Securing a Home for Bats in the Milk River Watershed

Final Report on Findings and Next Steps

Submitted by:

Allison Choquette, Wildlife and Outreach Technician

Milk River Watershed Council Canada

140 Main Street, Milk River, AB

April 28, 2023

Environment and Climate Change Canada | Environnement et Changement climatique Canada

TABLE OF CONTENTS

Acknowledgements

This project was funded in partnership with Environment and Climate Change Canada (ECCC). I would also like to thank various partner organizations for their shared knowledge and support throughout the duration of this project. Alberta Conservation Association, Nature Conservancy Canada, Alberta Community Bat Program, Alberta Environment and Parks, and BC Bats have provided tremendous support over the course of the year. In the field, the MRWCC summer outreach assistant, Tyler Eresman, also provided support throughout this project in equipment deployment. Additionally, I would like to thank the MRWCC board members for their support in providing me with local contacts and their extensive knowledge of the field study areas.

Finally, I would like to thank the countless landowners for their continued cooperation throughout this project. Without the landowners and their willingness to have their lands surveyed for this project, the work would not have been feasible.

1. BACKGROUND

1.1. Alberta Bats

The province of Alberta is home to nine bat species, three of which are long distance migrants, and six which are year-round residents and overwinter within Alberta (Alberta Bats, 2020). The three migratory species are the Hoary Bat, Eastern Red Bat, and Silver-haired Bat and are believed to leave the province during the winter months and move to locations with a milder climate further south (Olson & Flach, 2016). Year-round residents are presumed to hibernate within Alberta during the winter months but may still undergo short migrations to suitable hibernacula include the Little Brown Myotis, Long-legged Myotis, Big Brown Bat, Northern Myotis, Long-eared Myotis, and Western Small-footed Myotis. The Milk River Watershed, located within southern Alberta and contains the four southernmost counties of Cardston, Warner, Forty Mile, and Cypress, are known to contain eight of the nine bat species present within the province as the Northern Myotis is only found within northern regions. The most common bat species found throughout Alberta is the Little Brown Myotis (*Myotis lucifugus*), or more commonly known as the Little Brown Bat. While currently this species is abundant, the little brown myotis has been listed as Endangered federally in Canada and provincially in Alberta due to the impacts of white-nose syndrome (WNS) throughout other areas of North America (Alberta Bats, 2020).

Table 1. Alberta's native bat species (Alberta Bats, 2020).

Species	**Provincial Status Listing**	**Habitat Preference**	**Overwintering Strategy**	**Foraging Preference**
Eastern Red Bat (*Lasiurus borealis*)	Least Concern	Solitary, foliage-roosting on limbs and branches amongst leaves.	Migratory - likely spends the winter in the southeastern United States. May spend colder months hibernating in leaf litter.	Moths, but will eat a variety of insects.
Hoary Bat (*Lasiurus cinereus*)	Least Concern	Roosts among foliage of deciduous and coniferous trees, selecting taller trees. Species tends to roost alone.	Migratory species with behaviours widely unknown, but is believed to migrate to southern United States or Mexico.	Preference towards large moths but will also consume beetles and dragonflies.
Silver-haired Bat (*Lasionycteris noctivagans*)	Least Concern	Roosts primarily in crevices of large decaying trees, but may also use buildings, bat houses, and similar man-made	Primarily a migratory species that migrates to southern British Columbia and will occupy mines, caves, trees, and	Primarily small, soft bodied insects including flies, midges, moths, mosquitoes etc.

		structures during migration.	rock piles, but some individuals have been detected in southeastern Alaska as well.	
Big Brown Bat (*Eptesicus fuscus*)	Least Concern	Commonly found in prairie river valleys. Will roost in buildings, rock crevices, caves, and mines and can be found in colonies in the 100's.	Hibernate in deep rock cracks and holes caused by erosion in prairie river valleys. This is the only species known to occasionally hibernate in buildings.	Preference towards beetles, but diet varies on food availability.
Western Small-footed Myotis (*Myotis ciliolabrum*)	Sensitive	Within Alberta, will only occupy riparian bad land habitats, specifically along the Milk River, Saskatchewan River, and Red Deer River. Found roosting in rock crevices and erosion holes, but can be found in riparian cottonwood forests for foraging purposes.	Hibernates.	Consume a variety of small-bodied insects. This includes moths, flies, mosquitoes, and midges.
Western Long-eared Myotis (*Myotis evotis*)	Sensitive	Inhabits prairie river valleys, specifically in the badlands within sandstone boulders and erosion holes. Roosts nearer to the ground in areas such as erosion holes, rock piles, and tree stumps.	Hibernates.	Forage for sedentary insects by gleaning them from the surface of vegetation.

Little Brown Myotis *(Myotis lucifugus*)	Endangered	Commonly roosts in buildings, but also found in old trees, rock cracks, caves, mines, bridges, and bat houses. Colonies range from the 100's up to thousands.	Hibernates.	Large consumer of aquatic insects including midges, caddisflies, and mayflies. Will also consume beetles, moths, mosquitoes, and spiders.
Northern Myotis (*Myotis septentrionalis*)	Endangered	Habitat is contained to the boreal forest, foothills, and mountains. Roosts in the crevices of large, decaying old trees, typically in deciduous trees such as Aspen or Balsam Poplar.	Hibernates.	Forages by gleaning insects off the surfaces of vegetation.
Long-legged Myotis (*Myotis volans*)	Undetermined	Have been found in building roosts, but counts of this species have likely been underrepresented due to the fact that this species commonly roosts in mixed groups with the Little Brown Myotis. May also roost under slabs of rocks on cliff faces and large trees.	Hibernates.	Forages for moths primarily, but still may regularly consume aquatic insects.

Bats use echolocation, which is the process of emitting and receiving sound waves to perceive their surrounding environment. Signals used for echolocation can be used for locating prey in aerial feeders, avoiding obstacles in their environment, or socially as a function of communication (Bringham *et al.* 2004). When bats emit calls for different purposes, the pattern of the calls will vary with regards to sound frequency, shape, and frequency of calls. All of these calls are "ultrasonic", meaning that they are emitted at a frequency that is beyond the upper limit of human hearing, at a minimum of 20 kHz (Bringham *et al.* 2004).

1.2. Significance

Bats are extremely important at multiple scales; they are beneficial ecologically, economically, and socially. All of the species within Alberta are insectivores, meaning that their diet is solely based on arthropods, including insects and spiders (Maucieri & Barclay, 2021). For this reason, bats significantly reduce the burden of pest management for farmers. In fact, a single Little Brown Myotis can consume its own body weight in insects in a single night of feeding. Over the course of a year, the bats across the continent are estimated to save the North American agriculture industry $3.7 billion per year (Boyles *et al*. 2011).

While there are various methods in which bats can be studied to assess population and species diversity, the use of acoustic detectors in bat surveys has become increasingly important in assessing bat activities and habitat associations, as well as impacts from disease, climate change, and loss of important landscape features (Jones *et al.* 2009).

Despite the important roles that bats play ecologically and economically, there are still significant knowledge gaps regarding population abundance and distribution, biology, overwintering strategies, and appropriate management and conservation (Vonhof, 2006). This is largely due to the nature of bats being nocturnal, flying animals, making studies much more difficult to conduct. By recording the bats to identify species groups throughout the watershed, this will provide a more concrete baseline of current bat diversity and abundance prior to the spread of white-nose syndrome in the province.

White-Nose syndrome (WNS) is a fungal disease caused by a fungus known as *Pseugoymnoascus destructans* (Pd fungus). The fungus was originally introduced to North America and detected in New York in 2007 and has since been spreading throughout the continent (Cheng *et al.* 2021). As of 2023, the fungus was first detected in Alberta in areas around the Red Deer River, north of Calgary. While this does not necessarily mean WNS has been detected, positive cases of this disease are anticipated to start becoming prevalent within the province over the coming years. There is not currently any cure for this disease and bats exposed to the fungus have nearly a 100% fatality rate. For this reason, it is imperative to monitor the spread of this disease and mitigate any other threats to bats to ensure recovery for these impacted species.

2. OVERVIEW

2.1. Securing a Home for Bats in the Milk River Watershed

The purpose of this project is to work with private landowners within the Milk River watershed to identify potential bat roosts and hibernacula located on their properties. While there has been an increase in the research efforts to develop a better understanding of the biology of bats in Alberta, there are still notable knowledge gaps regarding distribution, habitat use, migration, and hibernation (Olson & Flach, 2016). For this reason, this project seeks to expand our knowledge of the distribution of bats, specifically in southern Alberta where there are large areas of private and leased land that have remained unsurveyed for bats.

A large portion of prairie bats, most often the Big Brown bats and Little Brown Myotis, roost in buildings and have adapted to forage over human modified landscapes, most of which are often located on private lands. This is because ranch lands and farmyards typically have suitable structures such as old barns and sheds that are appealing to bats and are often located in close proximity to important foraging areas such as riparian zones and waterways (Olson & Flach, 2016). In contrast, large areas of land that are farmed or cultivated typically do not experience high bat activity. Thus, maintaining the smaller tracts of land that are conducive to bat activity and roosting is imperative to the success of the species within southern Alberta. The participation of watershed landowners is an imperative component for conservation, stewardship, and

continued research to monitor the population of bats in Alberta prairies (Environment Canada, 2015) Thus, outreach activities to solicit producer cooperators in order to deliver reference materials to the watershed residents, provide bat houses as habitat enhancements, and deploy passive acoustic monitoring equipment were the primary focus for this project.

The three primary goals of the project were to provide habitat improvements or protections, conduct surveys and inventories of bats on private lands, and carry out outreach and education for bat conservation purposes. There was also specific focus on the Little Brown Myotis due to its endangered species designation both provincially and federally.

2.2. Habitat Enhancement and Procurement

The enhancement and protection of current bat roosting habitat and hibernacula is critical for the persistence of healthy bat populations. On properties that were surveyed for this project, landowners were provided with one or two multi-chambered bat houses to be installed on their properties based on recommendations from the Alberta Bat Program. Suitable bat habitats such as large diameter, decaying trees or old abandoned structures may be lost due to human development and agriculture, thus habitat enhancement and procurement may allow for bats to have increased survival in the face of habitat loss. While the effectiveness of bat houses is still widely debated, ensuring access to high quality habitat may still prove to be a beneficial measure to prevent unnecessary stressors to bats and may allow for continued survival and successful reproduction (Alberta Community Bat Program, 2019).

Bat houses are artificial structures that may be used by bats to roost during the day or between foraging for insects at night (Alberta Community Bat Program, 2019). Since southern Alberta can experience extreme heat days, a three chambered design was used for the bat houses, which allows for a greater temperature gradient for bats to pick between, thus increasing the likelihood of bats choosing to roost in the structures as they are more suitable for the needs of individual bats (Figure 1). A dark brown coloured exterior was also selected over a light brown or black, as this provides the opportunity for more solar radiation to be absorbed than a lighter colour, but still airs on the side of caution and may prevent overheating from too much solar absorption from a darker colour. Following the protocols recognized by the Alberta Community Bat Program, it was recommended to landowners that the houses be installed on the south and/or east facing walls of buildings, at a minimum of 5 feet from the bottom of the ground to ensure the highest success rate for occupancy.

Figure 1. Multi-chambered bat house design provided to all landowners who participated in the project.

In addition to the installment of the small bat house structures, one overwintering or maternity bat "condo" structure was constructed and erected at an identified high value site at the Weir Bridge Day Use Area, just off the Milk River. This condo is a large-scale design of a bat house, with many more chambers and erected as its own freestanding structure. Structural plans for the condo were based on the design by the Alberta Conservation Association and the Alberta Community Bat Program (Figure 2) (Alberta Community Bat Program, 2019). The purpose of the condo is to provide a safe environment for bats to roost in high numbers, either for maternity roosting or hibernation. Since the structure is so large, it creates a much more stable environment than smaller bat houses would, which is optimal for nursing mothers or hibernating bats, which have specific temperature and humidity requirements.

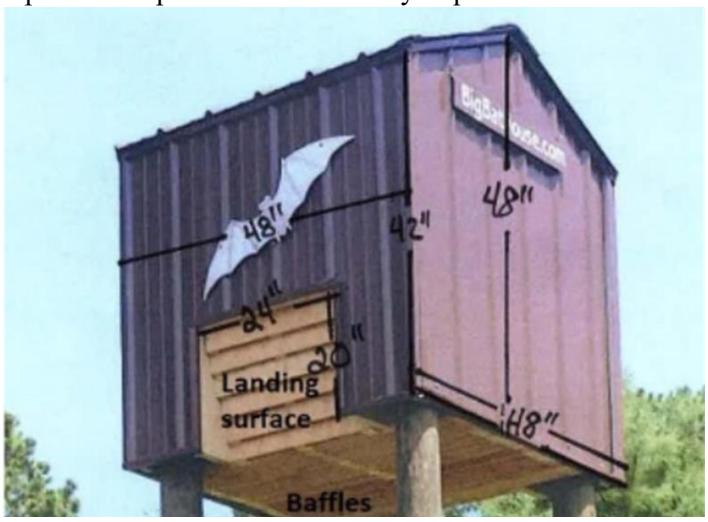

Figure 2. Bat condo design to be utilized for this HSP project (Alberta Community Bat Program, 2019).

2.3. Outreach and Education

Since this project entailed working directly with landowners to conduct monitoring, educational outreach was consistently being completed through discussion with these individuals. Every landowner was provided with an information sheet with basic information of Alberta bats, threats and conservation issues, best management practices for bats on their properties, and further resources for their viewing if they required more information. Additional follow-up information was provided to landowners following monitoring and analysis of recordings to share further knowledge of the species groups found on their properties. There were also numerous articles written and interviews with local news outlets to spread awareness of the project and to solicit landowner participation.

2.4. North American Bat Monitoring Program (NABat)

This project also included a collaboration with Alberta eBat, which is part of the greater North American Bat Monitoring Program (NABat). The purpose of NABat is to create a program across the continent to collect and share reliable data related to bat research, ultimately allowing for effective conservation decision making and long-term success for bat populations (Loeb *et al*. 2015). The program's main objectives are to provide a coordinated bat monitoring program to support local, regional, and range-wide inferences about trends in bat populations and the responses to threats such as WNS, climate change, wind energy, and habitat loss (Andrusiak *et al*. 2021). Contributions to NABat included the submission of recordings made during acoustic surveys at stationary points across the watershed. Through participation in this program, the recordings from this project can provide a baseline inventory of the species abundance and distribution within the Milk River Watershed.

3. METHODS

3.1. Landowner Outreach and Coordination

Due to the nature of this project, emphasis was placed on outreach and cooperations with private landowners and producers throughout the watershed. To achieve this, several methods of soliciting were undertaken to reach as many individuals as possible. First, a call for landowners' participation PDF document was created to describe the project objectives and needs, which was then distributed via social media channels, email membership lists, the MRWCC Meander newsletter, the MRWCC website, and at other MRWCC public meetings (Figure 3). This document was created to provide landowners with further knowledge of the importance of the work being conducted, as well as how they can be stewards for bats on their own properties through participation in the project. As an added incentive for landowner participation, bat houses were also provided to every landowner that allowed for their land to be surveyed and was to be installed at the landowner's discretion.

Securing a Home for Bats in the Milk River Watershed - We Need Your Help!

Bats on your property? Curious about the benefits of bats in the watershed?Looking to assist in the research and monitoring of Little Brown Bats? Let us know!

The Milk River Watershed Council will be conducting a research and monitoring project for the Little Brown Myotis throughout 2022. Through the collaboration with landowners across the watershed, our goal is to document important roosting and hibernation sites for this species to develop a better understanding of their population, and bolster their habitats with the implementation of bat houses. If you are interested in learning more, please contact Allison Choquette at allison@mrwcc.ca or call 403-647-4035.

Habitats of Interest

For the purpose of this project, we are particularly interested in seeking out properties with features that are conducive to bat habitat. Abandoned structures and aged buildings, hoodoos, caves, land with mature trees, and riparian wetland areas are all habitats we would be interested in surveying. We would also like to visit any bat houses currently sitting unoccupied to understand why they may be vacant and provide assistance in making them more bat-friendly.

Why We Need Your Help

Bats can provide a wealth of benefits both ecologically and economically with regards to farmland. By assisting in the identification of Little Bat Habitat in the watershed, you can aid in the monitoring of these populations to identify trends in these populations and protect critical habitat. In return, we will be providing landowners with complimentary bat houses to be installed on their properties to help provide complimentary roosting habitat for these bats. Additionally, we are seeking sunset bat-count volunteers - this provides the perfect opportunity for individuals of all ages to join us in the field and experience bats first hand!

Figure 3. One of the article submissions in the Milk River Meander newsletter to solicit landowner participation for acoustic monitoring.

Throughout the summer, continued calls for landowner participation were posted on the Milk River Watershed Council Facebook page and advertisements through participation at community events such as the Milk River Heritage Days was employed. As the project continued throughout the summer months, the number of landowners agreeing to participate in the project began to decline, thus landowners not on the mailing list needed to be contacted. Through mutual contacts with Milk River Watershed Council employees, several more landowners agreed to participate after being reached via phone and/or email.

3.2. Equipment Deployment

The choice of equipment for this project was the Song Meter Mini Bat Ultrasonic Recorder (SMU06100) from Wildlife Acoustics. This small device can be used to conduct bat species inventory and presence/absence surveys through capturing high quality ultrasonic vocalizations (Wildlife Acoustics, 2022). The weatherproof design, small compact size, and low-noise microphone made this device the optimal piece of equipment to conduct the work necessary for the project (Figure 4).

Figure 4. Song Meter Mini Bat Ultrasonic recorder attached to a fencepost at a landowner property in spring.

The equipment was deployed on properties throughout the watershed beginning March 24, 2022 up until September 22, 2022. The song meter was programmed via Bluetooth connection on an android device and placed on a schedule of recording calls 30 minutes prior to sunset until 30 minutes after sunrise. GPS coordinates were also input to the device to ensure proper timing with the sun based on the location. The recorder was programmed to record calls in a full-spectrum format and was subject to recording for a minimum of 3 seconds up to a maximum of 15 seconds at a minimum trigger frequency of 16 kHz. Once the equipment was programmed appropriately, a location was selected on the designated property. Ideal locations were areas that were open, but adjacent to habitat that was conducive to bat habitat and/or foraging areas such as riparian ecosystems, wooden structures, and large trees or rock structures with deep crevices.

Bats need to be within 30 metres of the microphone to be detected and for the recorder to produce good quality data (Bachen *et al*. 2018). Care was taken to avoid placing the equipment in areas that would produce too much background noise, such as in heavily treed areas or too close to bodies of water or metal structures that may cause sound to reflect off the surfaces. Avoiding areas of high environmental clutter was also important to avoid recording bats using approach phase calls rather than their search phase calls, which is necessary for identification (Bachen *et al*. 2018). This is due to the fact that approach phase calls have a greater overlap between species, making these types of calls more difficult to differentiate between species for identification (Bachen *et al*. 2018). The equipment was then zip tied to the highest point available, which was typically high fence posts, wooden structures, or corrals. Since the equipment was moved to a new location twice a week, the device was left for a series of 3-4 nights.

While there are benefits and downfalls to every method of surveying, acoustic detectors are much more versatile than methods such as mist-netting, as they can be conducted over a much greater spatial and temporal extent, and also requires much less expertise and labour (Rodhouse, Vierling & Irvine, 2011). Thus, detectors can be deployed by only one individual and generate large amounts of data quickly with little cost.

3.3. Data Analysis

Due to the nature of the equipment and Automatic Identification software, identification down to species level could not be reliably obtained. This is due to the fact that some calls are so similar in characteristics, it can be nearly impossible for the software to differentiate some recordings between different species. Bat species may be grouped together when their search phase call shapes are similar and may have overlap, which makes it difficult to distinguish two species apart from one another (Bachen *et al.*2018). For this reason, it was decided that the recordings should be grouped and identified to species groups, which were to be differentiated from one another based on call characteristics. These groupings were based on a combination of the methods used by the Montana Natural Heritage Program and North American Bat Monitoring Program in Alberta (Reichert, 2018) (Table 2.). These methods allowed for bat species to be grouped together based on the frequency level and pattern of the individual calls, including slope and duration (Burgar, 2021). This conservative approach reduces bias and potential for misidentification of species during the manual vetting process.

Table 2. Species groupings based on call characteristics for bats of Alberta. The Northern Myotis was excluded as this species is not found in southern Alberta.

Label	Species
LABO/MYLU	LABO, MYLU (Eastern Red Bat, Little Brown Myotis) → High frequency calls.
Myotis 40k	MYLU, MYCI, MYVO (Little brown myotis, western small-footed myotis, long-legged myotis) → species with pulses that have a minimum frequency in the range of 35-45 kHz.
Myotis spp.	MYLU, MYCI, MYVO, MYEV (Little brown myotis, western small-footed myotis, long-legged myotis, long-eared myotis).
20k	EPFU, LANO, LACI (Big brown bat, Silver haired bat, Hoary bat) → species with pulses that have a minimum frequency of 20 kHz.
No ID	Bat call was detected, but quality or recording is too low to determine species grouping.

The analysis software used for this project was Kaleidoscope Pro, which was purchased through Wildlife Acoustics. Kaleidoscope Pro allows for calls to quickly be sorted, labelled, and identified. This streamlines the identification process of the calls through the Auto-ID process. This is achieved through a clustering technology and utilizes a data inventory from hundreds of thousands of recordings that have previously been identified and reviewed by experts in the bat field (Wildlife Acoustics, 2022). While this tool is valuable, the automated identification software

is not 100% accurate, thus manual verification is necessary to avoid false positives for species counts. Some bats produce highly distinguishable calls, making them easier to positively identify, while others do not (Andrusiak *et al.* 2021). In general, automated identification programs are unable to account for any deviations to call structures due to different behaviours that may be exhibited by bats, including approach and social calls, cluttered environments, or recordings that contain multiple individual bats calling (Bachen *et al.* 2018). The process of hand review for bat calls through automated species identification is known as "manual vetting".

The software batch processes all files with the auto-ID software, applying one single species identification label per file, groups together noise files, and groups files containing calls not completely readable under a "NoID" label. When using the software, settings are programmed to suit the region of North America, specifically the Alberta region. This helps to reduce the number of species that may have overlap of calls, which would only further lead to error due to false species identification. Once the recordings have undergone the automated identification, call recordings need to be slowed to 1/10th of the speed in order for them to be audible to the human ear. Settings may also be used to adjust the viewing of the spectrogram in order to assess specific characteristics of the calls in more detail.

All recording files not identified as noise were manually examined, including those that received the label of "NoID". NoID labels are assigned to files where species-specific labels cannot be assigned. This is due to the software not being capable of deciding on a single species label, often due to high quality echolocation pulses of two or more species recorded in the file (Andrusiak *et al*. 2021). Therefore, a suggested species will be provided, and the files can be flagged for further analysis to assign the appropriate labels.

3.4. Submission to Alberta eBat

All the sites that yielded high quality recordings were submitted to the Alberta eBat program, which is part of the larger organization of the North American Bat Monitoring Program. Once all the recordings at a site had undergone manual vetting, the call files were submitted together, along with the manual identification file as a supplemental document. For each site, information including the organization name (MWRCC), site name (landowner last name), GPS coordinates, date of equipment deployment and pickup, as well as additional notes regarding location and habitat characteristics were included.

3.5. Guano Collection and Pd Fungus Swabbing

On November 20, 2022, sampling at three properties within the watershed that had previously confirmed presence of bat roosts in the summer was conducted (Figures 5 & 6). At each location, a vial of guano and multiple swabs of roosting surfaces were collected. Swabbing the inside of bat houses or roosts is a useful tool for detecting white-nose syndrome, as this can pick up traces of the DNA of Pd fungus. Guano collection can also be used as a tool to detect the fungus, however the older the guano is, the less reliable the results will be. Thus, the critical sampling time for Pd fungus is in the spring when bats are emerging from hibernation and returning from their migration. At this time, fresh guano can be collected, and the fungus will be most fresh on roosting surfaces, providing the most accurate samples for detection. All three of the samples yielded negative results for the Pd fungus. Future sampling will be conducted at these sites in the spring of 2023.

` Figures 5 & 6. Cory Olson of the Alberta Community Bat Program collecting swabs and guano samples in the MRWCC bat houses installed on landowner properties.

4. RESULTS

4.1. Recording Distribution

There were 40 landowner properties that were surveyed from April through September 2022. Sampling locations were selected based on landowner availability, habitats present on the properties, and proximity to other sampling locations. The goal of the acoustic monitoring was to achieve a watershed wide bat call inventory; thus, an even distribution of locations was required. A majority of the sampling sites were condensed within the middle of the watershed boundary, which was expected since there is a higher number of people living in these areas (Figure 7). The farther west and east regions of the watershed had a lower rate of interested landowners, partly because there are less individuals living in these more remote areas, but also because communication and outreach to these landowners was much more difficult. There was also a two-week period in which the equipment stopped recording due to software errors, thus one property located at (49.161032, -111.663761) yielded insufficient results while the equipment was deployed there.

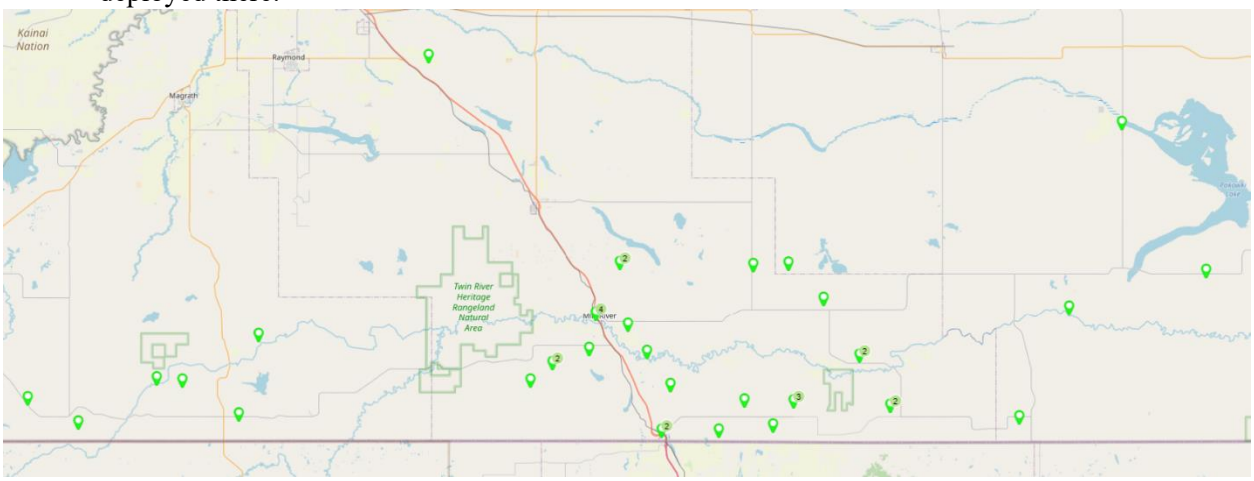

Figure 7. Acoustic monitoring locations for 2022.

4.2. Species Groups and Presence/Absence

The goal of collecting stationary point acoustic data is to determine site occupancy for each species through the examination and manual identification of high-quality bat call recordings (Reichert *et al*. 2018). There was a total of 13,945 bat call sequences recorded during the passive acoustic surveys, exclusive of all noise files. The majority of recordings were from the calls of bat species in the Myotis 40k group, with 6,822 call sequences identified, making up 49% of the recordings (Table 3). This was then followed by 3,441 or 25% of 20k.

Table 3. Summary of bat call recordings for species groups throughout the summer 2022 field season.

Species Groups	Total Number of Recordings
LABO/MYLU	2,447
Myotis 40k	6,822
Myotis spp.	336
20k	3,441
NoID	899
Noise	10,761
Total (not inclusive of noise files)	13,945

One maternity roost was identified in a wooden barn located at (49.015817, -111.296877) from the significant build up of guano along the walls and rafters of the structure. (Figure 8). The bats using this area are likely to be the Little Brown Myotis or the Big Brown Bat, since those species are known to roost in man-made structures. This can be backed by the most commonly recorded species group on the property belonging to the Myotis 40k group, with 122 recordings (61.93% of total calls) over three nights. Further investigation into species identification will be completed in 2023 through guano DNA analysis and potential manual capture.

Figure 8. Barn that was identified as a maternity roost within the watershed

4.3. Bat House and Condo Development

In total, 65 bat houses were distributed to landowners who participated in the project, as well as the Warner County and Erle River High School as part of the educational outreach portion of the project. These bat houses were to be installed by landowners at their own discretion, but each property was provided with recommendations for best practices regarding bat houses. Most often they were installed on the south or east facing walls of buildings (Figure 9). Most often these properties were owned by ranchers or farmers, but occasionally there were landowners within the town centres that wanted to improve bat habitat surrounding their homes, thus bat houses were also provided to these individuals (Figure 10).

Figure 9. (Left) Bat condo installed on an east-facing wall of a barn known to have bats roosting inside.
Figure 10. (Right) Landowner with one of the bat houses to be installed on their property after the removal of a large tree that was likely used by roosting bats.

Follow-up visits to all the landowner properties was not feasible due to the short sampling period throughout the summer, thus occupancy of each bat house was not assessed. However, two landowners, one located in the western portion of the watershed, in Del Bonita, and another located directly east of Writing-On-Stone Provincial Park, showed some occupancy by bats throughout the summer. In fact, the property located near the provincial park showed occupancy in both bat houses, with approximately 10 individuals in July. This is of particular interest as this structure had previously been equipped with a black, single chambered bat house prior to the addition of the two multi-chambered houses in 2022, yet there had never been occupancy previously in the original bat house. This may demonstrate the preference bats have towards the multi-chambered, lighter coloured bat houses within this region due to the variable temperature gradient. Upon revisiting a few more bat houses installed through this project in the early spring of 2023, it was evident that there had previously been occupancy on two more properties located in the eastern regions of the watershed, as made evident from the presence of guano in the houses.

The bat condo was installed on April 27, 2023. (Figures 11 & 12). The installment of the condo was delayed due to an early snowfall in the fall of 2022, thus the ground needed to be thawed in the spring prior to the installation of the structure. The location selected is at the day use area for the Weir Bridge along the Milk River (49.104114, -111.701453). This location was selected due to its proximity to the river, which provides bats with a reliable water source, nearby vegetated area which will present the opportunity for insect foraging, and education opportunities

for recreational river users (Figure 13). Two signs were also installed along with the condo to provide information on Alberta's bat species, their threats, conservation efforts, and the purpose of the condo, with an additional notice to the public to not disturb the bats or structure. The condo was installed with the approval of Warner County and assistance from county employees and board member volunteers.

Figures 11 & 12. Installation of the bat condo at the Weir Bridge day use area.

Figure 13. View from across the bridge, overlooking the day use area where the bat condo was installed. This area was selected due to the location on the river and surrounding vegetation.

4.4. Outreach Events

Throughout this project, ongoing educational outreach was emphasized to spread awareness of the project and gain landowner interest for participation in monitoring, but also as a tool to share information regarding the threats to bats, their threats, and what can be done to mitigate species losses. While a majority of outreach was completed through social media posts on Facebook and email communications with the MRWCC community mailing list, several presentations were conducted at events and forums in 2022 and 2023. Events included a guest presentation and bat house building workshop with the Waterton Lakes Biosphere Reserve, evening bat talk and walk at Writing-On-Stone Provincial Park, and presentations at the Milk River Watershed Council Annual General Meeting, Family Range Days Series, Milk River Science Forum, Prairie Conservation for Endangered Species Conference, Erle Rivers High School, and the Chinook Outdoors Club (Figures 14 & 15). Further outreach was also completed through interviews with local news outlets such as the Western Producer and article submissions to print news media such as the MRWCC Meander Newsletter and county newsletters from the County of Forty Mile, Warner County, and Cypress Hills.

Figures 14 & 15. Bat presentation and bat house building workshop with the Waterton Lakes Biosphere Reserve. Photo Credits: Waterton Biosphere Reserve Association.

5. DISCUSSION

While the recordings were not identified down to individual species, several inferences can be made regarding the identification of species groups. *Myotis lucifugus* was amongst the most commonly identified bat species by the automated identification software. Upon manual vetting, the species groups most often identified were the Myotis 40k group, with a good proportion also labelled as LABO/MYLU; both of these groups include the little brown myotis. For this reason, it can be assumed that a large number of the recordings belong to this species. This would also correlate with the habitat types that were used for equipment deployment. As a large proportion of the site surveyed belonged to local producers and ranchers, these sites often had an older barn structure nearby. The little brown myotis, along with the big brown bat, are the two most common species to be found roosting in man-made structures, which would account for the high proportion of calls being made from species groups containing these species.

While bat houses can be useful tools for habitat enhancements and education, it should be noted that there is not any current evidence showing that they provide the same high-quality roosting conditions that a natural roost or building can provide. In fact some bat houses have shown to have negative effects as they're prone to overheating and extreme temperature fluctuations (Alberta Community Bat Program, 2019). Also, the Little Brown Myotis and the Big

Brown Bat are the only species historically among Alberta's bats to use bat houses, thus it's not an all encompassing conservation measure. Thus these houses may be a beneficial addition to conservation, more emphasis should be placed on maintaining intact bat habitats and identifying where bats may be roosting and hibernating within Alberta.

When submitting the recording files to the Alberta eBat project, it was evident that there was a clear data deficiency regarding the surveying of private lands within southern Alberta. Prior to the 2022 submissions by the MRWCC, there were no sites located in south-central Alberta on the eBat map (Figure 16). Only areas of the Milk River Natural Area in the east and Waterton National park and surrounding areas in south western Alberta had been submitted. Therefore, the acoustic surveying conducted in 2022 by the MRWCC helped to fill this significant data deficient area. However, there are still some regions at the eastern and western-most regions of the watershed within Alberta that are relatively sparsely monitored on Alberta eBat. It would be beneficial to place emphasis on developing relationships with landowners in these areas that are less monitored to gain a better understanding of population dynamics within these regions.

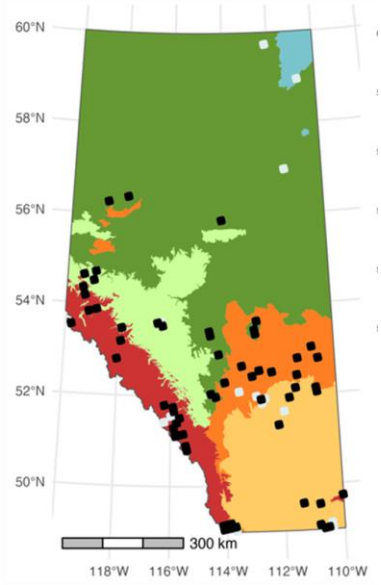

Figure 16. Alberta eBat passive surveying locations for 2021 (Burgar, 2021).

The findings from this research project are applicable in species presence/absence within the Milk River watershed, as the acoustic monitoring can only provide this level of data. This project did not employ random sampling methods or standardized plots to ensure even distance between sampling sites since the project relied solely on voluntary landowner participation. For this reason, spatial distribution of bat species groups cannot be accurately calculated.

6. RECOMMENDATIONS

6.1. Challenges

As this was the first year this project was being undertaken, there were various challenges that occurred throughout the planning and execution of the research. To start, the nature of the research goal to identify specific species and their abundance was not feasible with the resources available. While acoustic monitoring is a useful technique in determining presence of bats, the ability to accurately identify individual bats to species level is extremely difficult and takes years of training and experience. In order for species to be accurately identified, guano sampling and analysis in a lab or manual capture through mist netting is typically necessary. Additionally,

standardized protocols for acoustic monitoring are lacking, which leads to inconsistencies for data collection. Ultimately, acoustic monitoring as a whole requires further guidance on detector settings, protocols for proper deployment and spatial distribution, and standardization and education on analysis of acoustic data (Reichert *et al.* 2018). Furthermore, imperfect detection of calls is a notable challenge for all acoustic bat surveys, regardless of the equipment used and experience of the surveyor (Rodhouse *et al*. 2011).

Since echolocation calls can vary widely, this makes it very difficult to often identify which species are making calls (Fraser *et al*. 2020). Occasionally it was hard to differentiate between individual calls, especially in areas with high populations, as the calls from multiple individuals would often overlap. Additionally, approach phase calls are unreliable for identification, and these types of calls are used when bats are navigating through a cluttered environment or foraging. Oftentimes these calls are referred to as "feeding buzzes". The calls that are necessary for identification are known as "search phase calls", which are the calls used for general navigation in uncluttered areas. These calls will generally have consistent call characteristics, making them the most reliable for identification (Bachen *et al*. 2018). For this reason, the acoustic monitoring was challenging for a new research project due to lack of staff adequately trained in acoustics analysis.

There was also occasionally the issue of landowner participation, predominantly due to the uncertainty regarding conservation practices and regulations. In one case, a landowner decided to withdraw from the project due to a previous experience with a conservation group conducting surveys on their land for burrowing owls. Unfortunately, this experience ended negatively for the landowner, demonstrating their lasting negative views of surveying on their lands resulted in a lack of participation. This often was a topic of discussion with landowners, as several individuals expressed concern over similar experiences, however this was often overcome through a thorough discussion on the goals of the project and reassurance that this project would not result in the same implications. Additionally, communication with landowners in more remote communities and areas within the watershed, specifically the eastern-most regions, was lacking. Since outreach and soliciting for participation was conducted predominantly through social media and online newsletters, landowners without access to these resources were not reached. Further, when conducting educational outreach through community events and forums, individuals living in areas that are much farther from town centres were likely not attending these events and ultimately not learning about the opportunities to participate in the project.

As a one-person team, it was difficult to meet all the needs of the project to specifically identify where Little Brown Myotis colonies are roosting and in what numbers. For this reason, a rework of the project goals and expectations was required to investigate bat species groups within the watershed and still provide meaningful resources for conservation to private landowners.

6.2. Future Research and Next Steps

Given that the little brown myotis is known to commonly roost in man-made structures such as barns and abandoned buildings, there is an opportunity to improve knowledge on conservation of human-occupied landscape features as critical species at risk habitat. buildings provide critical habitat for the little brown myotis, especially for reproductive females, and maintenance of these structures will likely allow for larger populations. Therefore, this can be a priority for long-term conservation of the species in the face of the threat of white-nose syndrome (Johnson *et al.* 2019).

While the knowledge that can be gained from studying the bats within the Milk River Watershed has immense potential, changes with regards to monitoring methods need to be made. If acoustic monitoring is to continue, adequate acoustics training through certified courses will be

imperative to develop a greater capacity to identify calls to a more specific species level. However, since bat detectors cannot discriminate individuals by sex, age, and oftentimes specific species, the applicability of bat detectors for in depth research of bats can be quite limited. The downfall to stationary acoustic monitoring surveys is that there are problems associated with species identification and lack of ability to enumerate population size (Hayes, 2000). For some species, such as the Long-legged Myotis, their acoustic signature overlaps with several other Myotis species, making their calls difficult to distinguish. For this reason, additional methods such as manual capture or DNA analysis through guano is often necessary for species-level identification (Andrusiak *et al*. 2021). There are two properties that have unique characteristics and are located directly on the Milk River that are of particular interest for mist netting surveys for 2023 in partnership with the Alberta Community Bat Program. Communication with landowners has commenced to coordinate these potential mist netting projects and are anticipated to be conducted in May and June of 2023.

Additionally, further sampling of known roosts and hibernacula will be critical to continue surveillance of the occurrence and spread of Pd fungus within the watershed. Sampling should be completed in the early months of spring, to ensure the highest quality for DNA analysis. Landowners may continue to participate in this project by collecting fresh guano samples and freezing these in sealed envelopes. Upon collection of the guano samples, swabs of the roost may also be collected to be sent to the laboratory.

7. CONCLUSION

There appears to be a healthy, watershed wide distribution of various bat species located on private lands. A vast majority of the properties that were surveyed using acoustic monitoring equipment yielded high numbers of calls likely to be that of the little brown myotis, which is listed as an endangered species provincially and federally. To further examine the distribution and population structures of bats across southern Alberta, continued monitoring needs to be conducted. Acoustic monitoring is an effective and low-cost method of determining species presence, but to confirm the identification of species, additional monitoring efforts should be employed. To supplement acoustic monitoring, mist netting or fecal DNA analysis should be used to improve the quality of the information collected during this research project.

8. REFERENCES

Alberta Bats. (2020, October 4). *The Bats of Alberta*. Alberta Community Bat Program. Retrieved August 18, 2022, from https://www.albertabats.ca/batprofiles/

Alberta Community Bat Program (2019, June 6). *Building Homes for Bats: Alberta Bat House Guidelines.* Alberta Community Bat Program.

Andrusiak, L., Holroyd, S., Kellner, M., Lausen, C. L., & Rae, J. (2021). 2016-2020 BC Bat Action Plan Updated for 2021.

Bachen, D. A., McEwan, A. L., Burkholder, B. O., Hilty, S. L., Blum, S. A., & Maxell, B. A. (2018). *Bats of Montana: Identification and Natural History*. Montana Natural Heritage Program.

Boyles, J. G., Cryan, P. M., McCracken, G. F., & Kunz, T. H. (2011). Economic importance of bats in agriculture. *Science*, *332*(6025), 41-42.

Brigham, R. M., Kalko, E. K. V., Jones, G., Parsons, S., & Limpens, H. J. G. A. (2004). Bat echolocation research: tools, techniques and analysis. *Bat Conservation International. Austin, Texas*.

Burgar, J.M. (2021). North American Bat Monitoring Program, Alberta 2020. Alberta Environment and Parks, Government of Alberta, Canada.

Cheng, T. L., Reichard, J. D., Coleman, J. T., Weller, T. J., Thogmartin, W. E., Reichert, B. E., ... & Frick, W. F. (2021). The scope and severity of white-nose syndrome on hibernating bats in North America. *Conservation Biology*, *35*(5), 1586-1597.

Environment Canada. 2015. Recovery Strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ix +110 pp.

Hayes, J. P. (2000). Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. *Acta Chiropterologica*, *2*(02).

Johnson, J. S., Treanor, J. J., Slusher, A. C., & Lacki, M. J. (2019). Buildings provide vital habitat for little brown myotis (Myotis lucifugus) in a high-elevation landscape. *Ecosphere*, *10*(11), e02925.

Jones, G., Jacobs, D. S., Kunz, T. H., Willig, M. R., & Racey, P. A. (2009). Carpe noctem: the importance of bats as bioindicators. *Endangered species research*, *8*(1-2), 93-115.

Loeb, S. C., Rodhouse, T. J., Ellison, L. E., Lausen, C. L., Reichard, J. D., Irvine, K. M., ... & Johnson, D. H. (2015). A plan for the North American bat monitoring program (NABat). *Gen. Tech. Rep. SRS 208. Asheville, NC: US Department of Agriculture Forest Service, Southern Research Station.*, *208*, 1-100.

Maucieri, D. G., & Barclay, R. M. R. (2021). Consumption of spiders by the little brown bat (Myotis lucifugus) and the long-eared myotis (Myotis evotis) in the Rocky Mountains of Alberta, Canada. *Canadian Journal of Zoology*, *99*(3), 221-226.

Olson, C. R., & Flach, T. L. (2016). BENEFICIAL MANAGEMENT PRACTICES FOR BATS.

Reichert, B., Lausen, C., Loeb, S., Weller, T., Allen, R., Britzke, E., ... & Verant, M. (2018). A guide to processing bat acoustic data for the North American Bat Monitoring Program (NABat). *USGS*, *2018*, 1-43.

Rodhouse, T. J., Vierling, K. T., & Irvine, K. M. (2011). A practical sampling design for acoustic surveys of bats. *The Journal of Wildlife Management*, *75*(5), 1094-1102.

Vonhof, M. (2006). Handbook of Inventory Methods and Standard Protocols for Surveying Bats in Alberta.

Wildlife Acoustics. (2022). *Song meter mini bat ultrasonic bat recorder*. Retrieved September 7, 2022, from https://www.wildlifeacoustics.com/products/song-meter-mini-bat

APPENDIX

Table 6. Percentage of calls made by species groups at each recording location in 2022.

	LABO/ MYLU	Myotis 40k	Myotis spp.	20k	NoID	Total Number of Recordings

Ford	0%	36.36%	0%	9.09%	54.55%	11
Pimm	1.58%	27.08%	3.95%	1.98%	65.42%	506
Lindeman	0%	20.83%	0%	66.67%	12.5%	24
Shamber	7.19%	40.25%	0.21%	40.25%	12.11%	487
Lodermeier	15.38%	38.46%	7.69%	7.69%	30.77%	13
Cunningham	8.73%	47.78%	16.67%	3.33%	23.49%	630
Joyce	23%	60.5%	1%	15.5%	0%	200
King	5.08%	61.93%	12.18%	11.17%	9.64%	197
D. Wills	12.08%	65.49%	7.61%	6.52%	8.15%	368
Finstad	12.23%	65.49%	7.61%	6.52%	8.15%	368
B. Wills	27.17%	66.14%	3.54%	13.15%	0%	254
Walker	23.08%	56.92%	0%	20%	0%	65
Russel	33.66%	63.35%	0%	0.99%	0%	101
Audet	9.18%	21.43%	8.16%	58.16%	3.06%	98
Obbagy	20.88%	50.55%	0.47%	0.78%	27.32%	637
Waldy	33.76%	36.31%	28.03%	0.64%	1.27%	157
Buchanan	16.97%	52.71%	0.36%	26.53%	3.43%	554
Bird	0%	0%	0%	100%	0%	3
Galts	43.1%	33.11%	0.82%	22.89%	0.07%	1341
McCulloch	18.2%	67.41%	2.06%	11.87%	0.47%	632
Cody	7.52%	90.39%	0.63%	0.97%	0.49%	2060
Stronski	42.07%	42.72%	0.97%	14.24%	0%	309
Ellertgarber	49.48%	10.10%	0.62%	39.79%	0%	489
Balog	19.48%	38.96%	0%	38.96%	2.6%	77
Bakke	10.3%	18.76%	1.1%	68.95%	0.88%	1359
Smith	6.78	22.90%	1.4%	68.93%	0%	856

Losey	6.99%	36.27%	1.5%	52.08%	3.16%	601
Sommerfeldt	5.56%	9.26%	0%	85.19%	0%	54
MacCallum	2.2%	0%	0%	96.7%	1.1%	91
Lee	21.57%	69.41%	0.33%	5.29%	3.4%	1530
Foggin	14.12%	8.24%	0%	76.47%	1.18%	85
Hillmer	9.09%	36.36%	0%	54.55%	0%	11