Engaging Pest Control Operators for Improving Resilience of Bat Species-at-Risk Populations Facing the Threat of White-Nose Syndrome

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Table of Contents

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Executive Summary

Pest Control Operators (PCOs) are on the front lines of bat management when dealing with bats in buildings. Practices by this group can have significant impacts (either positive or negative) on local bat populations. The two bat species that commonly occupy buildings in Alberta and Saskatchewan include the Big Brown Bat (*Eptesicus fuscus*) and the federally endangered Little Brown Myotis (*Myotis lucifugus*). Conservation groups advocate for bat-friendly management of bats in buildings, but it is unknown how PCOs manage, perceive, and communicate with clients about bats. We conducted a two-part survey aimed at pest control companies in Alberta and Saskatchewan. The objective of the initial, brief phone survey was to make contact and encourage PCOs to fill out a second, more in-depth survey focused on the current practices PCOs use with bats. We had 101 unique respondents to the telephone survey which represents a response rate of 59% (101/170) but these respondents represented 75% of the franchises that we aimed to sample (129/170). 57 of the 101 unique respondents reported that they work with bats to some degree, but most bat colonies, especially larger ones, appear to be managed by a small subset of 5-6 of these operators. Of the 57 companies surveyed that work with bats, we received 28 unique and completed in-depth survey forms. That is a response rate of 49% which is above average for this kind of survey (generally, average survey response rates are about 33% and telephone surveys are typically only 18%, Lindemann 2019).

Evidence from the survey indicates that many of the current practices employed by PCOs in Alberta and Saskatchewan are not bat-friendly, including the practice of conducting exclusions during the pup rearing season, and a small number of PCOs appear to be using inhumane methods. However, PCOs appear to be open to learning and adopting bat-friendly strategies. Pre-exposure rabies vaccination uptake by PCOs appears to be below the level we would expect for a group that handles or works with bats (even if irregularly). PCOs report that it would be easier to be more bat-friendly if there were government policies in place that oblige homeowners to wait to conduct exclusions in a bat-friendly timing window. Bat-friendly exclusion practices also reduce the need for PCOs to directly handle bats, thereby increasing safety for both PCOs and bats. Suggested action items from this study include providing training for PCOs and the public, funding promotion of these materials, and enacting effective policies to protect bat maternity colonies and support bat-friendly practices.

1.0 INTRODUCTION

The objective of this project is to gather information on practices used by the pest control industry in Alberta and Saskatchewan as they relate to bats, and to improve communications and awareness among pest control operators (PCOs) to improve management and conservation of building-roosting bats. An important goal of engaging PCOs is to improve management practices that will lead to higher survival and reproductive success of bats, such as by avoiding evictions, accidental entrapment, and acts that lead to the injury or death of bats. Information gathered in this survey, and accompanying information resources, will aid in the delivery of outreach products to PCOs (nuisance wildlife control organizations), which is a high priority action item listed under Table 5 of the 2018 federal Recovery Strategy for Little Brown Myotis, Northern Myotis and Tri-colored Bat (Environment Canada 2015).

PCOs hired to manage bat colonies in buildings are almost always going to encounter either Little Brown Myotis (*Myotis lucifugus*) or Big Brown Bats (*Eptesicus fuscus*). Work in Alberta has shown that most reports of building roosting bats are of Little Brown Myotis, which is a species listed as endangered under the Species at Risk Act (about 85% of all reports; Alberta Community Bat Program, WCS Canada, unpublished data). Most groups of bats encountered in buildings are maternity colonies, exclusively consisting of females and their pups. Exclusions of bats from buildings undertaken during the breeding season can have significant negative effects on the success of reproduction and, potentially, the survival of breeding females (Brigham and Fenton 1986, Neilson and Fenton 1994, Brittingham and Williams 2000). Exclusion involves the blocking of the entry and exit points of a roost, while bats are not present, to prevent future use of the building. Eviction involves forced removal (e.g., using one-way exits or capture) during periods when bats are present and blocking re-entry, and should only be used for bat management outside of the period when pups are present. Unlike most small mammals, bats reproduce slowly, and high mortality rates cannot be sustained. Deliberate extermination or improperly timed exclusions have potential to cause substantial harm to local bat populations. Bat conservation programs run by WCS Canada and others promote bat-friendly management of building colonies that considers both human health and good bat conservation practices (ACBP 2019). Conserving bat colonies and avoiding unnecessary harm is important for building resiliency to other threats bats are facing, such as white-nose syndrome (WNS), a disease killing North American bats caused by a fungus introduced to North American by people in 2006 (WNS 2021, Dobony et al. 2018).

Background information pertinent to understanding survey methodology and the management of bat colonies by Pest Control Operators can be found in Appendix 1.

1.1. The Project Plan

Table 1. Tasks to complete.

Tasks:	Complete?
1. Develop a survey of Pest Control Operators (PCOs) for Alberta and Saskatchewan.	✓
2. Conduct the survey using phone contact and online form assessment tool.	✓
3. Summarize the survey results and produce a report.	✓
4. Create a Brochure of Best Practices for PCOs in both Alberta and Saskatchewan.	✓
5. Create a recorded and narrated presentation on the best practices for bats in buildings.	✓

6. Create a database of the PCOs with basic survey information (identification, interest in further education on bats, and interest in certification to work with bats); identify factors preventing PCOs from successfully being "bat-friendly".	✓

2.0 SURVEY METHODS

A list of all pest control and wildlife control operators in Alberta and Saskatchewan was compiled from a search of online resources (including the yellow pages and Facebook) and from a Google search. Contact data were compiled in a spreadsheet. Based on the company name and information provided on their website, priority calling was given to sites that mentioned bats or wildlife in their advertising. Second priority was given to companies with names that implied that they might work with bats or wildlife. The lowest priority was given to companies that appeared to be focused on bedbug control.

The survey was divided into three tasks.

1. The phone survey (brief).
2. The in-depth survey (long form to be completed by the respondent online).
3. The bat quiz (a short form also completed by the respondent online).

A phone survey form was completed for all respondents contacted. This was a short survey to obtain essential information. Do you work with bats? Will you do the survey? We also asked about professional memberships and how much of their business entailed working with bats, but this was also asked on the in-depth survey.

The in-depth survey links were provided to all contacts who agreed to complete the survey. This survey took about 20 minutes to complete. Participants that completed the survey were entered into a draw to win an Echometer Touch 2 ultrasonic bat detector unit (Wildlife Acoustics) that can be attached to a phone or tablet to make a "bat detector" (value of $180 CAD). The winner was selected by using the rand() function in excel to randomly generate a number between 0 and 1 for each PCO that completed the survey. The PCO with the highest number won.

The bat quiz link was provided along with the in-depth survey, but we emphasized to participants that we would like to see the in-depth survey completed. The Bat Quiz consisted of 19 questions about bat ecology and identification. It allowed the respondent to self-grade and evaluate their answers (correct answers were given for each question with a bit of explanation, with the intent to offer a bit of education as well).

All surveys were developed using Google Forms.

The in-depth survey was reviewed by several individuals with experience in biology and polling who provided many helpful suggestions. These included:

- Lisa Wilkinson, Senior Species at Risk Biologist, Alberta Environment and Parks
- Courtney Hughes, Wildlife Biologist, Alberta Environment and Parks (experienced with surveys)
- Dr. Mark Brigham, Professor, University of Regina

- Tanya Luszcz, Species at Risk Biologist, Environment and Climate Change Canada (experienced with surveys)
- Jeff Keith, Senior Species at Risk Biologist, Government of Saskatchewan
- Michael Anissimoff, Bat Conservation Working Group, Environment and Climate Change Canada
- Lynnea Parker, Government of Manitoba (experienced with surveys)
- Dr. Howie Harshaw, University of Alberta (social scientist, experienced with surveys)

The in-depth survey and the bat quiz were tested on a small group of people prior to release.

3.0 SURVEY RESULTS

1. Short survey
2. In-depth survey
3. The Bat Quiz

3.1. The Short Phone Survey

We compiled a list of 249 pest control and wildlife control franchises in Alberta and Saskatchewan along with their contact information. We contacted PCO franchises from February 4th to the 15th, 2021. It was apparent that quite a number of the pest control operators on our list were solely focused on bedbug extermination and 66 companies were not contacted directly because both their company name and advertising indicated a focus on bed bug extermination. Of the resulting list of 183 possible pest control franchises to contact that might work on bats, 13 were no longer in business. This left a possible 170 franchises to contact. There were 41 franchises that could not be reached (despite repeated call backs; sometimes these were either answering machines, answering services or front desk personnel who could not characterize the business or answer the survey questions; most were contacted at least twice to try and reach someone, and we left a contact number for them to call). For some respondents, their responses represented multiple franchises under the same company name. We had 101 unique respondents to the telephone survey which represents a response rate of 59% (101/170) but these respondents represented 75% of the franchises that we aimed to sample. Of the 101 unique respondents reached by phone, 44 said they did not work with bats, at that point, for these respondents, the phone interview ended. The remaining 57 said they worked with bats. 49 of the 57 completed a full telephone interview (of the eight who did not complete a full interview, five were front desk personnel who had limited knowledge and felt they could not answer any questions beyond knowing the company did take calls about bats, and three did not want to complete the phone interview).

During a telephone interview, we had varying levels of participation for each question; we report the number of respondents to each question as some respondents were not willing to provide information to every question. Some respondents were willing to answer all the questions asked; others did not want to spend time talking on the phone. Some of these respondents would relate that they did respond to the occasional call about a bat in someone's home, but they did not feel that they should be considered as a PCO that works with bats and did not want to answer all the survey questions.

Of the 101 operators we contacted directly, the majority of them were located in the largest urban centres of both provinces (Edmonton, Calgary, Regina, and Saskatoon).

The following results reflect the responses of the 49 full survey responses given by PCOs who said that they worked with bats. Again, not every respondent answered every question. The number of respondents providing an answer out of a possible 49 respondents is given for each question.

Of the 47 operators who responded to the question asking how many calls per year they get that involve bats, about 32% said they responded to fewer than 10 bat calls/year, 60% said they responded to 11-50 bat calls/year and 8% said they received more than 50 bat calls/year.

When asked about what percentage of all their business in a typical year involves bats, 82% of 45 respondents indicated that bats made up less than 5% of their annual. 13% indicated that bats made up 10-60% of their business and 2 respondents (4%) indicated that bats comprised 70-100% of their business.

When asked about the kinds of calls they get about bats, respondents indicated that the three most often calls were about “unwanted colonies in occupied buildings”, “a bat has entered the home and needs to be removed” or, “unwanted bats were found on the outside of buildings” (Figure 1). Occasionally respondents said that bats showed up in patio umbrellas or other locations. But rarely do people call about unwanted colonies in unoccupied buildings, which suggests some tolerance for bats in buildings.

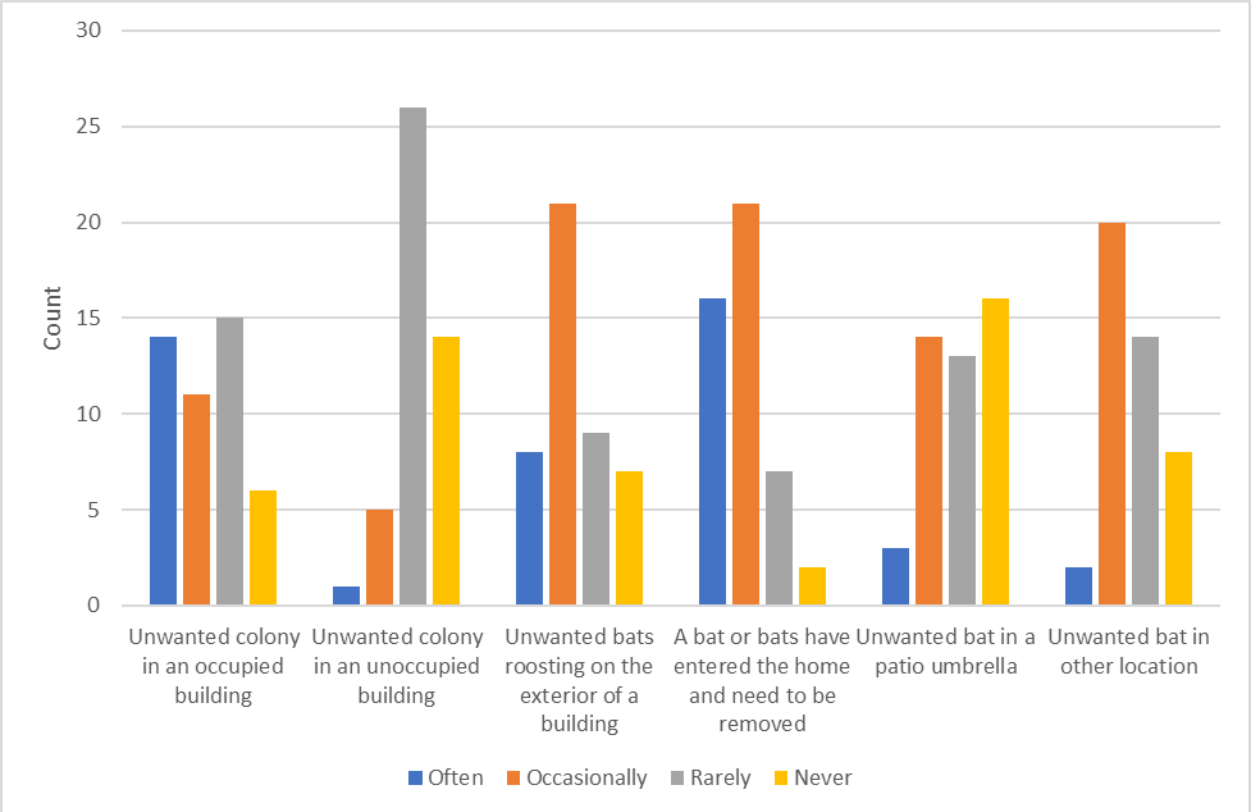

Figure 1. What kinds of calls do you get about bats?

We asked for additional comments about their experiences with different types of bat calls. Responses were varied. Comments indicated that some companies would do clean up in attics while many do not. Some only remove bats that have entered homes accidentally and will not work with colonies. A couple of respondents indicated that they had formal training with bats in terms of pest control, but most companies did not. Many seemed confused on what the actual regulations were regarding handling and exclusion. A few asserted that they did not work with bats because they thought bats were "protected", either provincially or federally, and therefore off-limits. The respondents that work regularly with bats seemed keen on conservation and learning more. These respondents also seemed very concerned and displeased with methods that other PCOs were using to deal with bats.

Of the 49 respondents who answered the question, "Would you be interested in specific training for bats?" 57% said yes, 20% said maybe and 22% said no.

We asked, "Are you affiliated with a professional organization?" and this seemed to cause a good deal of confusion. The pest management associations exist at a provincial, Canadian, and North American level and they are all linked to one another. There is no requirement that PCOs belong to any of these organizations, and many responded that it was not worth their investment. Saskatchewan respondents indicated that many Saskatchewan PCOs belong to the Alberta Pest Management Association and did not think the Saskatchewan organization was very active. Some were aware of the link to the Canadian Pest Management Association and National Pest Management Association (based in the USA).

We also asked if they required a permit to work with bats and who had issued that permit if their answer was "yes". The majority indicated that they did not require a permit to work with bats and those that said "yes" indicated that they had received their permits from the province of Saskatchewan (perhaps the wildlife department, although they were not certain) and the Canadian Wildlife Service.

There was an additional field for comments. In Alberta, several operators mentioned that they pass along calls that deal with maternity colonies to a single PCO in the Central Zone (who responds to calls throughout Alberta), who makes their entire business from bats. In Saskatchewan, the Bat Lab at the University of Regina seemed to be receiving redirected calls about bats from some respondents. A few respondents indicated that they did not work with bats because either they were a) too much work (and therefore the cost to homeowners would have been greater than the homeowner was comfortable with) or b) protected so they were not allowed to work with them. One company refused to work with bats because of the risk of rabies. Many said they get one or two bat calls each year and often they refer them to operators they know work with bats. We did chat with the Alberta Pest Management Association president and past president (both of whom own pest control companies) who suggested that there was a need for more information about bats and that delivering a talk or workshop at one of their annual meetings would be a good, targeted way to provide that information. As well, to keep their association membership in good standing, members are required to complete "training credits" each year. Attending a talk that is at least 55 minutes long would count towards a training credit. Another respondent suggested providing information to vendors selling bat houses at local Farmer's Markets. These vendors could reach homeowners who are either interested in bats or dealing with bats in buildings.

Some of the notable comments with conservation implications included implications of bat exclusion activity occurring during summer, observations of other operators using "glue boards" in colonies, and a few who seemed to lack basic understanding about either bat ecology or existing policies associated with their management. Positive responses about bat conservation came from the operators who regularly work with bats. Almost all the respondents who regularly deal with bats were interested in either a) more education opportunities, b) more information about bats for distribution to clients, and/or c) more clarity on legislation for bats. A couple of respondents plainly stated that clear rules on timing windows would help them because it would not be just based on their recommendations to wait to avoid harming bat colonies, it would be the rule to follow according to the province. Impatient clients often push exclusion work to be done immediately.

3.2. The "In-Depth Survey"

The In-depth Survey was divided into four sections.

- Section 1: Respondent Profile
- Section 2: Operations – Managing the Business of Bats
- Section 3: Pest Control Services
- Section 4: Needs

3.2.1. Section 1 – The Respondent's Profile

In total, we had 28 respondents to the in-depth survey. Not all respondents answered all questions. When respondents did not answer a question, it was unclear if they intentionally did not answer, or if they thought that leaving the question blank implied 'no', and it was something that they did not do, or it was not relevant to them. Due to this uncertainty, results shown only include the number of people that directly answered the question.

Of 25 respondents, three indicated that bats were their core business focus. Another three indicated that they primarily focused on wildlife issues while the majority (19/25) primarily worked on other pest management issues (including bats).

We used maps of the health regions of each province to determine where PCOs conducted operations (Figure 2). Considered together, the 28 respondents indicated that they worked at sites across all regions of Alberta and Saskatchewan (Figure 3). Respondents often indicated that they worked in more than one of the defined zones/regions.

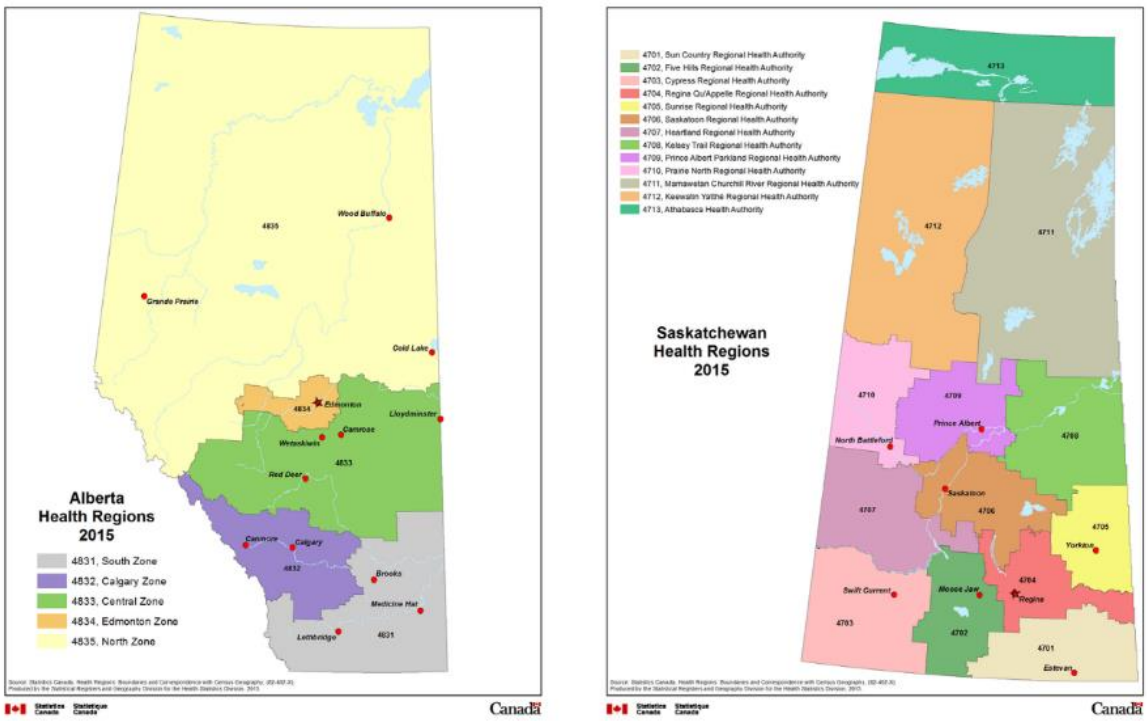

Figure 2. Maps of Alberta and Saskatchewan, Health Regions (Government of Canada 2015).

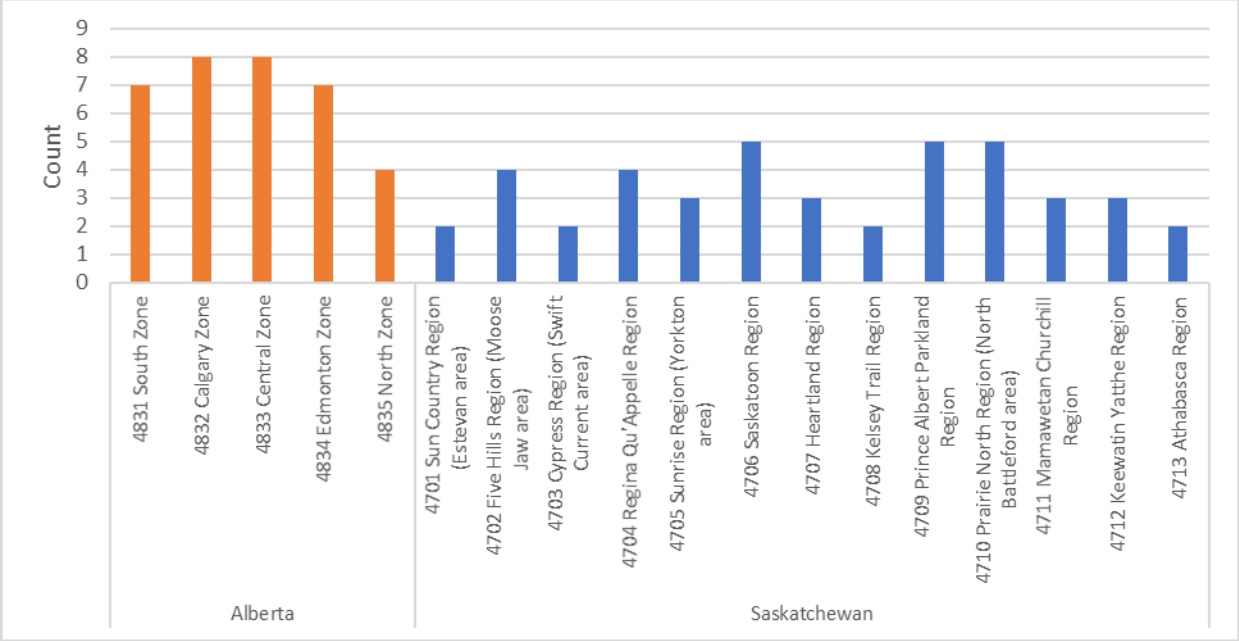

Figure 3. In what jurisdictions in Alberta and Saskatchewan does your company generally operate?

Of our 28 respondents, only four indicated that they belonged to a chain of PCOs, with 86% of respondents being independent companies. Half of the respondents currently conduct field work.

Independent owners often wear more than one hat, owning the franchise, managing the business, and doing the field work. Half of the respondents indicated that they also owned the business.

Most of our respondents are experienced PCOs with 64% having ten or more years of experience and 79% with up to six years of experience (Figure 4). Only one of our respondents had a year or less experience working as a PCO (Figure 4). The data were more spread, when asked how much experience they had working specifically with bats or bat colonies (Figure 4).

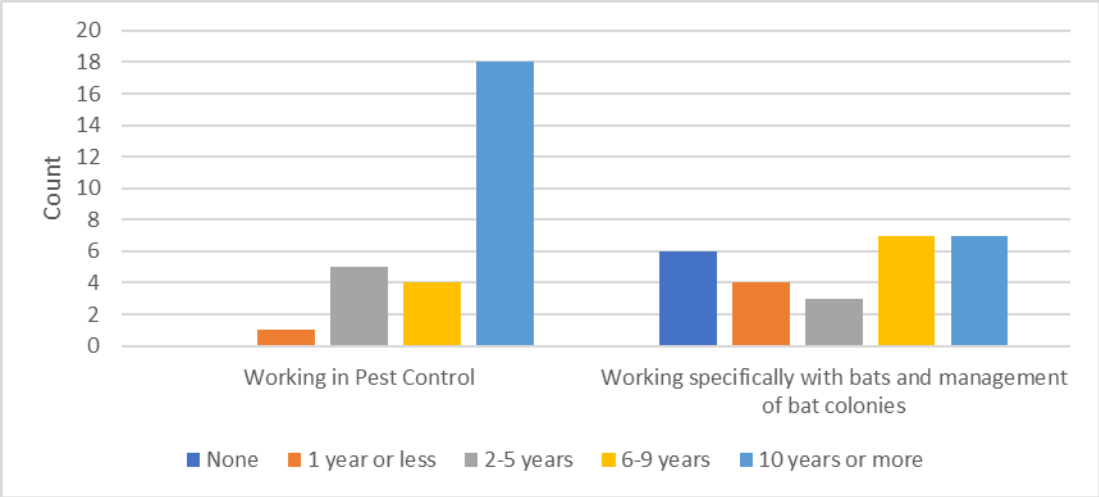

Figure 4. As an individual working in the pest control industry, how many years of experience do you have?

We asked respondents to name the professional organization they were affiliated with (if any). Out of 14 respondents who answered the question, some belonged to more than one organization (Table 2). Eight of 14 respondents were associated with a professional organization and six had no association membership. The fact that half of those surveyed did not answer this question may indicate that they did not belong to any organization.

Table 2. List of respondent affiliations with professional organizations.

Professional Organization	Number of Respondents (n=14)
Canada Pest Management Association	4
National Pest Management Association	5
Pest Management Association of Alberta	5
Saskatchewan Pest Control Association	1
Professional Pest Management Alliance	1

When we asked what title most accurately describes what respondents did, the majority responded with “pest control operator” but many considered “wildlife control operator” also applicable (Table 3).

Table 3. List of titles used by PCOs.

Title	Number of Respondents (n=27)
K9 Handler	1
Office staff	1
Pest Control Operator	22
Wildlife Control Operator	10

3.2.2. Section 2: Operations – Managing the business of bats

Section two of the "In-depth Survey" focused on the operations of pest control operators. Specifically, questions were focused on how much bat work they did, the type of bat work they responded to, as well as if they have any training, permits, or belong to any professional associations.

First, we asked how many calls per year they received that were bat related. Of the 28 respondents who answered the question the majority received 10-24 calls per year. A couple of respondents seemed inordinately busy with bats fielding 100 or more calls each year (Figure 5).

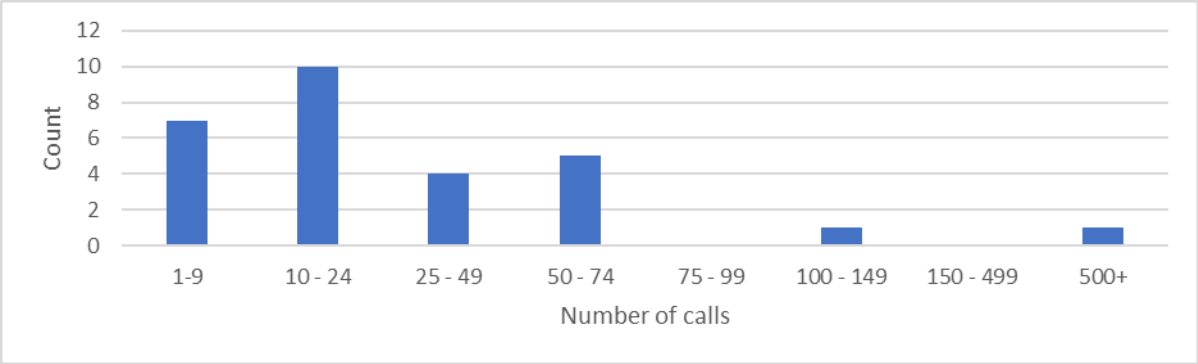

Figure 5. About how many calls per year does your particular office/franchise get that involve bats?

Of all these calls, respondents reported that the estimated total number of calls that involve a "colony" of bats was 744 calls per year. It should be noted that one respondent indicated they had received 480 calls per year and the rest of the respondents combined totaled 264 calls per year. It should also be noted that we loosely defined the term "colony", and some operators may not have fully understood the difference between a "colony" and a small group of non-reproductive females or males. Maternity colonies for Little Brown Myotis can range from a few individuals to over 1000.

Most respondents only get a few calls per year that involve bats, but for four PCOs, bat-calls represent 10-30% of their business, and two PCOs are doing most of the bat work (Figure 6).

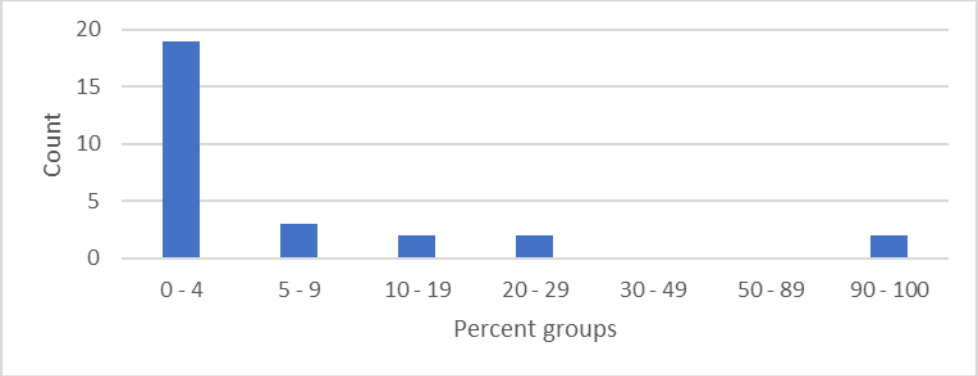

Figure 6. Out of the total calls your office/franchise received for ALL pest control issues in a year, about what percentage of those involve bats?

The question about revenue reflects the previous question that asked about the proportion of their work that involves bats. The half dozen operators who do most of the bat-work in the two provinces earn a substantial amount of their income from bats, while for most companies, the revenue from bats is inconsequential (Figure 7). Twenty-two respondents answered this question.

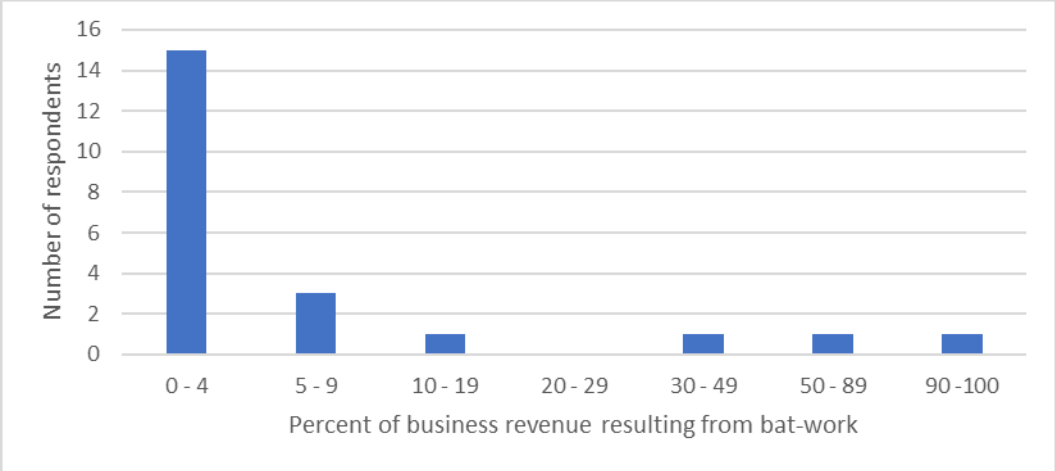

Figure 7. In terms of revenue, about what percentage of all the business your office/franchise conducts in a typical year involves bats?

Half of the 28 respondents indicated that they advertised publicly that they worked with bats, while the other half did not advertise. Generally, respondents indicated that they did not need a municipal permit to work with bats but about 18% said they needed a provincial permit and 7% indicated that they needed a federal permit (Table 4).

Table 4. Have you ever been required to obtain a permit or license (municipal, provincial, or federal) to handle or exclude bats as part of your pest control operations?

(n=28)	Yes	No
Permit or license to handle or exclude bats [Municipal]	0	27
Permit or license to handle or exclude bats [Provincial]	5	23
Permit or license to handle or exclude bats [Federal]	2	25

The governing bodies that respondents listed as issuers of permits included:

- Canadian Wildlife Service
- Parks Canada
- Saskatchewan Ministry of Environment
- Lakeland College Structural Pesticide Applicator Certification
- Provincial Applicators

We wanted to know how often PCOs received particular types of calls about bats (Figure 8). Rarely did they get calls about dead bats or bats in patio umbrellas or other random locations. Routinely or often, calls were about colonies of bats in human-occupied buildings or about a flying bat that needed to be removed from a home or business. Bats roosting on the outside of buildings also appeared to be a routine occurrence.

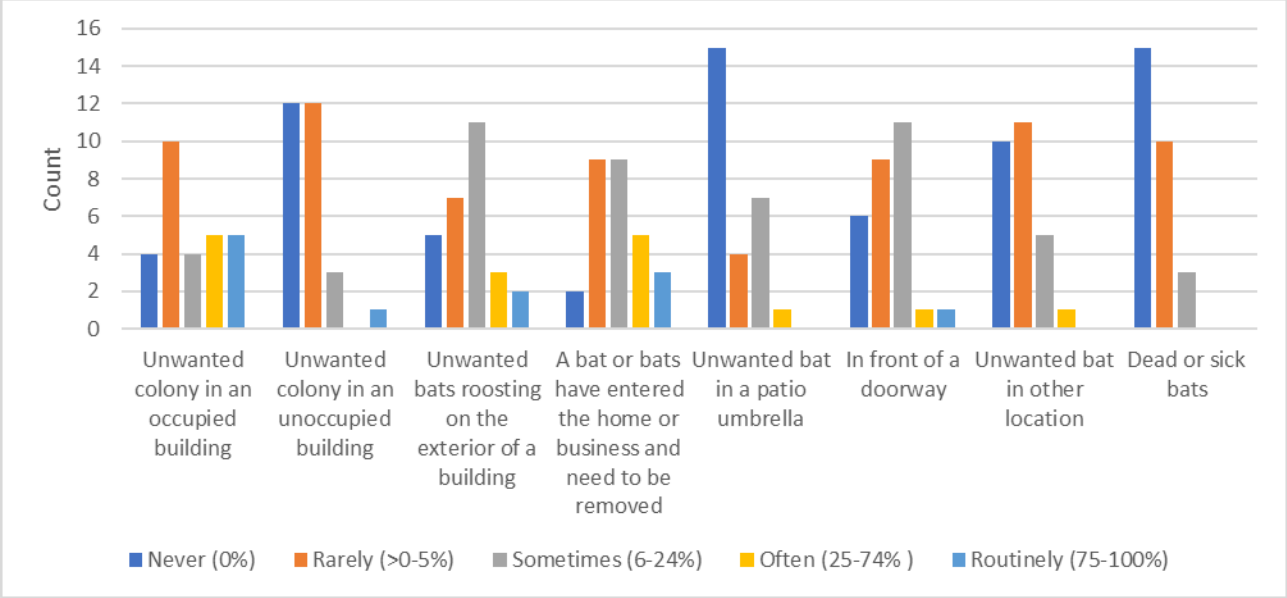

Figure 8. What kinds of calls do you get about bats and when considering just bat-related calls, how often do you get these particular types of calls? (note: colonies refer to groups of bats, typically females).

We also wanted to know where (rural, urban, suburbs, or First Nations reserves) bats were showing up and in what types of buildings (Figure 9). Rural cabins, homes, sheds, and churches frequently had bat issues. As did suburban homes, commercial buildings, and churches. Downtown homes, industrial buildings and churches also had relatively frequent reports of bats. We did not ask the age of structures, but it is likely that these are older structures that are attracting bats as older structures often have more accessibility for bats.

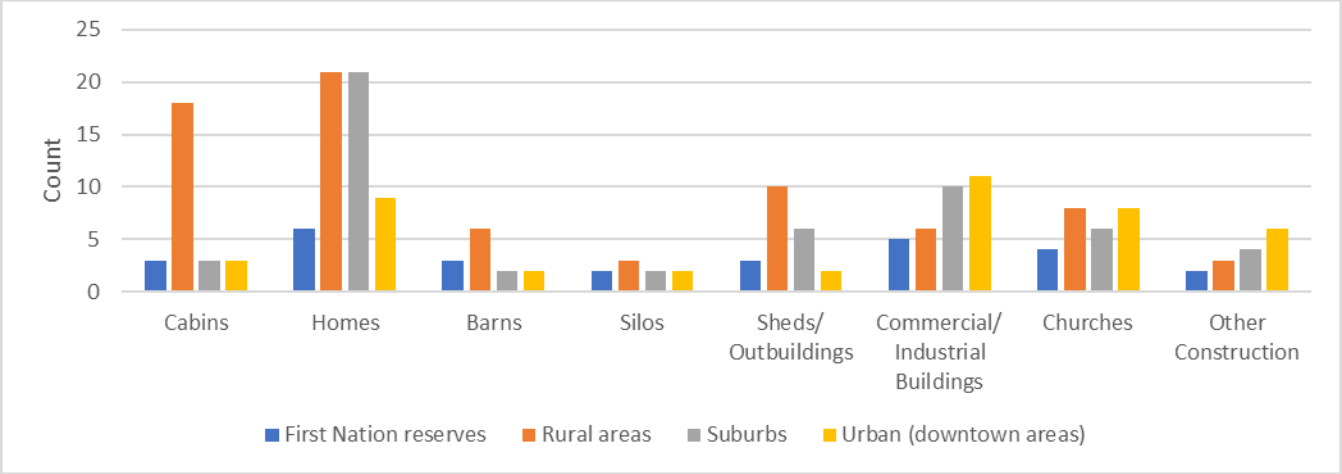

Figure 9. Please indicate the types of structures where you commonly deal with bats. (Select all that apply)

All 28 respondents replied to the question asking about the types of work they do with bats (Figure 10). Interestingly, almost 36% of the respondents indicated that they capture and physically remove colonies of bats from attics (although the remaining 64% said they never do this). Three-quarters of respondents do handle live bats but this involves capture to remove random bats that have flown into buildings. And 68% of respondents are involved in conducting bat exclusions.

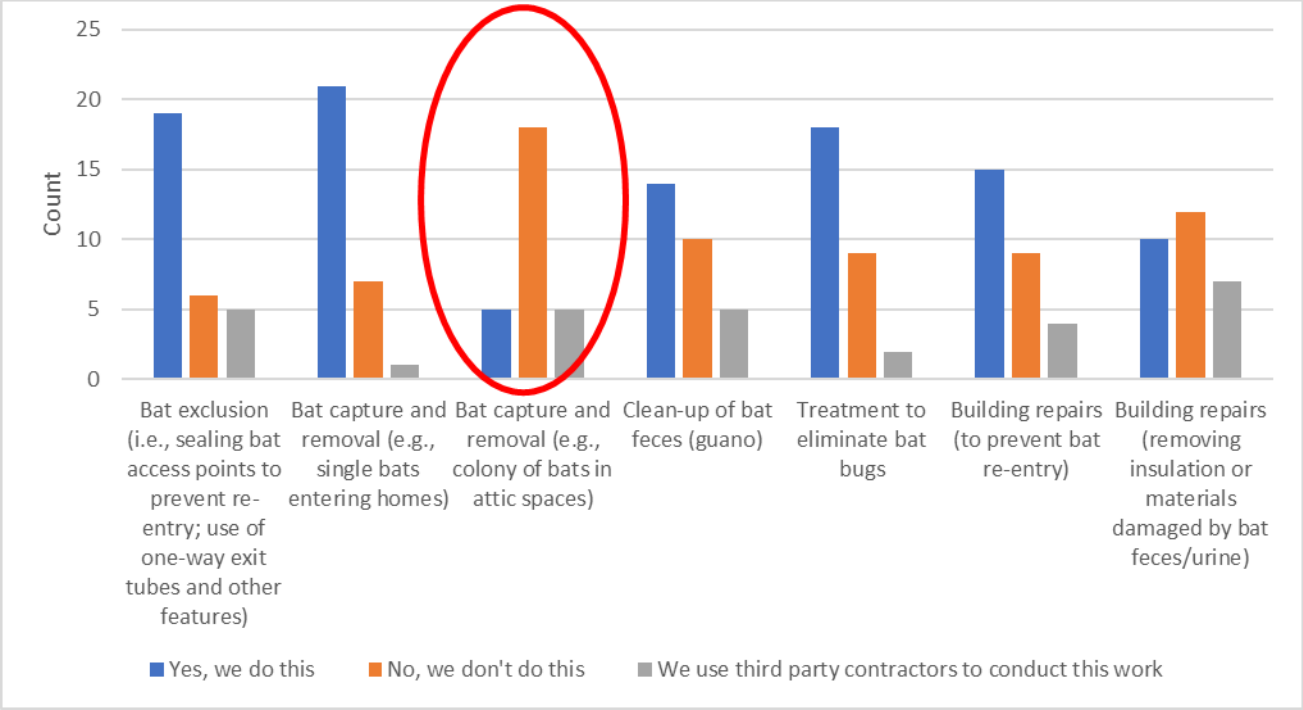

Figure 10. What services specific to bats does your company provide? Check all that apply. The red circle indicates a potential issue to be discussed further.

We asked if there were any geographic areas that seemed to generate more bat calls than others. There was a wide range of responses that reflect Figure 9 that indicates if bats were found in different types of buildings within different habitats such as urban, rural, suburban, or reserve areas. Of the 17 responses, 53% mentioned close proximity to water, 35% mentioned lakeside cottages or cabins, and 18% mentioned that older and/or taller buildings seemed to be involved with bat calls. Specifically, respondents mentioned Sturgeon Lake, Pigeon Lake, and the area north of Edmonton as areas that seemed popular for bats.

All 28 respondents answered the question regarding the typical colony sizes that are involved with the bat management issues that they respond to (Figure 11). It appears that most respondents do not encounter very large bat colonies, although four respondents routinely see colonies of over 100 bats. Colonies of 10 or fewer seem to be more commonly encountered by most respondents

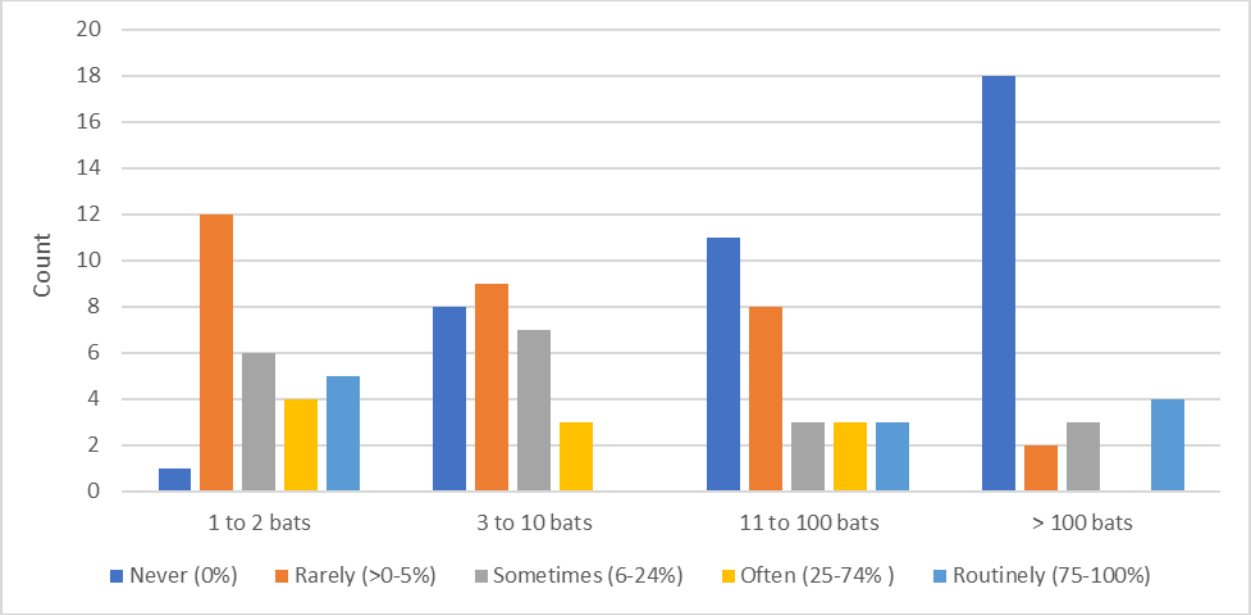

Figure 11. Considering just the calls where you are responding to a bat issue, how often do you respond to calls involving the colony sizes listed below?

Seven respondents provided additional feedback with the question, "Do you have any other comments about the exclusion process for bat colonies in buildings?" Notable comments included:

- *"I believe that people need to be way more informed about the fact that they are a protected species, and they can't just kill them. They also need to know the risk of damage they can do if ignored."*
- *"Pest control companies and homeowners should be charged when performing exclusion during the pupping season."*
- *"This is not something that is taught to pest control operators."*

One respondent described their exclusion process, which generally followed the ACBP guidelines, and another said that they refer exclusion work to a PCO who is a bat specialist based out of the Central Zone (but responds to calls throughout Alberta).

Respondents were asked about the federal listing of the Little Brown Myotis as endangered under the Species at Risk Act. 93% were aware of the listing of the species, and 7% did not know the Little Brown Myotis was listed. 95% of 19 respondents said the listing had not affected their business; one person said that it had. Respondents were given the chance to provide comment on how the species listing may have changed their business. Of the 19 respondents that commented, sixteen said there really was no change. One commented that "people are so misinformed about bats", another said they had always treated them as endangered, and a third said they had stopped taking bat work until the Saskatchewan provincial permitting process was defined. Another said they stay away from active bat work unless the bats are inside the living space of a building, and another replied that they only do bat clean up and do not deal with the bats directly. One respondent indicated that they do not relocate bats, they only

recommend building bat houses as exterior roosting structures, while another claimed to only practice relocation of bats.

We asked about bat-related training experiences and all 28 respondents answered the question (Figure 12). Primarily, respondents are learning about bats on their own or while on the job. A few have attended seminars or conferences to learn about bats and a few have taken in-person courses. Formal education was not frequent and the low numbers taking online courses.

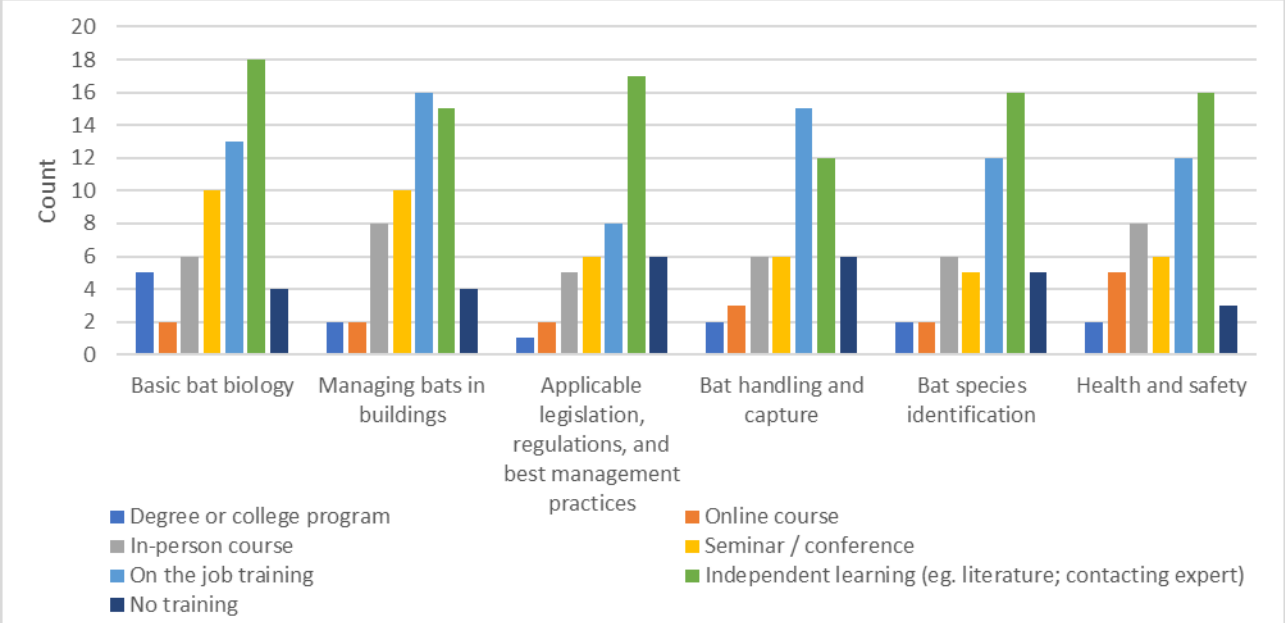

Figure 12. What training have you taken to manage bats in buildings or work with bats as a PCO (i.e., ranging from in-depth training to none at all).

3.2.3. Section 3: Pest Control Services

This section of the survey made inquiries into actual practices. Handling practices, safety for workers, timing, and types of management typical at building roosts (exclusions versus evictions), objectionable practices they are aware of, and their sources for bat information.

All 28 respondents answered the question regarding handling practices for managing bats (Figure 13). Most respondents do not euthanize bats, although three respondents said that it happens sometimes or rarely. 61% of respondents said they were not required to obtain a routine rabies vaccination and 82% did not check their titre. Only two of 28 respondents said that they never handled bats. Only one respondent said they routinely handled bats, but the remaining 25 respondents admitted to handling bats rarely, sometimes, or often. Five of 28 respondents said they never practiced live capture and release with bats, with six respondents saying that live capture and release was routine. However, it was unclear if this meant that they never capture bats or if they never release bats that they capture. Finally, 13 of 28 respondents said that they never identify bat species as part of their work with bats, and four individuals indicated that they do this routinely.

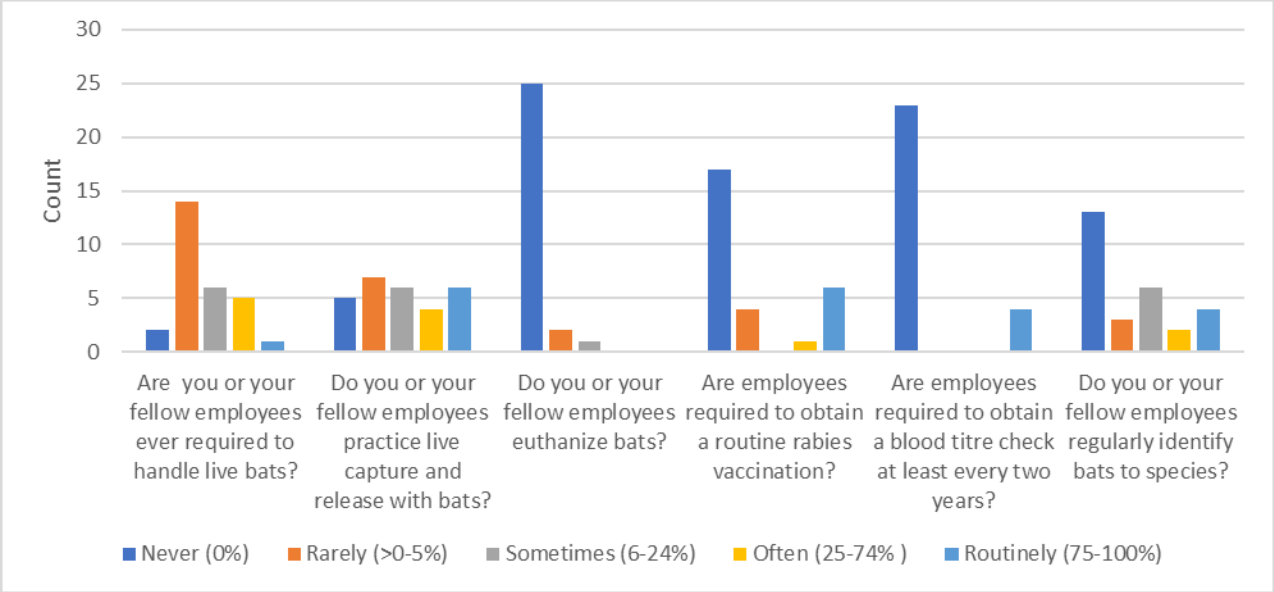

Figure 13. Please help us to understand current practices used by your employees for managing bats.

We asked respondents "Are there any existing industry protocols with respect to safe handling and removal/exclusion of bats for buildings?" More than half of the 28 respondents said they didn't know. 32% said yes there were industry protocols and 14% said no, there were no protocols.

The following question was focused specifically on the exclusion or eviction of colonies of bats and the timing of those activities (Figure 14). Respondents appear respond to service calls about bats year-round and are conducting evictions and exclusions when bats are raising pups. Twenty-five of 28 respondents answered this question.

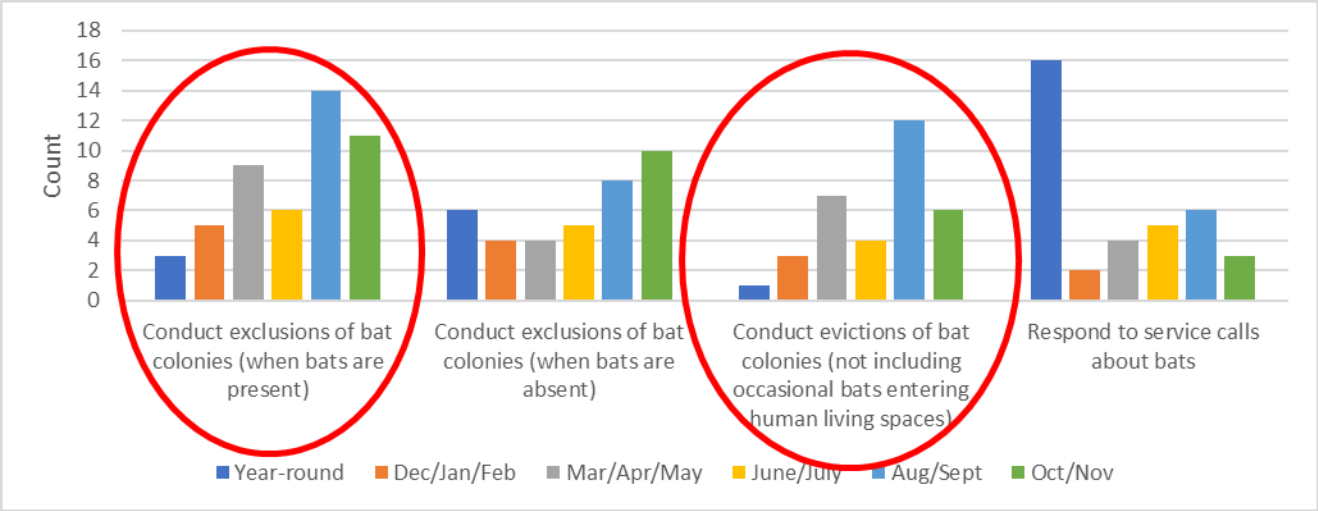

Figure 14. If your company conducts exclusions/evictions for bats, or respond to bat calls, what time of year do these activities occur? (a bat colony refers to a group of bats, usually females and their young). Please check all that apply. The red circles indicate potential issues to be discussed further.

Respondents were asked if they had seen bats or been contacted about bats using buildings during the winter (mid-November to mid-March), to address winter use of buildings by bats. Twenty-four respondents answered this question. Forty-two percent said "yes" they had winter bat calls, 54% said "no" and one person was unsure. When asked to provide comment if they had indicated that they had seen bats in winter, respondents indicated that people would hear bats in their attics when there were periodic temperature changes in winter, especially warming periods and bats would become active. Older schools, apartments, houses, and hospitals were noted as having wintering bats. Two respondents suspected Big Brown Bats although one also thought Little Brown Myotis were present.

We asked about the prevalence of bat bugs and surprisingly, these bat-related insects were not encountered very often, and few measures are taken to control these insects (Figure 15).

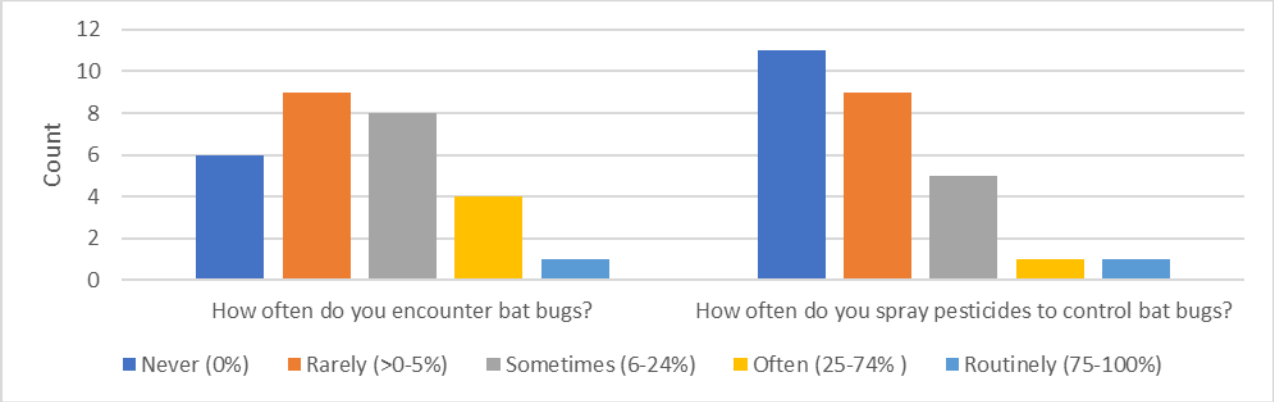

Figure 15. Please answer the following questions regarding bat parasites/bat bugs.

All 28 respondents answered the question regarding methods used to manage colonies of bats (Table 5). Methods that have high negative impacts on bats (suction/vacuum devices, extermination, chemical repellents, smoke/fogging) seem to be avoided by most respondents. Details regarding types of chemicals used were not requested. There may be some chemical repellents that could be considered low impact but others may be considered high-impact.

Eleven respondents report physical removal of bats (two do this routinely) and twelve report evicting colonies when colonies are present (three do this routinely). Six respondents report using mist-nets.

The green coded rows in Table 5 are methods that would be considered low-impact to bats and "bat-friendly". The yellow coded row indicates a row that we would express caution should be taken using this method; and the orange coded rows are methods that we would discourage because of negative impacts on bats. Exclusion using timing windows is reported routinely by only four respondents and "never" by 15 respondents. One-way exits appear to be used by many of the respondents and this can be a good method when used at the appropriate time but is not recommended when non-volant pups are present. Several respondents report using ultrasonic repellents.

Table 5. What kinds of methods are you most likely to use on roosting bats (e.g., colonies of >10 bats) in buildings? Please check all that apply.

(n=28)	Percentage				
Methods	**Never (0%)**	**Rarely (>0-5%)**	**Sometimes (6-24%)**	**Often (25-74%)**	**Routinely (75-100%)**
Colony exclusion - anytime of year	16	7	2	1	1
Colony exclusion - using timing windows	15	4	4	0	4
Colony eviction (colony present)	13	4	3	2	3
One-way exits	6	6	3	3	10
Mist-nets (to capture bats)	21	5	1	0	0
Netting (to prevent entry by bats)	18	6	2	0	1
Physical removal of multiple bats	17	8	1	0	2
Transport and relocation of bats	17	7	2	0	2
Ultrasonic repellents	20	4	2	1	1
Smoke or fogging	23	2	3	0	0
Other chemical repellents	26	1	1	0	0
Extermination	26	0	1	0	0
Suction/Vacuum devices to extract live bats	26	0	1	1	0

All 28 respondents answered the question "What kinds of methods are you most likely to use for managing a single bat (one) or a non-colony situation for bats (1-10) in buildings?" (Table 6). This question was targeted at random bats in buildings versus maternity colonies. Routinely, bats are simply physically removed. This would be expected for a bat that has flown in and become trapped in a home or business. Most commonly bats are simply physically removed. More rarely, bats are removed using methods that would not be considered bat-friendly practice. Suction devices, extermination, chemical repellents, distant relocations and mist-netting was reported.

Table 6. What kinds of methods are you most likely to use for managing a single bat (one) or a non-colony situation for bats (1-10) in buildings? Please check all that apply.

(n=28)	Percentage				
Methods	**Never (0%)**	**Rarely (>0-5%)**	**Sometimes (6-24%)**	**Often (25-74%)**	**Routinely (75-100%)**
Physical removal of the bat	4	4	6	2	12
Mist-nets (to capture the bat)	23	2	2	0	1
Transport and relocation of the bat	9	7	4	1	7
Ultrasonic repellents	23	1	2	1	1
Chemical repellents	24	3	1	0	0
Extermination	25	2	1	0	0
Suction/Vacuum devices for bats	25	2	1	0	0

Twenty-six respondents answered the question regarding extermination methods used while conducting PCO activities (Table 7). Two respondents admitted to the rare use of glue traps and cervical dislocation. This question specifically excluded euthanasia of accidentally injured bats.

Table 7. If you have exterminated bats within the last 6 years, what methods have you used? (excluding euthanasia of accidentally injured bats).

(n=26)	Percentage				
Methods	**Never (0%)**	**Rarely (>0-5%)**	**Sometimes (6-24%)**	**Often (25-74%)**	**Routinely (75-100%)**
Glue traps	25	1	0	0	0
Poisons	26	0	0	0	0
Cages/mechanical traps	26	0	0	0	0
Cervical dislocation	25	1	0	0	0
Gas/carbon dioxide asphyxiation	26	0	0	0	0
Injection/inhalent euthanasia drug	26	0	0	0	0

Respondents were asked to comment on practices they had heard being used by other pest control operators that they felt were harmful to bats. We did not ask that they specify the PCO in question but that they describe the harmful practice. Some of the practices noted include poor handling practices, excluding, removing, or exterminating colonies during July and August when pups are present, sealing bats into buildings and use of glue boards.

We also asked respondents, “Have you ever managed a building to retain a bat colony? If yes, which strategies have you used?” All 28 respondents answered this question and almost 90% said they had never managed a building to retain a bat colony. However, 40% of the 28 respondents did make a note that they used some of the strategies that are often employed to safely retain a colony. Respondents used practices such as cleaning up guano/urine and modifying access points for bat entry and exit as well as restricting access to a specific part of the building. They also installed flooring materials to enable easier annual clean up and educated clients on the benefits of bats and what to do if a bat enters the home.

We asked respondents to list building features that seem to be habitual problems for homeowners because of bats accessing the site (e.g., common entry points for bats or design features that favour bats). These features included:

- Types of roofing materials: cedar shakes, clay tiles, other spaces under shingles or other material
- Chimneys, missing mortar
- Compromised roofing features: fascia, flashing, under eaves, ridge caps, soffit gaps
- Issues with construction materials: cracks in cinderblock/cement walls, unsealed attics, spaces in siding
- Home design features: dormers on rooflines, multiple roof lines with overhangs, high open ceilings, log homes, brick homes, sun light windows (i.e., skylights) on roof
- Entry points into the building for power, phone, plumbing
- No screening on exhaust and intake pipes from the furnace or stoves

Respondents were asked to list other industry professionals that they often consult or coordinate with to solve bat issues (17 responded) answers included:

- No one (29%)
- Roofers (35%)
- Contractors (12%)
- Wildlife control companies (12%)
- Carpenters/home renovators (5%)
- Soffit workers (5%)
- Wildlife rehabilitation companies (5%)
- Bat biologists/other bat professionals (12%)

Often, part of the process of excluding bats from a building includes the installation of bat houses in the season prior to the actual exclusion. We asked if respondents recommended bat houses to clients and if they did, what type of bat houses they recommended (Table 8). Twenty-seven respondents answered this question and 44% recommend single-chamber boxes. Another 30% recommend small multi-chamber boxes and 18% do not recommend installing bat houses to clients. Only one respondent recommended the large multi-chamber nursery box, and no one recommends multi-chamber rocket boxes. We recommend installing multiple large multi-chambered bat houses, with options in both warm/sunny and shaded locations to reduce the risk of overheating.

Table 8. If you have suggested providing alternative bat habitat (i.e., bat houses) at locations where clients have had an issue with bats, what types of bat houses do you recommend?

What types of bat houses do you recommend	Count (n=27)
Single chamber boxes.	**12**
Small multi-chamber nursery roost boxes (less than 61 cm / 24" tall and 43 cm / 17" wide).	8
*Large multi-chamber nursery roost boxes (at least 61 cm / 24" tall and 43 cm / 17" wide).**	*6*
We never recommend bat houses.	5
General bat house (no specified dimensions).	3
Large multi-chamber bat condos.	1
Tell them to research for themselves.	1
Recommend putting their guano on it to help.	1
*Multi-chamber rocket boxes.**	*0*

*These two designs are recommended by ACBP

We were interested to understand how confident PCOs were in their ability to accurately identify bat species. Of our 28 respondents, one-quarter of them said they were very confident in their ability to identify bats (Figure 16). The remainder were somewhat confident or not confident.

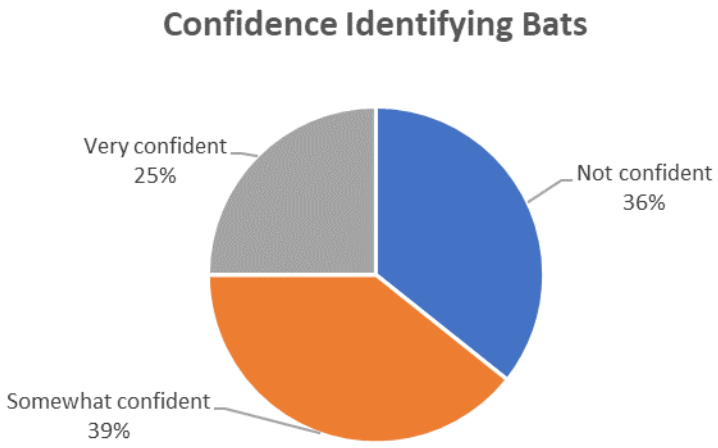

Figure 16. If you identify bat species as part of your job, how confident are you in the accuracy of your species identifications?

We asked, "What species of bats do you most commonly encounter as part of your work?" Unsurprisingly, the top three routinely encountered species were Little Brown Myotis, Unidentified Myotis and Big Brown Bat (Table 9). Interestingly, respondents indicated that all possible bat species were seen, albeit rarely. The ability to identify species would be key in the accuracy of these observations. Also surprising is that one respondent reported seeing Silver-haired Bats and Hoary Bats "often". Silver-haired Bats are occasionally seen in buildings, especially during the fall, but Hoary Bats

are primarily solitary tree-roosting species. It seems that the 27 PCOs that answered this question are having some interesting encounters with different bat species (and these reports would be useful to document) or require further training to identify species correctly. Hoary bats can be locally abundant in some areas and their appearance may also be related to seasonal migration patterns.

Table 9. What species of bats do you most commonly encounter as part of your work?

(n=27)	Percentage				
Species	**Never (0%)**	**Rarely (>0-5%)**	**Sometimes (6-24%)**	**Often (25-74%)**	**Routinely (75-100%)**
Little Brown Myotis	3	5	5	6	6
Unidentified Myotis species	11	4	1	0	2
Big Brown Bat	6	5	3	7	2
Long-legged Myotis	13	2	1	0	0
Northern Myotis	14	2	1	0	0
Long-eared Myotis	13	2	1	0	0
Western Small-footed Myotis	14	2	1	0	0
Silver-haired Bat	14	3	1	1	0
Hoary Bat	14	4	0	1	0
Eastern Red Bat	15	2	0	0	0

Relocation of bats can happen if a single bat is captured flying in a home and taken away, or if PCOs are evicting bats and capturing live animals. We wanted to know how far away bats are released from the original capture site (Figure 17). 54% of respondents relocate bats. 22% relocate 20 or more kilometres from the roost.

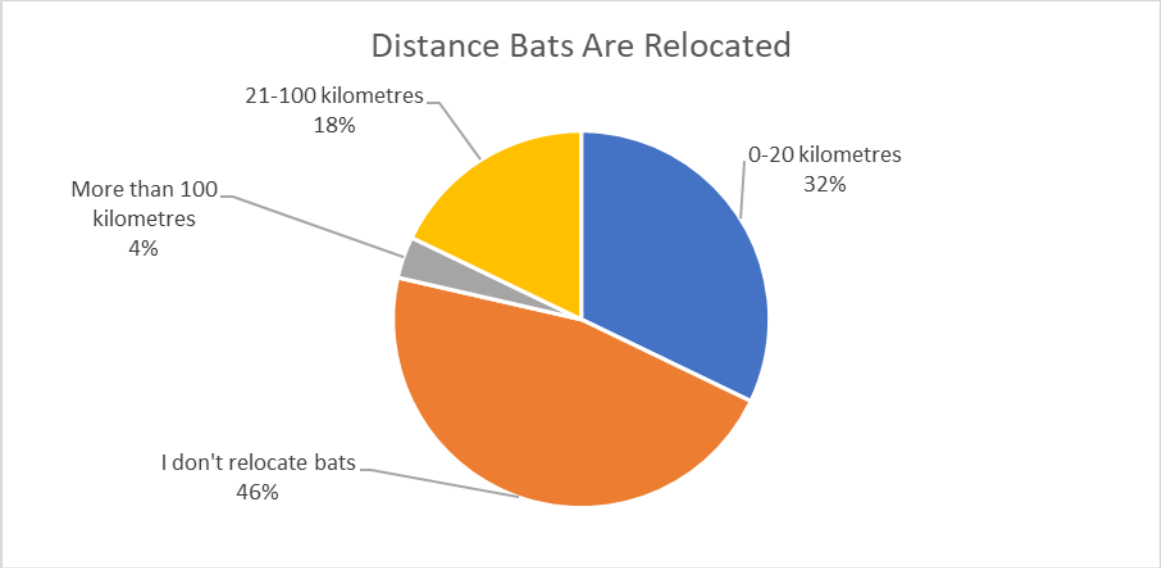

Figure 17. If you relocate bats, how far away do you typically release captured bats from the original capture site?

Safety equipment is for both the PCOs and the bats. There are specific decontamination procedures and personal protective equipment routinely used by bat biologists. We wanted to know what kinds of protection are used routinely by PCOs when working with bats. The PCOs who answered this question appear to routinely use both disposable and leather gloves and filtered masks. Disposable glove use is not as frequently used as the other gear (Table 10).

Table 10. Do you use Personal Protective Equipment (PPE) when working with bats? (e.g., gloves, masks?) Please check off all that apply.

(n=26)	Percentages				
PPE	**Never (0%)**	**Rarely (>0-5%)**	**Sometimes (6-24%)**	**Often (25-74%)**	**Routinely (75-100%)**
Disposable gloves	5	1	0	1	13
Leather gloves	0	3	1	2	18
Surgical mask	7	2	2	1	5
Mask with HEPA filter (or better)	1	2	1	4	17

The Canadian Wildlife Health Cooperative (CWHC) is a program that works across Canada to conserve wildlife and partner with human health initiatives that involve the interactions between wildlife and humans. They provide information for anyone working with bats and hold the most current policy and protocols for managing WNS in Canada. They have also published recommendations for preventing the spread of SARS-CoV-2 (the virus that causes COVID-19 in people) from humans to bats. Clearly, additional outreach is needed to make PCOs aware of this group as only 25% of respondents had ever heard of the program, but even fewer were using the CWHC as an information source. Almost a third of respondents had heard of the ACBP but “other sources” appear to be more frequently used for reference (Figure 18).

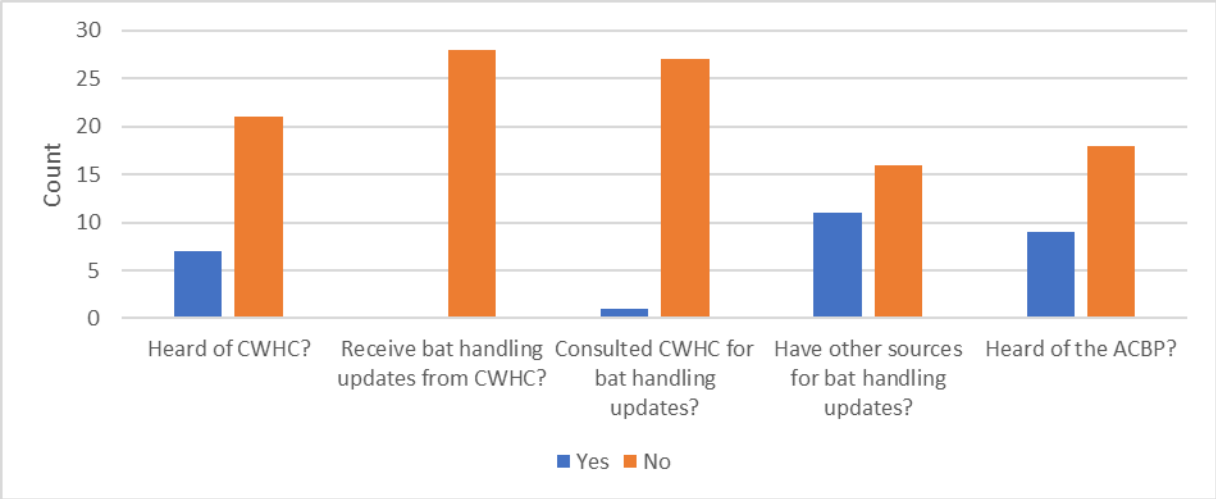

Figure 18. What resources for bats are being used by PCOs?

There appears to be no one clear source of information for PCOs and bat handling protocols (Table 11). The 14 respondents who answered this question appear to look to a variety of sources for information.

Table 11. If you use other sources for keeping up-to-date on wildlife handling protocols (especially bats), please indicate the sources you use.

Other sources for keeping up-to-date on wildlife handling protocols	Count (n=14)
Google	4
Fish and Wildlife	2
No other sources	2
Alberta website document	1
Association	1
Bat biologist	1
Books	1
Environment Canada	1
National Wildlife Control Operators Association	1
Online training	1
Provincial legislations	1
Seminars	1
Webinars	1
Wildlife rehabilitation centers	1
Youtube	1

PCOs often provide information to homeowners regarding the pest issue at hand. We asked respondents what types of bat information they provide clients (Table 12). Of the 26 PCOs who responded to this question, the top four types of information provided were about bat parasites, bat

houses, histoplasmosis, and rabies. 19% of respondents recommended the ACBP website (Table 12). It appears that about 70% of PCOs try to provide some kind of information for clients.

Table 12. What kinds of information do you provide to homeowners on bats?

What kinds of information do you provide to homeowners on bats?	Count (n=26)
Alberta Community Bat Program website www.albertabats.ca	5
Information on bat parasites (bat bugs, etc.)	18
Information on bat houses (types, designs, installation)	16
Information on Histoplasmosis	10
Information on rabies	10
Other Bat Management Guidebooks	5
Information on other diseases (Ebola, Hendra, MERS)	3
Google	1
gov.ab.ca / bats	1
Health Canada - Bat pamphlet	1
Provide assessment of building and then provide required info	1
We really don't want to cause the customer anymore distress (if they ask we talk about the above)	1

3.2.4. Section 4: Needs

In this section of the questionnaire, the objective was to determine what PCOs need to assist them in conducting their business in the most bat-friendly way. We asked what they would like to learn about, the type of training they would like to see, the information sources they currently use and methods for delivery of training. We also asked about cost, travel and time required for training.

The 26 PCOs who answered this question seemed interested in all the suggested topics (Table 13). The highest priority items that they wanted to learn more about included bat species identification, hazards for humans, and humane/bat-friendly exclusion methods. The high positive response to this question indicates that there is an appetite for more learning when it comes to bats.

Table 13. I would like to learn more about (click all that apply).

I would like to learn more about:	Count (n=26)
Bat species identification.	21
Hazards for humans.	21
Humane/ bat-friendly exclusion methods.	20
Best management practices for bats.	17
Hazards for bats.	17
Available certification/ training programs for working with bats.	15
Building and installing bat houses.	15
Ecological and economic benefits from bats.	14
Disease monitoring.	13
Monitoring bat colonies.	13
Participating in citizen science and monitoring projects for bats.	11
How bats might benefit farms.	10

A certification program for managing bats could be useful for PCOs but we wanted to know how they felt about such an idea and if it was needed. All 28 respondents answered this question and the majority appear in favour of a voluntary certification program delivered either in-person, or online with either live or pre-recorded webinars (Table 14). Discussion with Pest Management Association executives in Alberta revealed that training modules could easily be incorporated into annual training credits required for association members. Subsequent questions regarding a suitable length of training and costs indicated that most felt a half-day, or full-day course would be suitable and cost ranges generally up to about $200 would be manageable (although this value might vary depending on the length of the course).

Table 2. Voluntary Certification Program for Managing Bats for PCOs.

Training (n=28)	Very Interested	Somewhat interested	Not interested
Would you be in favour of a voluntary certification program for PCOs specifically for bats?	16	8	4
Would you attend an in-person certification course?	13	10	5
Would you use an online live webinar training program?	13	12	3
Would you use an online pre-recorded webinar training program?	14	12	2

To meet the information needs of PCOs, we wanted to understand where respondents would like to get their information on bats. Of the 23 respondents, half indicated that they were using or would prefer to use either the ACBP website or other websites. Books/manuals, hands-on workshops, emailed newsletters and videos also ranked as highly preferred. Social media platforms were not a preference for this type of information (Table 15).

Table 3. I prefer to use the following to get more information on bats (please check all that apply):

I prefer to use the following to get more information on bats:	Count (n=23)
Alberta Community Bat Program website	12
Other websites	12
Book or manual	11
Hands-on workshops	11
Newsletter - emailed	11
Videos	11
Pamphlet or brochure	9
Presentations - either live in-person or via video-conferencing applications online	8
Facebook	5
Newsletter - by conventional mail service	4
Twitter	0
Instagram	0

Respondents were asked if they would be interested in participating in monitoring programs for bats. The highest level of interest appeared to be in reporting roosts (with homeowners' permission) to a

community bat program (Figure 19). Varying levels of interest were indicated for programs that involved either submitting dead bats for Pd sampling or doing environmental swabs for Pd.

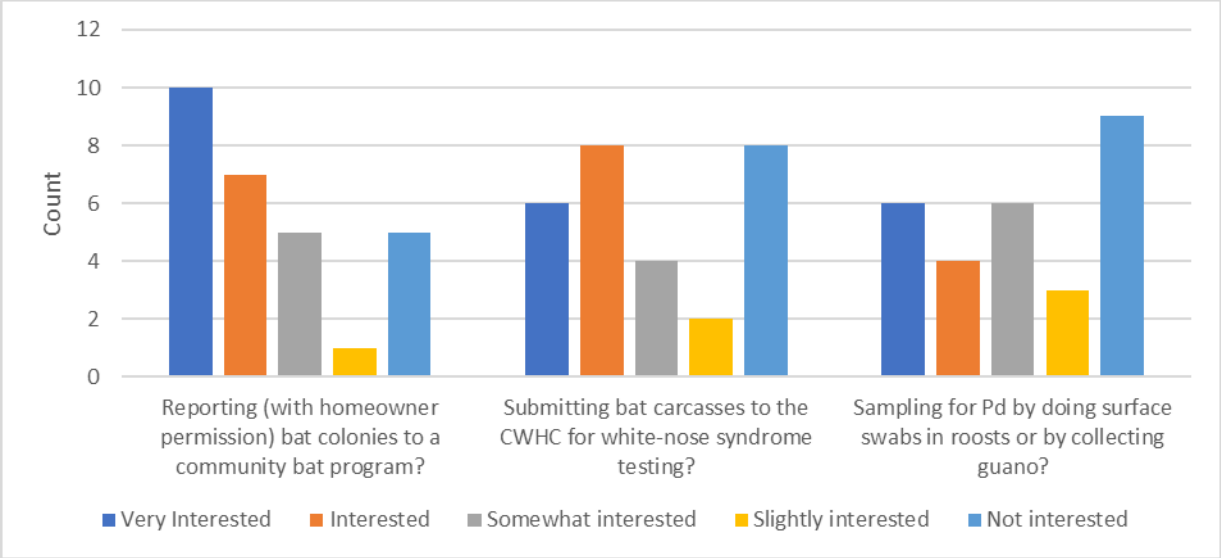

Figure 19. Level of interest in participating in monitoring programs for bats (n=28).

The three most identified barriers preventing PCOs from employing bat-friendly management practices involve the homeowner (Table 16). Fear of bats, lack of understanding, and cost to the homeowner were identified as the primary issues. Closely followed were concerns about human health, risk of contact with bats and unsanitary conditions that can arise when bat guano has been left to accumulate. Timing windows for homeowners was also identified as a barrier. About 20% of the respondents identified the timing windows as inconvenient but only 10% thought that the length of time to do the job properly was a problem.

Table 16. What are the barriers that prevent you from employing bat-friendly techniques (e.g., using timing windows for evictions, or recommending retaining colonies if possible)? Please check all that apply.

What are the barriers that prevent you from employing bat-friendly techniques	Count (n=19)
Homeowners fear of bats.	15
Homeowners lack of understanding of bats.	14
Cost to homeowner.	10
Human health concerns - risk of human contact with bats.	9
Timing windows are inconvenient for homeowner.	9
Human health concerns - unsanitary conditions.	7
Timing windows are inconvenient for pest control operators.	4
The job takes too long to do properly.	2

We allowed respondents to comment further on the barriers that prevent the use of bat-friendly techniques; eleven people responded. The major points from these comments are summarized:

- Education of the public is an issue – "*There is very little education out there for people about bats. Most people are just terrified of them and have no idea how much of a benefit they are*."
- Bad press – "*Media coverage on rabid bats is very misleading and results in far too many people killing bats out of fear*."
- Need for more training for PCOs – "I need more training." "Not aware of the techniques used for exclusion."
- Legislation is problematic – one person expressed a "*Fear of legislative repercussions*." While another complained that the "*Competition was doing work in non-bat-friendly ways that would result in clients to be bat free faster than using our methods*."
- One respondent stated that *"Heights and the equipment to manage heights"* was a barrier.
- Two basically said that there were no barriers and that they use bat-friendly methods.
- And another expressed that "*Everything taught over the years condones having bats in attics. Should never have bats in a building*."

And finally, we asked how we could help PCOs overcome the barriers identified as preventing the deployment of bat-friendly management practices (Table 17). The most frequent answer was education and training for PCOs as well as education for the broader public community. There were single votes for large fines for companies harming bats, providing pamphlets to homeowners, and offering suggestions for sites where bat-related gear can be purchased.

Table 17. How could we help you overcome those barriers?

	Count (n=13)
Education and training for PCOs	9
Education and training for the public	2
Large fines for companies harming bats	1
Provide information pamphlets about bats to give to homeowners	1
Supply or suggest sites for purchasing bat-related equipment	1

Additional comments from respondents:

- *As to my knowledge, I'm the only company in Alberta with a basic bat management certificate. I received this from NWCOA. This is an American organization. I strongly believe that all PCOs and wildlife management companies should have this or something similar. Preferably Canadian. Focus should be on best management practices and shared (proper) information to the general public by the wildlife management companies and PCOs . Every year I receive misinformation from a client that (received) from a professional... Bat advice. I would be happy to assist with any information training seminars you may be putting together. Currently I'm offering this service on my website.*
- *Our company is a very unique program in wildlife management, use ultrasonic and scents to deter wildlife.*
- *Education for the public- in commercial type information- short quick info bits*
- *I really think you need to take this to the national level and get this put on not only a regional seminar but on the national seminar. Those seminars are every year. This year is going to be only on the web but generally we have a national convention where are these types of courses would benefit so many Pest Control Techs.*

- *Its past due that the Provincial governments take bat protection seriously. Sask MOE just continues to allow bats to be slaughtered and holds no one accountable for doing so.*
- *The general public that choose to own near a body of water need education on bats.*
- *There are not enough bat calls to be overly involved in extra certification.*

3.3. The Bat Quiz Results

The quiz was completed by 14 respondents, primarily males living in Alberta, between the ages of 45 to 60 years. The average score for the quiz was 68%, highlighting the need for further education for bats in Alberta and Saskatchewan.

In general, respondents had a satisfactory understanding of basic bat knowledge. Almost all knew that bats are mammals, bats are a conservation concern due to their slow growing populations, and that there are sensitive times of the year when building exclusions should not be done. Almost 75% of the respondents were aware that typically only one baby is born to each mother each summer, and most respondents knew the difference between a maternity roost and night roost. Most respondents also knew that not all bat species found in Alberta and Saskatchewan roost in buildings or bat houses. There appeared to be some confusion about whether bats in Alberta and Saskatchewan will spend the winter in bat houses (64% answered correctly), and about hibernation behaviour of bats in Alberta and Saskatchewan (57% answered correctly). A notable area that requires further education is the diet of bats. All respondents knew that bats in Alberta and Saskatchewan eat insects (e.g., flies, beetles, moths etc.), and 50% knew that bats will sometimes eat spiders. However, 29% also said that bats eat fruit and/or nectar.

Almost all respondents were aware that bats are not listed as a pest species in either Alberta or Saskatchewan, and that a bat found cold and unmoving is not necessarily dead. An additional area that requires further education is bat guano. The respondents appear to be unaware that bat guano only rarely contains or supports a fungus that can cause Histoplasmosis (64% answered correctly). It appears that respondents use a variety of characteristics, including size, colour, texture, location, and smell to determine if the feces they encounter are bat or rodent. However, “texture – hard and claylike” is not a feature used to identify bat guano, and it was a characteristic selected by 36% of respondents. In addition, 14% said they only rely on size to differentiate feces types, which is likely not indicative enough. There is also some confusion of how to differentiate bat bugs from bed bugs, and what defining characteristics to look for.

Bat species identification was generally done poorly, except for the more commonly encountered species, the Little Brown Myotis and the Big Brown Bat. Just over half of the respondents knew that there were 8 or 9 different species in Alberta and Saskatchewan. 71% of the respondents were correctly able to identify the Little Brown Myotis. However, 21% also incorrectly identified the Little Brown Myotis as the Big Brown Bat, suggesting that due to misidentifications, similar protections should be applied to both species. 64% of respondents were correctly able to identify the Big Brown Bat, however it was also confused with other Myotis species (21%). The remaining species that were presented in the quiz were answered extremely poorly. The Long-eared Myotis was identified correctly 36% of the time, with the next most common answer being a Silver-haired Bat (21%). Respondents correctly identified the Silver-haired Bat 7% of the time with the majority thinking it was a Myotis species (36%) or a

Spotted Bat (21%). Respondents also seemed unaware of what a Hoary Bat looks like with only 29% correctly answering and the majority thinking it was a Silver-haired Bat (36%).

4.0 IMPLICATIONS AND CONCLUSIONS

4.1. The Short Phone Survey

- The "process" of conducting the telephone survey established a linkage between PCOs and the bat conservation program. PCOs who work with bats took the time to talk about their experiences and relay their own concerns. The take-away message from those conversations is that PCOs want clear regulations/policies, clear direction on bat-friendly practices and affordable, accessible training opportunities that focus on bats. Almost all the PCOs who work with bats regularly expressed clear support for bat conservation.
- Based on our survey result of 57 PCOs who responded that they would work with bats to some degree, there are about 50 to 60 PCOs between Alberta and Saskatchewan who will answer calls that involve bats. About 85% of these companies will generally handle "small bat jobs" like removing a bat from a home (inside or outside) and some will address small colonies that have occupied an attic or other part of the home. For these companies, bat work comprises 5% or less of their annual business. Some companies will do clean up only (some not at all). There are a small number of PCOs who make bat work their focus and a few companies that work with bats more than 30-50% of their time.
- There is no single association or group that will reach all PCOs in Alberta and Saskatchewan. It is not mandatory for PCOs to belong to the Pest Management Associations (PMAs) that exist in each province. Although it appears that many of the Saskatchewan PCOs belong to the Alberta Association. The provincial PMAs are linked to the Canadian PMA which also has close ties with the US-based National Pest Management Association. There does not appear to be a high degree of connectedness of PCOs to a single organization.
- Many PCOs are also aware of the US-based National Wildlife Control Operators Association (NWCOA) which appears to be the only organization that offers a clear, certification for working with bats. However, we were unable to access their course material to evaluate the suitability of that program as "bat-friendly" and relevance to Alberta and Saskatchewan. The material is only viewable by paid course registrants and we failed to get a response when we made inquiries regarding the course. Further investigation into this program might be worthwhile. The Structural Pest Control Operator certification course at Vermillion College (mentioned by many of the respondents) also may include a very small component on bats (as relayed by a former course participant). We did not get a response from Vermillion College regarding course content, but this may also be worthy of further evaluation.
- Based on conversations with the executive of the Alberta Pest Management Association (APMA), there may be opportunities to either provide a talk or booth at their next conference or to create another opportunity for PCOs to access a webinar that would count towards the "credits" they are required to earn annually to remain in good standing with the association. A session needs to be at least 55 minutes in length to qualify for any kind of credit. The APMA

seemed very open to discussing options if there is enough interest within the PCO community. The results of our survey suggest that there is a strong interest.

4.2. The In-Depth Survey

4.2.1. Section One – The Respondent's Profile

- Respondents to the in-depth profile all worked with bats, three of the 28 respondents were bat specialists. The group of 28 respondents covered all areas of both provinces with their work. Most of them were independent owners, and only 14% belonged to larger PCO chains. This group is also experienced with most PCOs having six years or more experience working in pest control and over half having worked with bats or bat colonies for 6 years or longer.
- Again, there was no clear Association that represents all the respondents.
- Pest Control Operators that work with bats may also be called Wildlife Control Operators.

4.2.2. Section 2: Operations – Managing the business of bats

- Most respondents receive 10-24 bat calls per year, but two respondents respond to more than 100 calls per year. One company reported fielding more than 500 calls per year. Of these calls, the total number of calls that involved a colony of bats was 744 per year (one respondent indicated that they had received 480 calls per year, with the rest of the respondents receiving a combined total of 264 calls per year). These numbers are notable. It is unclear just how many bats this represents. Summer colony sizes for Little Brown Myotis can range from around 10 to over 1000. Big Brown Bat summer colonies range in size from 10 to about 100 (although larger colonies can form, they are just not common). It may be the case for both provinces, that there are a small number of PCOs that are having the biggest impact (either positive or negative) on bats in buildings.

  Ideally, if PCOs working with bats could fill out a simple form indicating the size and species of colonies and a general location – this would give wildlife managers a much clearer picture of the potential impact of building management and exclusions on local bat populations. Submitting a guano sample for DNA analysis would provide definitive species identification. Even a non-formal permitting process that provides a workflow for PCOs to follow for submitting these kinds of data or samples would be helpful. This is exactly the kind of information that is gathered with the ACBP's citizen science driven roost-monitoring program. Responses indicate that there is really no formal permitting process in place in either province for working with bats as a PCO, and this is an area that they would like further clarification and support.

- From a business perspective, bats represent a livelihood for just a small number of operators, but a larger group also participates in bat work and all have the potential to a) influence bat populations and b) influence and educate homeowners. PCOs generally get three types of calls about bats. Bats that need to be removed because they have incidentally flown inside a building; bats that are roosting outside a building, and the larger job, managing colonies in occupied buildings.

- We did not ask about the age of buildings which was likely a factor in the types of buildings used by bats. Rural areas and suburbs had more reports of bats. However, bat colonies appeared in all types of buildings in all locations. Information on the size of bat colonies using different building types and age classes would have been informative. However, we had concerns that response rates may drop if questions became too onerous to answer.

- Most of the PCOs responding to the question about the types of work they do, indicated that they would remove incidental bats that have flown into buildings, and most do exclusion work and treat sites for bat bugs if needed. Not everyone participates in the attic cleanup and building repairs, and many indicated that they use third party contractors to complete this work.

  Of concern is the ten PCOs who indicate that colonies of bats are captured and removed from attics (either by themselves or a hired third party, Figure 10). This is an almost certain indication that bat work is being conducted during the sensitive timing window for bats. It is possible that PCOs are reporting on small groups of bats formed very early in the season (during early pregnancy) and outside the sensitive window. However, these bats could be excluded using one-way exits. In most situations bat exclusions can be done without ever needing to physically handle a bat. This process is not only safer for bats, but safer for people.

- Typical colony sizes handled by PCOs tend to be small (less than 10 bats) and most reported that they never see colonies of more than 100. However, four PCOs reported routinely responding to calls with colonies larger than 100 bats. Possibly the discrepancy is due to the fact that the few PCOs who are “bat specialists” may be handed the jobs of managing the very large colonies. Again, this indicates that the potential effect on the largest number of bats is held in the hands of just a few operators. The answers to this question may be slightly confounded by PCOs who lump single bats in with their definition of a “colony”.

- The comments provided by PCOs indicate that they want a clear and safe process for bat exclusions. They want that process available and for it to be consistently expected from operators across both provinces.

- Most operators were aware of the federal listing of the Little Brown Myotis as endangered. They did not feel that it had affected their business and many simply operate with the assumption that the bats they are working with are protected. However, some of the tactics used to manage bats in buildings would not necessarily be considered bat-friendly. This may be more a result of lack of information than willful action.

- Clearly there is a need for more training for PCOs. Current programs are not providing the necessary background. Most PCOs are hunting this information down by themselves and there is no guarantee that they will find reputable sources. The low numbers of PCOs taking online courses may simply reflect the lack of the availability of such a resource.

4.2.3. Section 3: Pest Control Services

- Based on the responses regarding rabies vaccinations and titre checks, it is concerning that PCOs handling wild mammals do not consider these as a standard practice (75% of 28 respondents said that rabies pre-exposure vaccinations were “never” or “rarely” a routine requirement for their work). Anyone expecting to handle bats as part of their work should have their pre-exposure rabies vaccine and check their blood titre to ensure that they have safe levels of immunity every two years (85% of the 27 who answered the question said they never did a titre check). Some PCOs may handle few bats, but if they expect to handle any bats, they should be vaccinated. The few PCOs that work almost exclusively with bats are the few that reported having their rabies vaccination and blood titre levels checked regularly. Although rabies is rare, it is fatal once symptoms appear, so preventative measures are important for those working in the industry. In addition to human health concerns, keeping human rabies cases at zero is important for conservation because it is one of the key drivers for negative public perceptions of bats. We consulted both provincial health authorities to determine the current position on rabies pre-exposure vaccinations (availability, cost, recommendations). Currently, pre-exposure rabies vaccinations are not covered under the Saskatchewan Health Authority guidelines; however, they are covered by Alberta Health Services (they can contact their family doctor or public health unit and indicate they work with bats). Saskatchewan does cover costs of post-exposure vaccinations.

- About half of the respondents indicated that they identify bats to species. Without measuring forearm length and closely examining animals, it can be a tricky proposition to do this accurately. Results from the “Bat Quiz” indicate that bat identification skills might be overestimated by respondents.

- One-third of PCOs indicated that there were safe handling and removal/exclusion protocols for bats while the rest said that either there were none or they did not know of any. This suggests that the certification process for becoming a “Structural Pest Control Operator” has either failed to provide instruction on bats or there is inconsistent training. It would have been helpful to go back to the PCOs who indicated that they knew of protocols to determine the source. The few PCOs who state that protocols exist may be referring to the NWCOA’s certification in the US (which was mentioned in the phone interview portion).

- There is clearly an issue with PCOs either excluding or evicting bat colonies within the sensitive window when females are pregnant or with pups. The circled portions of Figure 14 indicate that PCOs are conducting exclusions year-round, including the period of June and July (late pregnancy and lactation). We would expect to see no bat management activity during this period if PCOs were following bat-friendly guidelines. Admissions of evicting colonies implies that they are removing groups of bats, specifically in June and July, but the period of August and September may also be problematic (especially in years with wet and cold springs). Ideally, if PCOs were following bat-friendly protocols, most exclusions would be occurring outside the sensitive window and they would not be conducting evictions because bats would already have dispersed from the site on their own.

- Winter use of buildings by bats has not been well-addressed by anyone. We are currently learning just how prevalent this behaviour is with bats. We have some general practices to suggest for managing wintering bats but with better information, these best practices could be improved. In Saskatchewan and Alberta, it appears to nearly always be Big Brown Bats that hibernate in buildings during winter. Several PCOs indicated that they had found bats in buildings in winter. This issue seems particularly prevalent in Saskatoon, but it may be a more common behaviour than we know across the prairies where natural hibernation sites are suspected to be scarce.

- Methods used to manage bats range from low to high impact for bat health and safety. On the low impact side, PCOs routinely used one-way exits and a few routinely conducted colony exclusions using timing windows (Table 5). They also used ultrasonic repellents (it would be interesting to see how successful they have been with this method).

- The transport and relocation of bats has important implications for their conservation. For random bats flying into homes this practice may be necessary (but we would still recommend releasing bats within a kilometre of their capture site). What is more of a concern is if the PCOs are driving a large colony of bats in a cage 100 or more kilometres away and releasing them (Figure 17). Relocations are a risk to bats for several reasons. First, it may disrupt local bat communities that are now sharing food and roost resources with a new colony. Second, this practice risks accelerating the spread of disease agents and parasites, and is a particular concern given the proximity of Pd to Alberta and Saskatchewan. If bats are carrying the fungal spores of Pd, relocating them may accelerate infection rates of WNS to new uninfected populations. PCOs moving between bat colonies should be disinfecting boots, clothes, and equipment to prevent spread. Bats should be released close to their capture point.

- The most concerning practices include exclusions/evictions that are occurring anytime of the year or when bats are present, the use of mist nets for capturing bats, physical removal of multiple bats, smoking/fogging or use of other chemical repellents (although it is unclear if all chemical repellents are bad for bats) (Table 5) or for single bats the use of chemicals, extermination, and suction/vacuum devices (Table 6). Some of these activities were reported as “routine” others “rarely”. All are problematic and would not be considered a “bat-friendly practice”. Further, albeit rarely, PCOs admitted to the use of glue traps and cervical dislocation to dispatch bats (outside of instances where accidentally injured bats required euthanasia). These practices are inhumane and need to be specifically strongly discouraged. In fact, the use of glue boards was reported by a few of the telephone respondents who wanted to clearly state that they knew of other PCOs using them and they felt that it was both inhumane and wrong. There are more effective, humane methods that can achieve better outcomes than using these methods.

- Mist-nets are often used for research purposes and they do require specific training to use them without harming animals. There are also specific WNS decontamination protocols that need to be followed when using these kinds of live capture devices. Use of small mesh netting (not mist nets) in front of access points to prevent entry is also a good method to use with bats, but again,

only during the appropriate timing windows. Although ultrasonic repellents are low impact to bats, they are often cited as being ineffective. It's interesting to see that they are employing these types of devices. Transport and relocation of bats can be avoided if colony exclusions are conducted during appropriate timing windows. Bats should never be moved for release far from their point of capture. There can be negative impacts to bats using this method, including the potential to spread diseases or parasites, and eleven respondents are employing this method to varying degrees.

- The survey indicated non-friendly bat practices for single bat removal including the use of suction/vacuum devices, extermination, and chemical repellents. Albeit only a couple of respondents stated that this was an option; it is concerning that these methods are being used. Outside of euthanasia for accidentally injured bats it is unclear why two respondents reported using glue traps and cervical dislocation. Glue traps are considered inhumane, and they are not bat-friendly

- Managing a building to retain a colony is rare according to our 28 respondents. However, the PCOs who participated in the survey did use a number of the practices that we suggest for safely retaining colonies. The truth is that for some types of buildings (older structures that are very "porous"), it is almost impossible to seal up every access point for bats, and retention is the inevitable result. Safely retaining a colony is often a good option, not only for bats, but for people. Retention can be cheaper than spending a number of seasons trying to exclude bats, and people involved can be taught how to safely live with bats as neighbours.

- Truly managing bats in buildings is not a "bat issue" but rather a "building issue". Proper annual maintenance will ensure that there are no access points for bats. PCOs listed several common entry points for bats in buildings and almost all of them involve maintenance although some types of home or roof design often "accidentally" creates perfect homes for bats. Cedar shakes, clay or concrete tiles and tin roofing that leaves an accessible gap underneath will often be used by bats. Blocking the access point along the roof edge will prevent bat access. Building designs can sometimes "accidentally" create ideal bat roosting habitat too. Dormers, multiple roof lines with overhangs, and skylights can be an issue while log and brick homes are often attractive due to the stable thermal properties they offer.

  Roofing materials and compromised roofing features are often sources of access for bats and PCOs work with roofers and construction professionals to manage bat issues. These industries should also be part of an overall communication strategy to promote bat-friendly management of bats in buildings.

- There are some clear issues regarding the types of bat houses recommended by PCOs to clients. Out of 27 who responded to the question about bat house design, almost half of them said they recommend single chambered boxes which have been found to have issues with overheating, which could be a risk to bats, especially pups. . The second-most recommended style of bat house, the small multi-chamber boxes, may not be able to retain enough heat to reach high temperatures, but are unlikely to support maternity colonies. The ACBP recommended style (the

large multi-chamber nursery box) was only recommended 22% of the time. In addition, several respondents never recommend bat houses. Part of bat-friendly exclusion includes installing appropriately designed bat houses, if suitable locations exist, for bats in the summer prior to the exclusion so bats can become accustomed to the new roosting options in the area (Brittingham and Williams 2000, ACBP 2019, Arias et al. 2020). When the bats return the following spring, they are already aware of alternative roosts (i.e., bat houses) when they find access to the building roost blocked. A training program for bat-friendly exclusions for PCOs would include a component on bat house design and installation.

- One-quarter of the PCOs surveyed were very confident in their ability to identify bat species. It is possible that these individuals may reliably be able to identify a Big Brown Bat, but the myotis species can be very difficult to tell apart. Results from the "Bat Quiz" indicate that bat identification skills may be lacking in some respondents. When asked which species they most commonly encounter as part of their work, PCOs listed all possible species as "rarely" observed, but this assumes that they can accurately identify bat species. Specific training is required to accurately identify bat species, and this does require handling and measurements. Not surprising though that the top three species listed were Big Brown Bat, Little Brown Myotis and Unidentified Myotis. These would be the three species categories we would expect for buildings.

- There have been significant changes in handling practices for bats since the arrival of white-nose syndrome. Bat biologists routinely use disposable gloves and decontaminate equipment between sites and PCOs should too. There is some evidence that fungal spores can still be present in guano at maternity colonies year-round. Animals with spores or fungus growing on membranes may bring that material with them to the summer roost and in the process of grooming, ingest material and excrete it in their guano. Transport of spores from guano in these roosts is possible and therefore decontamination procedures should be followed before moving between bat roost sites.

- Current COVID-19 protocols have now added the use of personal protective equipment (PPE) when working with bats or near bats. The concern is that humans may be able to transmit the virus to bats (which is something that needs to be avoided). Recent work found that Big Brown Bats were resistant to infection by SARS-CoV-2, the virus that causes COVID-19 (Hall et al. 2020). However, scientists remain cautious of how other North American bat species may respond to the virus, so precautionary measures remain in place. The most recent CWHC protocols include:

  1. If close proximity to bats is occurring for an important project, recommended PPE includes at least: use of nitrile gloves, appropriate masks or respirators designed to filter ***exhaled*** *particles, and long-sleeved disposable or washable coveralls. Additional prevention strategies that should be adopted include proper hand and respiratory hygiene. (From CWHC 2021).*

- There are resources available for pest control operators, but it may be that only a few are aware of them. The ACBP has a series of useful guidebooks available on their website (www.albertabats.ca). The Canadian Wildlife Health Cooperative provides updates on both

white-nose syndrome and COVID-19 issues that affect wildlife including bats (CWHC no date – WNS protocols; CWHC 2021). However, these resources are not helpful if PCOs are not made aware of them.

Promotion of a single portal (a single online location) for PCOs for information on bats would be helpful. PCOs are often the first line of contact with the public, especially for residents dealing with bats in buildings. PCOs are providing information on bat bugs, bat house design, histoplasmosis, and rabies. If the objective is to get the public on board with being bat-friendly, it is critical that these information sources are not only unbiased and factual, but also easily accessed and distributable by PCOs. Fortunately, the internet makes dissemination of information much simpler, but time, effort and funding must support any targeted campaign, and this must be repeated annually. In the grand scheme of things, this might not even require a large amount of funding, but it does need support and the messaging should be re-visited periodically to ensure it is up to date.

4.2.4. Section 4: Needs

- PCOs need more opportunities to be educated about bats and bat-friendly exclusion processes. They have stated that they would like to learn more about all the potential topics that we have suggested could be important. Most were interested in a voluntary certification program and providing this kind of program and information online appears to appeal to most of them.
- Although PCOs did not show a high interest in biological sampling for white-nose syndrome, this may be due to lack of detail regarding protocols and the effort involved. Interest may have been higher if respondents understood the requirements for these tasks. With a simple process in place, it may be feasible to get PCOs on board to participate in sampling.
- Most PCOs appear to support a bat-friendly approach to bat exclusions but they need some back-up guidance to convince homeowners to follow through. As there are no consistent rules, a PCO that asks a homeowner to wait until the fall to conduct an exclusion may lose that client because they can go to other PCOs who will conduct evictions or exclusions when bats are present. Homeowners not wanting to wait until bats have left and the lack of flexibility on this issue is likely fueled by fear and lack of understanding. Public education and allaying fears are important to get homeowners on board.

5.0 LESSONS LEARNED AND FUTURE PRIORITIES

Of the 101 companies that were surveyed in Alberta and Saskatchewan that are described as Pest Control Operators and suspected to work with wildlife, 57 indicated that they worked with bats to some degree. Of those 57 companies, we received 28 unique and completed in-depth survey forms. That is a response rate of 49% which is above average for this kind of survey (generally, average survey response rates are about 33% and telephone surveys are typically only 18%, Lindemann 2019). Further, our initial phone survey was quite successful with 101 unique respondents to the telephone survey which represents a response rate of 59% (101/170) but these respondents represented 75% (129/170) of the franchises that we aimed to sample (there were 170 possible pest control franchises to survey).

Offering the "prize" of the Echometer Touch 2, bat detector module was a good incentive and provided a talking point to keep respondents interested. It is unclear what would have improved the response rate further. Perhaps attending a pest management annual conference and conducting surveys in person may have improved responses, Lindemann (2019) indicates a response rate of 57% for in-person surveys.

There is no way to know if our sample population was biased towards being bat-friendly or not. Responses to questions indicate that current practices reported are not necessarily bat-friendly. The actual total number of PCOs doing bat work in Alberta and Saskatchewan is likely accurately represented by the 57 companies contacted. There may have been a couple that we did not find, but our search was as thorough as possible.

Suggestions for going forward

1. Promote resources for PCOs, businesses, and homeowners that explain how to manage bats in buildings in a bat-friendly way.
2. Create a list of PCOs who have been certified as being bat-friendly and make that list available for consumers on the ACBP website.
3. Promote available resources for PCOs that explain concerns and procedures for both white-nose syndrome and prevent exposing bats to humans with COVID-19.
4. Make the brochure, "Beneficial Practices for Bats in Buildings for PCOs" freely available to both PCOs and to instructors of the certification programs for Structural Pest Controllers.
5. Make the ACBP guidebooks available to PCOs (and promote them to this group).
6. Develop a training module for PCOs on how to be bat-friendly; ensure that there is a pathway for delivery of the module.
7. Explore how existing government policies might be better used to ensure that exclusions are conducted outside of the pup rearing period or explore avenues for new policies or regulations.

5.1. Promotion of bat resources

- Conduct an information campaign to reach wildlife/pest control operators in Alberta and Saskatchewan. Provide links to downloadable/printable pdfs for distribution and/or print materials for distribution.
- Arrange for a speaking engagement and/or booth at the next Pest Management Association meeting for Alberta and Saskatchewan.
- Provide materials for PCOs on our website www.albertabats.ca/pco and fund social media efforts to promote this material.
- Produce a video to supplement educational/training materials and use also as promotion.

5.2. Brochure—Alberta Bats: Beneficial Management Guidelines for Pest Controllers

WCS Canada's Alberta Community Bat Program (ACBP) currently has a draft brochure directed at the pest control industry that provides information to improve how building roosting bats are managed. We

developed this guide based on information and recommendations in our “Managing Bats in Buildings” and “Building Bat-friendly Communities” guide (www.albertabats.ca/resources). These resources were developed in collaboration with Alberta Environment and Parks (Lisa Wilkinson), the Alberta Bat Action Team, the British Columbia Bat Action Team, and the BC Community Bat Program. “Managing Bats in Buildings” has since been adapted by the Northwest Territories (https://www.enr.gov.nt.ca/sites/enr/files/resources/3546-gnwt-enr-bats-guidebook_july15.pdf) and Newfoundland and Labrador (http://www.cwhc-rcsf.ca/docs/Bats%20in%20Buildings%20BMP-%20NL%20Version%20FINAL%20(October%2016%202018).pdf). Guides developed by the Alberta Community Bat Program are meant to be ‘living documents’ that will be continually updated as new information becomes available.

The Best Practices for Pest Control Brochure will be made available on the Alberta Bats website on our subpage dedicated to Pest Control Operators. www.albertabats.ca/pco.

The Brochure has been adapted for both Alberta and Saskatchewan and is attached in Appendix 7.

5.3. Guidebooks Currently Available Through WCS Canada’s Alberta Community Bat Program

These guidebooks are available at: www.albertabats.ca/resources

5.4. Bat-specific training for Wildlife and Pest Control Operators in Alberta/Saskatchewan

- Use materials and processes already developed by British Columbia to create a training module.
- Create specific training based on the three guidebooks listed above.
- Create a video and a recorded webinar for training purposes.
- Work with the Pest Management Associations to make this training “for credit”.
- Support the ACBP to engage the Pest Management Association at their annual conference with a bat talk and bat booth.
- Explore the feasibility of a hands-on course in-person if species identification and handling is identified as a priority.

5.5. Government policies and regulations

- Protect bats by requiring work on buildings with active colonies to wait until pups have flown and colonies have dispersed.
- Protect bats by requiring work on buildings with wintering bats to occur during the spring or perhaps more preferably during fall, outside the maternity timing window, and encourage the use of one-way exits.

6.0 APPENDICES

Appendix 1. BACKGROUND INFORMATION

Provincial Legislation for Bats

The Alberta Wildlife Act and Regulations

Bats are considered "prescribed wildlife" under the Wildlife Act and the Wildlife Regulations. Under the Alberta Wildlife Act Section 36(1) **A person shall not wilfully molest, disturb, or destroy a house, nest, or den of a prescribed wildlife in prescribed areas and at prescribed times**.

This regulation does not apply to situations that have specific authorizations such as under the Agricultural Pests Act or Water Act. Exceptions can also be made by those authorized in the control of wildlife depredation or collection or by permission of the minister.

From Section 96 of the Wildlife Regulations, Section 36(1)(a)(iii) of the Wildlife Act **applies to nests and dens of bats throughout Alberta and from Sept 1st to April 30th of the following year** and (a.2) **to the dens of bats, excluding those constructed by human beings, used as hibernacula, throughout Alberta and throughout the year**.

In Alberta, bats are listed under Schedule 5 of the Wildlife Regulations as "Controlled Animals", specifically, the regulations list: 5. All bats (order Chiroptera). Alberta bats are currently separated by species into two separate lists. With seven of the nine species listed as "Non-Game Animals" (Part 5) and two species listed as "Non-licence Animals" (Part 6). See Table A1.

Damage Control Licences and Permits may allow hunting and live trapping for non-licence animals throughout the year. Non-licence animals can be held without permit except bats which **can only be possessed for the purposes of relocating them**. Damage Control licences can be issued by the province for collection, taxidermy or for killing wildlife.

Table A1. Classification of Alberta bats by the provincial and the federal governments. All bats are considered "controlled animals" under the Alberta Wildlife Act and Wildlife Regulations.

Wildlife Regulations Species Designation	Alberta Species Status (2015)	COSEWIC Species Status	Common Name	Scientific Name
Non-licence	**May Be At Risk**	**Endangered**	**Little Brown Myotis**	***Myotis lucifugus***
Non-licence	**Secure**		**Big Brown Bat**	***Eptesicus fuscus***
Non-Game	Sensitive		Western Small-footed Myotis	*Myotis ciliolabrum*
Non-Game	Undetermined		Long-legged Myotis	*Myotis volans*
Non-Game	May Be At Risk	Endangered	Northern Myotis	*Myotis septentrionalis*
Non-Game	Secure		Long-eared Myotis	*Myotis evotis*
Non-Game	Sensitive		Silver-haired Bat	*Lasionycteris noctivagans*
Non-Game	Sensitive		Hoary Bat	*Lasiurus cinereus*
Non-Game	Sensitive		Red Bat	*Lasiurus borealis*
Non-Game	Accidental/Vagrant		Yuma Myotis	*Myotis yumanensis*

The Saskatchewan Wildlife Act and Regulations

The Saskatchewan Wildlife Act and Wildlife Regulations **protect native wildlife (i.e., including bats) from being taken, kept captive, wilfully destroyed or disturbed.** Wildlife (i.e., including bats) are considered property of the crown or the province and **are not allowed to be exported or imported without permit or licence**. "Designated species at risk" in the province enjoy further protective measures but the list of species is short and has not been modified since the creation of the Wildlife Act and the species at risk list in 1998 (Olive 2018). There are no bats currently designated as a species at risk by the province of Saskatchewan. Saskatchewan supports a Conservation Data Centre (SK CDC) that tracks selected wildlife species (Table A2). For bats, the SK CDC also tracks the occurrence of two species (Long-legged and Fringed Myotis) strongly suspected to occur in Saskatchewan (specifically, the southern region) based on proximity occurrences in the adjacent state of Montana.

Table A2. Classification of Saskatchewan bats by the provincial and the federal governments. All SK bats are considered "native wildlife" under the Saskatchewan Wildlife Act and Wildlife Regulations.

Wildlife Regulations Species Designation	SK Species Tracked by the SK Conservation Data Centre	COSEWIC Species Status	Common Name	Scientific Name
Native wildlife	**X**	**Endangered**	**Little Brown Myotis**	***Myotis lucifugus***
Native wildlife			**Big Brown Bat**	***Eptesicus fuscus***
Native wildlife	X		Western Small-footed Myotis	*Myotis ciliolabrum*
Native wildlife	X	Endangered	Northern Myotis	*Myotis septentrionalis*
Native wildlife	X		Long-eared Myotis	*Myotis evotis*
Native wildlife			Silver-haired Bat	*Lasionycteris noctivagans*
Native wildlife			Hoary Bat	*Lasiurus cinereus*
Native wildlife			Red Bat	*Lasiurus borealis*
Possible Occurrence*	X		Long-legged Myotis	*Myotis volans*
Possible Occurrence*	X		Fringed Myotis	*Myotis thysanodes*

*shaded areas in the table indicate species not yet determined to be present in Saskatchewan but present in the neighbouring state of Montana. We expect these species may show up as bat species inventory expands in Saskatchewan.

Common Building Roosting Bats

Little Brown Myotis

Status:

The Little Brown Myotis is currently ranked as G3 or "vulnerable" by Natureserve (2021). Vulnerable species are at a moderate risk of extinction or collapse due to one or more of the following reasons: a restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors (NatureServe 2021). COSEWIC (Canada's Committee on the Status of Endangered Wildlife in Canada) recommended listing the Little Brown Myotis as endangered in 2012 and this bat was officially designated as an endangered species under Schedule 1 of the Species at Risk Act (SARA) in

December 2014 (Environment Canada 2015). The reason for this designation was primarily due to extensive mortality caused by white-nose syndrome (WNS) at hibernation sites in the eastern parts of their range in Canada (COSEWIC 2013). Approximately half of all Little Brown Myotis globally are found in Canada and declines of up to 94% have been recorded in bat populations in Nova Scotia, New Brunswick, Ontario, and Quebec (COSEWIC 2013). The fungus (*Pseudogymnoascus destructans, Pd*) that causes white-nose syndrome is an invasive species introduced to North America before 2006 in New York state (WNS 2021), and since then has been progressively spreading across the continent. The most recent records of the fungus in the west come from Riding Mountain National Park, Manitoba, in July 2019, and more recently, from the northern border of Montana, immediately adjacent to Saskatchewan, in the spring of 2020 (WNS 2021). The distribution range of the fungus has been expanding at an average rate of about 200-250 km/year, and there are currently no effective treatments for the disease and no means of containment. The fungus has not yet been detected in SK or AB (as of March 2021) but if the spread follows the typical trajectory, it will likely be detected in these provinces within the next 1-3 years.

Threats:

The current primary threat to Little Brown Myotis populations in Canada is white-nose syndrome (COSEWIC 2013). Understanding hibernation ecology and knowing where bats hibernate is critical (The Protection of Bat Roost Guidelines 1992, Thomas 1995, Klüg-Baerwald and Brigham 2017). However, in western Canada, we have incomplete information regarding either, and it is not known if the needs and habits of western populations differ significantly from eastern populations (which have experienced such high levels of mortality from this fungal disease). Based on the current pattern of detection of the fungus in year one and observation of sick animals in the immediate subsequent years, western populations of Little Brown Myotis are likely to experience heavy overwinter mortality in the two or three winters after the fungus (Pd) is detected. Ongoing population monitoring by the Alberta Community Bat Program will indicate if populations suddenly drop. The ACBP continues to provide conservation strategies for this species.

Other threats continue to affect Little Brown Myotis and are cumulative (COSEWIC 2013). Threats such as: habitat loss (loss of roost trees and buildings) and alterations (bats are excluded from buildings through renovations and evictions); loss of insect prey (observed frequently in other parts of the world as well); changes in climatic conditions (which can significantly affect insectivores and a species with specific overwintering needs); as well as predation by outdoor house cats.

Habits and general ecology:

Few species in Alberta and Saskatchewan have shown such close affinity for human-made structures as the Little Brown Myotis (Pybus 1994, Coleman and Barclay 2012). Historically, they were often the most abundant bat species in urban areas, with reports of Little Brown Myotis forming colonies of 1,000 individuals or more (but average colony size is much smaller ranging from 40-200 bats) (Coleman and Barclay 2011, Firman et al. 1995, Schowalter et al. 1979). Little Brown Myotis are often found using bat houses as well (ACBP 2018, BCI 2021). Natural roosts for this species include tree hollows and rock crevices (Fenton and Barclay 1980). Switching between roosts is common, especially among tree roosting colonies (Olson and Barclay 2013) but less common in building-roosting bats (Lewis 1995).

Little Brown Myotis are quite opportunistic and will use any roost they deem suitable. The safe, warm, and spacious sites offered by buildings are often sites where pregnant bats have consistent reproductive

success. Groups of pregnant or nursing females are referred to as “maternity colonies”, and the structures they occupy during the day are referred to as “maternity roosts”. (Schowalter et al. 1979, Fenton and Barclay 1980). The same group of bats may use the same building roost for many decades (Lewis 1995). These colonies are often composed of females that are related to each other over many generations. Bats are a long-lived species group; there is a record of a Little Brown Myotis from Alberta that was at least 39 years old (Hobson 2014) and a record of a 23-year-old Little Brown Myotis from Saskatchewan (Florko et al. 2017).

Mating occurs during the fall, with ovulation and fertilization delayed until bats emerge from hibernation in the spring. Little Brown Myotis emerge from hibernation from April to May and females start showing up at their summer maternity colonies soon after (Schowalter et al. 1979). The length of pregnancy can vary depending on the weather and use of daily torpor by pregnant females, however, bats are usually pregnant for about 60 days (Kurta and Baker 1990). If spring conditions are cold and wet, pregnant females use torpor, thereby dropping their body temperature and metabolic rate to save energy. This slows the growth of their fetus, extending the length of their period of pregnancy (Racey and Swift 1985, Audet and Fenton 1988, Grinevitch et al. 1995). Thus, consideration of when bats may be present in a building maternity colony should always evaluate the weather patterns that occurred early in the season. The average date for births for a colony can vary up to two weeks (Holroyd 1993). Female Little Brown Myotis give birth to single pups (and very rarely twins) with birth dates generally ranging from about mid-June to mid-July (Schowalter et al. 1979, Coleman and Barclay 2011), although a few females may give birth just outside that date range. Colonies generally disperse shortly after pups start flying, which happens when they reach about 18 days old, however they are not completely weaned until day 26 (Kurta et al. 1989). Weaning occurs about a week or so later, at around 27 days of age (Kurta et al. 1989). In southern Alberta, flying juveniles appear around mid-July to August (Schowalter et al. 1979, Holloway 1998).

Little Brown Myotis are strongly associated with aquatic habitats for foraging (Fenton and Barclay 1980, Clare *et al.* 2014). Buildings or natural roosts near large aquatic habitats (e.g., lakes, rivers) appear most likely to be used as maternity colonies and are important resources for the species (Schowalter *et al.* 1979, Pybus 1994). Little Brown Myotis on the prairies may rely on buildings for roosting maternity colonies more than any other feature (Schowalter et al. 1979, Fenton and Barclay 1980, Coleman and Barclay 2011) but breeding females will use other roosts too, including rock crevices (Holloway 1998) tree cavities (Coleman and Barclay 2011) and bridges (Olson and Flach 2016). Non-reproductive females and males will use a broader range of roosts than breeding females, and may be found in cooler sites, typically in small numbers (one or two bats).

During the warm months of May to September, bats may be found using the outside of buildings in the late hours of the night. These “night roosts” are where bats take a break from hunting insects and roost together in a group to stay warm. Night roosts can be composed of males, females, non-reproductive females, newly flying juveniles, and sometimes different species of bats. These sites are usually in a protected spot out of the wind where bats socialize, digest their meal, and poop (Barclay 1982). Homeowners often have issue with night roosts because of the mess, but these sites can be managed by simply sweeping the guano into a flower bed or by installing a potted plant beneath the roost site. Most people never see the bats, only the guano they leave behind. There are no health hazards associated with bat guano at a night roost (dry guano will not support any problematic fungal species and rabies is not transmitted via bat guano or urine CDC 2021). Later, in August and September, bats are often found

clinging to the outside of buildings during the daytime. These may be juveniles dispersing from maternity colonies (Riskin and Pybus 1998) or adults moving between summer roosting areas and winter hibernation habitats.

Big Brown Bats

Status:

Big Brown Bats lack any effective protective legislation in either Alberta or Saskatchewan (Table A1 and A2). Alberta considers Big Brown Bats as non-license animals; Saskatchewan lists them as native wildlife. Both provinces consider populations of this species secure.

Threats:

Big Brown Bats have been shown to be affected by white-nose syndrome but less so than other species. One study from New York state found Big Browns to be resistant to the fungus that causes WNS (Frank et al. 2014) but another study in the northeast found a 41% decline in Big Brown Bat populations five years after WNS had arrived in that area (Turner et al. 2011). It is unclear how the fungus may affect wintering Big Brown Bats in Alberta and Saskatchewan, or how this species may fare in the face of this disease, but the ACBP citizen science project to monitor roosts across the province will give some idea of how populations are going to be affected. Other threats to this species include habitat loss (loss of old, mature trees for roosting), and wetlands and other productive habitats for foraging. Widespread use of pesticides may impact prey populations; global observations of insect population declines will affect this species. Destruction of colonies, especially in anthropogenic structures like buildings is probably the leading cause of mortality for this species. Big Brown Bats are also affected by wind turbines, but less so than migratory bat species (Davy et al. 2021). Climate change is likely a threat to all bat species by disrupting local weather patterns (Adams 2018). Bats are highly responsive to environmental temperatures and survive winter by enduring predictable, stable temperatures, while during summer, bats require warm temperatures to ensure maximum growth rates of pups, and warm, calm, dry nights for hunting insects.

Big Brown Bats can be difficult to discriminate from Little Brown Myotis which may suggest that the most cautionary approach to bat management in buildings is to assume that all colonies in buildings fall under the same rules as those applied to Little Brown Myotis. Of particular concern for Big Brown Bats is their tendency to hibernate in buildings in winter. Generally, for bats, hibernation sites are considered critical habitat. It is unclear whether winter building use by this species is an adaptation to a new habitat resource (buildings) or if it reflects a loss of habitat (natural winter hibernation sites) or a combination of both. The status of the species needs to be re-examined to ensure that loss of summer and/or winter roosting habitat in anthropogenic structures does not result in significant population losses.

Habits and General Ecology:

Big Brown Bats are flexible, generalists. Their diet is often dominated by beetles, but they will eat a variety of insects from a variety of habitat types (riparian, upland, farmland, and pasture areas). They will hunt patches of insects that collect around outdoor lights. Big Brown Bats are often associated with areas near rivers (Brigham and Saunders 1990, Wilkinson and Barclay 1997, Holloway and Barclay 2000); roosting sites are likely to be found near rivers or some type of water feature. They are strong flyers that can move up to 26 kilometers away from maternity roosts to hunt in a night (Wilkinson and Barclay 1997).

Big Brown Bats are one of the most common prairie bat species but less common in the boreal forest regions (Pybus 1994). Their natural roosts include cavities in large old trees and warm rock crevices; however, they will also readily use both buildings and bat houses (Schowalter and Gunson 1979, Agosta 2002) and often use multiple natural roosts in summer (Willis and Brigham 2004) but show high fidelity to building roosts (Lewis 1995, Barclay 2012). In some areas, human structures may represent their primary roosting habitat (Schowalter and Gunson 1979, Agosta 2002). Living in close proximity with humans puts them at risk of deliberate or accidental disturbance or mortality from human activities. Bat populations have historically not been monitored, so it is unclear what the impact is from the loss of anthropogenic roosting structures on this species.

Big Brown Bats give birth between mid-June to late July in southern Alberta (Holloway 1998, Lausen and Barclay 2006*a*, Barclay 2012). Environmental conditions, temperature and precipitation can influence the timing of birth and length of gestation (Grindal et al 1992, Holroyd 1993, Lausen and Barclay 2003, Barclay 2012). Mothers nurse their pups for 4-5 weeks (Kunz 1971) and juveniles begin flying between mid-July through until the end of August. Hibernation lasts between November to April (Nagorsen and Brigham 1993) but these bats may become active on warm nights throughout the winter, perhaps making flights to nearby sources of water (Lausen and Barclay 2006b, Klüg-Baerwald et al. 2017, Klüg-Baerwald and Brigham 2017).

Big Brown bats will hibernate in buildings and this may be a common occurrence in Alberta and Saskatchewan (Schowalter and Gunson 1979, Perkins *et al.* 1990, Whitaker and Gummer 1992, Nagorsen and Brigham 1993). Little research has been done in Alberta and Saskatchewan to evaluate the importance of building hibernacula for Big Brown Bats. Studies of natural hibernation sites have found that deep rock crevices in river valleys appear to be important hibernacula for Big Brown Bats in prairie environments (Lausen and Barclay 2006b).

Species Identification: Big Brown Bats vs Little Brown Myotis

Bats can be difficult to distinguish (Figure A1), especially without measuring the forearm length and closely examining identifying features such as the presence or absence of a calcar (Figure A2) and the length and shape of the ear and tragus. Little Brown Myotis and Big Brown Bats are similar in

Figure A1 Big Brown Bat (left) in comparison with Little Brown Myotis (right).

appearance and although Big Brown Bats are twice the size of a Little Brown Myotis, they both look small and can be easily confused. These two species can be separated by their echolocation calls, with the Little Brown Myotis echolocating at around 35 – 40 kHz and the Big Brown Bat echolocating at around 25 kHz. They can also be definitively identified by using bat guano for DNA analysis. Big Brown Bats are often distinguishable in photographs, especially if a clear picture of the head and face are obtained (see Table A3).

Table A3. Comparative differences between Big Brown Bats and Little Brown Myotis, a summary.

Big Brown Bat (*Eptesicus fuscus)*	**Little Brown Myotis (*Myotis lucifugus*)**
• Prominent cheek bulges that lack fur • Large bright eye and broad head • Ears are medium-sized and slightly rounded • Fur colour can vary from dark brown to blonde but back and belly tend to be similar in colour, with no silver tips • Typically weighs 15-20 grams • Forearm length is usually greater than 42 mm, the upper limit of Little Brown Myotis. • Prominent keel on calcar • Lacks furred underwing • The only other species with a keeled calcar and forearm is the Long-legged Myotis – but facial features are different and Long-legged Myotis have a furred underwing	• Small pointy nose with fur coming down a bit further on the nose than the Big Brown Bat • Cheeks are slightly furred • Ears are generally medium-sized but slightly pointy; ears do not extend past the nose-tip when pushed forward over the nose • Fur colour is often lighter on the belly than the back; fur is long and glossy • Typically weighs 8-9 grams • Forearm length is less than 35 mm • No keel on the calcar • This species can be confused with Yuma Myotis, but this species has not been found in Alberta or Saskatchewan (it is present in Montana and British Columbia)

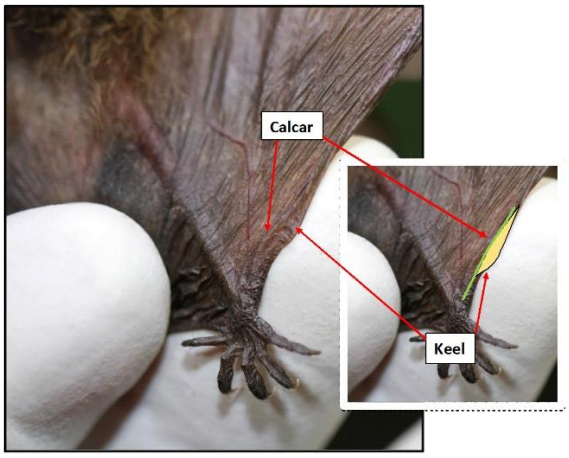

Figure A2. Illustration showing a bat's foot and identifying feature known as the "calcar" which may or may not have a protrusion or keel. (Photo compilation: Cory Olson).

Other bat species that are less commonly found in buildings

Little Brown Myotis and Big Brown Bats are by far the most common species found in buildings, especially as maternity colonies. Other bat species (Figure 3) that may use buildings include:

- Long-legged Myotis (*Myotis volans*) – known to use both buildings and bat houses in Alberta as sites for maternity colonies, but this is not common (has a keeled calcar but it is impossible to distinguish from other Myotis species without measuring and handling)
- Long-eared Myotis (*Myotis evotis*) – Has been found roosting in buildings in southern Saskatchewan and in the Rocky Mountains. Building roosting does not appear common but may go unnoticed because of their habit of roosting alone or in small groups. Can be distinguished from Little Brown Myotis by their much longer ears but may be confused with Northern Myotis.
- Western Small-footed Myotis (*Myotis ciliolabrum*) - very rarely found in buildings, night-roosting may occur on building exteriors (sometimes identifiable by its small size, very blonde fur and black wings, ears and mask, keeled calcar)
- Silver-haired Bat (*Lasionycteris noctivagans*) – no known maternity colonies in bat houses or buildings, could be night-roosting (especially on building exteriors) or using bat houses and buildings as temporary roosts (identified by overall dark colouration, short, rounded ears, unique face, and frosted silver-tipped fur on its back).

Figure A2. Three of the four additional bat species that could be found in buildings in summer (photos: Western Small-footed Myotis and Long-legged Myotis by Cory Olson; Silver-haired Bat by Jason Headley).

The types of roosts that we expect are most encountered by PCOs are “day-roosts”, which include both “maternity roosts” and “nursery roosts”, however it is acceptable to refer to both as simply “maternity roosts” (Table A4). Building roosts would be classified as a “permanent-type roost” and these sites can house very large colonies of bats (Table A4). PCOs might also receive calls about “night-roosts” as homeowners often complain about the guano that is left behind (Table A4). There is increasing evidence that bats, especially Big Brown Bats, are using buildings as “winter hibernation roosts” (Table A4). Hibernation sites are critical habitat for bats and eviction during the winter period will lead to bats dying as they cannot survive winter conditions and need their hibernation site.

Table A4. Types of bat roosts.

Roost Type	Definition
Ephemeral roost	A bat roost in a feature where the characteristics important to bats (e.g., microclimate) may change quickly and/or unpredictably; for example, an area under sloughing tree bark.
Permanent roost	A roost that is available for bat use over many years and has suitable characteristics (e.g., microclimate, access) that remain stable over time. Examples of permanent roosts include caves, cliffs, mines, bridges, buildings, and large hollow trees of a slow-decaying species that may remain standing several decades or more.
Night-roost	A roost where bats rest at night between foraging bouts. Bats may roost singly or congregate.
Day-roost	A roost where bats rest during the day in spring/summer/autumn. Day-roost types include maternity roosts, bachelor roosts, and mixed male/non-reproductive female/yearling groups. Use of a specific day-roost may be seasonal or variable within a season.
Maternity roost	A roost used outside the winter period by adult females that are capable of reproduction.
Nursery roost	A roost where females congregate to give birth and raise their young. A nursery roost is a type of maternity roost.
Bachelor roost	A roost used by one or more males during the day.
Fall migratory rest stop	A roost used by bats during migration between summer and winter habitats.
Winter hibernation roost	A site where one or more bats hibernate in winter (hibernacula [plural]). A given hibernaculum may be used by bats for only part of the winter and may not be used every winter.

Current Training Available for Pest Control/Wildlife Control Operators: bats

Alberta

Currently, Lakeland College in Vermillion, Alberta, offers the "Structural Pest Control Operator" certification course for western pest control operators. Permits are not required from either province for wildlife handling with this certification. There are additional certifications required for handling chemicals or operating lifts.

The course includes credits from the wildlife technician program, but we were unable to determine exactly what is included in the coursework on bats. Feedback from course participants interviewed during the survey indicated that the amount of information typically conveyed on bats through this course was minimal.

British Columbia

The British Columbia Community Bat Program facilitated a workshop to train Pest Control Operators. Although the development of the materials was welcomed by the industry, the actual participation in the workshop was limited. Nonetheless, participants indicated they thought the event was excellent. Participation may have been limited due to the location of the workshop (a small town in the BC interior rather than a larger urban centre) or they should have charged a fee for the event to ensure that the participants were committed. In addition, there may have been a higher attendance level if a blended course delivery was made available, where participants could either attend in person or in an online format.

USA

In the US, the National Wildlife Control Officers Association (NWCOA) is available for membership by both the US and Canadian operators. They offer a two-part course that starts with the "NWCOA Bat Standards Certified, Part 1" (https://nwcoa.com/page-18088) and a subsequent "Certified Structural Bat Management Professional" course (see https://nwcoa.com/page-18089).

Part 1 of the NWCOA course is oriented towards bat conservation and aims to educate those who perform bat exclusion in residential and commercial structures. The course covers bat biology, behaviour, identification, morphology, service agreement language for bat removal and guano removal, seasonal restrictions, inspection techniques, equipment, safety, detailed exclusion techniques, how to price jobs, decontamination protocols, rabies, bat handling and information on white-nose syndrome. The course material is targeted at bat species typical of the southern US. It is a one-day course, where participants must pass a test and once completed, can use NWCOA's "Bat Standards Certified" logo.

The subsequent course (Part 2) "Certified Structural Bat Management Professional" is two days long and has both in-class and practical training. This course covers the practical side of bat work including: "inspections, exclusion, clean-outs and decontamination protocol, but also delves deeper into safety, contracts, sales, pricing and liabilities". It also includes training to work at heights on scaffolding and ladders as well as chimney and roof repairs. Participants in this course must also be Occupational Safety and Health Administration (OSHA) certified for: "OSHA Aerial and Scissor Lift", "OSHA Ladder Safety for Construction", and "OSHA Fall Protection".

These courses may benefit PCOs in Alberta and Saskatchewan, however timing windows for Canadian bats may be slightly different than those discussed in the course if they focus on the bats of the southern USA.

Other Online Resources

- Alberta Community Bat Program Guidebook, "Managing Bats in Buildings" https://www.albertabats.ca/wp-content/uploads/Alberta_Bats_in_Buildings.pdf
- Bat Conservation International, "Bats in Homes and Buildings" https://www.batcon.org/about-bats/bats-in-homes-buildings/
- Bat Conservation Trust, UK, "Bats in Buildings" https://www.bats.org.uk/our-work/buildings-planning-and-development/bats-in-buildings
- PMP Pest Management Professional, USA, "Be a Bat Pro, 6 Steps to Exclusion Success" https://www.mypmp.net/2020/12/02/be-a-bat-pro-6-steps-to-exclusion-success/

Appendix 2. The Phone Survey Form

- Attached pdf.

Appendix 3. The In-depth Survey Form

- Attached pdf.

Appendix 4. The Bat Quiz Form

- Attached, annotated pdf.

Appendix 5. Database of all companies surveyed

- Attached excel spreadsheet

Appendix 6. Data from In-depth survey with cleaned

- Attached excel spreadsheet

Appendix 7. Summary table with selected data for all companies that do bat work

- Table 1. List of PCOs that conduct bat work in Alberta and Saskatchewan.

Appendix 8. Brochure

- Attached pdf.

Appendix 9. Narrated Presentation

- Attached Mp4 file.

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