravalli County in drainages of the Bitterroot National Forest. This area has undergone previous disturbance or modification by fire or insect. Areas that lacked previous disturbance were predominately Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest with small sections associated with Rocky Mountain Lodgepole Pine Forest, Rocky Mountain Lower Montane, Foothill, and Valley Grassland or Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland. Elevations within these drainages ranged from 1315-1579 m.

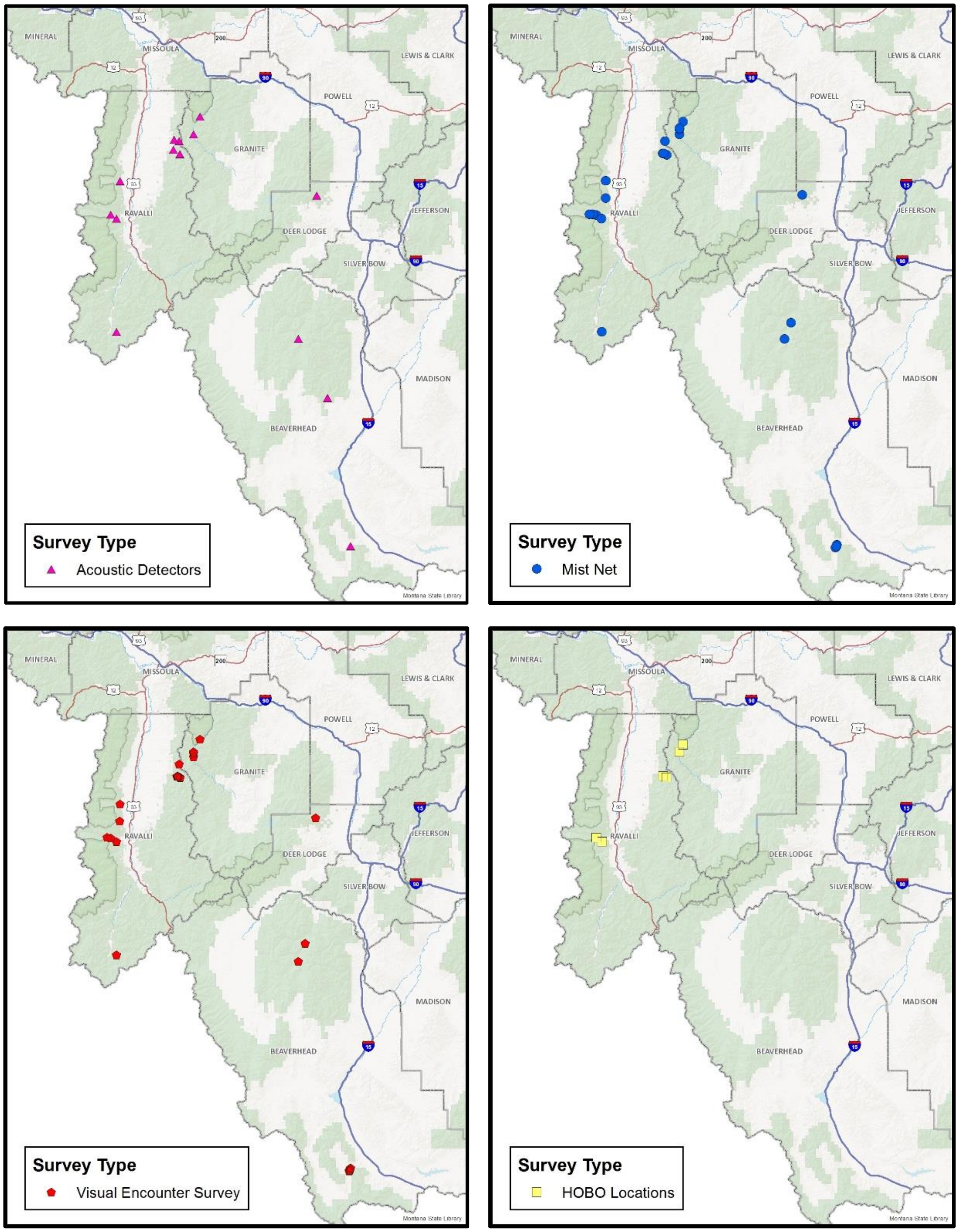


*Figure 1. Survey locations across Southwest Montana for 4 protocols: top-left) acoustic detectors, top-right) Mist net, bottom-left) Visual Encounter Surveys of talus slopes, bottom-right) HOBO temperature and humidity loggers in talus slopes.*

To determine if bats were present on talus slopes, we used three methods of detection: 1) acoustic detector/recorders, 2) visual encounter surveys of talus/rock outcrops, and 3) mist net surveys in proximity to outcrops. We recorded bat echolocation calls from sunset to sunrise nightly with a SM2Bat+ detector/recorder placed on talus slopes for a minimum of three nights. Each detector ran off a single marine grade 12v battery. Our deployment protocols were adopted from Montana's Bat and White-Nose Syndrome Surveillance Plan and Protocols 2012-2016 (*sensu* Maxell 2015). We placed microphone arrays approximately 2 meters above ground in an area of low clutter. We programmed acoustic detector/recorders to collect data each night from 0.5 hours before sunset to 0.5 hours after sunrise, thereby identifying emergence and immergence periods. We will process and analyze all recordings following standardized MTNHP protocols to determine bat species present within 50+kHz, 40kHz, and <30kHz species groups (Maxell 2015).

We completed talus surveys inspecting cracks and crevices for the presence of bats or guano. Cracks could be formed when a rock/boulder is partially broken, creating a crack within the same piece of rock or when two rock/boulders are stacked creating a space that could be used by bats. Crevices were deep spaces that appeared to go back into the talus slope, which could potentially provide an over-wintering location. We recorded a start location and surveyors would traverse the talus to cover as much ground as possible. Once a bat or guano was located, information pertaining to location, crack size, photo and if possible a sample were collected. We adopted our data collection based on rock outcrop surveys completed by MTNHP for reptiles in eastern Montana. Genetic analysis of guano samples will confirm genus or species identity of bats that are using talus as day or night roosts.

Our last survey method was to mist net at the base or within the vicinity of talus slopes. Sections of talus that contained potential flyways to a water source were our focus followed by those that had a flyway through forested areas and lastly, some sections directly over water. Net size was variable depending on location and habitat, but lengths ranged from 3-18m. We opened nets approximately 0.5 hours before sunset, but time depended on bird activity in the area thereby reducing the likelihood of by-catch. We closed the nets at approximately midnight, unless weather or activity levels were poor. Upon capture, we identified individuals to species and determined the sex, age, and reproductive status. To ensure accurate species identification, we recorded morphometric measurements and collected guano samples from all *Myotis* spp. when possible for genetic confirmation.

In areas of talus that appeared to be suitable for hibernation, we set up six long-term locations to identify microclimate conditions within the slopes. We deployed six HOBO temperature and humidity sensors within three drainages Rock Creek, Burnt Fork Bitterroot River, and Lost Horse Creek. We randomly selected a site on each of the six-talus slopes to place loggers at a depth ≥ 1m. HOBOs will remain in talus overwinter to identify how season and snow depth affect microclimates. Once we retrieve the units in the spring, we can use the minimum, maximum, and variation in temperature and humidity to determine conditions occurring during winter on these slopes. This may provide insight as to whether talus features mimic known conditions of hibernacula in caves.

# Results

## Visual Encounter Surveys

We surveyed 23 talus slopes across three regions in western Montana. We selected 13 slopes using aerial imagery and 10 sites were incidental. All sites surveyed were ≤ 100m from a road. Aspects were predominately south or west facing. On average surveys were 192.6m in length by 68.3m in width. Survey times averaged 111.39 minutes, and ranged from 28 to 300 minutes. For all sites, we attempted to survey 26-50% of the talus for a good representation of the slope. The dominant substrate was boulders (> 30cm diameter) and to a lesser extent cobble (4-30cm diameter). Of the 23 surveys completed, only six did not appear have the potential to support overwintering bats based on the size of substrate or lack of interstitial spaces within the slope.

We discovered ten bats during talus surveys; however, because we did not handle bats, confirmation of species was not possible for many individuals. Of the 10 individuals encountered, seven were potentially *Myotis evotis* or *M. thysanodes*. The remaining three were likely *M. ciliolabrum*. All bats were located within cracks between 1-3cm and rocks that ranged from 30-85cm in length by 30-75cm in width resting on rocks that were 50-150cm in length and 40-175cm in width (Table 1). All rocks that bats were located under were ≤ 20cm thick.

We detected guano at 35 locations; however, we only collected 25 samples from nine of the 23 surveys. The majority of samples collected were relatively small and likely belong to *Myotis* spp. Unlike formations where we detected bats, guano was located in a range of talus features such as under overhangs, in cracks resulting from stacked rocks or in partially fractured rocks/boulders. Only one sample was located under a large overhang created by a boulder 300cm x 250cm partially buried in the talus slope. Of the 35 locations where we detected guano, 14 of the samples (40%) were in rock fractures. In this instance, cracks were between 0.5-5cm and rocks ranged from 12-300cm in length by 15-150cm in width with the smaller outside piece 12-175cm in length and 20-65cm in width. Thickness of these rocks/boulders ranged from 4-80cm thick. Conversely, the remaining 19 samples were found under rock fragments or rocks >20cm. In these instances, cracks were between 1-8cm located under rocks that ranged from 30-115cm in length and 15-80cm in width resting on rocks that were 30-175 in length by 20-100 in width.

*Table 1: Results of talus surveys including whether bats or guano were detected, under what cover type, the size of cracks used, and rock/boulder sizes.*

| Detection Type (n) | Cover type | Crack size (cm) | Top length (cm) | Top width (cm) | Bottom length (cm) | Bottom width (cm) |
|---|---|---|---|---|---|---|
| Bats (10) | Under >20cm | 1-3 | 30-85 | 30-75 | 50-150 | 40-175 |
| Guano (14) | Fracture | 0.5-5 | 12-175* | 20-65* | 12-300 | 15-150 |
| Guano (19) | Under >20cm | 1-8 | 30-115 | 15-80 | 30-175 | 20-100 |
| Guano (1) | Overhang | - | 300 | 250 | - | - |

Note: One sample not included because no information collected.
* Indicates measurements are from smaller piece of rock/boulder that was fractured from main piece.

## Mist Net Surveys

We deployed mist nets at 22 sites within western Montana. Nets were between 3-18m in length depending on site features. The average length in net-meters at a location was 36m and ranged from

21-48m in length. We captured 36 individuals; however, five bats escaped prior to removal from nets. Our average bat capture was two individuals/night, but ranged from 0-13 individuals. We captured eight species (Table 2) with the most common capture either *M. yumanensis* or *M. lucifugus*. As it is difficult to distinguish these two species without genetic tools, we were unable to determine the species of any of these individuals. Of the 36 bats captured, 75% (n=27) were male, 11% (n=4) were female, and 14% (n=5) were of unknown sex. All individuals captured were adults with 50% considered non-reproductive (n=18), 44% reproductive (n=16) and 14% unknown (n=5). One of the females captured was a pregnant Silver-haired Bat (*Lasionycteris noctivagans*).

*Table 2: Total species captured during mist net surveys in western Montana.*

| Scientific Name | Common Name | Total Number Captured (n=36) | Escaped prior to collection |
|---|---|---|---|
| | Unknown bat | 2 | 2 |
| *Myotis sp.* | Unknown Myotis | 2 | 2 |
| *M. evotis* | Long-eared Myotis | 5 | - |
| *M. lucifugus* | Little Brown Myotis | 1 | - |
| *M. thysanodes* | Fringed Myotis | 1 | - |
| *M. volans* | Long-legged Myotis | 2 | - |
| *M. yumanensis* or *M. lucifugus* | Yuma Myotis or Little Brown Myotis | 13 | - |
| *Eptesicus fuscus* | Big Brown Bat | 2 | - |
| *Lasionycteris noctivagans* | Silver-haired Bat | 6 | - |
| *Lasiurus cinereus* | Hoary Bat | 2 | 1 |

**Acoustic detectors**

Of the 23 slopes surveyed, 14 had acoustic detector/recorders placed either on or at the base. The average number of nights for operation was four, but ranged from three to nine nights. These detector/recorder deployments resulted in an average of 36 hours of recordings at a site, but ranged based on logistics from 24 to 74 hours. Currently these data are being processed and analysis is expected to be completed in the spring of 2018.

## Discussion

Identifying active season roosts in natural features within Montana has been difficult, particularly in areas without known caves. Surveys of these roosts are necessary to provide information on the life history and help conserve vulnerable species (Lemen et al. 2016). Prior to this project only 61 active season roosts were known within Montana, and almost all of these were incidental detections during reptile surveys in Southeastern Montana (Montana Natural Heritage Program Data, 2017). This project has identified 44 new roosts representing a 72% increase. Data on roosts is critical for monitoring populations to assess impacts of exotic emerging pathogens like *Pseudogymnoascus destructans* (Pd) which causes White-nose Syndrome, and increases our knowledge of habitat selection and natural history for these bat species.

Whether talus slopes that serve as active season roosts also are suitable for hibernation, is as yet undetermined, but indirect evidence supports the hypothesis that these features are important hibernacula. For example, Johnson et al. (2017) hypothesized that telemetered bats tracked to talus may continue to use rock features in Yellowstone after the fall transition season. Moosman (2015) found Eastern Small-footed Bats (*Myotis leibii*) in torpor in talus during the transition period between active and hibernation seasons. Lemen et al. (2016) identified cracks in cliffs that serve as hibernacula adjacent to active season habitat. Acoustic detectors placed in rugged landscapes record more winter activity than those in areas with less topography and presumably fewer outcrops. The same species that were recorded in winter were also present at the site in the summer, suggesting hibernaculum and active season roosts are in close proximity if not in the same features (Montana Natural Heritage Program Data, 2017).

Rock outcrops including talus have the potential to provide a range of microclimates that may make areas suitable for both active season roosts as well as hibernacula. We detected bats in protected crevices with good solar exposure, similar to other active season roosts we have found in rock outcrops and bridges. Many slopes also had extensive interstitial spaces, which continue back below the frost line and potentially have similar climactic attributes as caves, mines, and other known subterranean hibernacula. Furthermore, snow deposits may help mitigate fluctuation of temperature and humidity. To test this, we placed temperature and humidity loggers at 6 slopes, and will retrieve them in the spring of 2018. We will compare these data to known conditions of cave hibernacula to determine if these features are potentially suitable for hibernation.

Although this project did not conclusively demonstrate that talus slopes serve as hibernacula, the data we collected has made further investigation of these features possible. Direct observation of hibernating bats within a talus slope is unlikely without significant effort and disturbance to the slope as the interspace between rocks is often too small for a person to enter. Therefore, surveillance of these slopes during the hibernation season with electronic devices such as acoustic detectors and thermal imaging cameras holds the most promise for assessing occupancy. Lemen et al. (2016) have recently demonstrated a technique to identify hibernacula features in Nebraska. They placed a dense array of detectors along a feature of interest and identified which detectors record relatively high amounts of activity. Afterwards, these areas can then be surveyed with mist nets or thermal cameras to determine what specific features are being used. While this technique works well in Nebraska where rock outcrops are limited on the landscape, rock outcrops in Montana can be much larger and would require a prohibitively large amount of detectors to survey. However, the use of detectors placed on or near talus holds promise to identify areas that contain hibernacula. Currently, we are working with a student at the University of Montana to place 10 detectors on the talus slopes surveyed this summer. By analyzing the activity across the hibernation season, we will be able to make inference about whether each slope contains hibernacula and if any data collected during the summer are predictive of winter use. Results from this project are expected in the spring of 2018.

Understanding the location and importance of hibernacula before WNS spreads to Montana is critical for surveillance efforts and to assess the impacts of disease on local bat populations. Implementation of surveillance protocols for Pd in areas without caves and mines is difficult and relies primarily on netting after emergence or finding maternity colonies in late spring, which reduces the chances of detecting the fungus if it is present.  Without baseline indices of abundance and distribution in areas without caves, we may not be able to assess disease-mediated changes in populations. White-nose Syndrome may not affect bats hibernating in cracks and crevices as severely as in cave or mine hibernacula.  Differences in environmental attributes such as temperature and humidity, or biological attributes such as the absolute number of animals using a roost and the density of these individuals may change disease transmission dynamics and impacts within these features (Langwig et al. 2012). Therefore, quantifying the effects of WNS at only cave and mine hibernacula will not give insight into how this disease is affecting all of Montana's resident bats.

## Literature Cited

Johnson, J. S., J.J. Treanor, M.J. Lacki, M.D. Baker, G.A. Falxa, L.E. Dodd, A.G. Waag, and E.H Lee. 2017. Migratory and winter activity of bats in Yellowstone National Park. Journal of Mammalogy 98(1): 211-221.

Langwig, K.E., W.F. Frick, J.T. Bried, A.C. Hicks, T,H. Kunz, and A. Marm Kilpatrick. 2012. Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome. Ecology letters 15(9): 1050-1057.

Lemen, C.A., P.W. Freeman and J.A. White. 2016. Acoustic evidence of bats using rock crevices in winter: A call for more research on winter roosts in North America. Transactions of the Nebraska Academy of Sciences and Affiliated Societies 36: 9-13.

Maxell, B.A. Coordinator. 2015. Montana Bat and White-Nose Syndrome Surveillance Plan and Protocols 2012-2016. Montana Natural Heritage Program. Helena, MT. 205 p.

Moosman Jr, P.R., D.P. Warner, R.H. Hendren, and M.J. Hosler. 2015. Potential for monitoring eastern small-footed bats on talus slopes. Northeastern Naturalist 22(1): 1-13.