

The Effect of Outside Temperature on Habitat Selection for Bat Roosting Sites at Beaverhill Natural Area

May 2025 – September 2025

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Introduction:

Despite their poor reputation, bats are one of the most important animals globally. They are the primary predator to flying insects, many of which left unchecked prove to be disastrous on an ecological, economical and health front. A 30,000 strong *Myotis* colony can annually consume 50 tons of insects, including mosquitos (common vectors of human disease) and crop damaging insects (Ducummon, 2001). It's estimated bats save agricultural and forestry industries in North America a billion dollars annually from pest damage (Ducummon, 2001). As well by acting as natural pest control, they can act as a preventative for the use of harmful pesticides within the environment.

Within Alberta there are 9 species of bats, two of which are endangered (Alberta, 2025). There are multiple factors as to the current decline. A major issue within Alberta species is the emergence of White-nose syndrome (WNS), a fatal fungal disease, which is spreading in North America. While WNS is a major factor, for this study the main threats I'll be focusing on are habitat loss and climate change impact. It's estimated 98% of bat species are experiencing habitat loss in North America (Bat Conservation International, 2023). Cavity roosting species are particularly affected as they often roost within large trees (Crawford and O'Keefe, 2023) which through urbanization, agriculture and forestry have been reducing over the years. These tree cavities are essential for the bat's life cycle, acting as maternity roosts and hibernacula. These roosts are vital for predation and weather protection, energy conservation and to meet their social requirements (Kunz and Lumsden, 2025). It's estimated in the next 15 years 82% of North American bat species will be at risk of impact from climate change (Bat Conservation International, 2023). The main impacts would be from droughts, heat waves and unpredictable weather (Bat Conservation International, 2023). The effect of those events would alter the available food, reproduction and development of the bats, expenditure of energy to maintain body temperature and periods of torpor (Sherwin et al., 2012).

The Beaverhill Natural Area (BNA) is home to multiple species of bats, notably Little Brown Bats which make up most of the cavity roosting bats in the area (Uy, 2024). The natural area provides a wide range of environments from wetlands and lakes to Aspen-Balsam forest and grasslands. Within these many environments the Beaverhill Bird Observatory (BBO) installed the bat houses in 2016, within the BNA. Since then, they have been annually monitored over the summers.

The Little Brown Bats are one of the 2 endangered species within Alberta. They are cavity roosters and the most common ones seen within the BNA based on data from 2021-2024 (Uy, 2024., Lewicki, 2022., Mejia 2023., Waldron & Burke, 2021). Pregnant/nursing females tend to roost together, forming maternity roosts while males and nonpregnant females tend to

roost alone or in smaller groups (Saskatchewan Prairie Conservation, 2020). Pregnancy and lactation are high energy demands on the mother, so heat is vital to her success, as well as the development and vigor of the young (Saskatchewan Prairie Conservation, 2020). To increase heat the females will roost together, preferring larger houses to accommodate larger groups (Saskatchewan Prairie Conservation, 2020). They have also shown to prefer roosts near wetlands and open forests, areas abundant with prey, meaning they minimize energy expenditure by minimizing flight distances needed from roosts to hunting grounds (Balzer et al., 2022).

Roost selection is vital for a bat's survival. It provides a protected area from predators but also notably a site that is thermally stable. Temperature stability of roosts is vital for bats. In the presence of low temperature bats can enter a state of decrease metabolism called torpor (Wilcox & Willis, 2016). This torpor state helps them to survive harsh weather but can inhibit lactation and delay birth (Wilcox & Willis, 2016) which could affect the survival rate of pups. The roosts can also serve to protect bats from extreme heatwaves as they can offer shelter and prevent dehydration which appears to be the main threat associated with heat (Czene, Noakes & Wojciechowski, 2022). This dehydration may also affect pup survival as lactation in mammals is typically highly demanding on water (Czene, Noakes & Wojciechowski, 2022) and could be impacted by lack of it.

In this study I focused on the preference of Little Brown Bats (*Myotis lucifugus*) at house occupancy in different habitat locations, specifically preferences. Chamber preference within multi-chamber houses was also explored in this study. I hypothesize that there will be a preference for houses located in interior and edge habitats during high temperatures as these habitats would feature shielding from the sun via trees and foliage and in the case of edge habitat may be cooler from the proximity to a body of water. As for the chamber usage I hypothesize that the inner most chamber will be the most popular as their natural roosts is within the cavity of trees (Kunz and Lumsden, 2025) so the chamber closest to the trunk may most closely simulate a natural roost and would also be the most sheltered from the weather.

With the growing dangers from disease, habitat loss and climate change bat species are faced with a declining future (Bat Conservation International, 2023). The loss of suitable habitat for roosting has been attempted to be alleviated with the use of artificial houses as seen in the BNA. However there has been a trend of increasingly hot summers in Alberta (CCI, 2024) that could impact these bats' roosting habits. The implication of this study is to provide data into BBOs long term monitoring program for better understanding of bat roosting habits and populations as well as look to see if the increasing temperature of Albertan summers will impact roosting behaviour. The practical purpose is to be able to build houses that are the most effective for ensuring larger bat usage and overall bat pup survival in maternity roosts.

Methods:

Study Site:

All data was collected in the Beaverhill Natural Area (BNA), located in Beaver County (53.367, -112.541), roughly 8 km east of Tofield. The total area it covers is 1,013.1 acres, though all data collected came from about a 2 km loop on the Beaverhill Natural Area trails (Image 1). Thirty-eight bat houses were surveyed along this loop, their designs varied from single chamber to multi-chambered (2-4). The houses were attached mainly to balsam and aspen trees, with some being attached to human structures (posts/buildings), attached 5' to 18' (most around 10') off the ground. The houses were built, placed and maintained by the BBO. The houses were placed in one of four habitats: clearing, forest opening, interior forest and forest edge. These habitats are defined as; clearing is an opening that is surrounded by forest, interior is habitat that is heavily forested, edge is an area that is on the cusp of the forest and near a water source and lastly opening is an area that is primarily open field (image 1, 2).



Image 1: Map of the BNA that was surveyed. The pins represent the bat houses that were monitored along with their number. List of houses in Appendix. (Low, 2024)

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Image 2: Showcases the four types of habitats the bat houses can be found in. Clearing (a), interior (b), edge (c) and lastly open (d) (Low, 2024).

Data Collection:

Bats in boxes were surveyed weekly from May 2025 to September 2025. Collection was performed on an alternating schedule between the two data collectors, with a minimum of 4 days between each collection. Surveys were conducted in most weather aside from moderate or severe rain/wind and thunderstorms. All surveys occurred at least 45 minutes before sunset to ensure as many bats were still resting as possible. The bats were counted by shining a flashlight up into the house and doing a visual count of the bats. Some bat houses were difficult to get accurate counts due to plant growth blocking view or height. In multi-chamber houses, the chamber(s) the bats were in was also recorded, with 1 being the closest to the attachment (image 3).

Conditions for data collection were also recorded mostly on site aside from previous night/day weather conditions, and current day $T_{\max}$ which was collected using a mix of the Environment Canada site (recorded from their Shonts station) and the Apple weather app. The start and end temperatures were recorded from an onsite thermometer while cloud % was estimated visually. Wind was measured visually based on the Beaufort wind scale.



Image 3: Multi-chamber bat house with four chambers. The chambers are labeled 1-4 based on vicinity to the tree the house is attached to (image taken during 2025 survey).

Data Analysis:

For the analysis, weather was described using the recorded current day $T_{\max}$ that were recorded on the day of a count. The weather was then broken into “cold”, “normal” and “hot”. “Hot” was defined as if the temperature was 5°C or more above the historic average $T_{\max}$ for the day, while “normal” was as long as it fell less than 5°C above or below the historic average. The historic average was taken from the site Weather Spark (2025), which had historic averages for individual dates. Only one day qualified as “cold” being 5°C below and was omitted from temperature related analysis.

Results:

General Results of 2025 Occupancy:

In 2025 a total of 2726 bats were counted during 17 surveys, of which all were Little Brown Bats aside from 3 bats that were marked as potentially being Big Brown Bats. However, identifying them was difficult and not certain. The weeks with the largest total count of bats were June 29 and July 16th with 430 bats and the smallest total count was the week of September 12th with 3 bats (Figure 1).

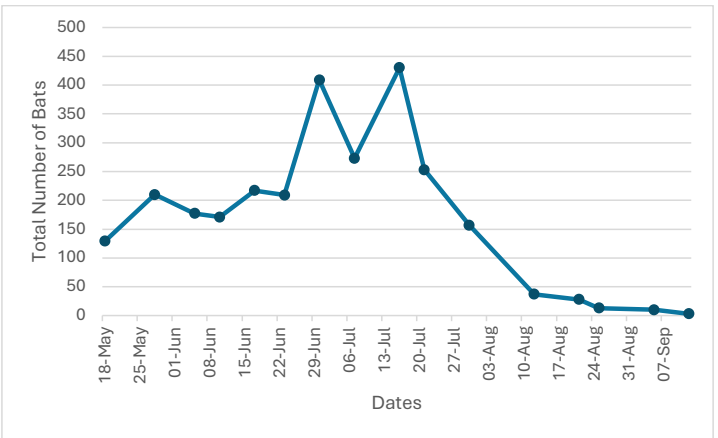


Figure 1: Total Number of Bats Counted in Houses from May - September 2025

Only one box had a final count of 0 bats for the entirety of the survey which was the single chamber box 10 located in the interior. The box with the highest total count was M45 a multi-chamber box in the forest edge, with 381 bats counted from May to September. In total multi-chamber boxes made up 83.9% of all bats counted (2228) while single chamber boxes made up the remaining 16.1% (438) (Figure 2). Of the single chambered boxes on average boxes located in the open had the most bats with 39 while edge had the lowest average of bats at 3.2 (Figure 3).

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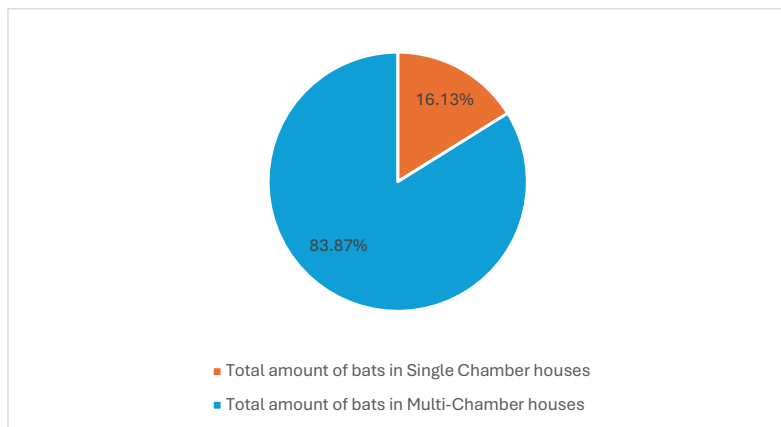


Figure 2: Single Chamber Bat House use was less compared to Multi-chamber Bat House use

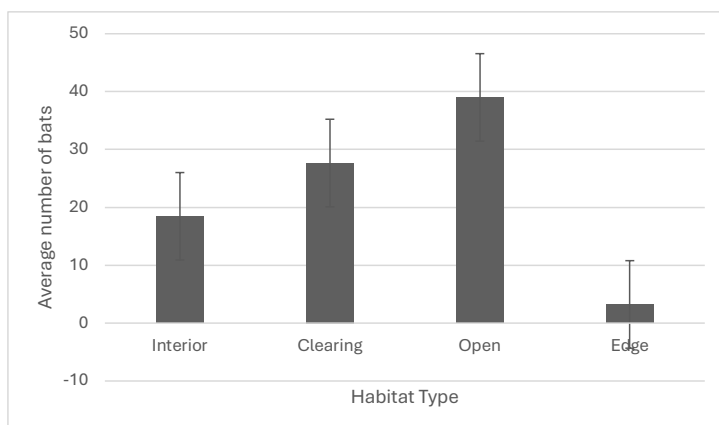


Figure 3: Average number of bats found in single chamber houses based on habitat types (Does not include data from June 23)

Four-year Occupancy Analysis:

In 2025 the highest count for a single week was 430 compared to 2024s highest count of 344 resulting in a 25% increase. 2021 was the lowest of the single weeks' peak counts with 227 bats, 2025 saw a 89% increase from 2021. 2025 also saw the largest cumulative count of 2726.

The cumulative count has been steadily increasing since 2021 (aside from 2023 which was a decrease). From 2021 to 2025 there has been an increase of 76.2% in cumulative count.

There are 17 houses that have had fewer than 20 bats for their cumulative count every year since 2022 to 2025. These 17 houses are 2, 9, 10, 18, 0, 21, 23, 25, 26, 27, 30, 32, 33, 35, 36, 37, 38, and 39. All are single chamber houses likely occupied by males or non-breeding females.

Table 1: Bat counts at Beaverhill Natural Area from 2021-2025 (excluding 2022). Completeness accounts for houses missed/skipped during surveys (e.g. total amount of box surveys possible for 2025 is 570 but 552 were actually surveyed equals 96.8% completeness)

	2021	2023	2024	2025
Highest Single Survey Count	227	364	344	430
Cumulative count	1547	1396	2233	2726
Houses	33	38	38	38
Surveys Conducted	15	13	14	15
Completeness	99	97.1	99.4	96.8
Dats of Sampling	May 16- Aug24	May 19-Sept 08	May 17 - Sept 04	May 18 - Sept 12

Weather and House Occupancy Analysis

Of the 16 surveys the temperature was considered hot on 8 days, cold on 2 days, and normal on 9 (figure 4). For analysis the 2 cold weather days data was not included nor was the 2 hot surveys from September as there was no normal weather data for that month and as seen in **Figure 1** September has a very low bat count that could affect the results. As well data from June 23rd was not included. There was no significant differences in house occupancy in any of the habitats in hot or normal weather (Edge: $t = -0.45$, $df = 8$, $p = 0.67$; Clearing: $t = 0.48$, $df = 9$, $p = 0.64$; Interior: $t = -0.31$, $df = 10$, $p = 0.76$; Open: $t = -0.11$, $df = 10$, $p = 0.91$).

Table 2: Dates of surveys categorized based on their current T_{max} category.

Hot	May 28, 2025	June 5, 2025	June 30, 2025	July 30, 2025	August 25, 2025	September 5, 2025	September 12, 2025	
Cold	July 21, 2025	June 23, 2025						
Normal	May 18, 2025	June 10, 2025	June 17, 2025	July 7, 2025	July 16, 2025	July 21, 2025	August 12, 2025	August 21, 2025

Chamber Section Preference Analysis

For the use of specific chambers, only four chambered houses were examined and data from May 18th to July 21st were used, which was the peak of multi-chamber use during the survey. **Figure 4** shows the different use between the chambers with most used being chamber 2 at 50 sightings and chamber 1 with the least at 38 sightings. There was no significant difference in which chamber was occupied ($F = 1.64$; $df = 2$; $p = 0.198$).

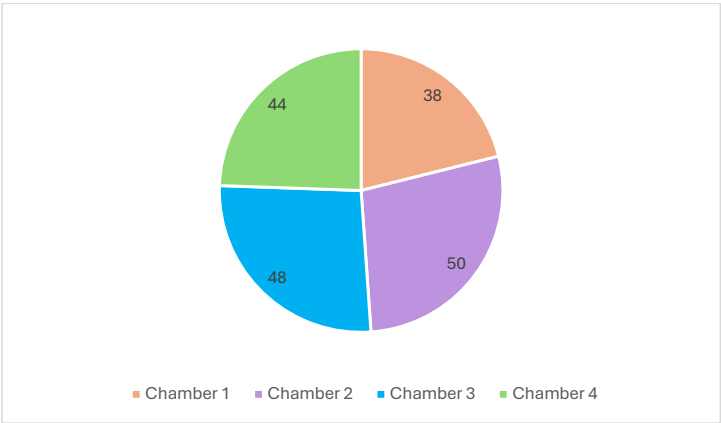


Figure 4: Pie chart of the total number of bats counted in each chamber of the four chamber houses between May 18 to July 21. Chamber 1 was closest to the post/tree and chamber 4 was the farthest.

Discussion:

2025 saw the highest cumulative and weekly bat counts compared to 2024, 2023 and 2021. The increase from 2021 is likely related in part to the addition of more houses. 2023, 2024 and 2025 all had the same number of houses at 38. The increase between these years may be related to 2025 having 1-2 more counts than other years. Potentially also environmental factors or last years pups returning to the site could attribute to this increase, however there isn't the data available to confirm. There was also a steep decline in bat counts that began in mid – late July, which has been recorded in past years' studies in the BNA (Uy, 2024). This decline is likely a result of the pups from the maternity roosts fledging as the fledgling season starts in late July and continues into August at which point the maternity roosts of bats are no longer need and pups and adults disperse (Saskatchewan Prairie Conservation, 2020). There is also a drop in late June – early July which then returns to the peak next week. This was also noted in 2024's report, though specific cause is not known (Uy, 2024).

In the past studies at BNA, multi-chamber houses have housed most of the bats counted (Uy, 2024). This pattern continued in 2025 with 83.9% of bats counted being from multi-chamber houses which aligns with the results from 2024 which had 81%. Of the 16.1% of bats in single chamber houses on average houses in the open habitat had the most at a mean of 39 bats, followed by clearing with 28, interior at 18 and edge being 3. These results were a bit surprising as other studies suggest bats tend to roost close to water for easy access to food which edge would be the most fitting of that description (Balzer et al., 2022). While these results may be somewhat biased based on the different amount of houses each habitat type has, but as seen in appendix 3, most of the habitats have total house counts in the 20-50 range, except for edge which is much lower which suggest the different number of houses is not heavily impacting the results. As well many of the houses within the edge were covered with cobwebs and had hornets/wasps living in them that could be affecting the bats' use of the houses. I also looked to see if there was any preference in which chamber the bats tended to be in or not in, however there was no statistical significance.

The hypothesis that there would be a preference for interior and edge chambers under "hot" conditions was not supported by the results. The relationships between habitat preference and high temperature were not significant. Based on other studies, *Myotis* prefer to roost in houses that are within their thermoneutral zone which in other studies is set as 32°C (lower critical temperature) (Wilcox & Willis, 2016). Since we could not record internal house temperature it is possible that despite the temperatures being above the average temperature for the area and date the house's temperature may not have exceeded the bats natural thermoneutral zone. Likewise, the hypothesis that the closest chamber to the tree trunk would show preferences was also not supported by the results as there was no significant preference for any of the 4 chambers.

Limitations:

This study was limited by the data collected around temperature. Because most of the survey days were “hot” and only one was “cold” affected what could be looked at within the study. Originally, I wanted to compare hot vs cold however with only one cold data point I was unable to adequately compare them.

Other limitations included the difference in number and types of houses between habitats. Some habitats had upwards of 19 houses, many of which were multi-chamber houses such as edge while others like open had only 2 single chamber houses. This makes comparing difference between habitats difficult and likely to have bias.

Recommendations for Future Studies:

For future studies in the BNA around temperature improvements could be applied by actively picking days to sample based on temperature. Because this study saw the temperature was more often to be around normal or hot, to get cold data it may be necessary to intentionally select days predicted to have colder weather (still following a minimum of 4 days between sampling and sampling weekly). In addition, surveys could be conducted in the morning when air temperatures are lowest. The bats have the ability to move between chambers though internal holes in the chamber walls. BBO could also mitigate some of the limitations by adding more houses to the open and clearing habitats as to make comparisons between habitats less biased. Another suggestion is to have thermometers in the compartments to measure the actual internal temperatures to determine how variable they are.

Conclusion:

This study found that above average temperature did not significantly impact the preference for habitat type for house selection by roosting bats. Likewise, this study also found no significant preference between chambers of a multi-chamber house for roosting bats.

Data collected for this study in 2025 supports the findings of past years (2021-2024) of multi-chambered houses being where the majority of Little Brown Bats were roosting. As well supports past years (2021-2024) patterns of rise and fall in the number of bats in roosts.

It is important the long-term study of bats in the BNA continues to allow for a clearer understanding of the colony growth and preferences in the area. The continued increase in bats

suggests that the introduction of houses through this long-term study is potentially having a positive impact on the population. This study is also well positioned to document any population level impacts WNS which has been confirmed in Alberta.

Acknowledgments:

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Lastly, I want to thank all my friends and family that willingly came out with me day and night to count bats.

References:

- Alberta. 2025. Human-wildlife conflict – Bats. <https://www.alberta.ca/bats>.
- Balzer EW, McBurney TS, Broders HG. 2022. Little brown Myotis roosts are spatially associated with foraging resources on Prince Edward Island. Wildlife Society Bulletin. 47(1). doi: <https://doi.org/10.1002/wsb.1405>.
- Bat Conservation International. 2023. 2023 State of the Bats Report. Bat Conservation. <https://digital.batcon.org/state-of-the-bats-report/2023-report/>.
- Canadian Climate Institute. 2024 Jul 23. FACT SHEET: Climate change and heat waves. Canadian Climate Institute. <https://climateinstitute.ca/news/fact-sheet-heat-waves/>.
- Crawford RD, and O'Keefe JM. 2023. Improving the science and practice of using artificial roosts for bats. Conservation Biology. doi: <https://doi.org/10.1111/cobi.14170>.
- Czenze ZJ, Noakes MJ, Wojciechowski MS. 2022. Home is where the heat is: Thermoregulation of European bats inhabiting artificial roosts and the threat of heat waves. Journal of Applied Ecology. 59(8):2179–2188. Doi: <https://doi.org/10.1111/1365-2664.14230>.

- Ducummon SL. 2001. ECOLOGICAL AND ECONOMIC IMPORTANCE OF BATS.
<https://www.cbd.int/financial/values/g-ecobats.pdf>.
- Kunz HT, and Lumsden FL. Bat Ecology. 2025. Google Books. [accessed 2025 May].
<https://books.google.ca/books?hl=en&lr=&id=3JsLGJIPZH0C&oi=fnd&pg=PA3&dq=habitat+loss+on+cavity+roost+bats&ots=m3f3sZ6wgF&sig=r3h7F4ZmJOsAvt1i4c8t78IT6So#v=onepage&q=habitat%20loss%20on%20cavity%20roost%20bats&f=false>.
- Lewicki HM. 2022. Impact of Weather Conditions and Proximity to Water on Bat House Occupancy in the Beaverhill Natural Area. Beaverhill Bird Observatory.
<https://www.beaverhillbirds.com/media/2302/impact-of-weather-conditions-and-proximity-to-water-on-bat-house-occupancy-in-the-beaverhill-natural-area.pdf>.
- Low E, & BBO staff and board directors. 2024. Internship information packet, Beaverhill Bird Observatory. BBO.
- Mejia M. 2023. Historical bat house occupancy of *Myotis lucifugus* in the Beaverhill Bird Observatory, Alberta: Implications of bat house design in relation to sun exposure. Beaverhill Bird Observatory. <https://www.beaverhillbirds.com/publications/student-interns/>.
- Saskatchewan Prairie Conservation Action Plan. 2020. Guide to Managing for Optimal Habitat Attributes: Little Brown Bat (*Myotis lucifugus*). https://www.pcap-sk.org/rsu_docs/documents/little-brown-bat-habitat-guide-final-draft.pdf.
- Sherwin HA, Montgomery WI, Lundy MG. 2012. The impact and implications of climate change for bats. *Mammal Review*. 43(3):171–182. doi: <https://doi.org/10.1111/j.1365-2907.2012.00214.x>.
- Uy F. 2024. Status of bat box occupancy at the Beaverhill Natural Area and temporal variations in relation to roost characteristics and weather conditions. Beaver Hill Bird Observatory. <https://www.beaverhillbirds.com/media/2532/bat-monitoring-14-house-occupancy.pdf>.
- Waldron C & Burke K. 2021. Occupancy of *Myotis lucifugus* among various bat house designs and habitats in the Beaverhill Natural Area. Beaverhill Bird Observatory.
<https://www.beaverhillbirds.com/media/2214/2021-occupancy-research-report-final-formatted.pdf>.
- Weather Spark. 2025. Tofield Climate, Weather By Month, Average Temperature (Alberta, Canada). <https://weatherspark.com/y/2565/Average-Weather-in-Tofield-Alberta-Canada-Year-Round>.
- Wilcox A, Willis CKR. 2016. Energetic benefits of enhanced summer roosting habitat for little brown bats (*Myotis lucifugus*) recovering from white-nose syndrome. *Conservation Physiology*. 4(1). Doi: <https://doi.org/10.1093/conphys/cov070>.

Appendix:

Bat House ID	Site	N chambers	Attachment	Colour	Inside Painted?	Habitat Type	Direction	Sunlight exposure	Height off ground	Distance to tree / obstacle	Nearest bat house (m)	Distance to well (m)
2**	medium	1	tree (balsam)	green	no	interior	southeast	partial sun (only morning or afternoon sun)	10'	2'	67	890
3**	medium	1	tree (balsam)	green	no	interior	east	mostly shade (minor sun)	8.5'	3'	60	740
6**	medium	1	tree (aspens)	green	no	interior	west	mostly sunny (minor shade)	5'	5'	54	695
7**	medium	1	tree (aspens)	green	no	interior	southwest	mostly shade (minor sun)	8'	3'	54	700
9	small	1	tree (aspens)	red	yes	interior	south	partial sun (only morning or afternoon sun)	9.5'	5'	31	675
10	small	1	tree (aspens)	red	yes	interior	south	partial sun (only morning or afternoon sun)	8'	5'	22	654
11*	large	1	tree (aspens)	brown	no	clearing	south	mostly sunny (minor shade)	8'	10'	1	840
12	large	1	post	brown	no	open	southwest	full sun (no shade)	10'	20'+	151	835
13	large	1	post	brown	no	open	southwest	full sun (no shade)	10'	20'+	165	980
14*	large	1	post	brown	no	clearing	southeast	mostly sunny (minor shade)	10'	28'	50	720
15	large	1	tree (balsam)	brown	no	interior	southwest	partial sun (only morning or afternoon sun)	9'	4'	65	775
16	large	1	tree (balsam)	brown	no	interior	southeast	partial sun (only morning or afternoon sun)	8'	4'	45	890
18	small	1	tree (aspens)	red	yes	edge	south	partial sun (only morning or afternoon sun)	9' plus 1' to bush	5'	30	550
20	small	1	tree (aspens)	red	yes	edge	southwest	partial sun (only morning or afternoon sun)	8' plus 1' bush	2'	30	355
21	small	1	tree (aspens)	red	yes	edge	south	partial sun (only morning or afternoon sun)	10'	3'	25	350
23	small	1	tree (aspens)	red	yes	edge	south	partial sun (only morning or afternoon sun)	9' plus 3' bush	5'	25	340
25	small	1	tree (aspens)	red	yes	edge	southwest	partial sun (only morning or afternoon sun)	3' to protruding branches	1.5'	25	330
26	small	1	tree (aspens)	red	yes	edge	south	mostly shade (minor sun)	9'	3'	4	340
27	small	1	tree (aspens)	red	yes	edge	southeast	partial sun (only morning or afternoon sun)	10'	3'	4	350
30	small	1	tree (aspens)	red	yes	edge	southeast	mostly shade (minor sun)	9' plus 1' bush	3'	25	475
32	small	1	tree (aspens)	red	no	edge	southeast	partial sun (only morning or afternoon sun)	10.5'	3.5'	24	550
33	small	1	tree (aspens)	red	lightly painted	edge	southeast	partial sun (only morning or afternoon sun)	9'	6'	24	575
35	small	1	tree (aspens)	red	yes	edge	south	partial sun (only morning or afternoon sun)	10'	2'	20	700
36***	small	1	tree (aspens)	red	no	edge	southeast	mostly shade (minor sun)	10'	6'	15	730
37***	small	1	tree (aspens)	red	yes	edge	southeast	partial sun (only morning or afternoon sun)	8.5' plus 2' vegetation	1'	15	735
38	small	1	tree (balsam)	red	lightly painted	interior	east	mostly shade (minor sun)	8.5'	2'	66	735
39*	small	1	tree (aspens)	red	lightly painted	clearing	south	mostly sunny (minor shade)	10'	3'	1	845
M08	large	4	tree (aspens)	brown	no	interior	southwest	mostly shade (minor sun)	8'	6'	65	MISSING
M17****	large	4	tree (aspens)	brown	no	interior	southwest	partial sun (only morning or afternoon sun)	9'	10'D	22	MISSING
M19	small	4	tree (aspens)	brown	no	edge	southwest	partial sun (only morning or afternoon sun)	10'	2'	32	MISSING
M22	large	4	tree (aspens)	brown	no	edge	south	partial sun (only morning or afternoon sun)	10'	4'	22	MISSING
M24	large	4	tree (aspens)	red	no	edge	west	partial sun (only morning or afternoon sun)	9'	41'	24	MISSING
M41****	Large	4	tree (aspens)	brown	no	clearing	south	mostly sunny (minor shade)	10'	20'	12	860
M42****	Large	4	tree (aspens)	camo blue	no	interior	south	partial sun (only morning or afternoon sun)	13'	5'	8	710
M43	Large	3	tree (aspens)	blue	no	interior	South	partial sun (only morning or afternoon sun)	14.5'	5'	8	745
M44	Large	3	tree (aspens)	blue	no	edge	South	partial sun (only morning or afternoon sun)	14.5'	4.5'	14	680
M45	Large	3	tree (aspens)	blue	no	edge	South	partial sun (only morning or afternoon sun)	18'	5'	29	590
M46	Large	2	tree (aspens)	blue	no	edge	southeast	mostly shade (minor sun)	13'	4'	26	480

Appendix 1: Metadata of the bat boxes that were surveyed for this study (Low, 2024).



Appendix 2: Images of the variety of sizes of bat housing types at BBO, (ai) and (aia) are large boxes (single and four-chamber respectively). (b) is a medium single chamber box and lastly (c) is a small chamber box. What is not pictured is two-chambered and three-chambered boxes that are also on site (Low, 2024).

Appendix 3: Table of the total amount of bats counted for each single chamber house sorted by habitat type

Interior House	Total Number of Bats
2	13
3	20
6	53
7	26
9	7
10	0
15	48
16	39
38	18
Clearing Houses	
11	32
14	55
39	1
Open Houses	
12	40
13	41
Edge	
18	2
20	2
21	2
23	5
25	4
26	3
27	2
30	6
32	6
33	8
35	2
36	2
37	1