REPORT 2022: Survey of Bats at Corona Hill, Hall Ranch: Twin Lakes, Walden Ponds, Overwintering Activity at Ingersol Quarry, High Elevation Building Roosts, and Lefthand Canyon Elevational Transect

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(52 pages, 1 Table, 71 Figures)

Abstract

In 2022, major emphasis was placed on a survey of Corona Hill at Hall Ranch. This area showed high bat activity and high propensity for bats roosting in quarried areas, especially the small-footed myotis (*M. ciliolabrum*) and the fringed myotis (*M. thysanodes*). In addition, the active prairie dog colony on site was the most active foraging area, however this was driven primarily by *M. ciliolabrum* which appears to have a unique relationship with prairie dog colonies. The *M. thysanodes* maternity colony located in Geer Canyon continued to be active and productive in 2022 despite the severely burned stands most proximate to their roost site. Plumely Canyon also was highly active with bats despite the severity of burn throughout the area. Ingersol Quarry was highly active in 2022 and continues to be an important drinking and foraging site, especially for myotis species, including *M. ciliolabrum* winter activity indicating over-wintering in rocks at the site. At the eastern property of Twin Lakes tricolored bats (*P. subflavus*) continued to increase, whereas at Walden Ponds, number of passes per night decreased from 2020 to 2021 but rebounded somewhat in 2022. The Left Hand Canyon elevational transect begun in 2021 and also showed high activity at middle and highest elevation near Brainard Lakes in fall 2022. High-elevation building sites, Rocky Mountain Mammoth, Cardinal Mill, and Blue Jay Mine showed continued high activity in 2022 and showed clear indication of large maternity colonies for little brown myotis (*M. lucifugus*) and long-legged myotis (*M. volans*).

Introduction

The main emphasis of the 2022 grant was to survey bats at Corona Hill, Hall Ranch, an area demarcated as Critical Wildlife Habitat (Fig. 1). The area is also replete with old quarry

pilings that have the potential for roost sites of some myotis species. I also continued to survey Ingersol Quarry, MYEV_Thinned site, Plumely and Geer canyons, Cardinal Mill, Rocky Mountain Mammoth. And Blue Jay Mine. In addition, I surveyed some sites that were not contracted in 2022. This included Twin Lakes and Walden Ponds for tricolored bats due to the likelihood of being listed as endangered by the USFWS soon, and three sites in Lefthand Canyon marking an elevational transect that was begun in 2021. Unfortunately, the South St. Vrain elevational transect could not be surveyed due to continued construction and road closures in 2022.

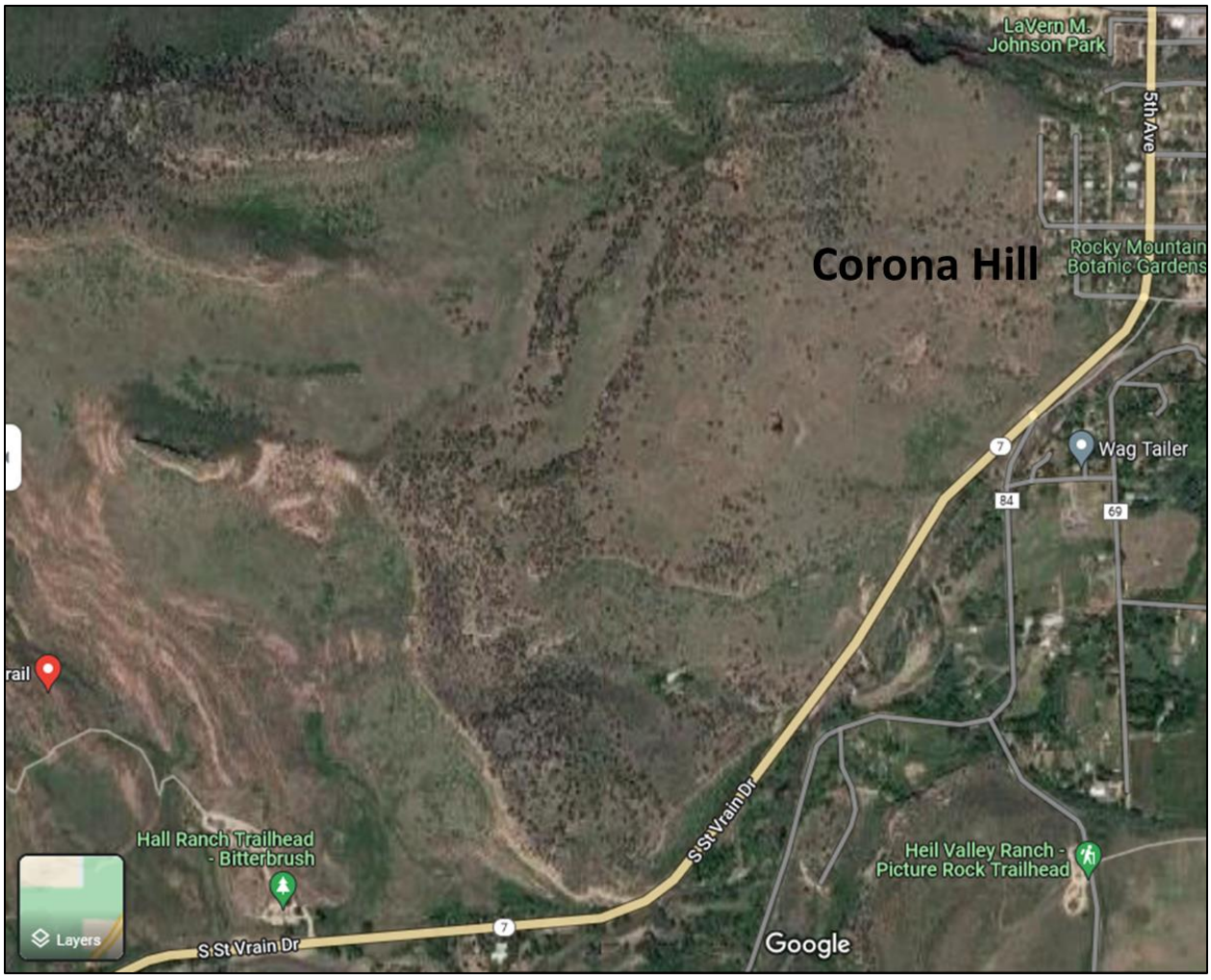


Figure 1. Map showing surveyed area of Corona Hill at Hall Ranch designated as critical Wildlife habitat.

Tricolored Bats in Boulder County

Until 2017, there had been only two individuals of the tricolor bat (*Perimyotis subflavus*) documented in Boulder County (Armstrong et al. 2006, RA Adams personal observation 2013). However, the finding of a grounded female with two pups along South Boulder Creek in eastern Boulder County by a wildlife rehabilitator in 2017 provided evidence that this species is reproducing along the Front Range (Adams et al. 2018). Sonar evidence gathered in 2020 showed that tricolored bats are increasing in numbers at Twin Lakes and Walden Ponds and this increase is either due to reproduction and survivorship of young, increased migration into the county, or both. Tricolored bats have been devastated by white-nose syndrome in the eastern US and a petition has been submitted for listing this species as endangered. A recent survey in the Guadalupe Mountains National Park and Culberson County extended the range of this species into the Trans-Pecos region of Texas (Hannttula and Valdez 2021). Although movement patterns of this species are poorly known, some evidence indicates that at least some individuals may undergo long-distance seasonal migrations latitudinally (Fraser et al. 2012). **On September 13, 2022, the USFWS announced its intention of listing the tricolored bat as endangered under the Endangered Species Act. Therefore, several BCPOS properties will be central to conservation management of this species as populations have been established and continue to persist and, in some cases grow, over the last five years.**

Elevational Migrations and Bats

Outside the general patterns that our local bat species move among different elevations seasonally, the relationship of these local migratory movements to annual weather patterns or more long-term changes in climate remains unclear. It has been presumed that myotis bats and big brown bats overwintering in Boulder County move between higher elevation underground hibernacula and summer foraging areas at lower elevations seasonally. Adams and Hayes (2018) analyzed capture data over the last 23 years and found that the long-legged myotis (*M. volans*) were not as prevalent at lower elevations in the spring and early-summer months as was documented previously. They infer climate change and the well-known fact that this species is sensitive to heat stress at lower elevations during mid-late summer and typically

moves to higher elevations during these months. If this species is no longer descending to lower elevations in years where springtime temperatures are above average, this would be the first bat species for which climate change is disrupting its seasonal migration patterns. In 2019, we began tracking seasonal movements of bats using sonar detectors across elevations in South St. Vrain Canyon and in fall 2021 we replicated this along Lefthand Canyon Creek. Quantifying elevational migrations in Boulder County will help with understanding how various bat species may react to regional climate warming.

Winter Bat Activity

Gilbert White (1777) noted in his journal the observation of bats aerially emerging from their hibernaculum in winter. Moffat (1904); Barrett-Hamilton (1910-11); Venables (1943) and Vesey-Fitzgerald (1949) noted occasional occurrences of winter feeding by pipistrelle bats in Britain as did, later, Avery (1985).

Winter activity by bats in temperate North America was made clear by at least 1989 (Whittaker and Rissler 1992, Indiana). In the western US, winter bat activity has been noted in New Mexico (Geluso 2007), Yellowstone National Park (2017) and Montana 2014). In arid regions such as New Mexico (Geluso 2007), Utah (Ruffner 1979), and Colorado (Adams unpub. data) such activity appears restricted along water sources that provide winter water due to surface-melt on warmer days. Rather than humid underground caverns, bats are using unconventional hibernation sites that require regular arousal and water replenishment. More understanding of these behavioral patterns should prove important for proper management of these unique locales.

Methods

Corona Hill, Hall Ranch Critical Wildlife Area: Sonar surveys for bats were carried out to cover the extent of Corona Hill as well as to sample the various habitat types using stratified sampling. Wildlife Acoustic SMU Mini Bat Detectors were deployed for four-five nights (five if weather was significantly different on one of the nights) at each location. In the case of quarry rocks surveyed for roost sites using a trailcam and SMU detectors, recordings ranged up to

eight nights. Recorded sonar sequences were analyzed with SonoBat 4.4 version software to identify bat species. Each site was GPSed and classified in terms of general habitat features such as meadow (few or no trees), ponderosa pine woodland (relatively close stands of trees), shrubland (various shrubs with no trees), quarry (remnants of rock quarrying), or cliff (natural rock formations). In addition, special focus was directed towards the prairie dog colony as well as several of the mining slag piles replete throughout the area. Sonar detectors were placed at several slag piles as well as a trailcam to assess roost site usage by bats.

Other Survey Sites: Ingersol Quarry was monitored throughout the year using a Wildlife Acoustics SM4 Songmeter. Data were gathered from the site once a month. The MYEV_Thinned site, near Ingersol Quarry was surveyed once in August using an SM2 with high-end SMM microphone. Blue Jay Mine was surveyed in spring and fall using SMU mini and SM4 detectors, whereas Cardinal Mill and Rocky Mountain Mammoth were surveyed only in fall with SM4 and SMU mini detectors. The eastern properties of Walden Pond and Twin Lakes were surveyed in spring and fall with SMU mini detectors. The Lefthand Canyon transect was deployed in fall using SMU mini detectors.

Quantifying Bat Activity: Bat activity was defined as the sum of sonar call sequences recorded regardless of species or if the call sequence was indefinable to species. In some cases, these data were converted to mean number of Passes per Night (PPN) to compare different sites if the number of survey nights differed or to give information on nightly activity.

RESULTS

Corona Hill Critical Wildlife Area Survey, Hall Ranch: Fourteen sites were surveyed with SMU mini sonar detectors at Corona Hill (Fig. 2) during the months of July, August and September. Seven of these sites were also surveyed with trailcams at rock quarries to check for bat roosting sites as well as the prairie dog colony in attempt to capture foraging bats. Site 2 (prairie dog colony) was sampled twice (7/14-7/18 and 9/4-9/6 with trailcam) as was Site 12 in which the first survey indicated the possibility of the presence of roosting sites. Sites 13 and 14 were

sampled initially with trailcams both for eight nights. Four sites, numbers 7, 8, 9, and 10 were surveyed for five nights due to inclement weather on one of the nights.

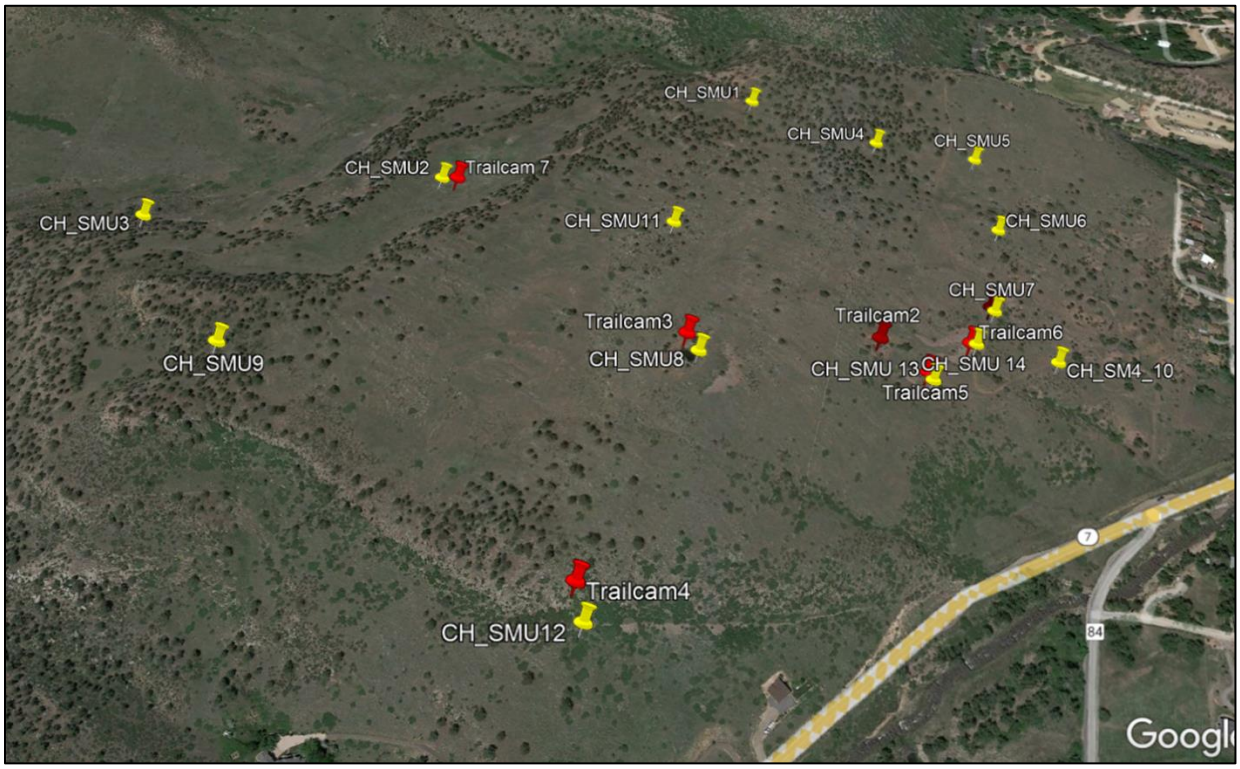


Figure 2. Map of survey points on Corona Hill in July and August 2022. Yellow markers indicate SMU mini sonar detectors, red markers indicate trailcams.

General Findings. A total of 16,843 call sequences were recorded on Corona Hill during the survey period with an average number of passes per night (PPN) of 222.1. Sites varied in terms of their activity. Of the 14 sites surveyed, five were categorized as meadow, three sites were ponderosa pine woodland, three sites were shrubland (one site near cliff face), and three sites were at rock quarries. Three more rocky quarry sites were sampled with trailcams after initial evidence from surveys in proximate habitats indicated possible nearby bat roost sites. Three sites were surveyed twice to assess activity further, these were Sites 2 (prairie dog colony with trailcam), site 8 for rock crevice roosts and site 12 for cliff-face roosts.

By far the most active site was Site 2 located in the prairie dog colony that is currently active with prairie dogs (personal observation). This was true in terms of raw activity data and passes per night (PPN). Other sites were relatively similar to one another. Species activity at

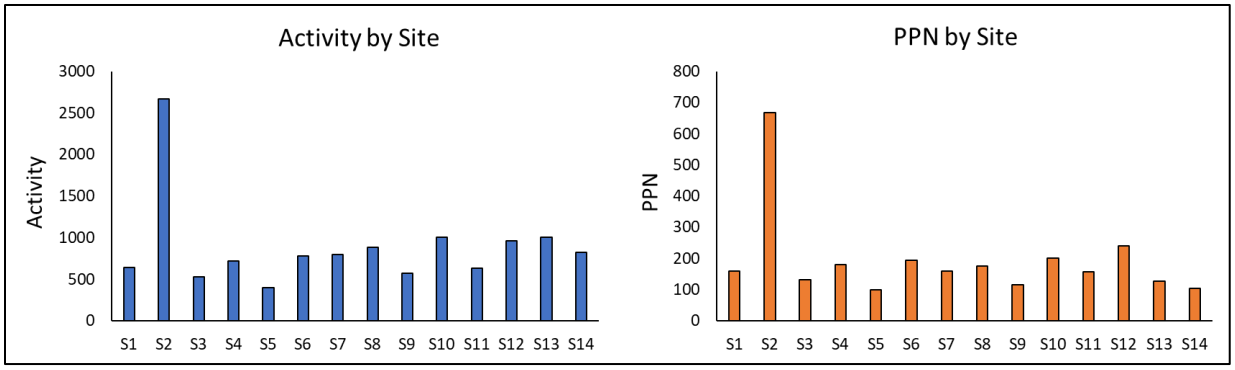


Figure 3. Comparison of 14 (S1-S14) sites surveyed at Corona Hill in 2022 in terms of raw activity and mean passes per night (PPN).

Corona Hill was dominated by small-footed myotis (*Myotis ciliolabrum*) followed by open aerial foragers, big brown bats (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris noctivagans*). It should be noted that fringed myotis (*M. thysanodes*) were also relatively high in activity and tricolored bats (*Perimyotis subflavus*) were the lowest in activity.

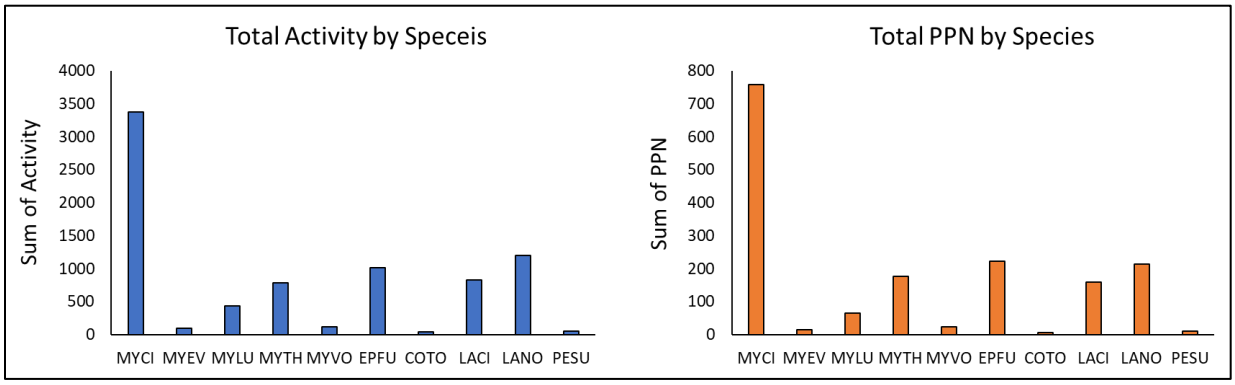
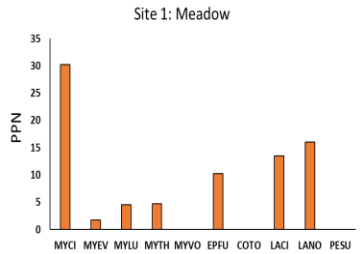
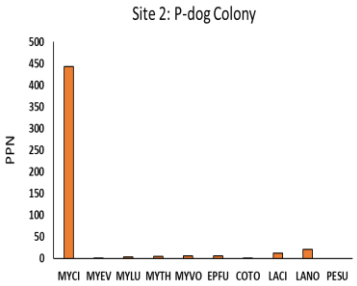
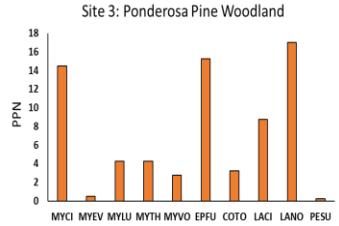
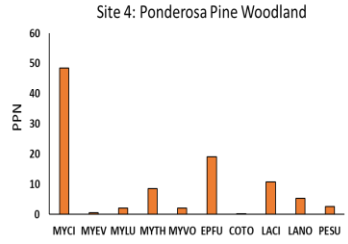
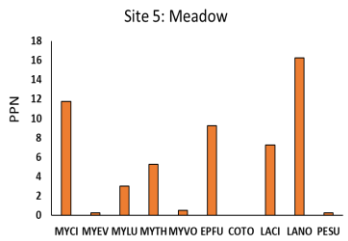
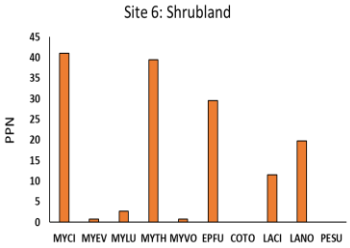
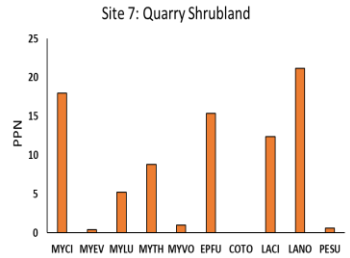
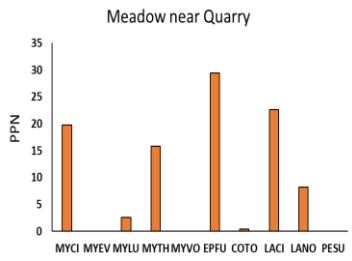
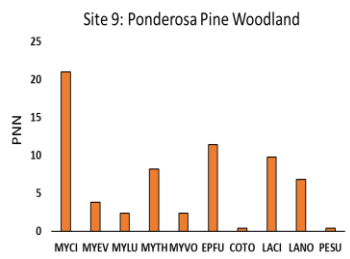


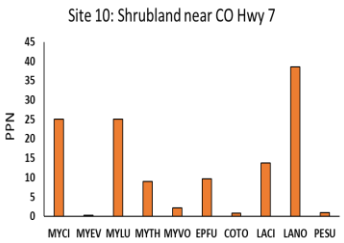
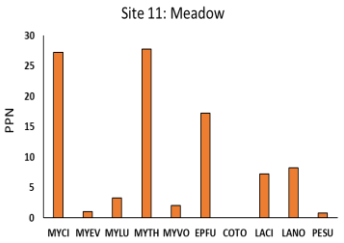
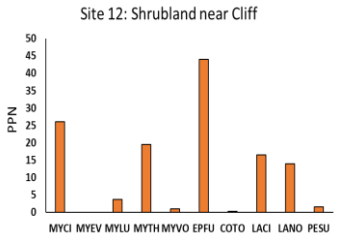
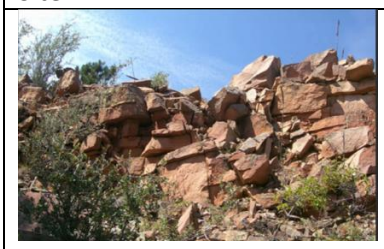
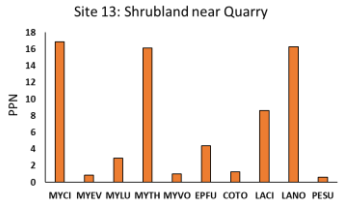
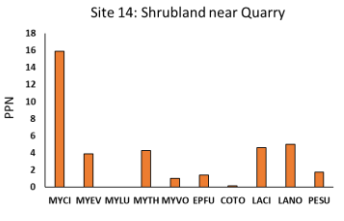
Figure 4. Sum of activity and passes per night (PPN) across 14 survey sites at Corona Hill by species. MYCI = *Myotis ciliolabrum*, MYEV = *M. volans*, MYLU = *M. lucifugus*, MYTH = *M. thysanodes*, MYVO = *M. volans*, EPFU = *Eptesicus fuscus*, COTO = *Corynorhinus townsendii*, LACI – *Lasiurus cinereus*, PESU = *Perimyotis subflavus.*

Site-Specific Results. Most sites showed a complement of some activity from all 10 species known for Boulder County. Of course, activity of any given species varied by site (Table 1). The least common species was Townsend's big-eared bat (*Corynorhinus townsendii*) which only occurred in higher numbers at Site 13. Second least common were tricolored bats (*P. subflavus*) showing highest activity at Site 4 in ponderosa pine woodland.

Table 1 & Figs 1-14. Descriptions of 14 sites surveyed at Corona Hill, Hall Ranch in 2022 and species-specific bat activity in mean passes per night (PPN). MYCI = *Myotis ciliolabrum*, MYEV = *M. volans*, MYLU = *M. lucifugus*, MYTH = *M. thysanodes*, MYVO = *M. volans*, EPFU = *Eptesicus fuscus*, COTO = *Corynorhinus townsendii*, LACI – *Lasiurus cinereus*, PESU = *Perimyotis subflavus.*

Sites	Location	Dates	Habitat	Species Passes per Night
 Site 1	40 13.250, 105 16.748 1737m	14-18 July	Meadow with a few ponderosa pine trees	
 Site 2	40 13.250, 105 16.748 1753m	14-18 July	Meadow, with active prairie dog colony	
 Site 3	40 13.038, 105 17.074 1777m	14-18 July	Ponderosa pine woodland	
 Site 4	40 13.247, 105 16.652 1718m	18-22 July	Ponderosa pine woodland	

Sites	Location	Dates	Habitat	Species Passes per Night
 Site 5	40 13.261, 105 16.580	18-22 July	Meadow	
 Site 6	40 13.206, 105 16.554	18-22 July	Shrubland	
 Site 7	40 13.135 105 16.540 1681m	24-29 July	Rock Quarry (in shrubland)	
 Site 8	40 13.051 105 16.715 1725m	24-29 July	Meadow after dried up water source, near quarry	
 Site 9	40 12.971 105 16.967 1770m	24-29 July	Ponderosa pine woodland	

Sites	Location	Dates	Habitat	Species Passes per Night
 Site 10	40 13.125 105 16.502 1668m	24-29 July	Shrubland adjacent to Colo Hwy 7	
 Site 11	40 13 131 105 16.762 1738m	31 July-4 August	Meadow with some ponderosa pine trees	
 Site 12	40 12.910 105 16.723 1690m	31 July-4 August	Shrubland near natural rocks and cliff face	
 Site 13	40 13.086 105 16.577 1688m	28 August-4 Sept.	Rock Quarry with shrubs	
 Site 14	40 13.117 105 16.555 1687m	6 – 14 Sept.	Rock Quarry with Shrubs	

Species-specific use patterns can be discerned with the caveat that these patterns likely alternate throughout the survey period. However, these data do provide a bit of a snapshot into use patterns (Fig. 15). The small-footed myotis (*M. ciliolabrum*) preferred meadows, but

this was predominately due to very high activity in the prairie dog colony. Indeed, 70% of all *M. ciliolabrum* activity was accounted for in the prairie dog colony. The long-eared myotis (*M. evotis*) occurred in relatively sparse numbers overall but were most active in ponderosa pine woodlands and shrubland where they could glean insects from vegetation. Little brown bats (*M. lucifugus*) also occurred in lower numbers having a maximum of 4.25 PPN, mostly active above shrubland. For the fringed myotis (*M. thysanodes*), a species of high conservation concern, Corona Hill was a well-used area and some data indicate the presence of probable roost sites (discussed later in this report). However, when foraging this species preferred shrubland, although the majority of activity was at a single shrubland site (Site 6). Typically, this species is a forest specialist, but the ponderosa pine woodlands were least used during this survey period. The highest number of PPN for the long-legged myotis (*M. volans*) was in the

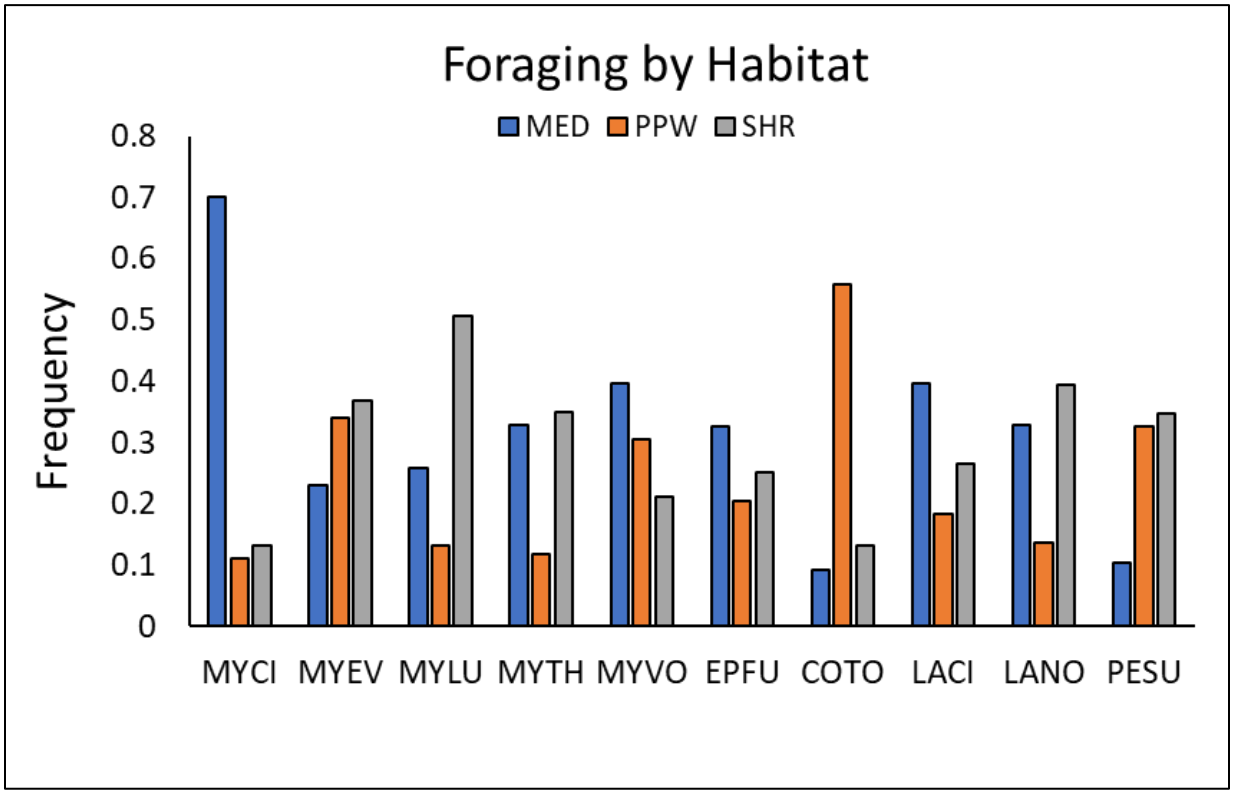


Figure 15. Distribution of bat species at Corona Hill in 2022 across the three major habitat types: MED = meadow, PPW = ponderosa pine woodland, and SHR = shrubland. MYCI = *Myotis ciliolabrum*, MYEV = *M. volans*, MYLU = *M. lucifugus*, MYTH = *M. thysanodes*, MYVO = *M. volans*, EPFU = *Eptesicus fuscus*, COTO = *Corynorhinus townsendii*, LACI – *Lasiurus cinereus*, PESU = *Perimyotis subflavus.*

prairie dog colony at a mean of 6.75 PPN, otherwise this species was sparse at Corona Hill. The open aerial foragers (*E. fuscus*, *L. cinereus*, and *L. noctivagans*) hunted mostly in meadows and above shrublands. All three of these species were in relatively high numbers across Corona Hill. Townsend's big-eared bat (*C. townsendii*) we recorded rarely across the 14 sites, but when detected they occurred predominately in ponderosa pine woodlands. The tricolored bat (*P. subflavus*) is of special interest because the USFWS indicates it will soon be listed as an endangered species with Federal protections, were recorded in low numbers at ten of the 14 sites with highest activity (2.5 PPN) at Site 4 in ponderosa pine woodlands. However, *P. subflavus* sonar calls were not recorded in the prairie dog colony, and very rarely in meadows or shrubland. Although this species seems well-established in eastern Boulder County (see data on Twin Lakes and Walden Ponds below), it currently appears less present in foothills habitats at higher elevations. However, populations there may increase over time.

Overall, variation in use patterns by the 10 species of bats was evident for most species, especially those present in higher numbers (Fig. 16). Obviously, bats will follow nightly insect

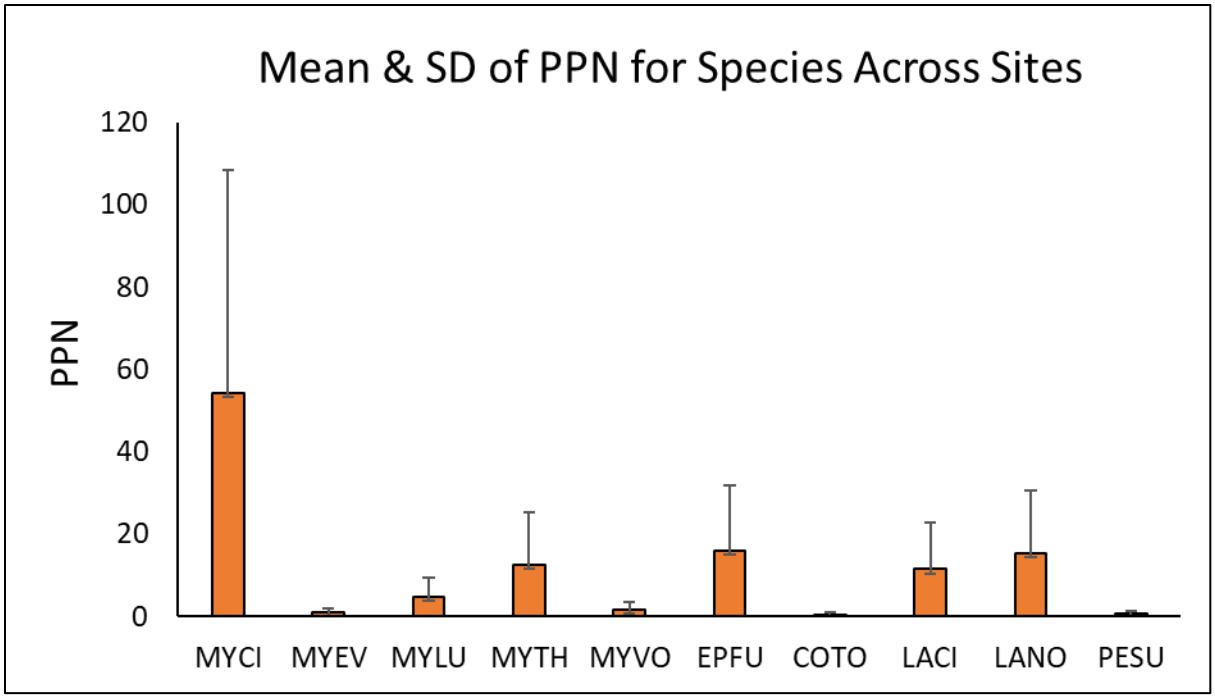
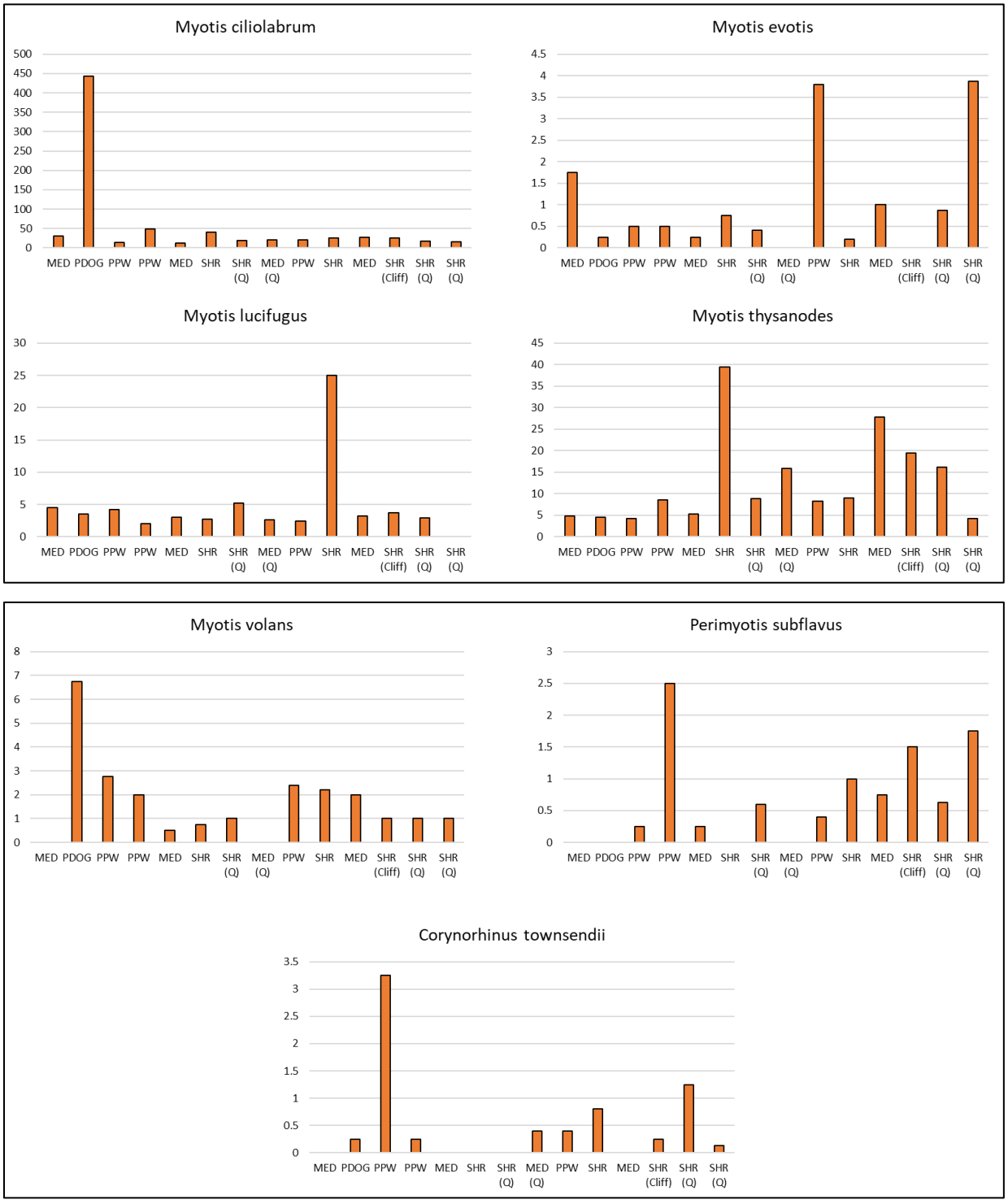


Figure 16. Means and standard deviations (SD) of species activity across all sites. Vertical lines indicate variation (SD) in foraging data across the 14 sites and show relatively high night-to-night switching across habitat types.

emergences and therefore may forage outside of preferred habitat depending on prey base. The distribution of bat species across all sites is shown in Fig. 17.



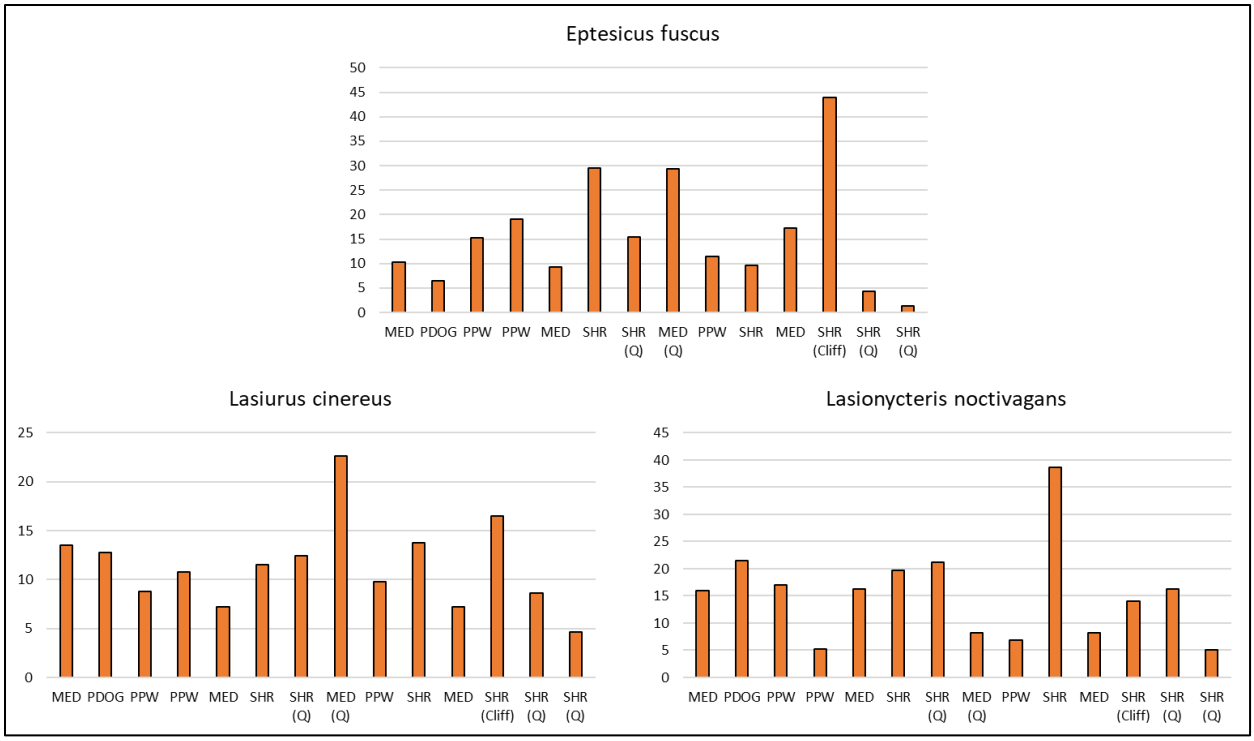


Figure 17. Distribution of individual bat species across three habitat types and 14 sites at Corona Hill in 2022. Please note, y-axis is not standardized across graphs. PDOG = prairie dog colony, MED = meadow, PPW = ponderosa pine woodland, and SHR = shrubland

Sites of Particular Interest

Site 2: Prairie Dog Colony.— This site was surveyed twice, once for four nights in July and again for two nights in September. As mentioned, the prairie dog colony at Corona Hill supported the most bat activity. However, this pattern was driven largely by a single species, the small-footed myotis (*M. ciliolabrum*) (Fig. 18).

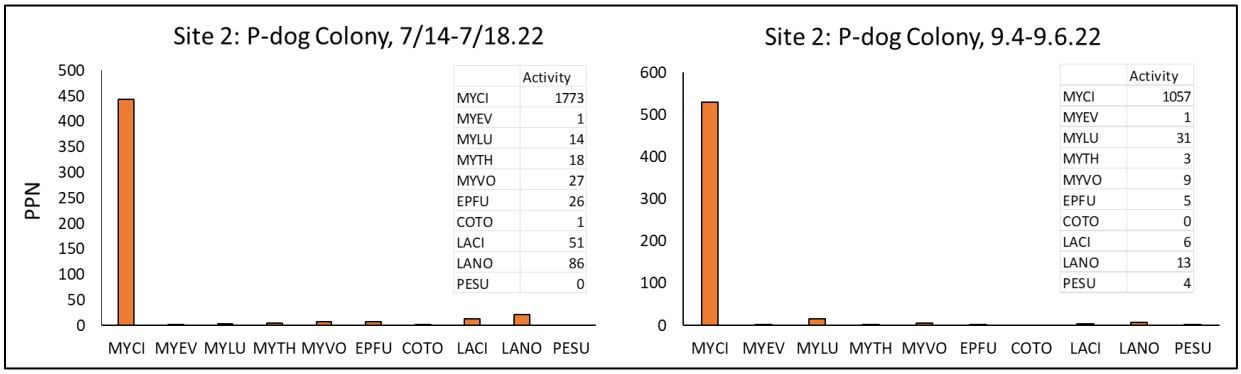


Figure 8. Passes per night (PPN) recorded in active black-tailed prairie dog colony on Corona Hill in July and September. Bat use patterns were similar with small-footed myotis making up the majority of passes.

The 7/14-7/18 survey involved two other nearby sites surveyed simultaneously (Fig. 19) for four consecutive nights. Both the meadow site lacking prairie dogs and ponderosa pine woodland site had similar overall activity in 550-590 PPN range. The black-tailed prairie dog colony had nearly five times the activity of these other sites. However, nearly all passes were

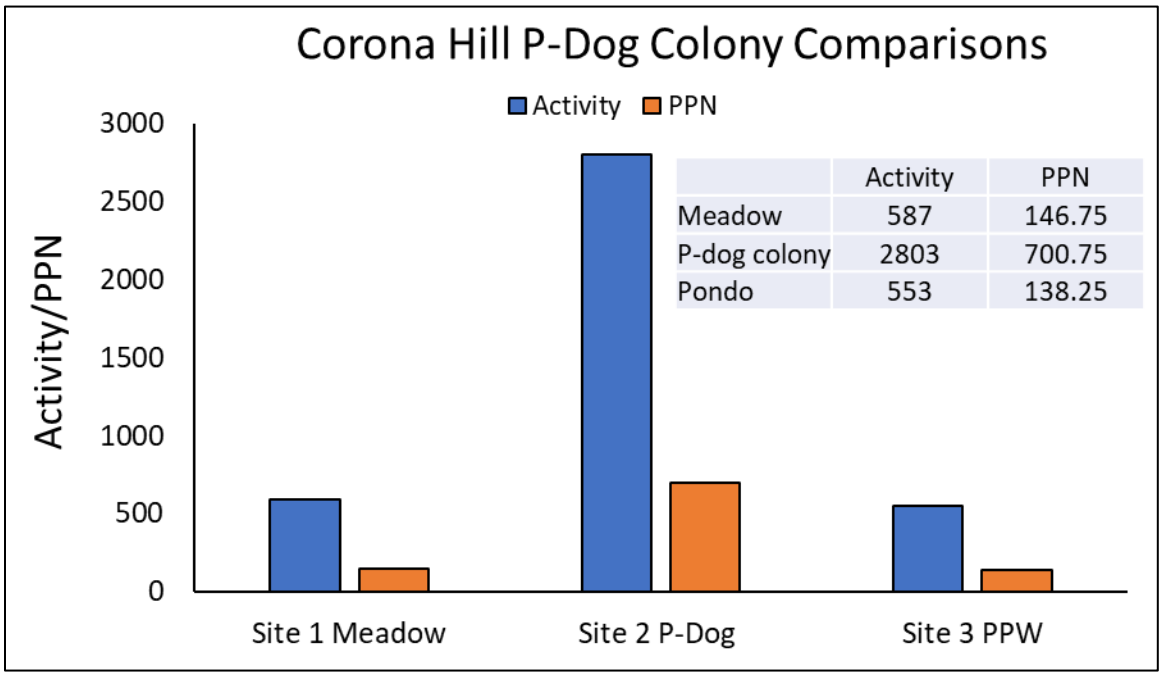


Figure 19. Comparison between three sites (meadow lacking prairie dogs, meadow having prairie dogs, and ponderosa pine woodland) all surveyed simultaneously and located approximated 0.3 km from each other.

from small-footed myotis (*M. ciliolabrum*) (Fig. 20). In lower activity numbers, however, were eight other bat species making a total species richness of nine, with the only exclusion being tricolored bats (*P. subflavus*). Comparison of bat species activity across the three sites showed that the meadow lacking prairie dogs also had relatively high numbers of small-footed myotis as well, but only about 15% of that species activity in the prairie dog colony. This site also supported seven bat species of more equal proportions to *M. ciliolabrum* than the prairie dog colony. The ponderosa pine woodland (PPW) had all 10 bat species present with again *M. ciliolabrum* having the highest number of calls among the myotis recorded over the four nights. There were also more Townsend's big-eared bats (*C. townsendii*) recorded in the PPW site

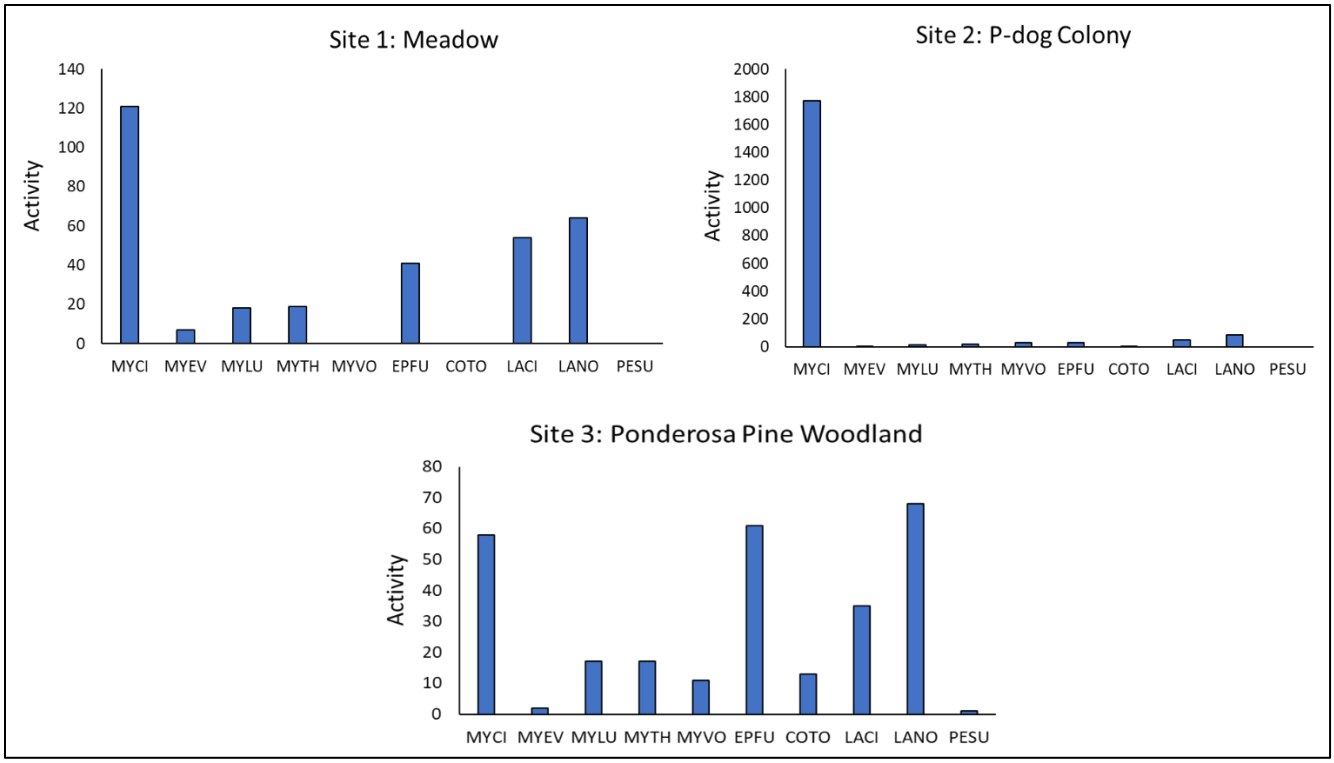


Figure 20. Comparison of bat species activity at three sites simultaneously surveyed. A meadow site with prairie dogs, a meadow site without prairie dogs and a ponderosa pine woodland.

compared to the other two meadow sites (Fig. 20). A trailcam placed with the SMU detector in September did not record any video of bat activity (Fig.21).

Figure 21. SMU sonar detector and Viken trailcam positioned in Corona Hill black-tailed prairie dog colony in September 2022.

Rocky Quarry and Natural Rock Sites: Five quarry sites and one natural rock site were surveyed specifically for roost sites. Four of the quarries (Trailcams 1, 3, 5, and 6) were monitored with combined trailcam and SMU detector, one quarry site (Trailcam 2), which was in proximity to another was monitored only with a trailcam. The natural rock site (Trailcam 4) was monitored with trailcam and SMU detector (Fig. 22).

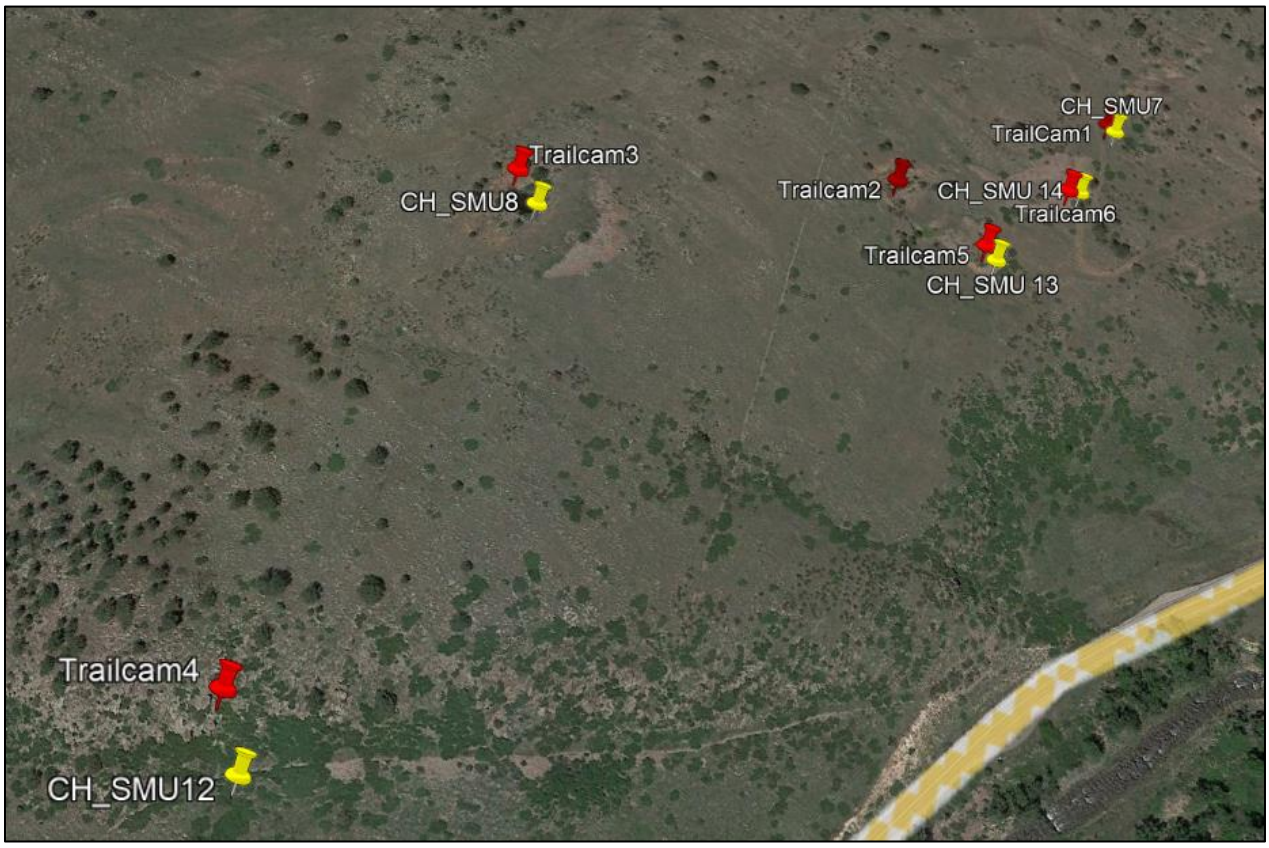


Figure 22. Map showing quarries and natural rock sites monitored with trailcams (red pins) and detectors (yellow pins).

Generally speaking, the trailcams were not very effective at capturing bat outflights, but there was some limited success. At trailcam 2, located at a quarry that was not associated with an SMU detector but was within 60m of Site 13, a bat was detected leaving a crevice roost (Fig. 23A) near the top of the quarry. The bat quickly flies out and towards the trailcam (Fig. 23B-E) and then exits the frame. It appears this was a solitary individual and likely a small-footed myotis (*M. ciliolabrum*).

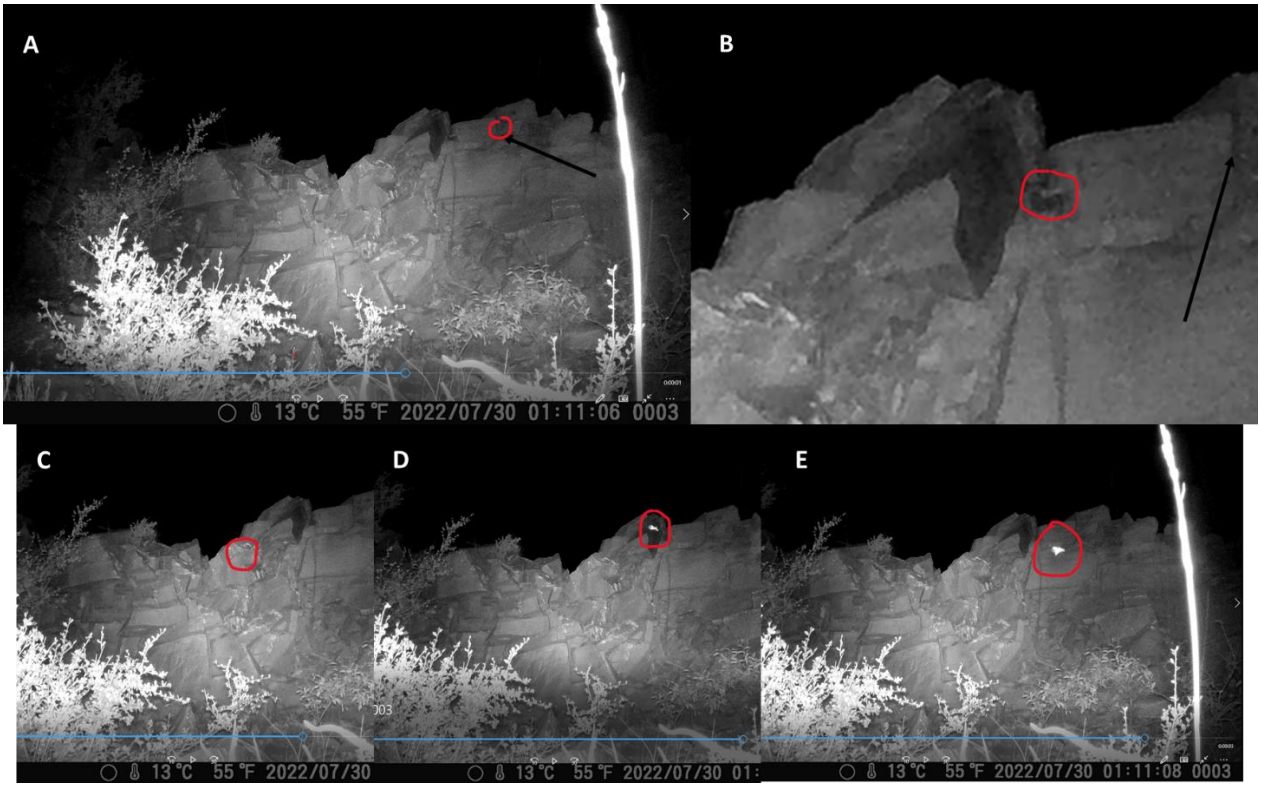


Figure 23A-E. Still frames from trailcam 2 placed at rock quarry appearing to show a small-footed myotis leaving a rock crevice at 01:11am.

The only other video recording was from trailcam 4 placed at the natural rock face located at the SMU 12 detector position on 8/23 at 2:30am and was determined to be a small-footed myotis (*M. ciliolabrum*) (Fig. 24A-C). From the footage it is difficult to determine if this individual was leaving a roost site or simply flying through from low to high at the time. It seems clear that in the rare instances of trailcams videoing flying bats, the detectors were likely set off by something other than the bats but recorded bat activity haphazardly.

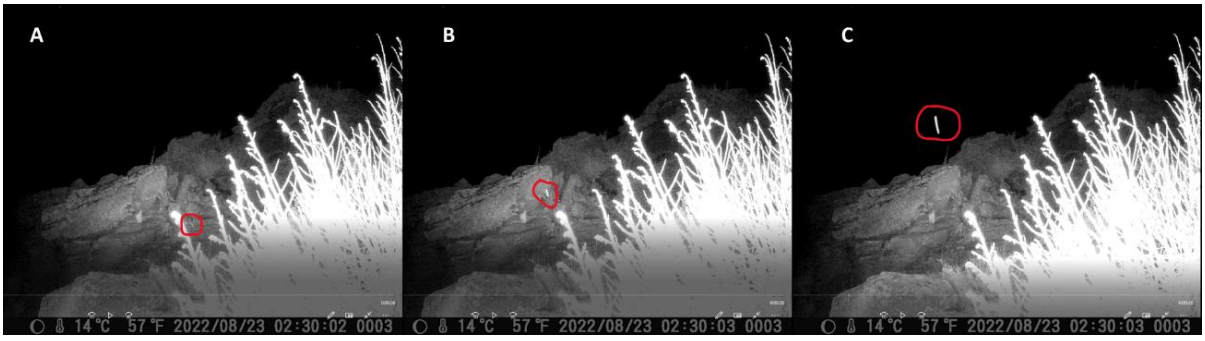


Figure 24A-C. Images from trailcam 4 video recording at a natural rock face at location SMU 12. The SMU sonar detector recorded a small-footed myotis (*M. ciliolabrum*) at this time.

Sonar Activity at Rock Quarries and Natural Rocks

SMU Mini detectors placed at rock quarries and one natural rock site recorded bat activity that could indicate roost sites. Focusing on the myotis species that would likely be using rock crevices, passes per night (PPN) were highest at the natural rock area (Site 12), but all sites showed relatively high activity (Fig. 25). In terms of which myotis species were most active at

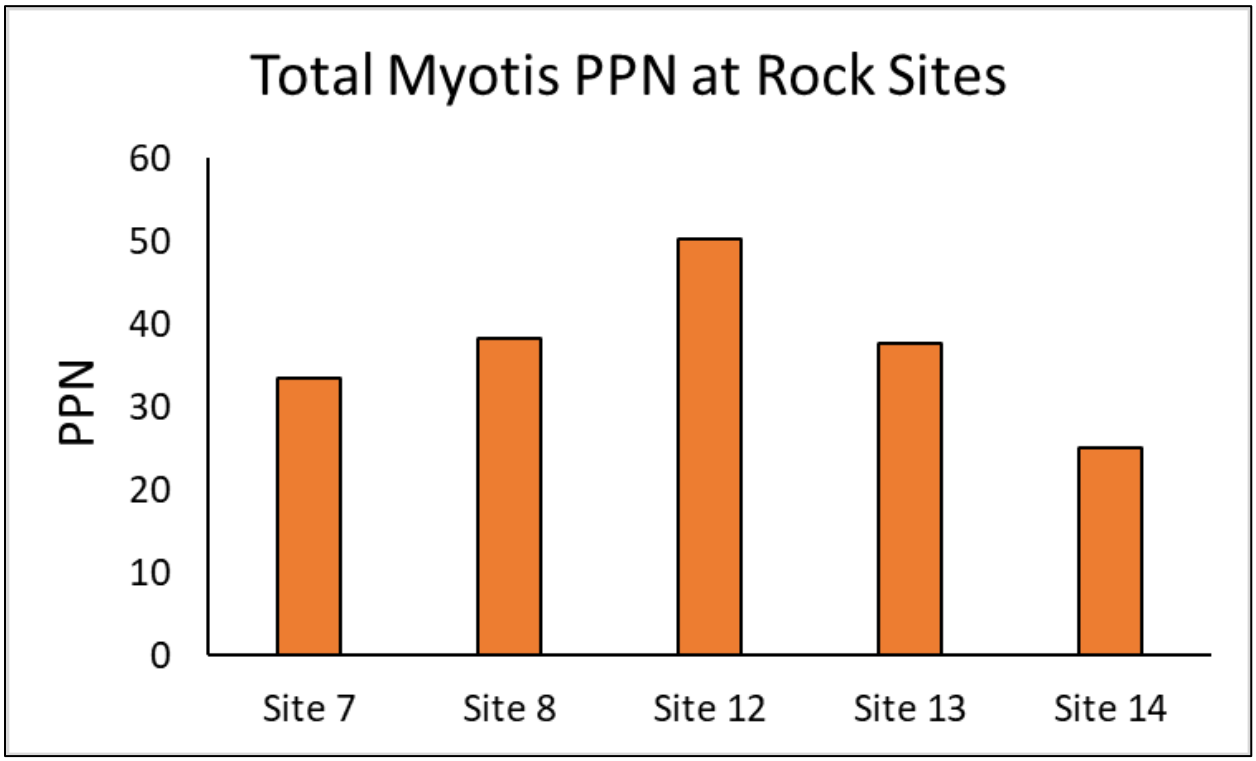


Figure 25. Passes per night (PPN) of myotis species at four quarry sites and one natural rock site (Site 12).

active at these sites the pattern is clear (Fig. 26A). Small-footed myotis (*M. ciliolabrum*) was the most common species recorded at these sites, followed closely by fringed myotis (*M. thysanodes*). The other myotis species were much lower in PPN. The highest incidence of *M. ciliolabrum* and *M. thysanodes* were at Site 12, the natural rock area. The quarry sites showed relatively consistent use by *M. ciliolabrum*, whereas Sites 8 and 13 were used at relatively higher levels for *M. thysanodes* (Fig. 26B).

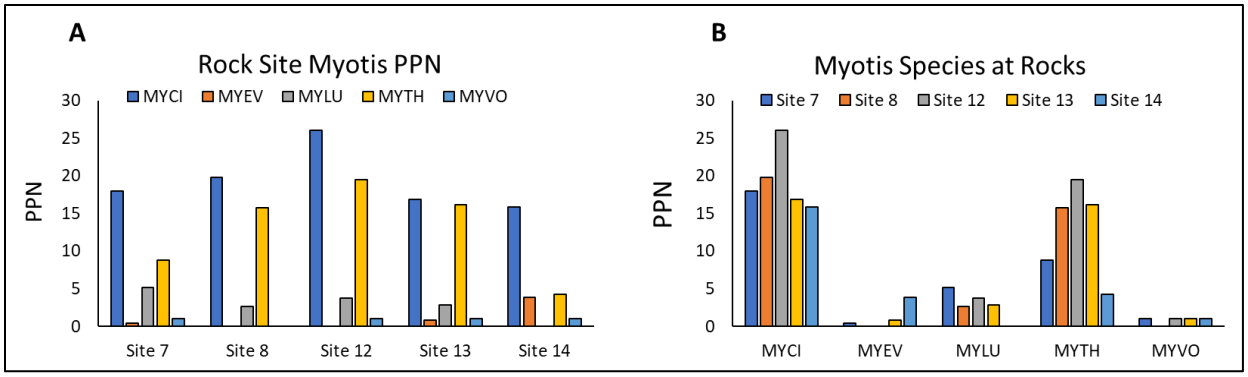


Figure 26. Myotis species at rock crevice areas. **A**) Site by site relative passes per night (PPN). **B**) Species-specific PPN at each site.

Conclusions: Corona Hill is a vibrant bat activity area with nearly 17,000 call sequences recorded resulting in more than 222 passes per night on average at any given site. All 14 sites surveyed showed foraging activity and use by 10 species of bats. However, the black-tailed prairie dog colony (*Cynomys ludovicianus*) was a magnet of high bat activity driven mostly by small-footed myotis (*Myotis ciliolabrum*). The most common bat species were by far *M. ciliolabrum*, followed by big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*) and fringed myotis (*M. thysanodes*). Other species presence numbers were lower but consistent. Of particular interest besides *M. thysanodes* which is considered a species of highest conservation concern in Colorado, were tricolored bats (*Perimyotis subflavus*), a species likely to be listed as Federally Endangered by the USFWS in the near future. Although in relatively low numbers, this species was present at 10 of the 14 sites surveyed. It should be noted that this species is mostly associated with riparian corridors which provide deciduous trees it uses for diurnal roosting. Therefore, county properties that have mountain streams and/or ponds (such as for example Hall II property) will likely have more concentrated activity of this *P. subflavus*. However, equally important are nightly foraging areas which can occur on any of the BCPOS properties.

Foraging habitat by species analysis (Fig. 25) shows *P. subflavus* was associated mostly with ponderosa pine woodlands and shrubby habitats, whereas open meadows were least active. Curiously, meadows were the most active foraging areas for *M. ciliolabrum* even outside of the prairie dog colony, and being of similar body size as *P. subflavus*, may be the most likely

direct competitor. Shrubland areas, which are common at Corona Hill, were very active with bats, especially fringed myotis (*M. thysanodes*), the second most common myotis species present in 2022. Other species such as the long-eared myotis (*M. evotis*) and little brown bats (*M. lucifugus*) were higher in shrublands but their overall numbers on Corona Hill are relatively low. Of the open aerial foragers, silver-haired bats (*L. noctivagans*) were the most active in shrublands.

Rock Quarry sites were relatively active with bats, and of the myotis species, were particularly active with *M. ciliolabrum* and *M. thysanodes*. The data indicated that these species are using the rock quarries and natural rock cliff (Site 12) as roost sites. The small-footed myotis (*M. ciliolabrum*) tends to roost singly or in very small groups, rather than forming colonies. This is true even for reproductive females with offspring. Therefore, it is very difficult to protect specific sites from human disturbance because the individuals may be dispersed throughout the quarry piles singly or in small groups. The fringed myotis (*M. thysanodes*) tends to roost in colonies and the higher numbers recorded near rock quarries and in particular the natural rock area at Site 12, along with generally high foraging activity at Corona Hill, suggest a maternity roost or roosts on Corona Hill.

There are at least two potential water sources on Corona Hill. One is located at the crest of Corona Hill near the prairie dog colony (Site CH_SMU 2) and the other proximate to an east-facing quarry (Site CH_SMU8) (Fig. 27). Although these water sources were dry in July, August, and September 2022, when holding water these sites would provide a critical resource for bats and other wildlife calling Corona Hill home.

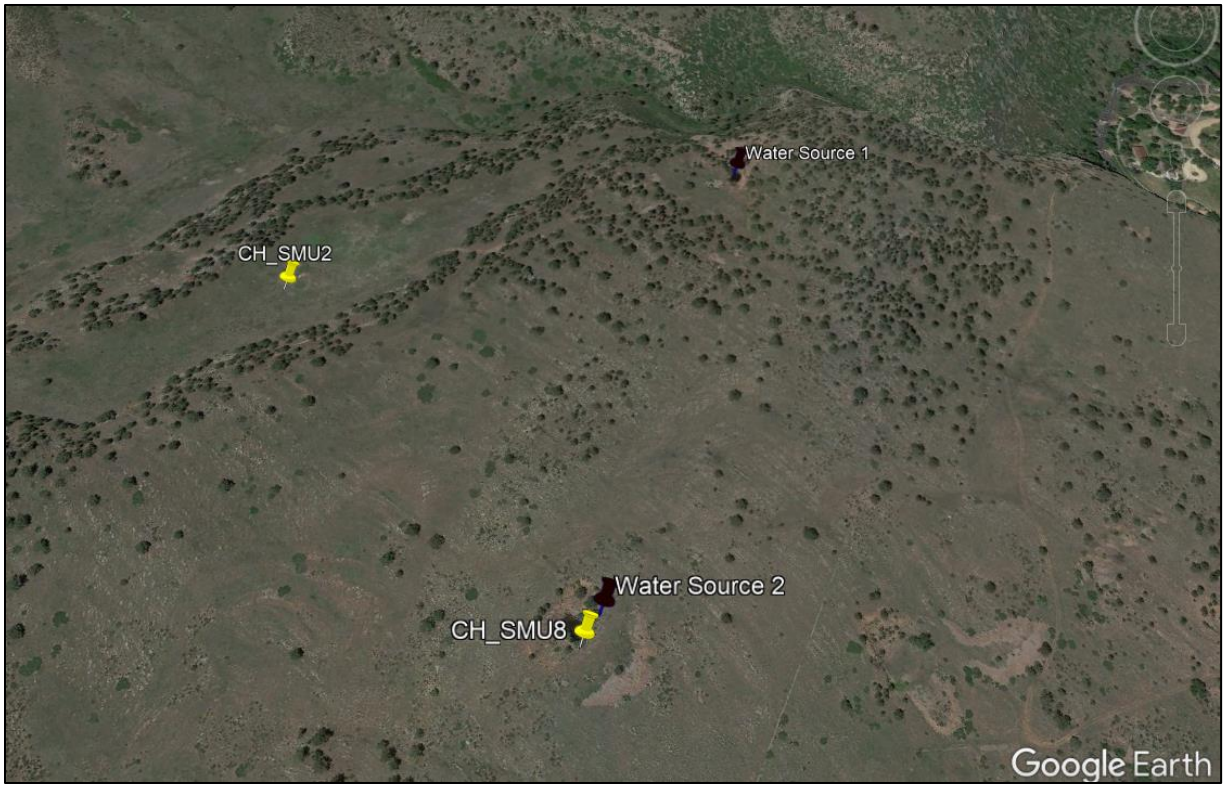


Figure 27. Map showing ephemeral water sources on Corona Hill. Water Source 1 near the prairie dog colony (CH_SMU2) and Water Source 2 near an east-facing quarry site that could house bat maternity colonies.

Recommendations: Any increase in human activity on Corona Hill should be directed away from rock quarries, natural rock formations (particularly Site 12) to avoid disturbance of bat roosting sites. Similar considerations should be taken to avoid disturbances at the very limited water sources for drinking present on Corona Hill.

Continued Surveys at Heil Valley Ranch

Four sites were surveyed at Heil Valley Ranch in 2022. These included Ingersol Quarry, MYEV_Thinned site near Ingersol Quarry, Plumely Canyon and Geer Canyon.

Geer Canyon: In 2022, Geer Canyon was surveyed from a location below and SW of the fringed myotis (*M. thysanodes*) maternity site (Fig. 28). Surveys were conducted using an SM4 detector from 8-27 June and from 2-19 August. Total number of bat passes recorded in June and August were similar (5,672 v 5,920), however, PPN was higher in August by 52 calls per night (Fig. 29).

Figure 28. Map showing Geer Canyon survey site in 2022.

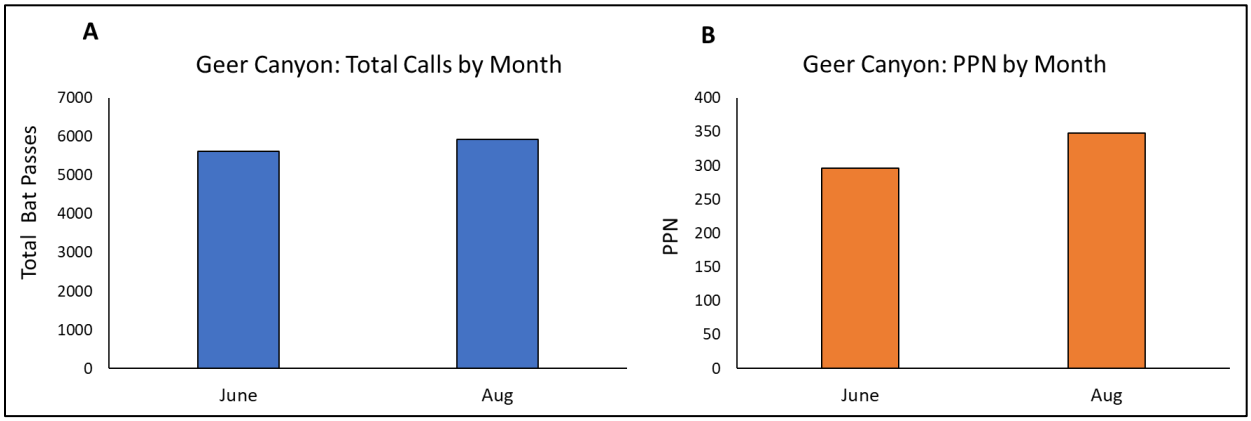


Figure 29. Comparison of survey periods in Geer Canyon in 2022. **A**) Total number of bat passes recorded. **B**) Adjusted for number of nights and relative activity (PPN).

Species-specific patterns were similar in relative activity with the notable exception of fringed myotis (*M. thysanodes*) which increased in activity by about 43% (Fig. 30A, B) producing a nearly three-fold increase in passes per night (PPN) (Fig. 30C). This increase in *M. thysanodes* activity is a clear sign of successful reproductive output from the maternity colony in 2022.

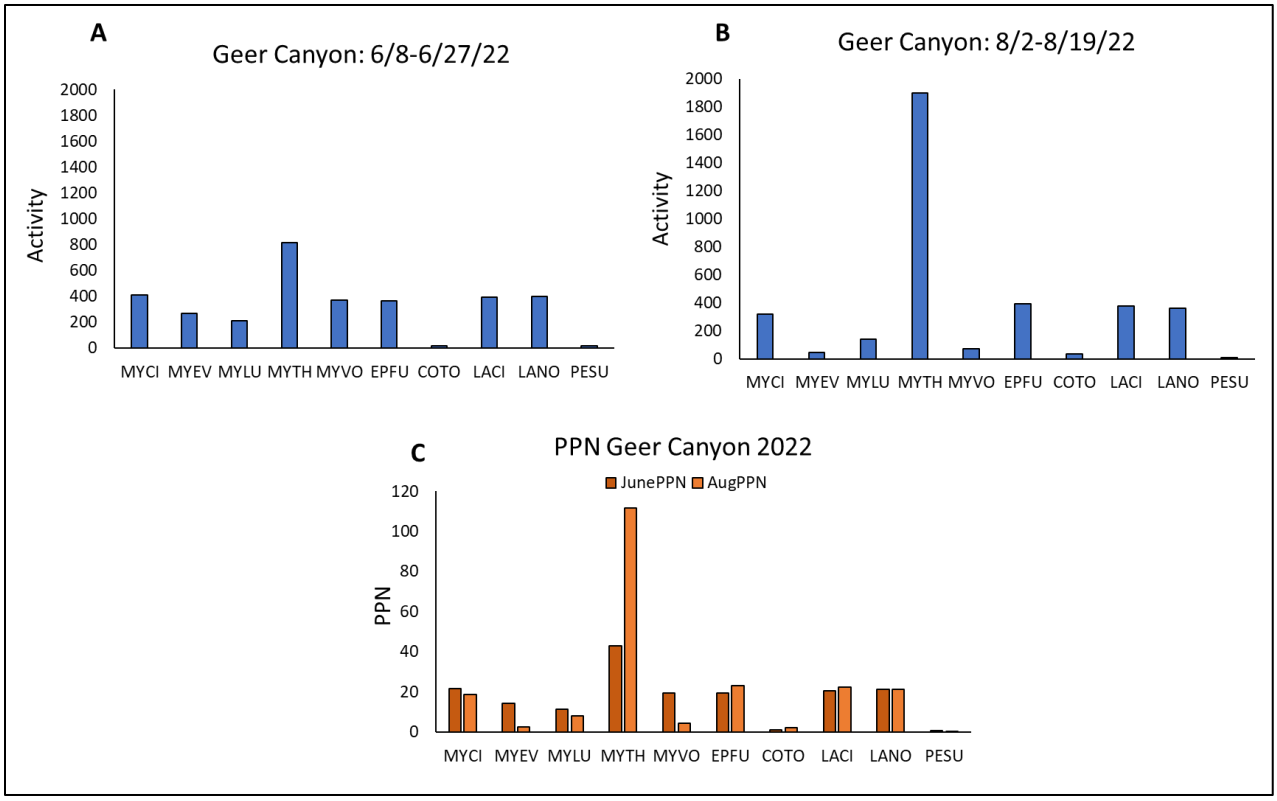


Figure 30. Comparison of survey periods of bat species in Geer Canyon. **A**) Activity in June, **B**) Activity in August, **C**) Comparative passes per night (PPN) between June and August.

Plumely Canyon: In 2022, Plumely Canyon was surveyed from a location at the junction of Plumely and Marietta canyons (Fig. 31). Surveys were conducted using an SM4 detector from 9-22 June and from 2-17 August. Total number of bat passes recorded in June and August differed (8,304 v 12,384) (Fig. 32A). When adjusted for number of survey nights, passes per night (PPN) remained higher in August by 140 calls per night on average (Fig. 32B).

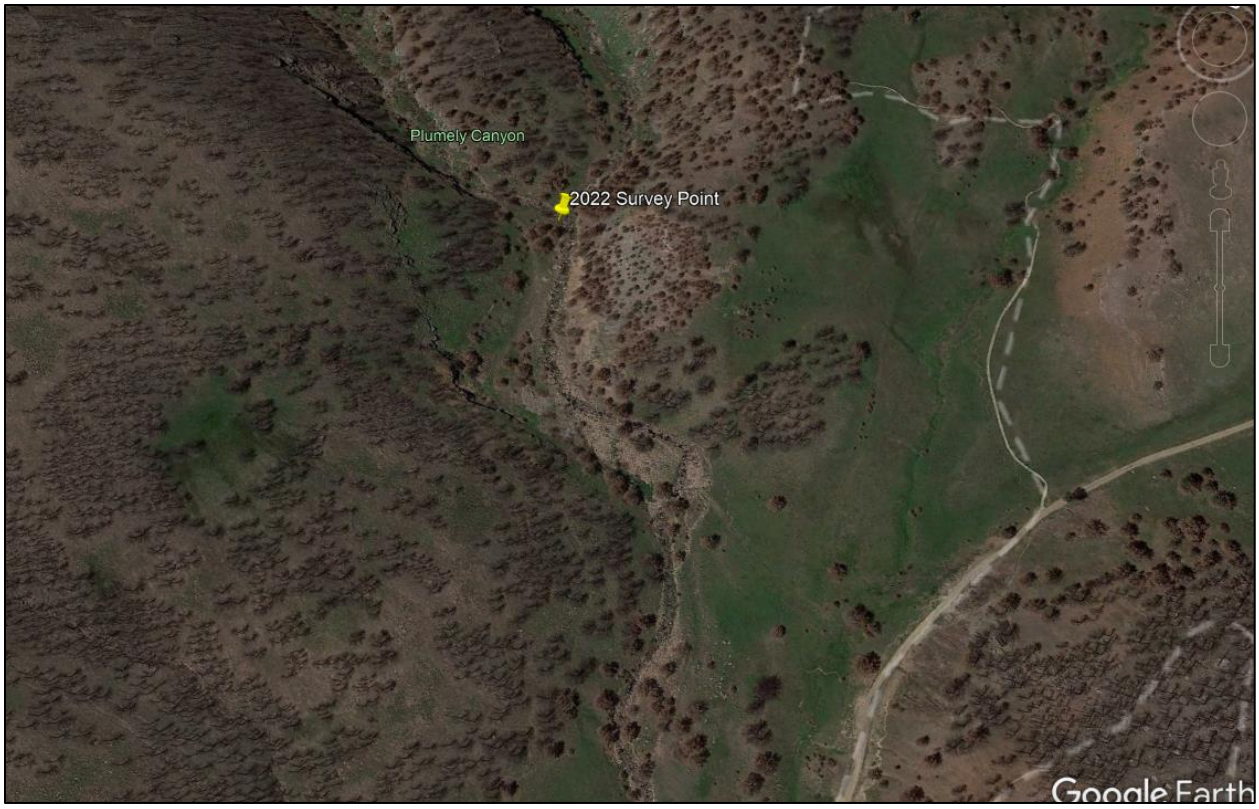


Figure 31. Map showing survey point in Plumely Canyon in 2022.

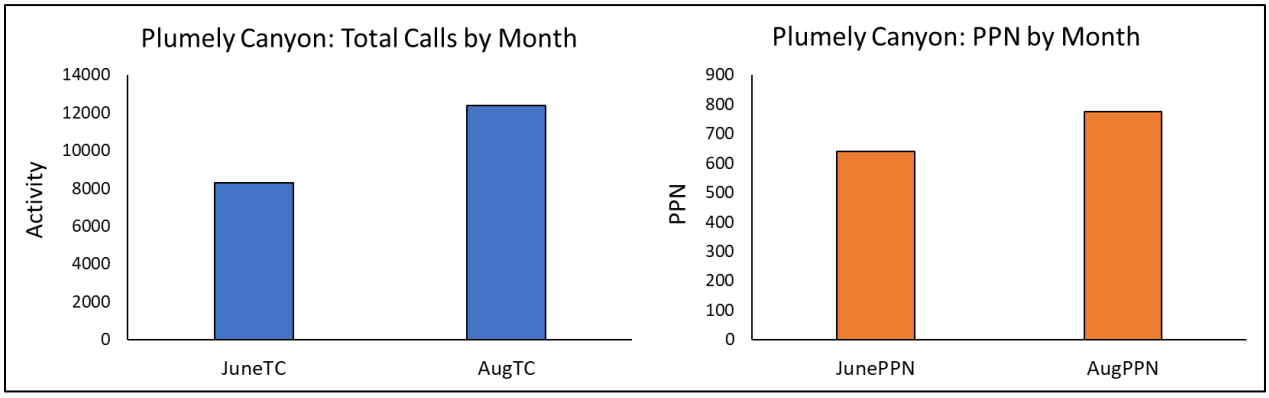


Figure 32. Comparison of survey periods in Geer Canyon in 2022. **A**) Total number of bat passes recorded. **B**) Adjusted for number of nights and relative activity (PPN).

Species-specific patterns were similar in relative activity with the notable exception of silver-haired bats (*L. noctivagans*) which increased in activity by nearly 70% (Fig. 33A, B) producing a nearly three-fold increase in passes per night (PPN) (Fig. 33C). This increase in *L. noctivagans* activity may represent successful reproductive in 2022. Because these are tree-roosting bats,

they do not form colonies and therefore it is difficult to determine if the cause was reproductive output or new individuals moving into the area.

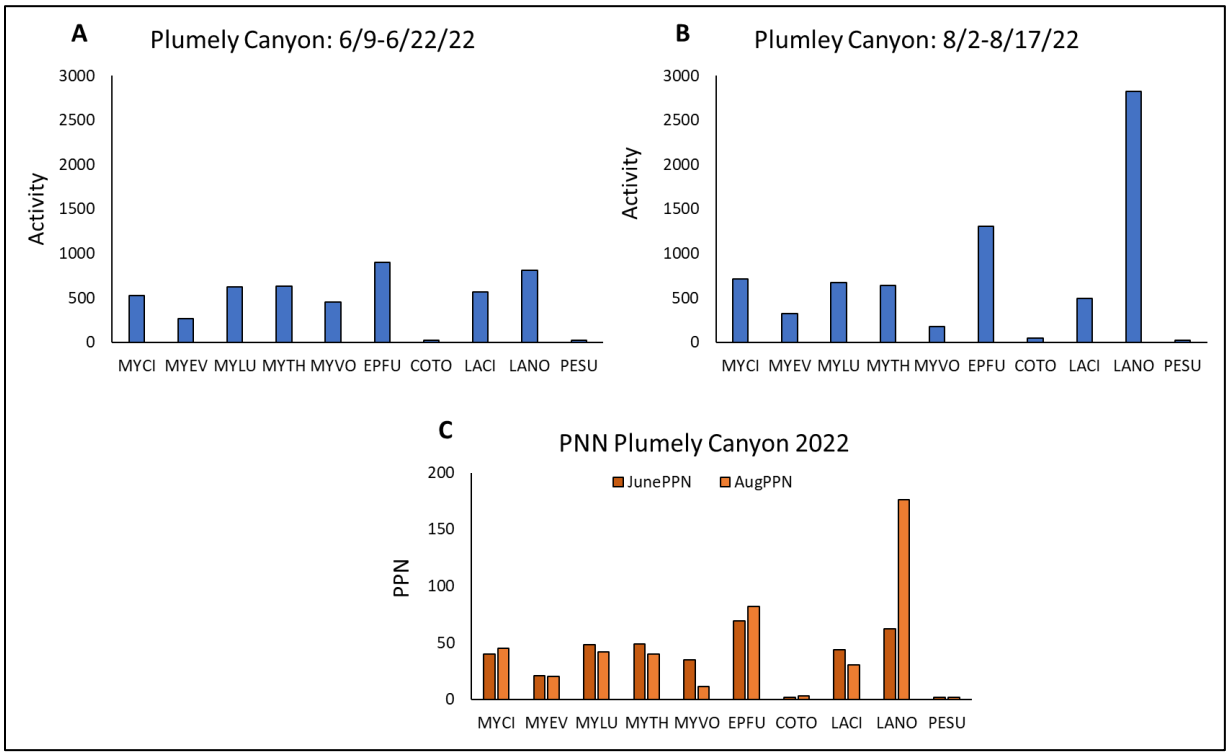


Figure 33. Comparison of survey periods of bat species in Geer Canyon. **A**) Activity in June, **B**) Activity in August, **C**) Comparative passes per night (PPN) between June and August.

Conclusions: Despite the severe nature of the Cal-Wood Burn event, both Geer and Plumely canyons remain highly active with bats and support all 10 species known to have reproductive populations in Boulder County. Indeed, 2022 showed the highest numbers of bat activity in both canyons over the last seven years (Fig. 34).

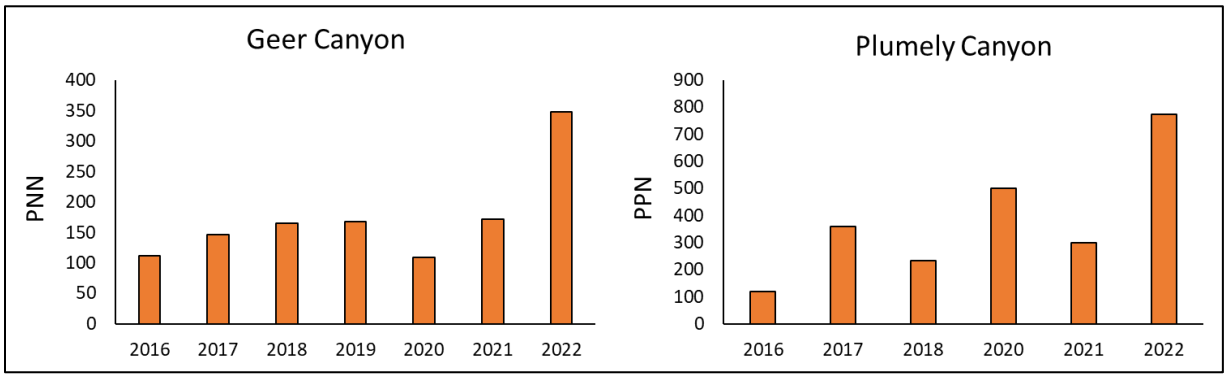


Figure 34. Comparison of passes per night (PPN) of bats in Geer and Plumely canyons from 2016 to 2022.

Species composition in the canyons has remained relatively constant. In Geer Canyon there were spikes of long-eared myotis (*M. evotis*) and Townsend's big-eared bats (*Corynorhinus townsendii*) as well as hoary bats (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*) in 2021, the summer after the Cal-Wood fire, indicating an increase in moths, the favorite food of these species (Fig. 35). In Plumely Canyon, there were spikes in

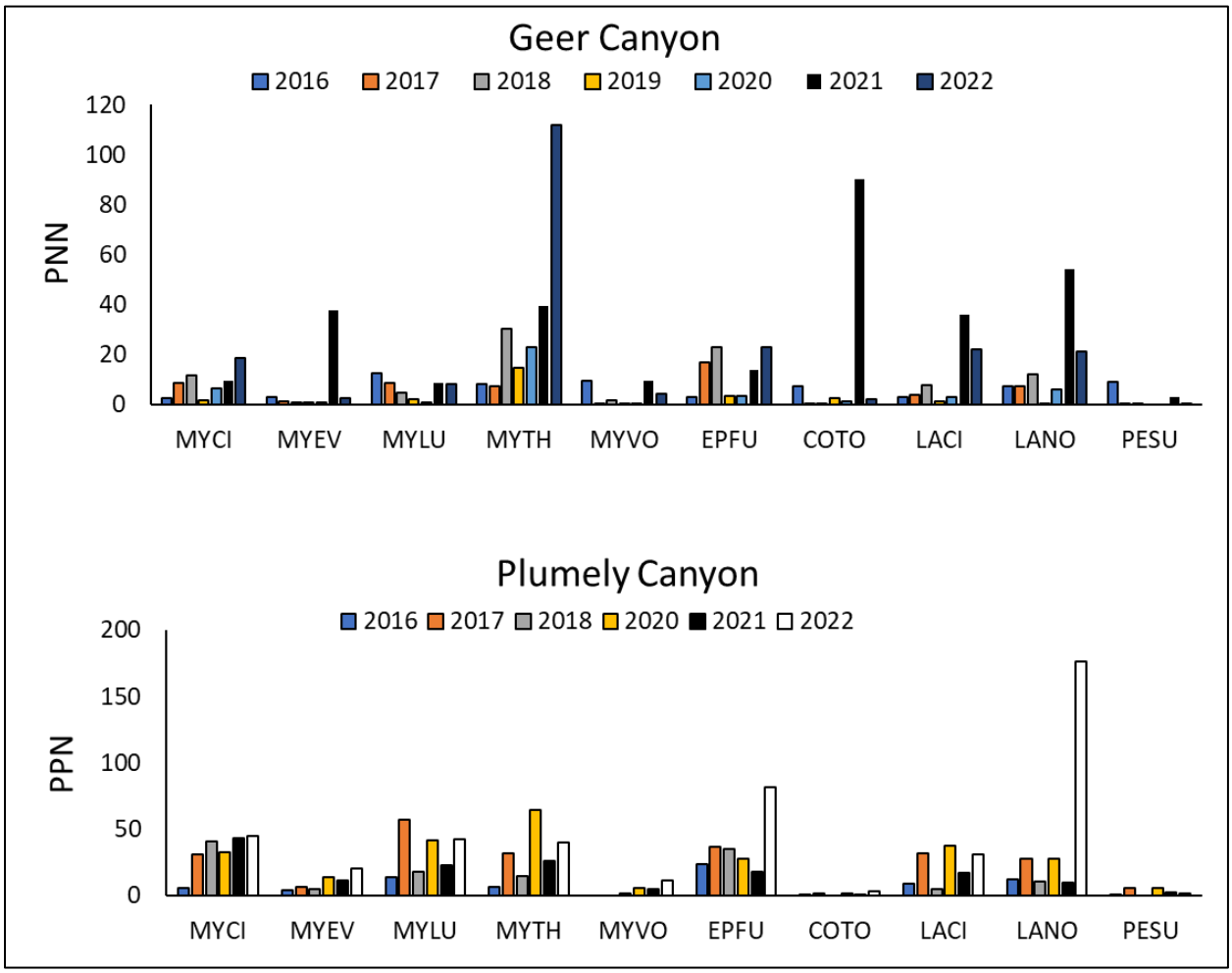


Figure 35. Comparison of passes per night (PPN) by species in Geer and Plumely canyons from 2016-2022.

big brown bats (*Eptesicus fuscus*), which was relatively minor, and a larger spike in *L. noctivagans*. All other species were either down in numbers or holding steady (Fig. 35).

MYEV_Thinned Site: There was only a single survey period (2-14 August) for MYEV_Thinned Site near Ingersol quarry (Fig. 36) using an SM2 outfitted with high-efficiency SMM microphone.

Figure 36. Location of MYEV_Thinned Site, labelled as Site 21 during postCal-Wood burn at Heil Valley Ranch.

In 2022, the site was dominated by long-eared myotis (*M. evotis*) as it was before thinning occurred in 2018. Nine out of 10 species with reproductive populations in Boulder County foraged at the site. The only exception was tricolored bats (*Perimyotis subflavus*) (Fig. 37).

Conclusions: The reinvigoration of this site after the Cal-wood burn, especially for the long-eared myotis (*M. evotis*) is interesting. Although the overall bat activity numbers were down from 2021, *M. evotis* activity skyrocketed in 2022 (Fig. 38). This is likely due to an influx of moths into the site as this species is a moth specialist. *M. evotis* is a gleaning species, and nocturnal moths, which tend to be light-colored, landing on darkened burned bark, may add a visual opportunity for this species to find prey. If this were the case, the effect would be similar to the peppered moths of the industrial revolution in Europe.

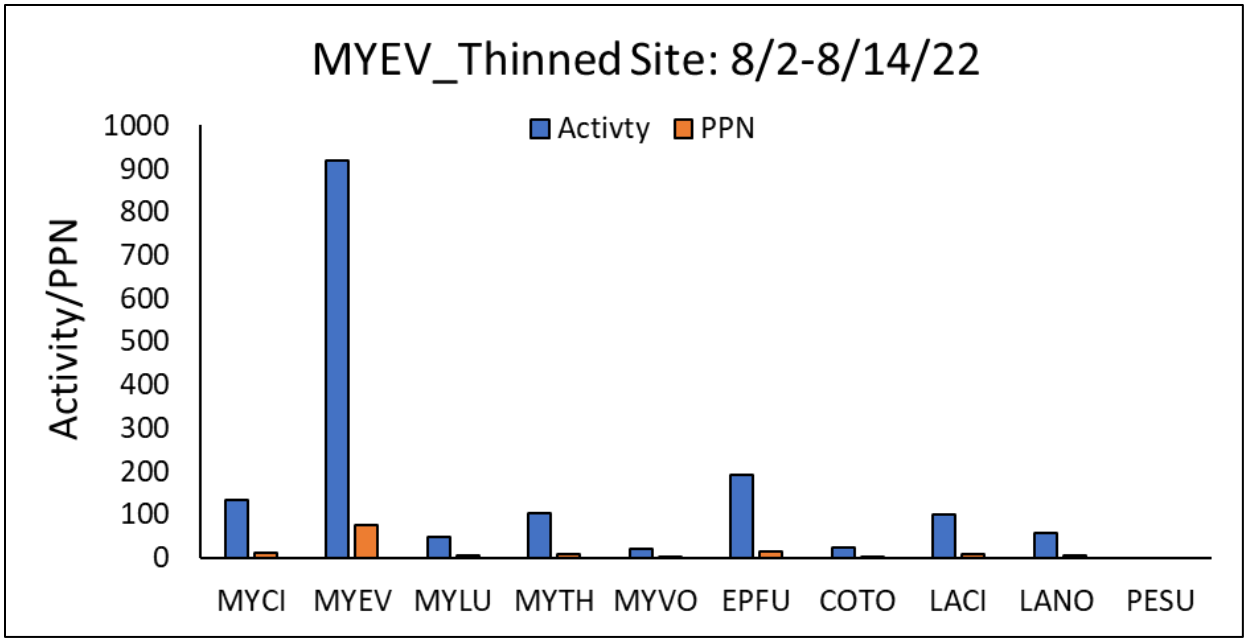


Figure 37. Species-specific bat activity at the MYEV_Thinned site near Ingersol Quarry.

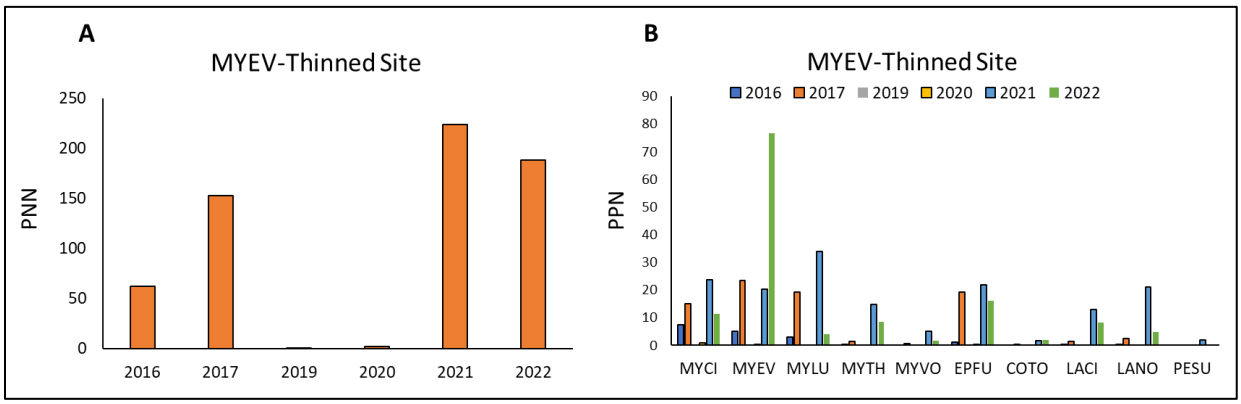


Figure 38. Comparison of bat passes per night (PPN) at MYEV_Thinned site. A) Overall bat activity from 2016-2022. B) Species-specific passes per night (PPN) from 2016-2022.

Ingersol Quarry: This site was monitored monthly with an SM4 detector from January to mid-September 2022. Over-winter activity at this site indicated that some individuals are hibernating on-site and active during all months of the year. In January 2022, four species of bats were recorded. Most recording were from big-brown bats (*E. fuscus*), the second most active was hoary bats (*L. cinereus*), followed by small-footed myotis (*M. ciliolabrum*), and silver-haired bats (*L. noctivagans*) (Fig. 39).

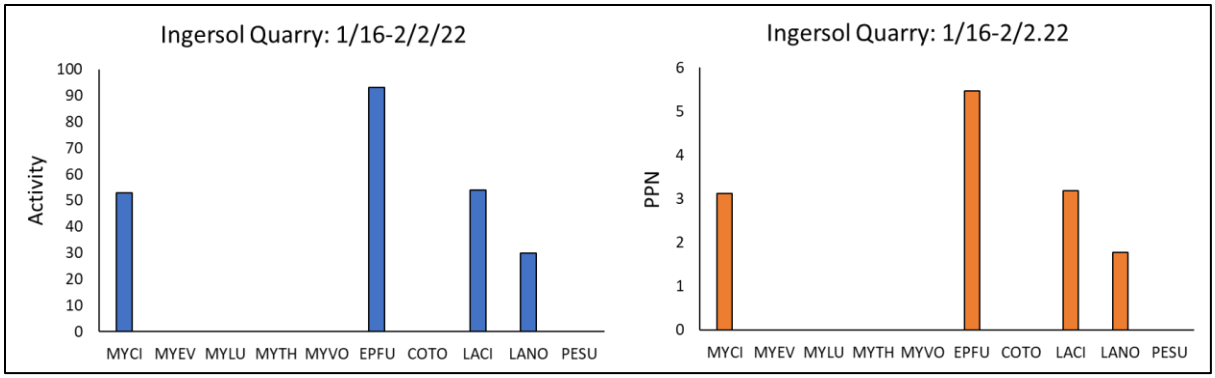


Figure 39. Sonar data (activity and passes per night, PPN) from Ingersol Quarry in late January to early February. Blue bars represent activity, orange bars represent passes per night (PPN).

In mid- to late March, activity was dominated by big brown bats (*E. fuscus*), followed by hoary bats (*L. cinereus*), silver-haired bats (*L. noctivagans*), with a few passes by small-footed myotis (*M. ciliolabrum*), and one by a little brown bat (*M. lucifugus*) (Fig. 40).

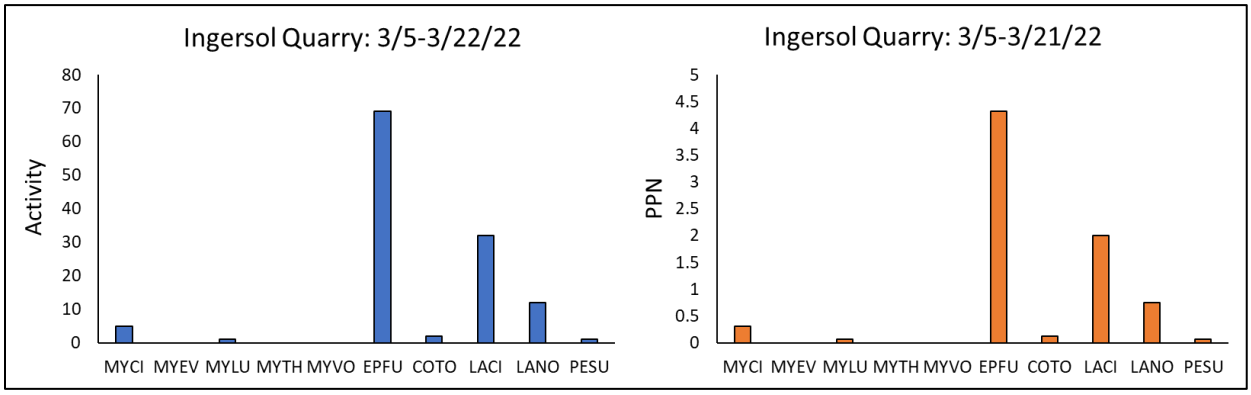


Figure 40. Sonar data (activity and passes per night, PPN) from Ingersol Quarry in mid- to late- March. Blue bars represent activity, orange bars represent passes per night (PPN).

In April, there was a major increase in activity at Ingersol Quarry. Sonar recording of all 10 Boulder County species occurred. Most calls were from big brown bats (*E. fuscus*) and the fewest calls were from tricolored bats (*Perimyotis subflavus*) (Fig. 41).

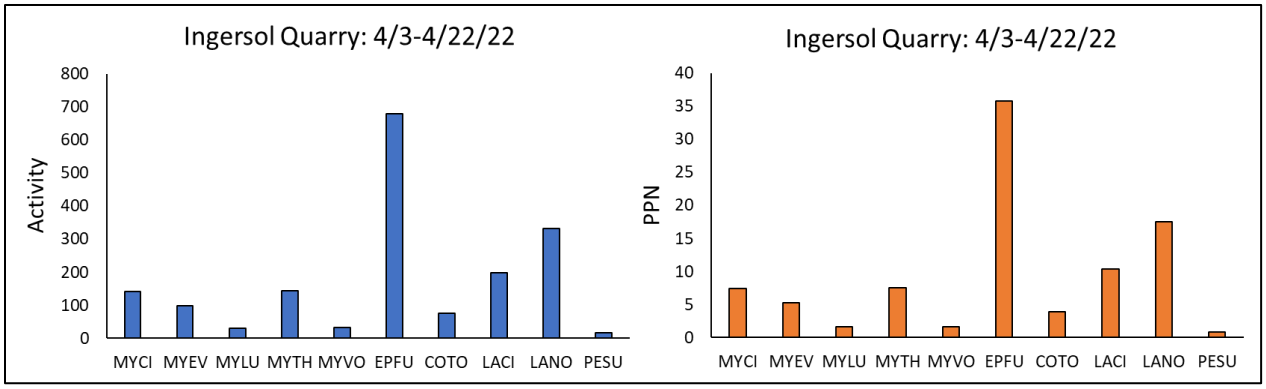


Figure 41. Sonar data (activity and passes per night, PPN) from Ingersol Quarry in early- to mid- April. Blue bars represent activity, orange bars represent passes per night (PPN).

In May, 11,569 passes were recorded over 31 nights giving a passes per night of 373.1 PPN. The most active species by far was big brown bats (*E. fuscus*). High activity among myotis species were small-footed myotis (*M. ciliolabrum*), long-eared myotis (*M. evotis*), and long-legged myotis (*M. volans*). (Fig. 42).

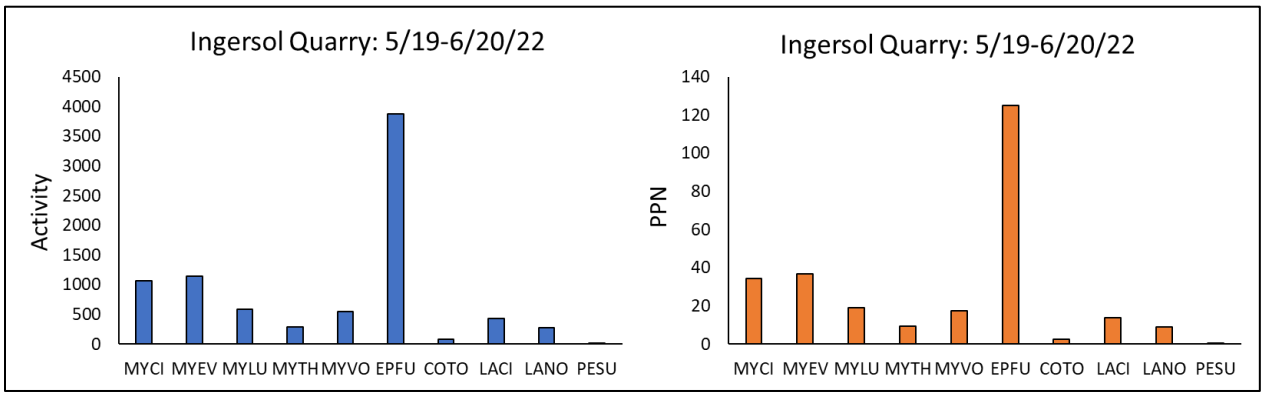


Figure 42. Sonar data (activity and passes per night, PPN) from Ingersol Quarry in mid- May to mid-April. Blue bars represent activity, orange bars represent passes per night (PPN).

In August/September, 19,491 call sequences were recorded over 17 nights resulting in 1,146.5 passes per night (PPN). The highest activity was from the long-eared myotis (*M. volans*) with more than 371 PPN and the fringed myotis (*M. thysanodes*) with 151.4 PPN (Fig. 43).

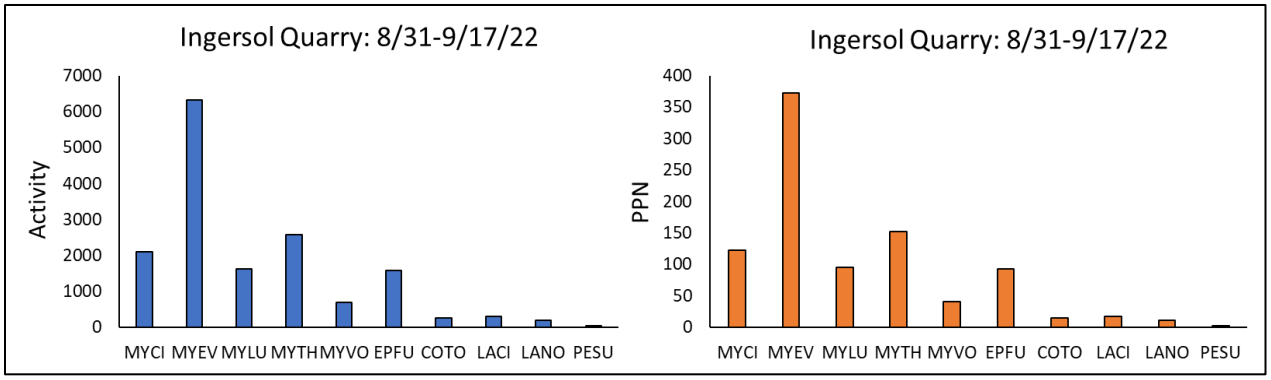


Figure 43. Sonar data (activity and passes per night, PPN) from Ingersol Quarry in late-August to early/mid-September. Blue bars represent activity, orange bars represent passes per night (PPN).

Conclusions: Ingersol Quarry continues to be a year-round, highly important resource for bats at HVR. Activity during the summer is unsurpassed by any other sites in the park as a drinking and foraging area especially for long-eared myotis (*M. evotis*), fringed myotis (*M. thysanodes*), small-footed myotis *(M. ciliolabrum*), and Townsend's big-eared bats (*C. townsendii*). In addition, this site provides drinking opportunities for larger-bodied bats that require a long-approach path to skim the surface (i.e., big-brown bats, *E. fuscus*; hoary bats, *L. cinereus*; and silver-haired bats, *L. noctivagans*). In addition, several species of bats continued to hibernate at Ingersol Quarry in 2022. These species included *M. ciliolabrum*, *E. fuscus*. *L. cinereus*, and *L. noctivagans*.

Recommendations: Continue to monitor seasonal bat activity at Ingersol Quarry. Periodic water quality testing is encouraged to determine if leaching of heavy metals has changed since 2014 when it was tested last (Adams Report 2014). This site was also relatively high in total dissolved calcium in 2014 important to reproductive females and young.

Elevational Transects

South St. Vrain Transect: The SSV transect was not run in 2022 due to continued construction and inaccessibility of the road.

Lefthand Canyon Elevational Transect: This transect was established on 10 September and ran till 5 November 2022. The lowest elevational site (LHT-Site 1, 40^{o} 7.937N, 105^{o} 17.905W) was

located at Heil Valley Ranch near the old schoolhouse. The intermediate site, Site 2B (40° 4.088N, 105° 26.550W, ele 2447m), was located at a beaver pond and Site 3 (40° 4.714N, 105° 30.687W, ele 2915m) was located off of Brainard Road about ¼ mi (0.5 km) south of Duck Lake (Fig. 44).

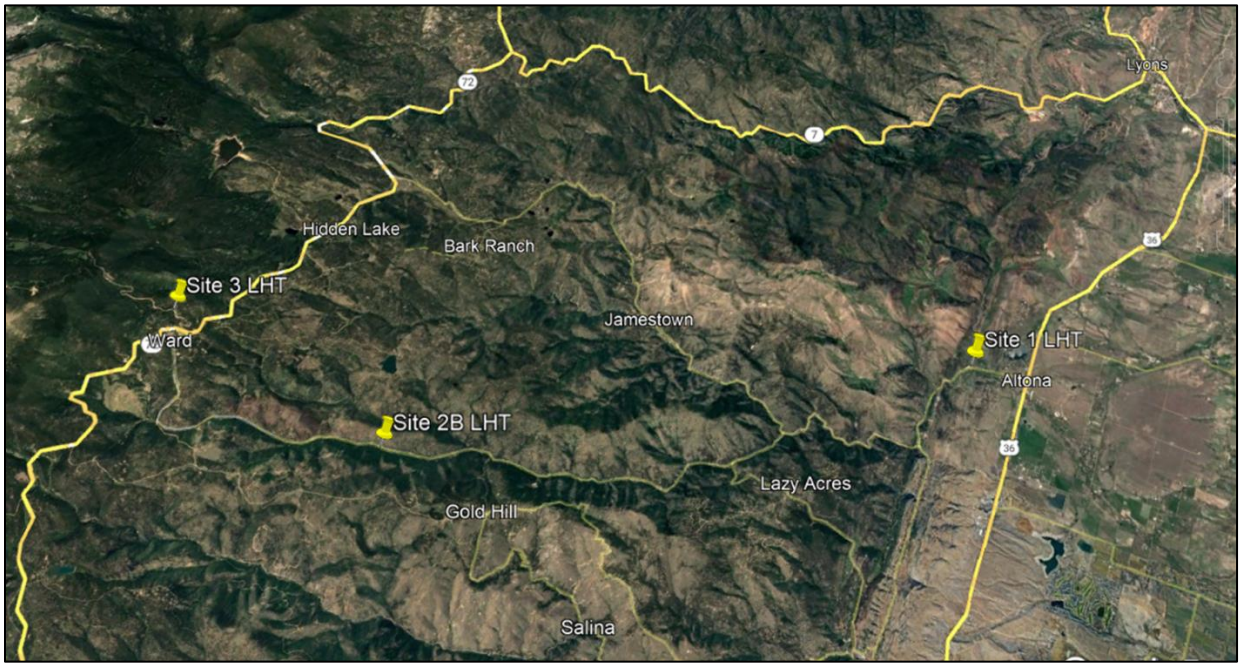


Figure 44. Map showing locations of sonar detector placement along an elevation gradient in Lefthand Canyon in September, October, and early November 2021. Site 1 is located at HVR, Site 2B was located in proximity of Reynolds/Gail Property and Site 3 was off Brainard Lake Road south of Duck Lake.

Activity of Bats: Bat activity at each of the three elevational sites was documented using SMU Mini Bat Detectors in September and October 2022. Total Call Recorded was calculated for each survey period (September and October) at each site. Species-specific bat activity was summed each month as was passes per night to compare survey periods which differed in number of nights.

Site 1: This was the lowest elevation site (1,738m) located at the School House on Heil Valley Ranch property. There was an increase in overall call sequences recorded in October (Fig. 45). In late-September, nine bat species were recorded at Site 1 with the exception being Townsend's big-eared bat (*Corynorhinus townsendii*) (Fig. 46A). In October, nine species were also recorded with the exception being long-eared myotis (*M. evotis*) (Fig. 46B). Comparison of

passes per night (PPN), showed decreases in the passes of all species over time; however, silver-haired bats (*L. noctivagans*) remained highest in activity (Fig. 46C).

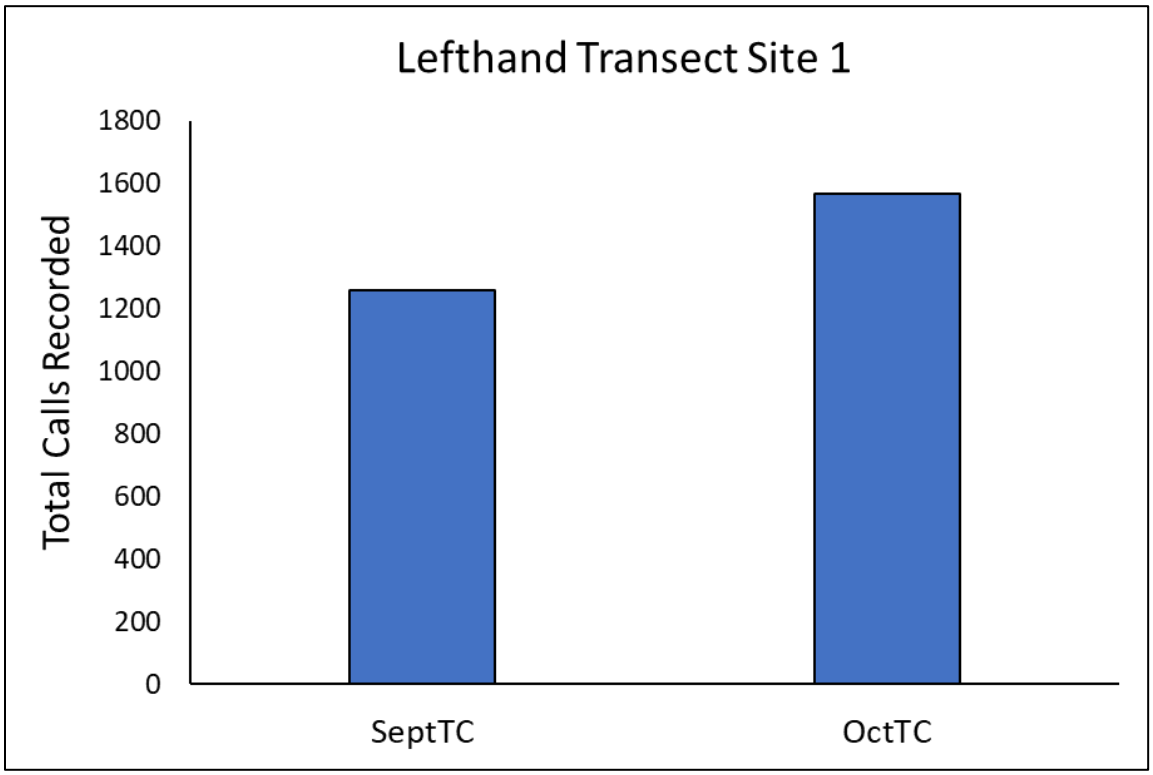


Figure 45. Comparison of total call sequences recorded in each month at Site 1.

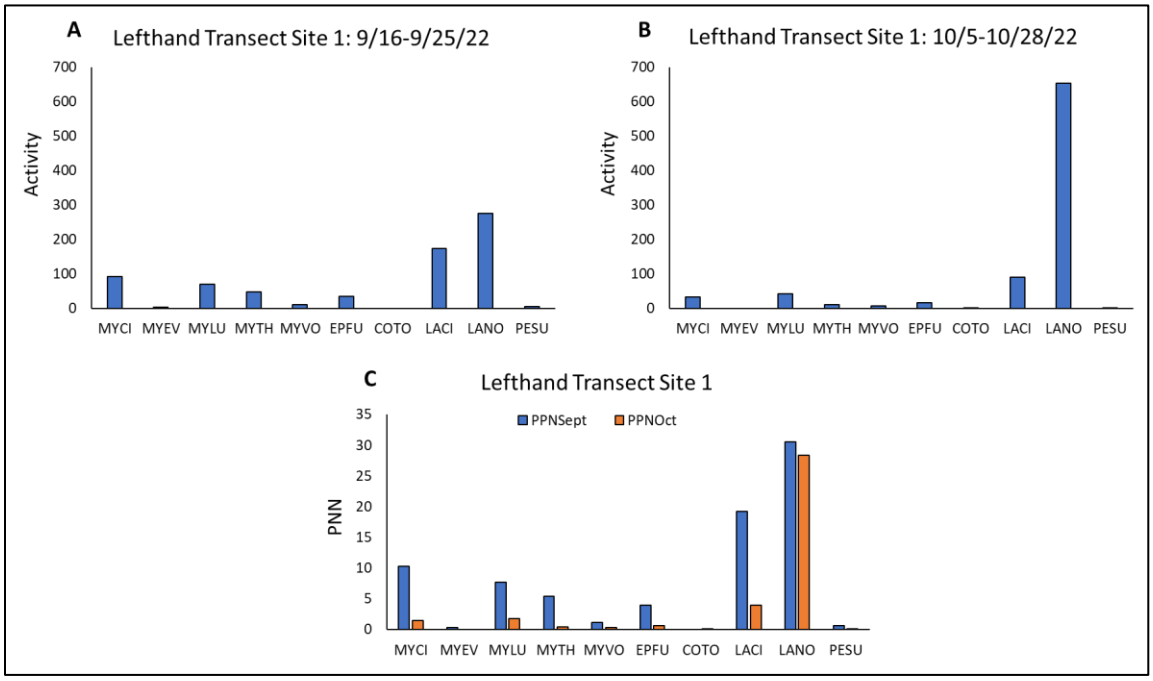


Figure 46A-C. Activity and passes per night (PPN) at Site 1 in Lefthand Canyon in September and October 2022. Blue bars represent activity, orange bars represent passes per night (PPN).

Site 2: This site was located at mid-elevation (2,455m) at a beaver pond near mile marker 13 (Fig. 44) and was surveyed three times. One survey occurred in May using an SM2 with high-resolution SMM microphone. Fall surveys in September and October were conducted with SMU mini detectors.

In May, total calls recorded was 712 (59.3 PPN) and there were nine species detected at the site with most activity from silver-haired bats (*L. noctivagans*), big brown bats (*E. fuscus*),

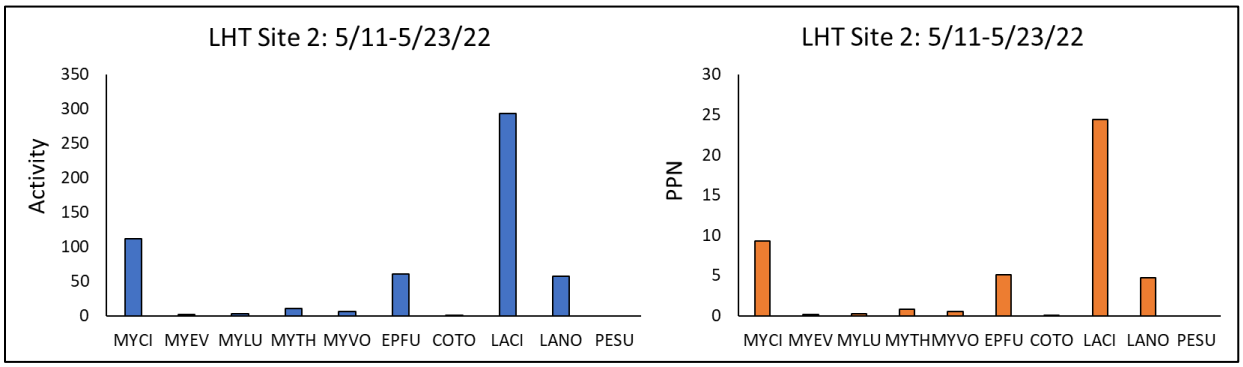


Figure 47. Activity and passes per night (PPN) at Site 2 along the Lefthand Canyon elevational transect in mid-May. Blue bars represent activity, orange bars represent passes per night (PPN).

and small-footed myotis (*M. ciliolabrum*) (Fig. 47). In September, a total of 2,051 calls were recorded over 7 nights (PPN 293). Nine of 10 species were recorded, with the exception being Townsend's big-eared bat (*C. townsendii*). Of the myotis species, *M. ciliolabrum* and *M. volans* showed the highest activity. Silver-haired bats (*L. noctivagans*) were also relatively high in activity (Fig.48).

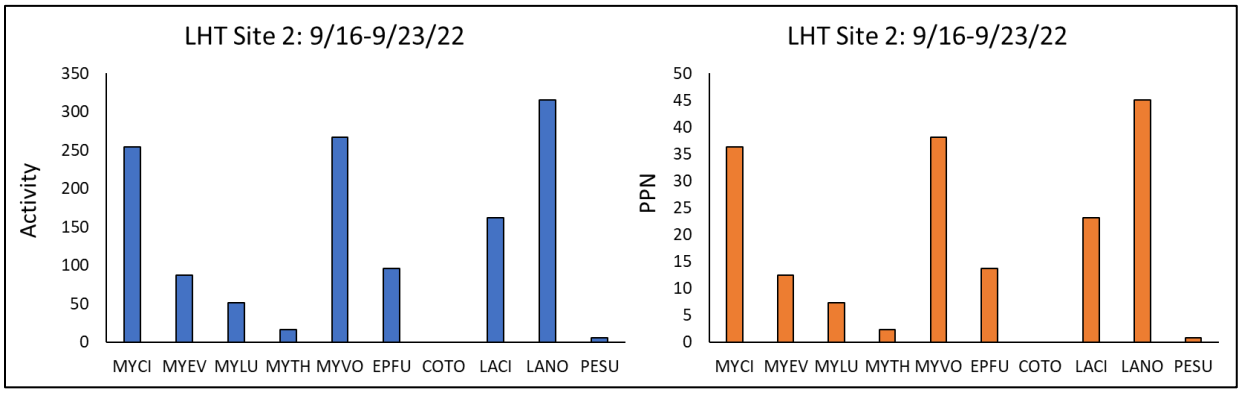


Figure 48. Activity and passes per night (PPN) at Site 2 along the Lefthand Canyon elevational transect in mid-September. Blue bars represent activity, orange bars represent passes per night (PPN).

In October, activity at site 2 was lower than in September with 1,955 passes recorded over 22 nights (PPN 88.9). Nine of 10 species were recorded with highest activity from big-brown bats (*E. fuscus*), hoary bats (*L. cinereus*), and silver-haired bats (*L. noctivagans*) (Fig. 49).

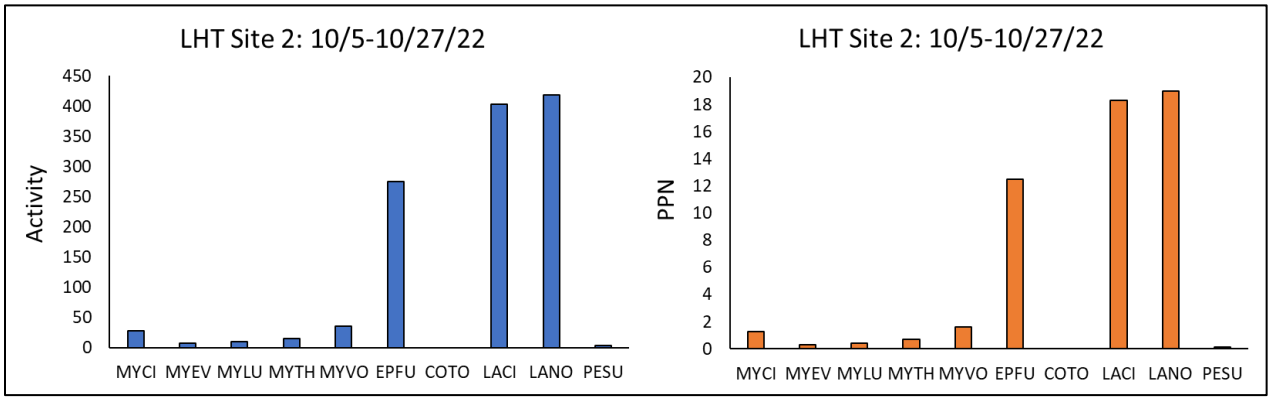


Figure 49. Activity and passes per night (PPN) at Site 2 along the Lefthand Canyon elevational transect in mid-September. Blue bars represent activity, orange bars represent passes per night (PPN).

***Site 3*:** This was the highest elevation site located near Brainard Lakes (2,874m) and had three survey periods in 2022, May, September, and October. In May, 69 calls were recorded over 14 nights resulting in only 5.9 PPN. Six species were recorded, with the highest activity from long-eared myotis (*M. evotis*), little brown bats (*M. lucifugus*), and long-legged myotis (*M. volans*). Curiously, 11 of the 69 calls were from tricolored bats (*P. subflavus*) perhaps suggesting a hibernaculum in the area (Fig. 50).

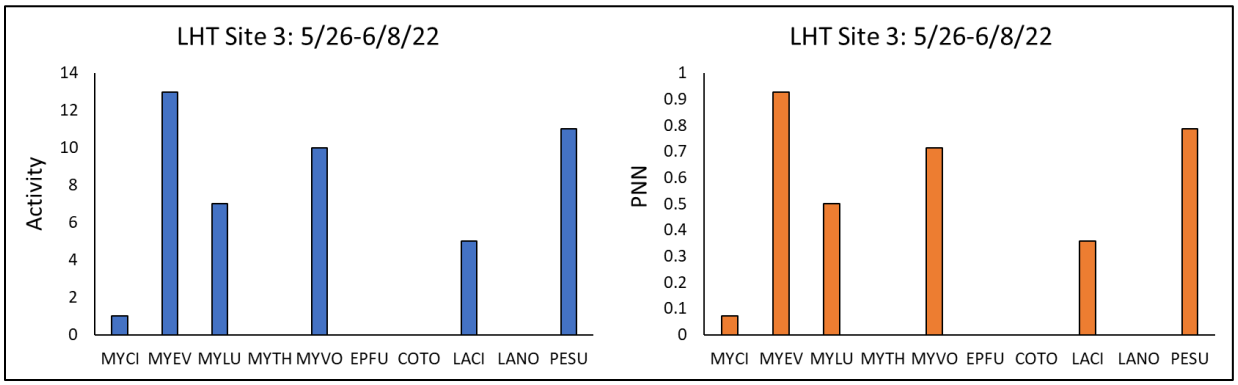


Figure 50. Activity and passes per night (PPN) at Site 3 along the Lefthand Canyon elevational transect in late-May to early-June. Blue bars represent activity, orange bars represent passes per night (PPN).

In September, activity was highest for *M. volans, L. cinereus*, and *L. noctivagans* (Fig. 51).

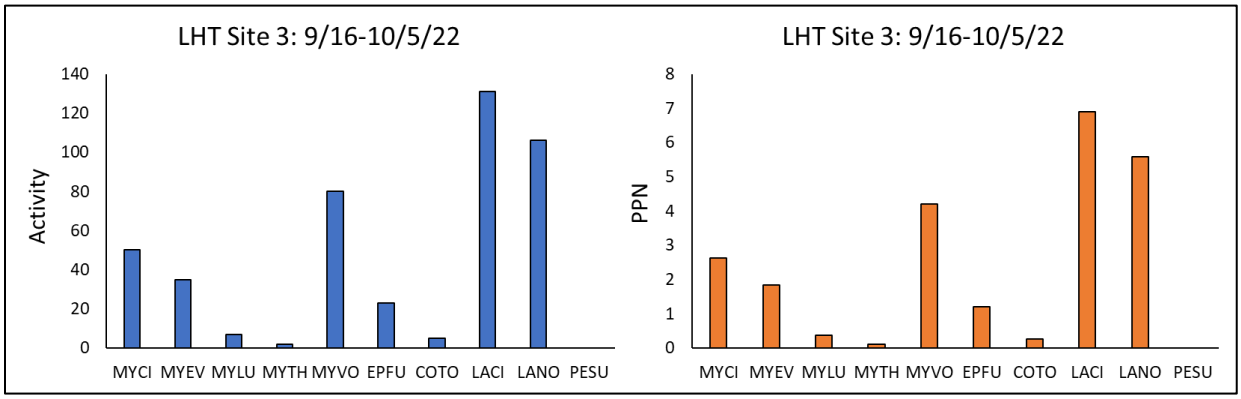


Figure 51. Activity and passes per night (PPN) at Site 3 along the Lefthand Canyon elevational transect in mid-September to early-October. Blue bars represent activity, orange bars represent passes per night (PPN).

M. volans, L. cinereus, and *L. noctivagans* were the most active at Ingersol Quarry, whereas in October, only four species were recorded, with the most active being *L. noctivagans* (Fig. 52).

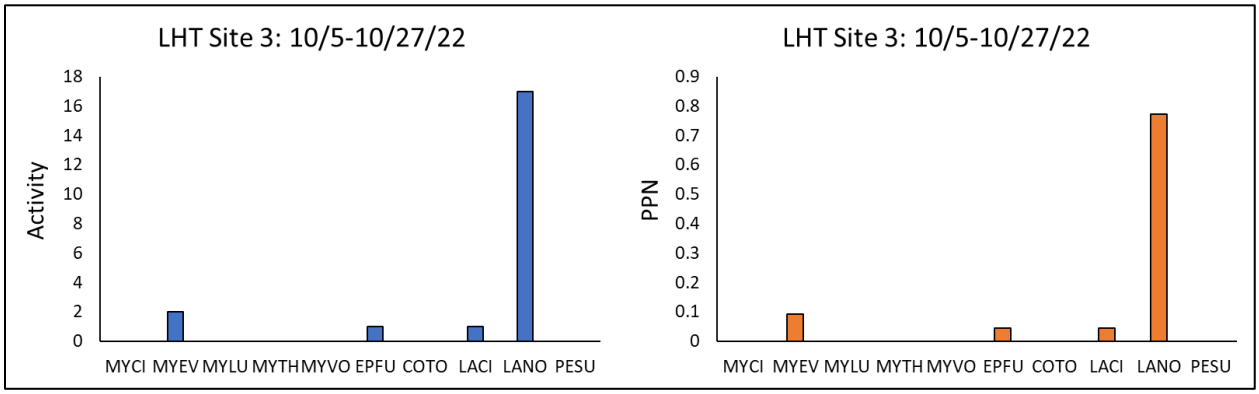


Figure 52. Activity and passes per night (PPN) at Site 3 along the Lefthand Canyon elevational transect in mid-September to early- to late-October. Blue bars represent activity, orange bars represent passes per night (PPN).

Conclusions: Lefthand Canyon continues to be active with bats. Sites 2 and 3 were most active in the fall, indicating bats moving to higher elevations for swarming and hibernation.

Recommendations: Continue to track bat activity in Boulder County canyons over elevational gradients. Long-term data can be compared to shifts in annual temperatures and precipitation in relation to climate warming.

Eastern Properties

Walden Ponds: I surveyed Site 3 (the most productive site for tricolored bats) at Walden Ponds located on the south side of Wally Toevs Pond (Fig. 53). Survey dates were 6-16 June and 31 August – 1 September 2022. Overall activity recorded in June over nine nights was 1,898 call sequences with 210.8 passes per night, whereas in September 2,114 call sequences were recorded in a single night. Unfortunately, the detector malfunctioned and only ran for a single night resulting in the 2,114 PPN (Fig. 54).

Figure 53. Map showing location of Sites 3 (Wally Toevs Pond) surveyed at Walden Ponds in 2022.

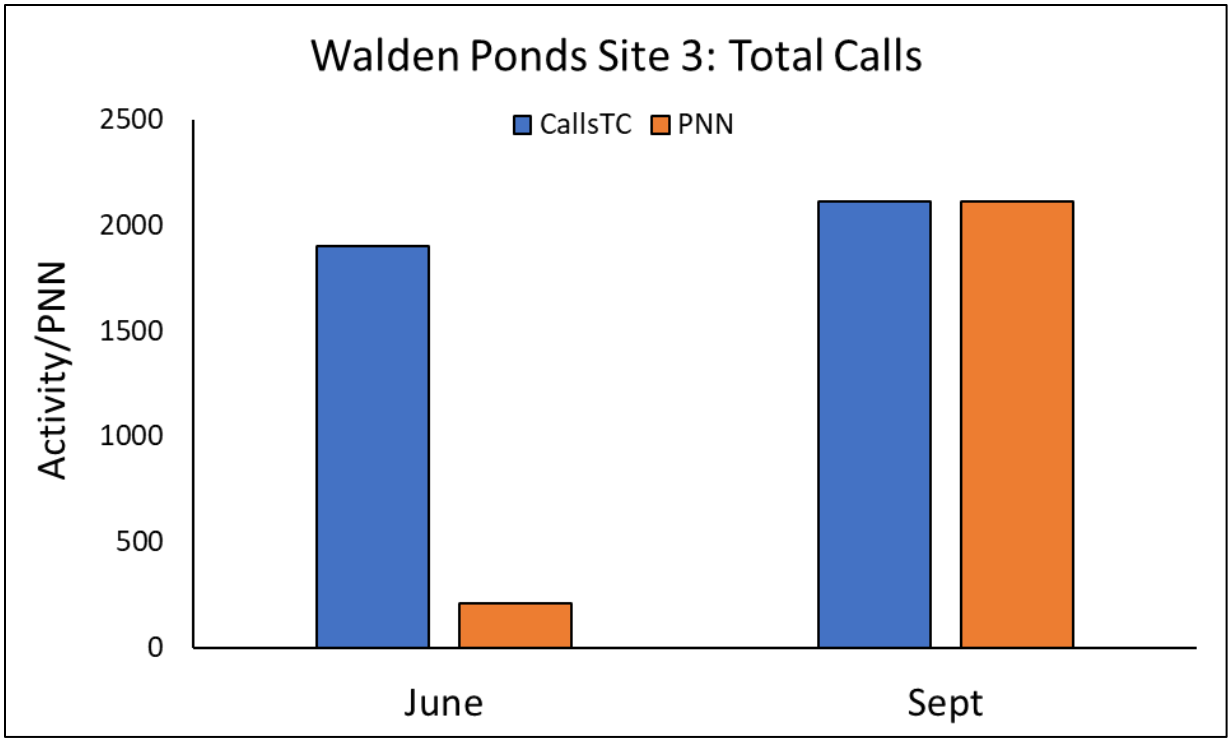


Figure 54.Activity (blue bars) and passes per night (PPN, orange bars) at Site 3 (Wally Toevs Pond) in June and September 2022.

Seven species were present at Site 3 in June and included *M. ciliolabrum*, *M. lucifugus*, *M. volans, E. fuscus, L. cinereus, L. noctivagans*, and *P. subflavus*. Most active were *M. lucifugus, E. fuscus,* and *L. noctivagans* (Fig 55).

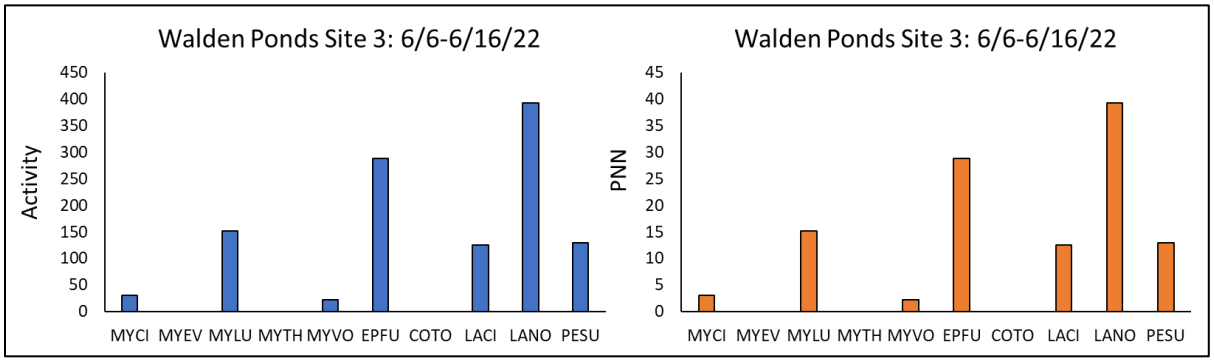


Figure 55. Species specific activity (blue bars) and passes per night (PNN, orange bars) at Site 3 (Wally Toevs Pond), Walden Ponds 2022. Blue bars represent activity, orange bars represent passes per night (PPN).

In September, the most active species were *M. ciliolabrum*, *M. lucifugus*, and P. *subflavus* (Fig. 46). For tricolored bats (*P. subflavus*), activity was higher in September than June, seemingly due to reproduction (Fig. 56).

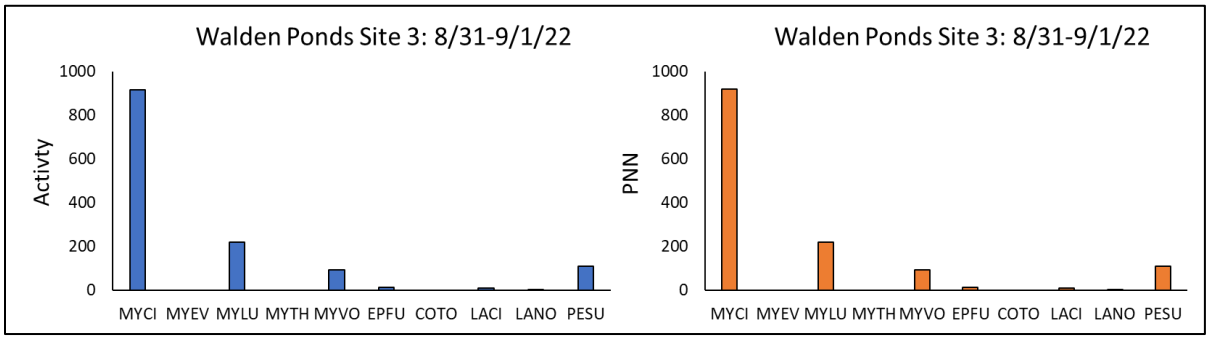


Figure 56. Species-specific activity (Blue bars) and passes per night (orange bars) for Site 3 at Walden Ponds in late June and late July 2021. Blue bars represent activity, orange bars represent passes per night (PPN).

Twin Lakes: Site 2 at Twin Lakes (Fig. 57) was monitored in 2022 because it is the most active area for *P. subflavus*. Two survey periods, one from 13-17 May and the second from 17-21 August occurred. In May, 59 total call sequences were recorded over four nights giving 14.75 passes per night (PPN). In August, 1,644 call sequences were recorded over four nights giving 411 passes per night (PPN).

Figure 57. Map of sites sampled at Twin Lakes in 2022, 2021, and 2020

Over three survey periods, 2,234 bat call sequences were recorded at Site 1. Comparison of the three survey periods showed an increase in activity from June into July with waning activity in early September (Fig. 58). Only three species were recorded in May (*L. cinereus, L. noctivagans*, and *P. subflavus*) (Fig. 59) However, in August, eight species were recorded at the site. The most active species were *E. fuscus* and *P. subflavus* (Fig. 60).

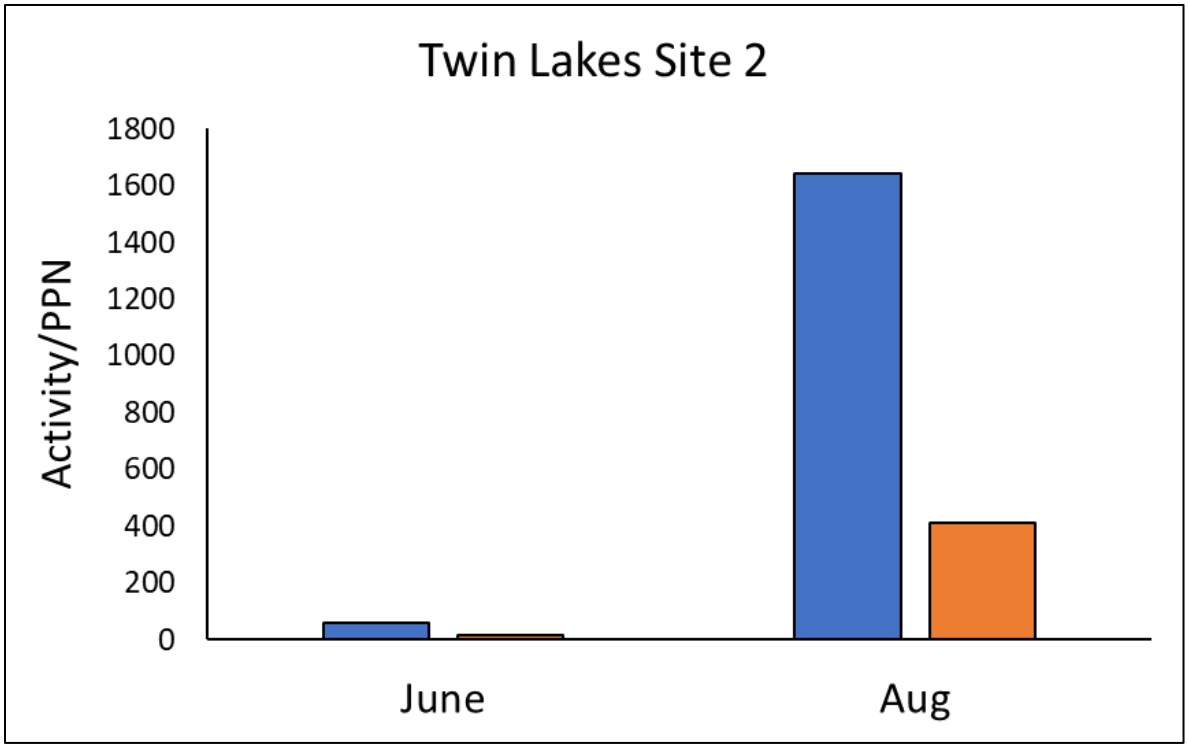


Figure 58. Activity (blue bars) and passes per night (PPN, orange bars) at Site 2, Twin Lakes, in June and August 2022.

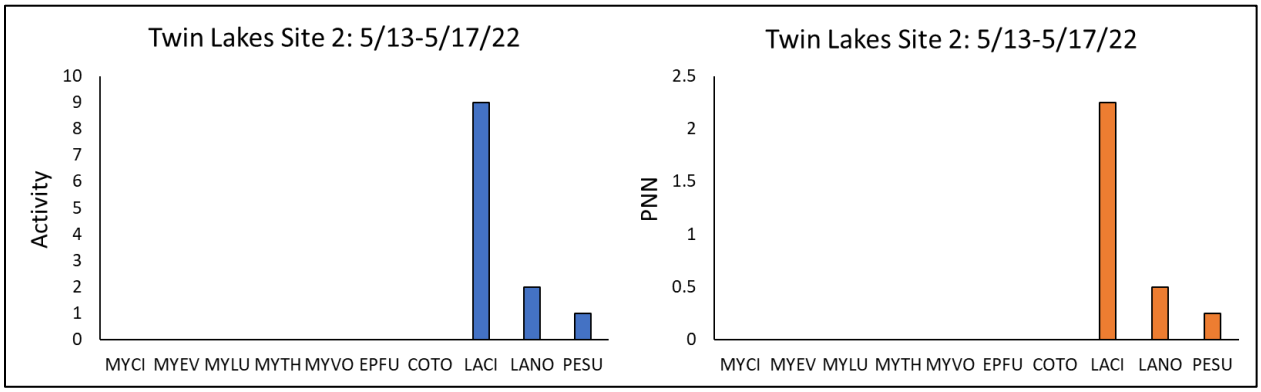


Figure 59 . Activity (blue bars) and passes per night (PPN, orange bars) at Site 2, Twin Lakes, May 2022. Blue bars represent activity, orange bars represent passes per night (PPN).

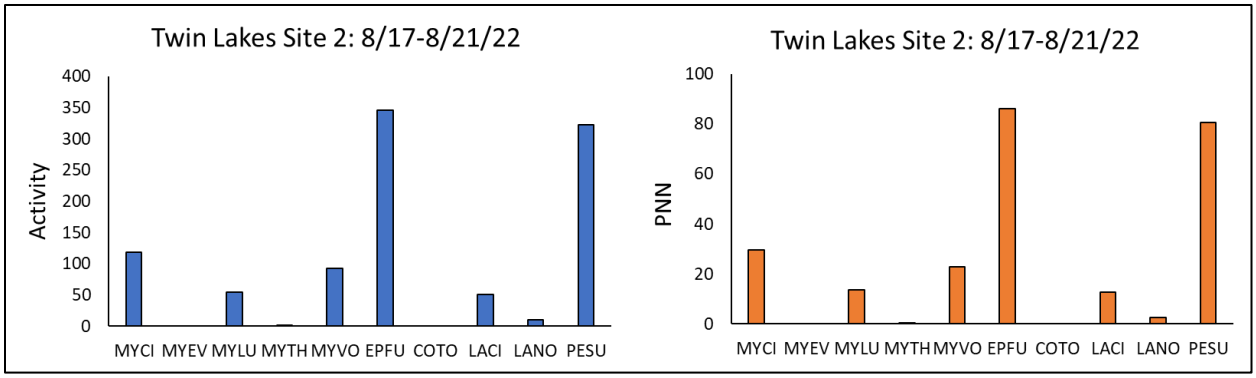


Figure 60. Activity (blue bars) and passes per night (PPN, orange bars) at Site 2, Twin Lakes, August 2022. Blue bars represent activity, orange bars represent passes per night (PPN).

Conclusions: Twin Lakes and Walden ponds are prime tricolored bat (*P. subflavus*) habitats. In addition, many other species also take advantage of these protected areas including some long-legged myotis (*M. volans*) as well as fringed myotis (*M. thysanodes*). These species typically are foothills distributed and even though it appears to be only a few individuals, this areas support seven of 10 Boulder County bat species.

Recommendations: Continue to protect these areas, especially along streams, ponds and ditches in terms of water availability, water quality, and deciduous trees that allow for roosting sites for many bat species, and in the case of tricolored bats, nursery sites for females and young. Comparing the two sites from 2016 to 2022, Walden Ponds showed a large decrease in 2021 from 2020, but in 2022 the activity is again tracking upward. Twin Lakes' tricolored bat population continues to trend upward since 2020 (Fig. 61).

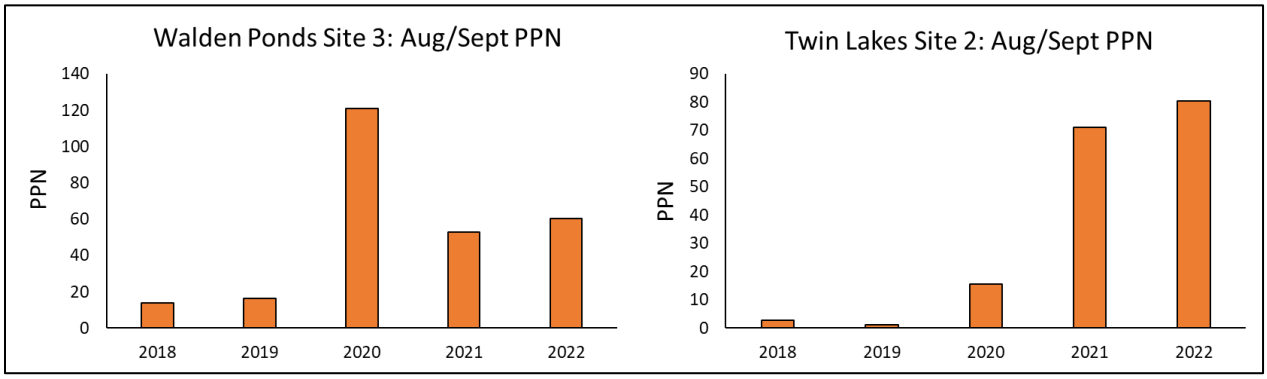


Figure 61. Comparison of tricolored bat (*P. subflavus*) passes per night (PPN) between sites and across years from 2016 to 2022.

High-Elevation Human-Structure Maternity Colonies

Three high-elevational sites that contain human-made structures that bats are using as maternity roosts were monitored in 2022. These included Blue Jay Mine, Cardinal Mill, and Rocky Mountain Mammoth (Fig. 62).

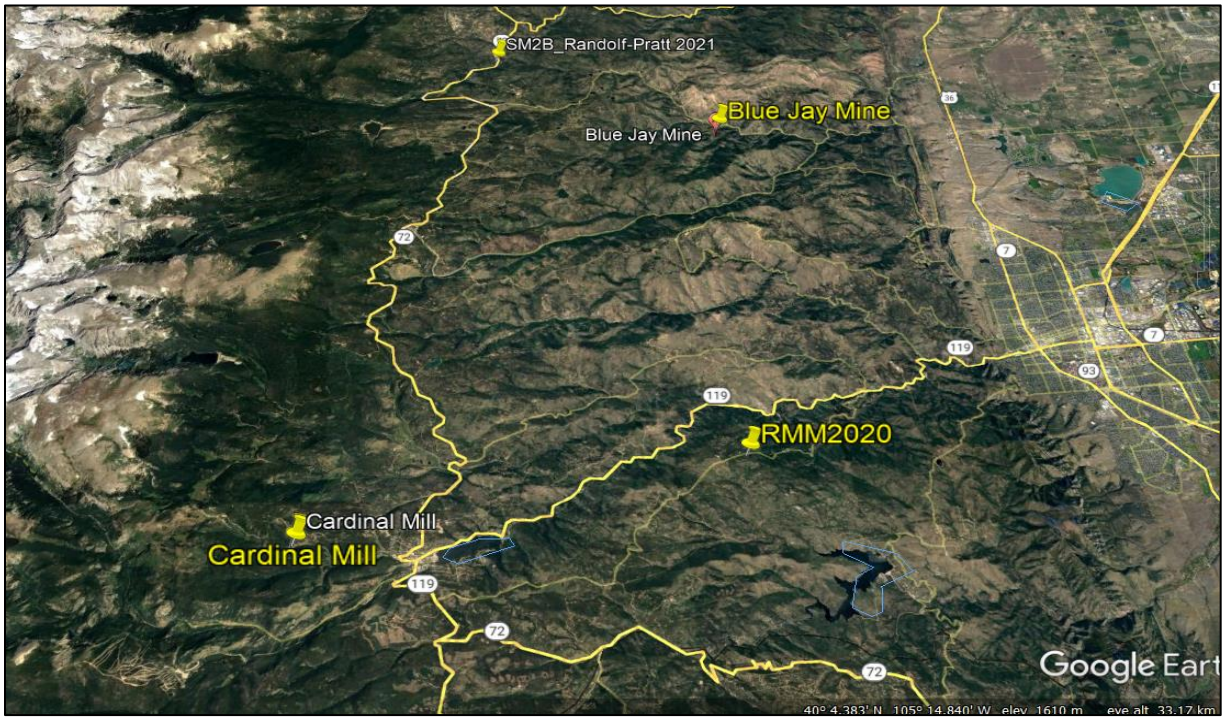


Figure 62. Map showing locations of three high-elevational sites having human-made structures housing bats.

Blue Jay Mine: This site is located southeast of the township of Jamestown (40º 6.511, 105º 22.027, ele. 2161m) and consists of a grated vertical mine shaft with an outbuilding (Fig. 63). Extensive guano inside the outbuilding suggests maternity colonies are present (Fig. 64).

Figure 63. Map of Jamestown and location of Blue Jay Mine.

Figure 64. Guano inside Blue Jay Mine outbuilding indicating the presence of one or more maternity colonies using the structure.

Sonar data collected at the site from 5 March to 29 April 2022 resulted in 819 bat sonar sequences were recorded, resulting in an average of 15.1 passes per night (PPN) of which 499

were identified to species. Species -specific sonar analysis indicated that of the eight species identified, with no calls recorded for *M. thysanodes* and *P. subflavus*. The most prevalent species present by far was *M. volans* followed by *E. fuscus*, and *M. lucifugus* (Fig. 65).

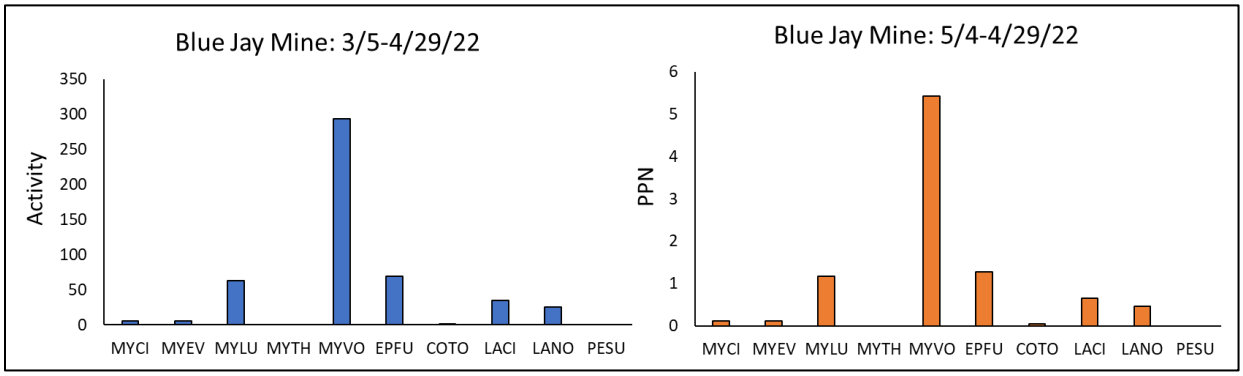


Figure 65. Species-specific activity (blue bars) and passes per night (PPN, orange bars) at Blue Jay Mine in March and April. Blue bars represent activity, orange bars represent passes per night (PPN).

A second survey was conducted in September. Despite being at the site for three weeks, the detector malfunctioned and only recorded for a single night. A total of 262 passes were recorded over this single night survey with the most active two species being *M. lucifugus* and *M. volans* (Fig. 66).

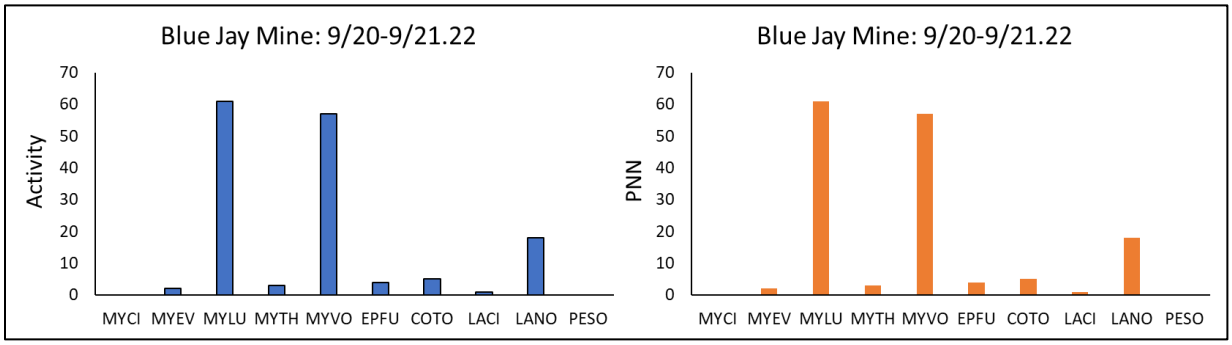


Figure 66. Species-specific activity (blue bars) and passes per night (PPN, orange bars) at Blue Jay Mine in March and April. Blue bars represent activity, orange bars represent passes per night (PPN).

In October, 530 call sequences were recorded over 17 nights giving 31.2 passes per night (PPN). Most dominant species activity was from silver-haired bats (*L. noctivagans*). Most myotis activity was from *M. lucifugus* and *M. thysanodes* (Fig. 67).

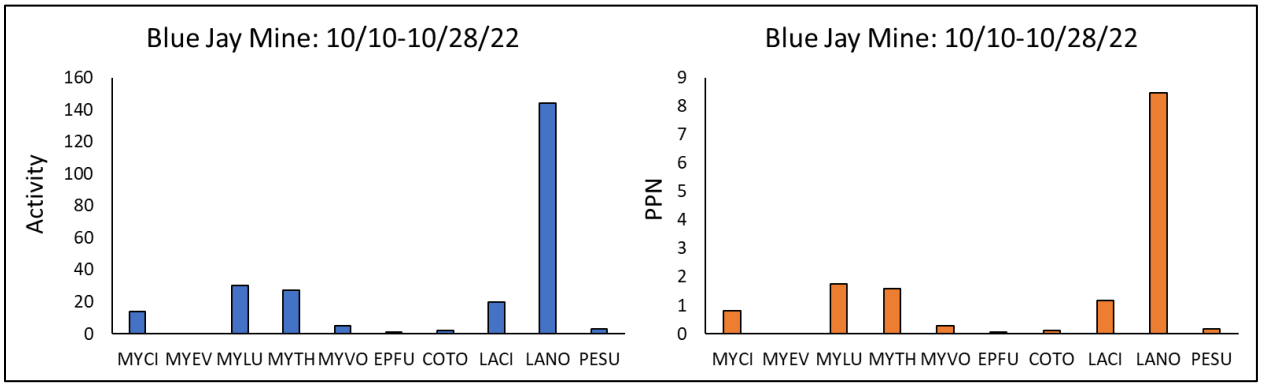


Figure 67. Species-specific activity and passes per night (PPN) at Blue Jay Mine in October. Blue bars represent activity, orange bars represent passes per night (PPN).

Conclusions: In 2020, an SM2 was placed at this site in October and found zero activity. However, in 2021, an SMU Mini sonar detector was placed at the same spot and recorded nearly 1,927 passes over 11 nights resulting in 175.2 PPN. In 2022, unfortunately, the September survey only included a single night wherein 262 PPN was recorded. If we extrapolate this out to 11 nights as in 2021, this estimates 2,288 total calls, seeming in-line with the 2021 data. In October survey recorded only 530 passes over 17 nights giving 31.2 PPN. Thus, this site remains very active as a maternity site for *M. lucifugus* and *M. volans* and in September as a possible swarming location even after the building was largely boarded up to protect the bats inside.

Recommendations: Continue to protect this site and remove information panels from the window slats that provide bat flight pathways in and out of the structure. These signs pose an unnecessary collision hazard to young bats learning to fly.

Rocky Mountain Mammoth: This site consists of an outbuilding (Fig. 68) and is located off of Magnolia Rd (39^{o} 58.904, 105^{o} 23.843, ele. 2516m). Sonar data collected from 23 August to 9 September 2022 showed 7,622 passes over 17 nights resulting in 448.3 PPN. By Far the most active species was the long-legged myotis (*M. volans*) which has a maternity colony in the building. All other four myotis species were recorded in lower but significant numbers (Fig. 69).

Figure 68. Photograph of Rocky Mountain Mammoth outbuilding in 2021 (credit R. Adams).

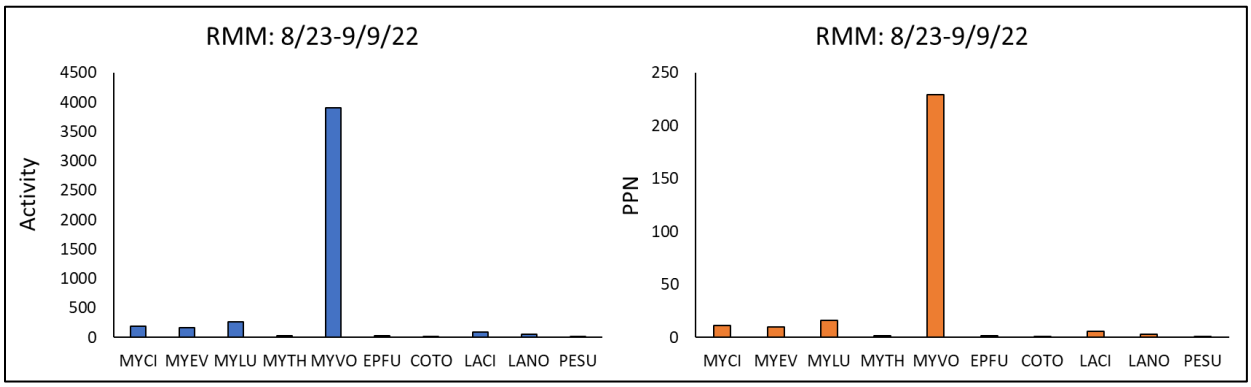


Figure 69. Species-specific sonar analysis of Rocky Mountain Mammoth (RMM) in Aug/Sept 2022. Blue bars indicate activity, whereas orange bars indicate passes per night (PPN).

Conclusions: Rocky Mountain Mammoth appears to be stable relative to previous years' data and remains an important high-elevation site for several myotis species likely using the structure as a maternity roost.

Recommendations: Continue to monitor, limit human-disturbance, and protect this site.

Cardinal Mill: This site is located west of Nederland off of Caribou Rd. (39^{o} 57.946, 105^{o} 32.993, ele. 2689m) and consists of a large processing building. An SM4 detector was placed on a fencepost just west of the mill (Fig. 70). Survey period 23 August to 9 September 2022.

Figure 70. Photograph of Cardinal Mill in 2022 showing placement of SM4 bat sonar detector attached to fencing (credit R. Adams).

A total of 10,272 bat call sequences were recorded over 18 nights giving 570.7 passes per night (PPN). Two species made up the majority of activity and these were *M. lucifugus* and *M. volans*, both of which appear to have maternity roosts in the building. The small footed myotis (*M. ciliolabrum*) also was present in relatively high activity. Individuals of all 10 Boulder County species were recorded at the site (Fig.71).

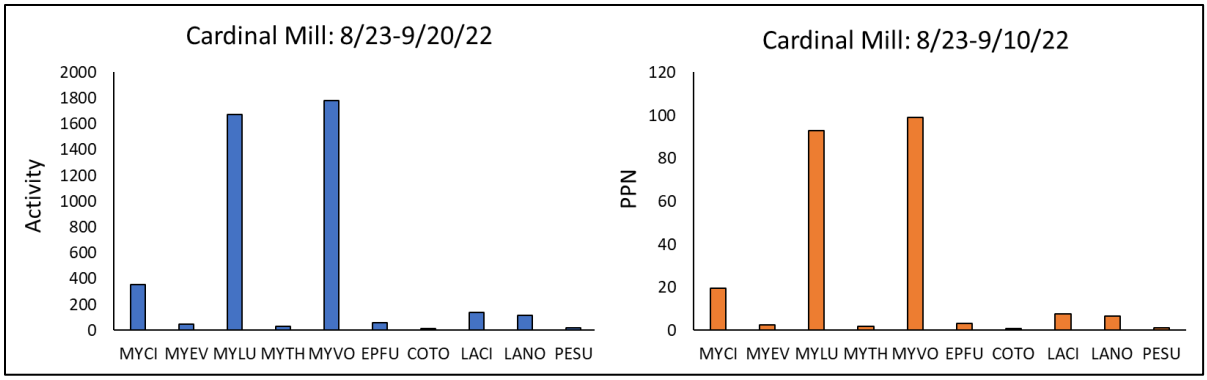


Figure 71. Species-specific sonar analysis of Rocky Mountain Mammoth (RMM) in Aug/Sept 2022. Blue bars indicate activity, whereas orange bars indicate passes per night (PPN).

Conclusions: Cardinal Mill continues to be an important high-elevation maternity site for long-legged myotis (*M. volans*) and a large colony, likely maternity, for little brown myotis (*M. lucifugus*). These two species composed about 81.5% of all identified sonar calls recorded 2022. This site is unique as it possesses a thermal environment conducive to the inhabitance of bat nursery colonies of females and their young which is likely rare at this elevation and area.

Recommendations: Continue to protect this site and minimize human disturbances during the reproductive season (April-October). Although *M. lucifugus* is generally considered to be tolerant of human disturbance, *M. volans* is much less accepting and is rarely found residing in human-occupied, or otherwise disturbed, buildings.

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