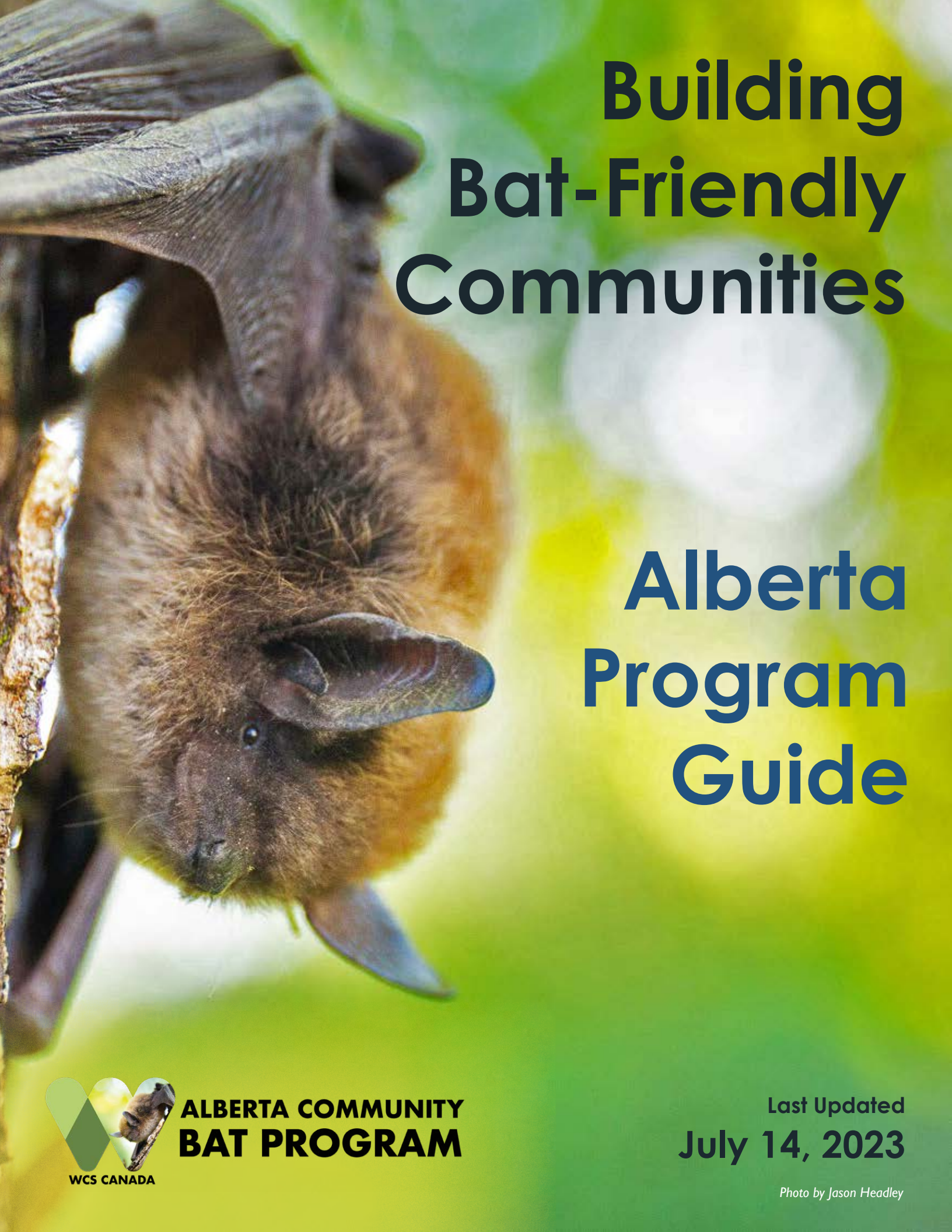

Building Bat-Friendly Communities

Alberta Program Guide

ALBERTA COMMUNITY BAT PROGRAM

WCS CANADA

Last Updated

July 14, 2023

Photo by Jason Headley

Version

This document was written in 2017 and some parts have been updated as recently as July14 2023. Please check www.albertabats.ca/resources for the latest version. Comments, corrections or suggestions for new material may be emailed to info@albertabats.ca.

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Alberta Government

alberta ecotrust

THE CHAWKERS FOUNDATION

Alberta Conservation Association

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Environment and Climate Change Canada
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Why Build Bat-Friendly Communities?

Alberta has at least 9 species of bats, and although rarely seen because of their nocturnal habits, they are often among the most common wildlife in our communities. Bats are major predators of insects, and are important for maintaining healthy ecosystems throughout the province. Many pests of forests, crops, and people are among the favourite foods of bats. Their organic control of these pests is estimated to be worth billions of dollars annually to the North American economy (an estimated $23 billion to the U.S. agricultural industry alone).

Most bats give birth to just one pup per year, and only about half of those young make it through their first winter. To make up for this slow reproductive rate, they need to live long lives, potentially living for multiple decades. One bat in Alberta was known to be at least 39 years old when last seen! Their slow reproductive rate means they are particularly vulnerable to habitat loss and other sources of mortality. Human development has brought new sources of mortality in many regions, such as from collisions with wind turbines, collisions with vehicles, introduction of new predators (such as cats), entrapment, and extermination. Two of Alberta's bat species (the Little Brown Myotis and the Northern Myotis) have been listed as Endangered in Canada because of white-nose syndrome, a fungal disease recently introduced to North America, most likely by people. This disease is spreading across North America, and has already been confirmed in Washington, near British Columbia's southern border.

Many bats live in close association with human communities, and a few species, such as Little Brown Myotis, rely extensively on human made structures as sites for roosting and raising offspring. Few other groups are as reliant on people for their survival and successful reproduction as bats. Stewardship and management of bats is therefore important for the future of this group in the province.

Bats need three basic things to survive: food, shelter and water. Well managed habitats in urban, rural and wild areas can provide these key elements. Maintaining the diversity of features found in natural environments is important for ensuring the success of our bats. Providing bat houses and buildings suitable for bats is unlikely to be sufficient if our ecosystems no longer support the insect communities that they rely upon for food.

This guide provides information to individuals, communities, and organizations that are interested in maintaining and enhancing bat habitat. Our objective is to focus on the ecosystem as a whole, rather than only on the provision of bat houses and the management of buildings. This guide identifies habitat features important for bats and how to enhance those elements. It also identifies hazards for bats and how these can be mitigated. This guide will be revised as new information becomes available.

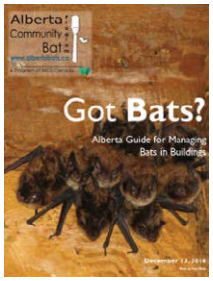
What's in this guide?

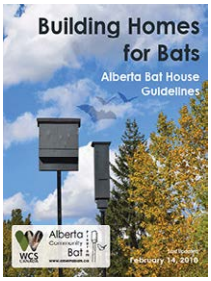
Planning for Bat Conservation

Several agencies and programs in Alberta have potential to influence environmental management and policies relevant to bat conservation and the development of bat-friendly communities. The following are some of the resources available to learn more about bat conservation and planning initiatives in Alberta.

Regional bat programs

- BatCaver Program (Wildlife Conservation Society Canada)
- Alberta Community Bat Program (Wildlife Conservation Society Canada)
- BC Community Bat Program
- Neighbourhood Bat Watch
- Alberta Bat Action Team
- Western Canada Bat Network (Newsletter)
- Western Bat Working Group





Alberta Community Bat Program publications

- Got Bats? Alberta Guide for Managing Bats in Buildings
- Building Homes for Bats: Alberta Bat House Guidelines

Conservation programs and planning initiatives in Alberta

- MULTISAR Program
- Alberta Riparian Habitat Management Society (Cows and Fish)
- Alberta Land-use Framework
- Alberta Land-use Guidelines

Best management practices and other guidelines

- Best Management Practices for Bats in British Columbia
- Beneficial Management Practices for Bats for the Milk River and the South Saskatchewan Watershed in Alberta
- Bat Mitigation Framework for Wind Power Development
- Wildlife Directive for Alberta Wind Energy Projects

Other resources for community bat conservation initiatives

- Water for Wildlife: A Handbook for Ranchers and Range Managers (Bat Conservation International)
- Bats in American Bridges (Bat Conservation International)
- Habitat Management for Bats: A guide for land managers, land owners and their advisors (UK Joint Nature Conservation Committee)

White-Nose Syndrome

Hibernating Little Brown Myotis with white-nose syndrome

For more information, see:

- *Alberta decontamination procedures*
- *Preventing accidental translocation of bats in campers/trailers (Canadian Wildlife Health Cooperative)*
- *Canadian Wildlife Health Cooperative white-nose syndrome protocols and resources*
- *United States Geological Survey information on white-nose syndrome*
- *Whitenosesyndrome.org (information on white-nose syndrome and latest range map)*

White-nose syndrome is a disease affecting bats caused by the fungus *Pseudogymnoascus destructans*. The fungus does not occur naturally in North America and was introduced from Europe, most likely as a result of human activities. The first known case was in New York State in 2006. As of 2018, the disease has spread to at least 31 states and five Canadian provinces. The fungus does not affect people. However, millions of hibernating bats have died in affected regions of North America, leading to the endangerment of what were historically some of our most common species. Three bats in Canada—Little Brown Myotis, Northern Myotis, and Tri-Coloured Bat (not in Alberta)—are now listed as Endangered in Canada as a direct result of white-nose syndrome. Several additional Alberta species likely are susceptible to the disease.

Until recently, white-nose syndrome was primarily a disease affecting bat populations in eastern North America. However, in 2016, white-nose syndrome was confirmed in Washington State. Although the disease has not yet been confirmed in western Canada, it has been found very near the southern border of BC, and has potential to reach Alberta in the next few years.

Once established in a region, the disease spreads mainly from bat-to-bat, or else by bats coming into contact with contaminated surfaces. However, large geographic movements of this disease are likely from people transporting bats, or bringing contaminated equipment into bat habitats such as caves and mines. We likely cannot stop the spread of this disease to Alberta, but preventing human-induced spread is critical for prolonging the time until it reaches the province, and allowing time to develop more effective management approaches.

What can I do?

- Ensure you follow appropriate decontamination protocols whenever you are working with bats or bat habitat.
- Report bats that are flying or found dead during the winter and early spring (Nov through May) to the Alberta Community Bat Program.
- Be sure bats are not accidentally hitching a ride in vehicles or cargo travelling long-distances (e.g., RVs, boats, trailers, transport trucks). See the Bats Astray brochure for information on what you can do.
- Report and monitor bat colonies (see Citizen Science).
- Give bats the best chance to survive and successfully reproduce. The recommendations in the subsequent pages of this guide are designed to help achieve this goal.

Bats and People

Millions of bats live near people and provide tremendous benefits for controlling insect pests. The vast majority of these bats remain out of sight and do not pose a risk to people. However, as with all wildlife, there are important precautions that should be taken to ensure both you and bats remain safe.

Never touch bats with your bare hands. Like many wild animals, bats will defend themselves by biting if they feel threatened, such as when someone attempts to pick them up or reaches into a place they are hiding. Although very rare, there is potential to contract rabies from a bat bite. Rabies is a virus that occurs at very low levels in bat populations throughout Alberta. **Post-exposure shots must be administered as soon as possible after any exposure, or suspected exposure, because once rabies symptoms appear, the virus is almost always fatal.** Bites typically do not leave visible puncture wounds and rarely bleed, so it may be difficult to determine if someone was bitten—if in doubt, always seek medical treatment. Rabies can also be prevented through vaccinations delivered prior to exposure, but regular testing is needed to ensure continued immunity.

The best prevention is to never handle bats with bare hands. Bats do not seek out or attack people. Exposure is typically through accidental contact or deliberate handling of bats. Bats should not be allowed to enter the living quarters of a home, although they can quite often safely use portions of a building where human contact will not occur. Pets should always have up-to-date rabies vaccinations.

Photos in this guide may contain bats being held by hands covered by disposable latex or nitrile gloves. These are worn by bat researchers to prevent the spread of microbes from one bat to another. Most bats can bite through these gloves, and they **do not** provide adequate protection from bites. To protect yourself from bat bites, **leather gloves** must be worn.

Have you or your pet been bitten?

If you come into contact with a bat in Alberta, contact the Provincial Rabies Hotline at 1-844-427-6847 for instructions on receiving treatment (alternatively, contact Health Link at 811). It is important you receive prompt medical attention from a doctor or nurse, even if you are unsure whether you were bitten. Treatment will typically consist of post-exposure prophylaxis, a series of shots that helps your immune system destroy the virus during its early stages. These shots are small injections in the muscle of the arm or leg, much like other vaccinations we commonly receive. Check in with your veterinarian to ensure your pet's vaccinations are up-to-date.

Never handle living or dead bats with your bare hands. If a bat must be moved, wear thick leather gloves and use another object, such as a pillow case, towel or box, to gently move the bat. If the bat must be temporarily contained prior to release, ensure the box or bag is tightly closed to ensure the bat will not escape once it becomes active.

Bats will never seek out or attack people, but will bite when handled or accidentally touched. Bites require immediate medical attention. When left alone, bats are not a threat to people. If you must move a bat, be sure to wear thick leather gloves to protect from bites.

Visit the provincial wildlife disease webpage for more information on wildlife health concerns in Alberta

Bats and People

Guano is often found on insulation in attics where bats are roosting. Protective measures may be required if cleaning, or otherwise disturbing materials in these areas.

Vermiculite used to insulate homes has potential to contain asbestos fibres (a potentially harmful material). Be careful not to disturb this material when cleaning, and seek professional advice if it is present.

Visit the Fish & Wildlife area contacts webpage for a list of Fish & Wildlife offices and contact numbers

Bat guano and urine

Bat guano and urine are typically not health hazards. However, in rare cases, bat or bird feces has been associated with histoplasmosis. This disease has only been detected a few times in Alberta, and the risk is likely low in most areas of the province. However, beware that bats are often in areas where other health concerns, such as hanta virus from rodents, dust, mould, or asbestos, may also be an issue.

Histoplasmosis is a lung disease caused by the inhalation of the spores of *Histoplasma capsulatum*, which grows in humid conditions in areas with high concentrations of bat or bird droppings. Once the fungus dries, it can be inhaled, and people who inhale the spores may become sick. Most people recover on their own, and may not even be aware they were exposed. More serious health consequences may occur in some situations, especially for those with weak immune systems.

Appropriate respiratory protection, gloves, and coveralls should be worn if disturbing the feces of any wild animal, especially in confined areas such as attics. Wetting an area prior to cleaning (e.g., by using a spray bottle containing a 10% bleach solution) will help reduce the amount of dust generated. Respiratory protection should include at least an N-100 (high-efficiency) respirator for protection from histoplasmosis. **However, buildings with bats are often old and may have other health risks that require additional precautions, such as to prevent exposure to asbestos and rodent-associated diseases** (note that an N-100 respirator does not provide adequate protection from Asbestos). Professional services may be needed for high-risk situations.

Have you found a dead bat?

Do not touch bats, regardless of whether they are alive or dead. Bats may go into a state of 'torpor' during the day, and throughout winter hibernation, which involves lowering their body temperature so that they can conserve energy. This makes bats immobile, and they may appear dead. However, they will become active once they rewarm their body and may still bite.

If you are confident the bat is dead, the carcass can be delivered to a local Fish & Wildlife Office. Call the Alberta Environment and Parks information line at 1-877-944-0313 to locate your nearest office or visit their webpage. Bats submitted to a Fish & Wildlife Office may be used as part of the province's routine wildlife disease monitoring program. If you need additional advice or assistance regarding living or dead bats, contact the Alberta Community Bat Program.

Distressed Bats and Rehabilitation

Have you found an injured or distressed bat?

Encounters with bats are most often reported during the late summer and fall, when young bats are learning to fly or large numbers of bats are undergoing long-distance movements to their winter habitat. During this period, bats may be found in highly unusual locations, such as the sides of building and under patio umbrellas. **In most of these cases, the best option is to leave the bat alone—it may simply be resting until it can take off again the following night.**

If the bat is on the ground, or in an inappropriate location, it may need to be moved. If the bat does not look sick or injured, it may be placed in an elevated location where it can take off into open flight space and where it is safe from predators such as magpies and cats. Suitable locations may include a decaying tree that can provide hiding spaces for bats (e.g., sloughing bark, cavities, holes, cracks, and breakage). A pillow case can be effectively used to help move and provide cover for the bat until it can be released (see image panel). Thick leather gloves should always be worn when moving a bat. Choose a location near a clearing so the bat doesn't crash once it attempts to fly. The bat will most likely seek shelter and rest until dark. If the bat is still there the following day, you may wish to contact a rehabilitation centre (see the Alberta Community Bat Program webpage for a listing).

Bats exhibiting unusual behaviour, such as flying during the day or lying on the ground, are more likely to be sick (possibly with rabies) and should be treated with care. On hot days, bats flying during the day may simply be getting water and are otherwise healthy. As a precaution, avoid the area where the bat is located and keep pets inside. If necessary, put on gloves, and use a stick, spade, or pillow-case to gently move the bat into an area away from humans and pets.

If you are confident the bat is injured or sick, contact the Alberta Community Bat program or your local Fish and Wildlife Office for advice and assistance. In some situations, you may be able to deliver it to a wildlife rehabilitation centre. Remember to always use safe procedures when handling bats and wear thick leather gloves. Place the bat inside a cardboard box with SMALL air holes and ensure the box is tightly closed. Bats cannot chew through fabric or cardboard, but they are fantastic at finding their way out of loosely closed bags or boxes. Other than to deliver a bat to a wildlife rehabilitation centre or veterinarian, keeping bats in captivity is not recommended or legal—it requires appropriate permits, and is typically unsuccessful without extensive experience and knowledge of animal care. The best option is to contact a wildlife rehabilitation centre.

Visit the Alberta Community Bat Program Website for a listing of wildlife rehabilitation centres that accept bats.

A pillow case can be a useful tool to pick up and contain bats prior to release (leather gloves must also be worn). The pillow case can be used like a glove to gently grab the bat and then inverted (and tightly tied) for containment. To release the bat, the pillow case can be tacked, open side up, to the side of a tree (at least 2 metres high to avoid predators). A healthy bat will likely wait until after sunset and then fly away. Bats can bite through fabric, so always wear leather gloves for protection, and make sure the bat is placed in a location where contact with people will not occur.

Bat Basics

Bats drink by dropping their bottom jaw into the water while flying above the water's surface. Shown above is the Pallid Bat, a species found in the dry interior of British Columbia.

Long-eared Myotis feeding on a moth. Moths are among the most important prey for several bat species.

Bats crawl using a claw on either thumb and their hind feet. They require rough surfaces for traction.

How do bats make a living?

Bats have the same needs as people—water, food, and shelter. Habitats that do not have all three of these resources will not support bats. Building bat-friendly communities requires ensuring all these resources are available in the community, while also ensuring hazards and threats remain below levels that would threaten bat populations.

How bats use these resources is strongly influenced by their unique characteristics. Some of these include:

- **Bats have wings**—The ability of bats to fly means they can range over large distances. Flight is energetically demanding and the increased surface area of wings results in substantial water loss. To survive these demands, bats **must** have access to drinking water and plentiful food resources.
- **Bats drink while flying**—Bats do not land to drink. Rather they drink while in flight, which requires open, standing water that does not have thick vegetation or other obstacles. In some areas, these features may be scarce, preventing bats from using the habitat.
- **Bats eat bugs**—bats in Canada do not eat any food other than bugs (mostly insects and spiders), and typically only those that are active at night. A wide variety of bugs are eaten, including biting insects and pests of crops and forests. Moths are likely the most important group for sustaining bat populations. Management decisions that reduce nocturnal insect abundance will harm bats.
- **Bats need places to hide**—As small mammals, bats have many predators that would eat them if given the chance (such as cats, owls, magpies). To reduce this risk, bats typically select well-hidden and/or well-protected spaces to rest (called roosts; winter roosts may also be hibernacula). Roosts are often in narrow cracks and crevices or other difficult-to-reach sites. Bats reproduce slowly, so locations protected from predators are essential to their survival. Most bats *do not* use bat houses and require natural roost sites.
- **Bats have claws to crawl and hang**—bats hang upside down to roost using claws on their hind feet. However, they often crawl to access roosts or to reach take-off locations for flight. Crawling is aided primarily by a single claw on either thumb. They cannot grip smooth surfaces, so only locations with rough-textured surfaces for crawling, landing, and hanging can be used for roosting. Likewise, they may become trapped in structures that have smooth surfaces.
- **Bats like it hot**—bats do not like to spend energy keeping warm. Pregnant or nursing mothers need warm roosts to raise their young. These are often locations that people find very hot—such as attics. Locations with stable temperatures are best—this prevents them from overheating during the day or getting cold at night.

Bat Basics

How do bats survive the winter?

All bats in Canada eat only insects and other arthropods, and most of these foods are inaccessible to bats during our prolonged Canadian winters. So how do bats survive the winter? There are two strategies that bats use: migration and hibernation.

Migrate: While all bats are migratory to some extent, three species appear to leave the province altogether—the Hoary Bat, Eastern Red Bat, and Silver-haired Bat. This strategy may reduce the need to accumulate large fat stores to survive the winter, and may help explain why this group typically gives birth to more than one pup. It is largely unknown where our migratory bats overwinter, but it may include the southern US, Mexico, or even the warmer regions of British Columbia. Bats that leave the province for the winter may still hibernate during cold winter weather, albeit for shorter periods.

Hibernate: The majority of bats in Alberta appear to hibernate in the province during the winter. This includes the Big Brown Bat and all the Myotis species found in Alberta. Bats that hibernate may still undergo long-distance movements between summer and winter habitat. Banding records from Alberta have found Little Brown Myotis, Long-eared Myotis, and Big Brown Bats moving at least 300 - 500 kilometres between summer and winter habitat (one Little Brown Myotis moved almost 500 kilometres from Warner to Stony Plain)[1].

Where the majority of bats in Alberta hibernate is unknown. A few caves have been identified that support hibernating Little Brown Myotis, Northern Myotis, Long-legged Myotis, and Big Brown Bats. Deep rock-crevices, such as those in some Alberta river valleys are known to be used by hibernating Big Brown Bats. Big Brown Bats may also hibernate in buildings, possibly even moving into the cities during the winter, but this has not be observed in other species. All known hibernacula combined account for a very small portion of the bat population, making it uncertain what our bats do during the winter (see also Hibernacula).

Where are bats found?

Bats occur throughout Alberta. They are among the most common wildlife in cities, especially in our river valleys and parks where there is water and old trees. Some bats have ranges that likely span the entire province, while others may only be found in particular habitat types or regions of the province. The maps on the next page provide an overview, but there is still much to discover about what habitats and regions of Alberta bats occupy.

Photo by Cory Olson

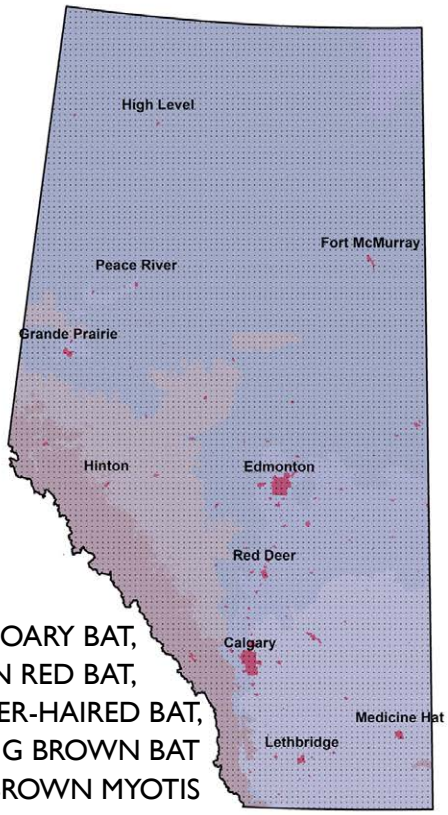
Hoary bats are one of the three bats that migrate out of the province during the winter.

Photo by Dave Hobson

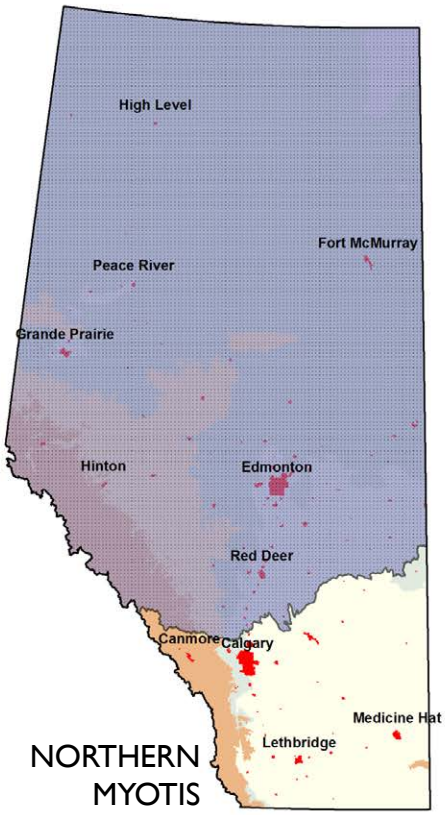
A group of hibernating bats (Little Brown Myotis or Long-legged Myotis) at a cave in Alberta.

[1] based on unpublished banding data by T. Schowalter.

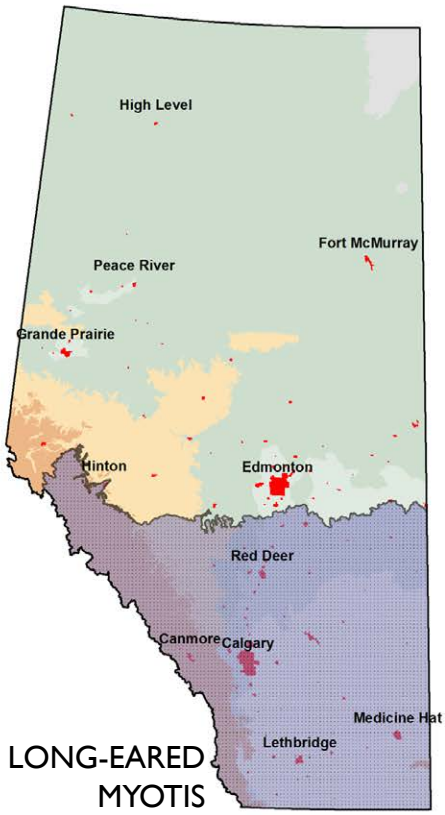
Bats of Alberta



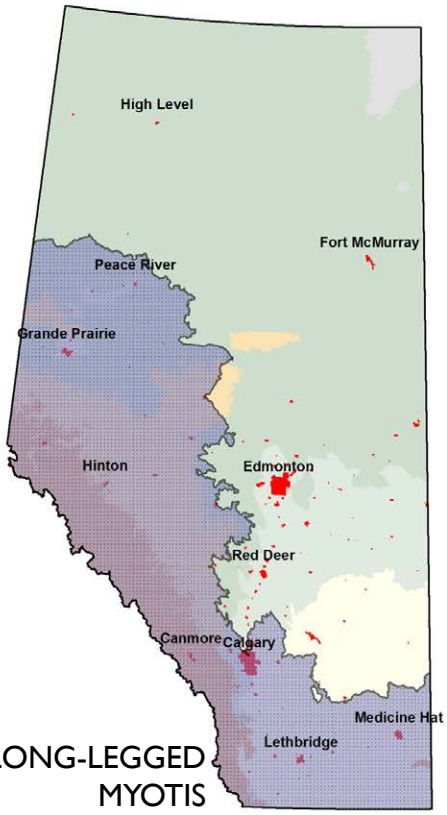
HOARY BAT,
EASTERN RED BAT,
SILVER-HAIRED BAT,
BIG BROWN BAT
LITTLE BROWN MYOTIS



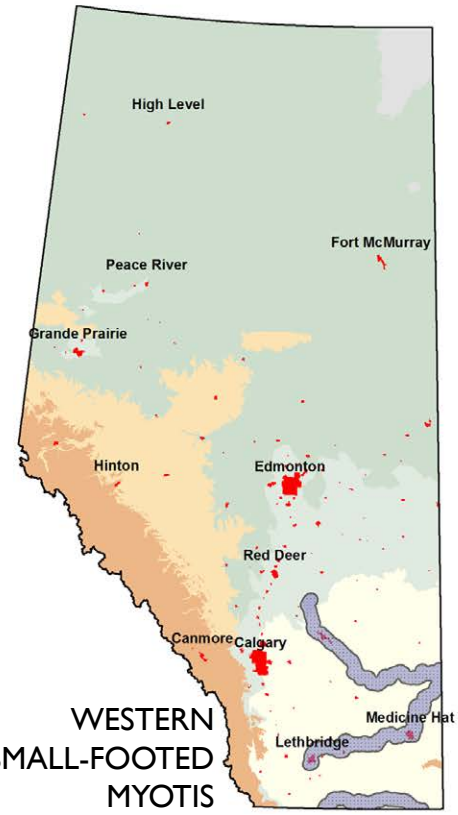
NORTHERN
MYOTIS



LONG-EARED
MYOTIS



LONG-LEGGED
MYOTIS



WESTERN
SMALL-FOOTED
MYOTIS

GEOGRAPHIC RANGE OF ALBERTA BATS

Identifying Species

Bats are difficult to tell apart without close examination and extensive training. Even experts can have difficulty with some species groups and often require specific body measurements to tell species apart. Species can sometimes be determined using a combination of behaviour, habitat use, and observation. However, bats often share the same habitats, so the only reliable method to determine species is through genetic testing or close inspection by a qualified biologist. Recent advances in genetics techniques allow the species to be determined from a sample of guano (bat feces). The Alberta Community Bat Program may be able to assist with species identification using a guano sample. See the web page or contact the program directly for more details.

Silver-haired Bat

Silver-haired Bats are among the most common, wide-ranging and easily recognizable bats in Alberta. They are slightly larger than Myotis species, and are typically black except for a silvery frosting to their hair (which varies in its intensity). They are adapted for fast long-distance flights, and forage in the open for moths and other insects. Foraging may occur above wetlands, high in the canopy, or along the edges of forests. Treks of up to 10 kilometres or more are common.

Roosting occurs primarily in the crevices of large diameter decaying trees, but is more variable during migration (common sites include the side of buildings, bat houses, and under patio umbrellas). A variety of structural defects in trees may be used for roosting, and use of old woodpecker holes is common. Suitable hiding spots are most often in deciduous trees (e.g., aspen or balsam poplar) but any suitable tree may be used. Females may produce twins and groups of mothers and pups roost in small groups of up to 35 individuals (often closer to 10).

Silver-haired Bats are long distance migrants, and most appear to leave the province during the winter to find warmer climates. Where Silver-haired Bats from Alberta spend the winter is largely unknown. However, this species has been confirmed to hibernate in southern British Columbia, where they occupy locations such as caves, mines, trees, gaps among tree roots, and wood and rock piles. There is growing evidence that male Silver-haired Bats in southern BC are year-round residents, whereas many of the females are moving in from other locations (possibly including Alberta). Winter bat activity has also been detected in southeastern Alaska [1], suggesting they may hibernate in more locations than is currently known—more investigation is needed to understand their winter behaviour.

Bat or mouse droppings?

Bat guano often forms piles whereas mouse droppings are scattered. Bat droppings crumble when crushed whereas mouse droppings are hard and do not easily crumble. Bat droppings have shiny pieces (insect exoskeletons) whereas mouse droppings have vegetation and are more prone to growing fungus (mold).

Fecal pellets of bats and rodents. From left to right: Little Brown Myotis, Bushy-tailed Woodrat (*Neotoma cinerea*), Big Brown Bat.

Silver-haired Bat (*Lasionycteris noctivagans*)

[1] Blejwas, K.M., C.L. Lausen, and D. Rhea-Fournier. 2014. Acoustic Monitoring Provides First Records of Hoary Bats (*Lasiurus cinereus*) and Delineates the Distribution of Silver-Haired Bats (*Lasionycteris noctivagans*) in Southeast Alaska. Northwestern Naturalist 95(3): 236–250.

Bats of Alberta

Hoary Bat (*Lasiurus cinereus*)

Eastern Red Bat (*Lasiurus borealis*)

Hoary Bat

Few bats are as colourful as the Hoary Bat (*Lasiurus cinereus*) and the Eastern Red Bat (*Lasiurus borealis)*. Hoary bats have a distinctive yellow mane and their cinnamon-coloured coat is frosted with white tips like "hoar-frost", which is why they were given the name *Hoary* Bat. Weighing about 35 grams, they are the largest bat in Canada. They are fast, long-distance foragers that typically forage in the open, often along the edges of forests and above the forest canopy. They have a fondness for large moths. Other insects are also eaten depending on what's available—including beetles and dragonflies. Foraging flights of up to 20 kilometres (plus return) are not uncommon.

The species roosts among the foliage of deciduous or coniferous trees, typically selecting trees that are taller than the surrounding canopy. Their colouration makes them very difficult to see among the foliage of trees. They roost alone, except for mothers roosting with their twin pups. Hoary Bats are long-distance migrants leaving Alberta's winter behind with flights that may be well over a thousand kilometres. Their migratory behaviour is poorly understood, but they likely overwinter in the southern United States or Mexico, and may undergo periods of hibernation when they reach these locations.

Eastern Red Bat

Eastern Red Bats are medium-sized bats with long, narrow wings for high, fast flights. Like many bats in Alberta, moths are the main component of their diet, but they will eat lots of other insects as well. They are solitary foliage-roosting bats, typically roosting out on the limbs of branches where they are well concealed among clumps of leaves. Mothers roost in the tree canopy with their pups, which may number up to four in the eastern parts of their range (which is an exceptionally large litter size for bats). Almost nothing is known about reproduction by Eastern Red Bats in western Canada, and most observations are of males and non-reproductive females, making it uncertain whether they actually breed in the province.

The species is named for the colour of its fur: males are bright red, females are more of a grey-red. Their fur colour makes them almost invisible among the leaves of deciduous trees. Once believed to be rare vagrants in Alberta, recent studies, particularly as part of oil sands and wind energy projects, have revealed that the species is a common visitor of Alberta's deciduous forests. This species migrates to warmer climates during the winter, likely in the southeastern United States. During cold winter weather, they may crawl into leaf litter and undergo short periods of hibernation.

Bats of Alberta

Big Brown Bat

The Big Brown Bat (*Eptesicus fuscus*) is one of the larger bats in the province, typically weighing between 15-20 grams. This bat has a broad head and fur ranges from pale to dark brown. Unlike other brown coloured bats, Big Brown Bats have swollen-looking sides to their nose which may help identify them in photos where size is often hard to determine. They are common throughout the southern half of Alberta (including Edmonton), and are one of the most common bats around agricultural communities. Their range is sporadic in the boreal regions, but have potential to occur anywhere in the province. Big Brown Bats are a common resident of prairie river valleys, and a few have been confirmed to hibernate in deep rock cracks and erosion holes along these rivers. They are the only species in Alberta that are known to hibernate in buildings, although it is unknown how often this occurs. Individuals of this species may be active on warm winter days, and may be detected flying outside their hibernaculum.

Big Brown Bats roost in buildings as well as in trees, rock crevices, caves, and mines. Colonies typically consist of fewer than 100 individuals, but sometimes reach several hundred individuals. Colonies tend to be larger in the southern portions of the province, where up to 100 individuals are common. Big Brown Bats have strong jaws, and are one of the most likely species to eat beetles, but diets are variable depending on what is available in their environment.

Little Brown Myotis

The Little Brown Myotis (*Myotis lucifugus)*, also called the Little Brown Bat, is the most common species found throughout Alberta. They commonly roost in buildings, in groups ranging anywhere from a couple individuals up to over a thousand individuals. Other common roost structures include old trees, rock-crevices, caves, mines, bridges, and bat houses. This bat weighs about 8 or 9 grams (about half the weight of Big Brown Bats). Like many bats, their fur is a medium brown colour, although some individuals in southern Alberta may have very pale brown coloured fur. They appear similar to Big Brown Bats but are much smaller.

The Little Brown Myotis eats aquatic insects such as midges, caddisflies and mayflies as well as beetles, moths, mosquitoes, spiders, and various types of flies. They are a common occupant of cottages and other buildings that occur near water. This species has recently been listed as federally Endangered in Canada due to the devastating impacts of white-nose syndrome in parts of North America.

Big brown bat (*Eptesicus fuscus*)

Little Brown Myotis (*Myotis lucifugus*)

Comparison of fecal pellet size between Big Brown Bats and Little Brown Myotis (small squares = 2 millimetres).

Bats of Alberta

Long-Legged Myotis (*Myotis volans*)

Long-legged Myotis

The Long-legged Myotis (*Myotis volans)* is approximately the same size as the Little Brown Myotis and has a similar physical appearance. They may roost in mixed groups with Little Brown Myotis, and may be overlooked in many regions. Recent advances in DNA testing now make it possible to increase the number of reports for this species, but their use of buildings is still poorly understood. Building roosts have been reported in the rocky mountains and foothills, and the use of buildings may be common in some areas. The typical size of colonies is unknown, but a maternity roost in Jasper was found to have over 100 individuals. They are also known to roost under slabs of rock along cliff faces, and may also roost in trees. Long-legged Myotis may be more likely to forage away from wetlands than Little Brown Myotis, where they may target moths rather than aquatic insects.

Western Small-footed Myotis (*Myotis ciliolabrum*)

Western Small-footed Myotis

The Western Small-footed Myotis is the smallest bat in Alberta, weighing only about 5 grams and is about the size of a thumb. Fur is typically blonde, and their dark skin gives them the appearance of having a black mask. They occupy a variety of arid and semi-arid habitats in western North America and Mexico, but in Alberta they are believed to only occur in riparian badland habitat — in particular, along the Milk River, South Saskatchewan River, and Red Deer River. Other river systems in Alberta with badland/eroded topography also have potential to be used. Their narrow range in Alberta makes them particularly sensitive to habitat loss.

They roost primarily in rock crevices and mudstone erosion holes in Alberta. However, they appear to rely on riparian cottonwood forests as high-quality foraging habitat. They eat a variety of small-bodied insects, such as small moths and flies (including mosquitoes and midges).

They roost in matrilineal family groups (i.e., related through common ancestry on their mothers side), which range from 2 to 35 individuals (more often 2-5 individuals)[1]. These groups show high fidelity to specific regions of a river system, which may only span a little over 100 metres. Therefore, the loss of a relatively small area of habitat may displace an entire multi-generational lineage of small-footed bats[1].

[1] *Lausen, C.L. 2007. Roosting ecology and landscape genetics of prairie bats. Dissertation, University of Calgary, Calgary, Alberta.*

Long-eared Myotis

The Long-eared Myotis is the second smallest bat in Alberta. They have a dark complexion and especially long ears (about 18 millimetres long), but without close inspection may look similar to the other Myotis species in the province. They are particularly maneuverable, and well adapted to slow flight. This ability appears to allow them to occupy roosts that are close to the ground, such as in erosion holes, tree stumps, under rock piles, and in boulders and other rock crevices. They often glean moths and other insects from the surfaces of vegetation, allowing them to capture sedentary insects, and forage in conditions where cold temperature limits the availability of flying insects.

Long-eared Myotis are common residents of prairie river valleys, especially in the badlands, where they may roost in locations such as sandstone boulders, rock crevices, or erosion holes. They are also common in the mountains, where they have been observed roosting among the scree of rocky slopes. Roosts have occasionally been reported in buildings, but groups are generally small, making them more likely to go unnoticed. Mothers either roost alone or with 1 or 2 other individuals. Larger groups are possible, especially in buildings, where groups of up to 20 individuals have been observed.

Northern Myotis

The Northern Myotis is superficially similar to the Little Brown Myotis, but is slightly smaller, has longer ears, a more pointed tragus (a projection in front of the ear canal), and typically has a more pale complexion. They are slightly larger, and have paler fur, and shorter ears than the Long-eared Myotis. Northern Myotis are residents of the boreal forest, foothills and mountains, typically coinciding with regions of the province where Long-eared Myotis do not occur (although their range along the Rocky Mountains is poorly delineated).

Northern Myotis are better able to hunt close to vegetation than the Little Brown Myotis (with which they share most of their range). They forage by gleaning insects that rest on the surfaces of vegetation, often in the understory of old forest. Mothers give birth to a single pup, and maternity colonies can be up to at least 29 individuals. Roosting typically occurs in the crevices of old, large decaying trees (both living and dead), often using deciduous trees such as Aspen or Balsam Poplar.

Long-eared Myotis *(Myotis evotis)*

Although not commonly reported, Long-eared Myotis (shown here) will also roost in buildings.

Northern Myotis (*Myotis septentrionalis*)

Where do bats drink?

Drinking Water

Aquatic habitats support rich prey communities, and provides an important source of drinking water for bats.

A wetland used for waste disposal in Canada. Bats drink from open water and could be exposed to potential contaminants or other hazards.

For a review of the role of water for bat conservation, see pages 215-241 Bats in the Anthropocene: Conservation of Bats in a Changing World.

Providing drinking habitat for bats

Water is essential for bat survival. Bats require open, standing water for drinking and typically this must be close (i.e., less than 2 kilometres) to their summer roosts. Breeding females get especially dehydrated while nursing young in hot maternity roosts. One of the first thing bats do when they leave the roost at nightfall is find a water source for a drink. Studies in arid regions of Europe found that bat home range size was defined by the locations of their day roost and their source of drinking water. Loss of foraging and drinking habitat can result from urbanization, habitat modification (draining wetlands), channelization and loss of riparian habitats, and contamination and sedimentation of wetlands, and ponds. Bat diversity is highest in areas where roosting, foraging, and drinking habitat exists together in close proximity. A mosaic of habitats is what is needed for bat conservation; each habitat type is key.

Is this really an issue for bats?

Yes! Water is a fundamentally important resource affecting the distribution and abundance of bats. In some areas, such as arid prairie habitats, water may be a limited resource. Pups can become stressed if they do not receive enough fluids from their mother, which will negatively affect growth and survival. Urban, industrial and transportation projects may divert water sources as part of development plans, affecting important habitats such as wetlands, meadows, and riparians areas. This can eliminate habitat and possibly reduce water quality as well. Contamination of water sources in urban settings can result from water run-off over lawns with fertilizers or pesticides, or over roads and other hard-surfaces that may be a source of other environmental contaminants.

Not all water sources are available to bats

Bats drink while flying. They need open pools of drinkable water without obstacles that could obstruct their flight path, or prevent them from dropping their bottom jaw into the water. For example, an algae-covered pond is not accessible water for bats unless a section is regularly kept free of debris.

Different sizes and types of bats approach water differently. If they are large, built for speed and not very maneuverable like a Hoary Bat, then they need a long straight-line flightpath to approach and lap up water as they pass. Large water bodies like dugouts, lakes and ponds are good water sources for these bats. If they are small and maneuverable, like the Long-eared Myotis, then even a large deep mud puddle may suffice. In fact, these small slower flying bats may not like

to approach large open water bodies due to the increased predation risk of being out in the open. Different sized waterbodies are needed for different species of bats. But suitable water sources all have these traits in common: (1) they are close-by (the closer the better, but < 2 kilometres is a good rule of thumb); (2) they are calm and quiet (turbulent or fast flowing water may not be accessible to bats); (3) the water surface is free of emergent vegetation and surface debris; and (4) the water source is permanent, so that bats have consistent, predicable access to water.

A few bird species also drink water while flying (nighthawks, swallows and swifts), and all of these species require a clear flight path over open calm water so that they can safely swoop down to the water's surface to drink. Bats may fall into the water if they hit obstacles or debris. Bats can "swim" using their wings to flap across the water's surface, but in areas with human-made water structures (e.g., watering troughs for livestock, retention ponds, rain barrels, backyard pools and ornamental ponds), bats can become trapped and will drown if they are unable to climb out (see the Hazards section and the Water for Wildlife guide for more information).

Escape structures are an easy way to prevent drowning, and should be considered if you have a pond, pool, rain-barrel or other water receptical on your property that bats may use for drinking. There needs to be a rough-textured surface leading from the edge of the water and extending at about a 45 degree angle into open flight space. Bat Conservation International's 'Water for Wildlife' guide has detailed recommendations for escape structures and bat-friendly water sources. A simple solution is to place a rough log or post (non-pressure treated) into the water that bats can use to climb out.

How big do water sources need to be?

Larger water sources typically support more species. Bat species that are highly maneuverable (such as Western Small-footed and Long-eared Myotis) can use small ponds and toughs—in the range of about 1 metre in length (and 1 metre wide). Less-maneuverable Myotis bats (such as Little Brown Myotis) need open water that is at least 3 metres in length (and 1 metre wide). Larger species, such as the Big Brown Bat and Silver-haired Bat, need more space, and water sources a minimum of 15 metres long are preferred. Fast flying bats like the Hoary bat need up to 30-metre-long stretches of open water for drinking.

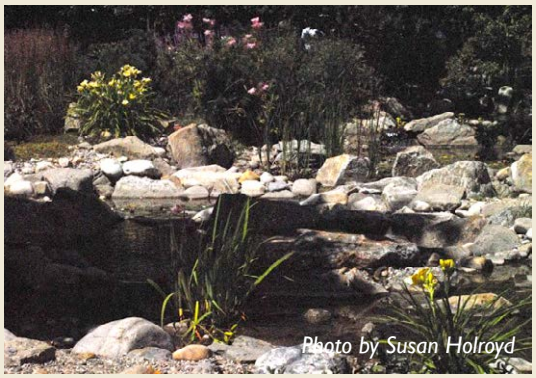
In dry regions, bats may frequently visit water troughs to obtain water. Exposed sides, wire, and other obstacles, such as those shown above, may create major hazards for bats. Reducing obstacles and incorporating an emergency escape will help reduce bat fatalities.

The eutrophication of wetlands, caused by the runoff of fertilizers and other nutrient sources, may cause thick vegetation mats to develop, thereby depleting access to drinking water.

For more information on designing bat-friendly water sources, see Bat Conservation International's Water for Wildlife guide.

Drinking Water

Beavers create productive wetlands that bats use to feed on insects and access drinking water. Allowing beaver dams to remain in place can provide important benefits for bats.



Ponds should be clear of vegetation to allow for straight flight-paths of bats skimming the water to drink.

How can people help provide drinking water for bats?

- Maintain water quality by avoiding contamination with the use of fertilizers or pesticides next to the water source or in areas where rain-water run-off may pick up ground-surface contaminants and carry them into the water body.
- Artificial water features, such as dugouts, are also important as drinking water sources and for insect production. Consider enhancements and management actions that would benefit bats.
- If you are creating a pond, choose areas near forests or near lines of vegetation that provide security cover and connectivity between foraging and roosting habitats. Use natural designs that do not impact other important habitats, with appropriate vegetation in and around the feature, and realistic stream or pond profiles.
- If ponds or water tanks have steep smooth sides, provide escape structures so that bats can climb to escape the water. Keep water levels in ponds and tanks high so that bats have safe access to the water's surface and to make escape easier if they fall in.
- Ensure that drinking water sources are free of obstacles over the water surface.
- Manage vegetation to ensure bats have security cover when commuting to drinking water from roosting or foraging areas. Replant gaps in hedgerows with native tree or shrub species to provide a continuous cover for flying bats, and link these lines of vegetation to water sources, where possible.
- To the extent that space allows, provide a length of open water that meets the requirements of the target bat species (see above).
- Retain natural features of waterbodies, watercourses and wetlands (e.g., shallows, spits and riffles, open ponds and pools, emergent vegetation, ephemeral pools, oxbows, meandering areas of streams). These features are important for creating access points for drinking water, and for supporting insect prey.
- Let running water pool in places so that bats have access to standing water. Removing log jams or beaver dams for example can often restore water flow and make the water inaccessible to bats for drinking.
- Avoid stocking ponds with fish as this may cause depletion of aquatic invertebrates and possibly lead to eutrophication of the waterbody. Stocking fish in natural wetlands is illegal without a permit.
- Promote good angling practices such as ensuring that all fishing line and hooks are removed.

What Are Roosts?

Roosting Habitat

Bat roosts are sites where bats rest when they are not active. Bats in Canada are entirely reliant on pre-existing structures in their environment for roosting. They do not build nests, chew holes, or otherwise modify the structure of their roosts.

Roosts can be broadly categorized as day roosts (used during the day) or night roosts (used during the night). Maternity roosts are locations where bats raise their offspring, and are often used as both day and night roosts. Hibernacula are roosts used during the winter while bats are hibernating.

Night roosts

Night roosts are places that bats use during the night to rest between feeding bouts. These are often in open spaces out of the wind, such as under bridges, archways above doors, covered patios, garages, and trees. People rarely see bats at night roosts, but instead will observe droppings in the morning where the bats were the night before. Evidence left behind by night roosting bats may include a large number of moth wings, which are discarded by bats while eating their meal. Bat guano is rarely a health risk, and makes great fertilizer for flower gardens. Consider placing a flower pot to collect the guano underneath places where bats have been night roosting.

Day roosts

Day roosts (including maternity roosts) are sites where bats gather to sleep and live during the day. They can be used by a lone bat (often a male or non-reproductive female) or a colony of females and their pups (maternity roost). Usually these roosts are crevices where bats are protected from the weather and predators. Occasionally a bat may choose a day roost in the open, especially inexperienced pups that are learning to fly. Open day roosts may be located on an outside wall or under a patio umbrella. Day roosts of males and non-reproductive females tend to be in cool locations. Some day roosts may be temporary with a bat coming and going over the summer and fall, while others may be used consistently through the summer.

Maternity roosts

Maternity roosts are locations where multiple females gather to raise pups and are characteristically very warm locations. Female bats and their pups may roost in groups ranging from two up to over a thousand individuals. Maternity roosts in buildings are often easy to detect due to noise, odour, or guano, and may include places such as attics, barns, sheds, siding, and other enclosed spaces. Maternity colonies may also be in tree and rock crevices, especially in regions of the province where buildings do not occur, and for species that do not roost in buildings.

Photo by Cory Olson

Night roosting bat on the outside wall of a building

Photo by Darcey Shyry

A night roost along the siding and under the eaves of a shower building in Alberta. Bats depart by morning, but their presence is given away by the guano and urine left behind.

Photo by Juliet Craig

Maternity colony occupying a bat house. View is looking up from the bottom of the bat house.

Where Do Bats Roost? Roosting Habitat

Crack in a cliff face used as a hibernaculum by Big Brown Bats along the Red Deer River.

Root wad cavity used as a winter roost by Little Brown Myotis in Alaska.

A group of female Little Brown Myotis in a maternity roost.

Although mother bats typically leave their pup behind while they forage, they are capable of carrying their pup among roosts. It is common for mother bats to use several roosts throughout the year. Some roosts may be used consistently for long periods in a season, while other roosts are used for only short periods before bats move to a new roost. In general, larger more permanent roosts (such as buildings, bat houses, and large rock crevices) are likely to be used more often and for longer periods than smaller more temporary roosts (such as tree cavities). Ensuring bats have access to many suitable roosts, with different roosting conditions, is an important consideration for the management of bat habitat.

Hibernacula

Hibernacula (singular hibernaculum) are locations where bats hibernate during the winter. Alberta bats have been found hibernating in caves, deep rock crevices, and buildings. Elsewhere in Canada, they have also been reported to hibernate in old wells, wood piles, cavities created in the ground by root wads, and transportation tunnels.

Only a small number of bat hibernacula have been located, and these account for a minor portion of the overall bat population. We do not know where the overwhelming majority of bats in Alberta hibernate. However, bats require very specific conditions to survive the winter, which limits the possible locations they could be found. Bats require stable, cool temperatures to conserve enough energy to survive the winter, but it cannot be so cold that they will experience freezing conditions. High humidity is also required to avoid dehydration. Suitable conditions can be found in caves, but may also be found in deep rock crevices (extending below the frost line), mines, and occasionally buildings. Such locations are not common in many of the regions that bats occupy during the summer, so many resident bats will need to move to find suitable winter habitat (traveling as much as 500 kilometres). Suitable locations may include river valleys, mountains, or the Canadian Shield. Big Brown Bats (the only species in Alberta that is regularly found hibernating in buildings) may even move into cities to find buildings suitable for hibernation.

Bat sociality

Unlike birds and some rodents, bats do not build nests to keep their young warm. Instead, many bat species are known to keep warm by huddling with other bats. In fact, bats as a group are among the most social of all mammals. Having many bats in a single roost can greatly increase the roost temperature, providing warm conditions needed to support growing pups. Most often large groups are mothers raising offspring, while males typically roost alone or in small groups.

Roosting habitats used by bats in Alberta

Some species in Alberta show a strong preference for certain types of structures, while others appear to be highly flexible depending on what is available in their environment. For example, the Hoary Bat and Eastern Red Bat nearly always roost hanging among the leaves of trees (although they may be found in a greater variety of locations during migration). Other species occupy a wide range of structures depending on what is available, such as buildings, bridges, bat houses, rock crevices, caves, and tree cavities. Although a wide variety of structures are used, they all have a few important characteristics in common, including: (1) they are well protected from weather and predators, (2) they provide temperature conditions conducive to growth and survival, and (3) bats are able to get inside, which requires rough surfaces for landing and crawling (using a claw on either thumb and feet). Surfaces made from rough wood, brick, or fabric (screen door fabric; umbrellas) provide highly suitable locations for bats to land and crawl.

Tree cavities, exfoliating bark and rock-crevices are the most common natural roosting structure. Some bat species now commonly roost in buildings, either because natural roosts are no longer available, or because some aspect of these features make them more attractive to bats. Contrary to myth, few bats in Canada roost in caves during the summer (temperatures are too cold). Table 2 below provides some key places bats in Alberta may be found. However, many roosting locations have not yet been discovered. This list will continue to be developed as new roosts are reported.

TABLE 1. COMMON HABITATS USED BY BATS IN ALBERTA

Species	Roosting Habitat in Alberta	Hibernation Habitat
Hoary Bat	• Among the foliage of tall living trees	• Migrates to warmer regions
Eastern Red Bat	• Among the foliage of tall living trees	• Migrates to warmer regions, where they may hibernate in leaf litter
Silver-haired Bat	• Cavities and crevices of trees and snags • Buildings and bat houses (uncommon)	• Migrates to warmer regions, where they hibernate in trees, caves, mines, buildings, wood piles, rock crevices.
Big Brown Bat	• Buildings, bridges, and bat houses • Cavities and crevices of trees and snags • Rock-crevices and erosion holes	• Buildings • Deep rock crevices and erosion holes • Caves
Little Brown Myotis	• Buildings, bridges, and bat houses • Cavities and crevices of trees and snags • Rock crevices • Caves and mines	• Caves • Other locations likely
Long-eared Myotis	• Rock-crevices and erosion holes • Under piles of rock • Cavities and crevices of trees and snags • Tree stumps and downed logs • Buildings (uncommon)	• Mostly unknown; possibly deep rock crevices or erosion holes
Long-legged Myotis	• Rock-crevices • Cavities and crevices of trees and snags • Buildings	• Caves • Other locations likely
Northern Myotis	• Cavities and crevices of trees and snags	• Caves • Other locations likely
Western Small-footed Myotis	• Rock-crevices and erosion holes	• Mostly unknown; possibly deep rock crevices or erosion holes

Tree roosts

Tree roosts are one of the most widespread and important roost structures used by bats, and the majority of bat species in Alberta use tree roosts to some extent.

The Hoary Bat and Eastern Red Bat roost among the foliage of living trees, typically hidden among a clump of leaves towards the edge of the crown. These are most often tall trees that open into clear flight space, although vines, shrubs and smaller trees may occasionally be used, especially during migration.

All other tree-roosting bat species in Alberta typically roost in the crevices of living trees or snags (dead trees that are still standing). These bats exploit a variety of structural defects in trees, including knot holes, old woodpecker cavities, sloughing bark, frost cracks, splits, breakage, or any other structure that creates a concealed space protected from predators and weather. Although living trees are often used, most suitable roosting structures develop once trees become mature and begin to decay—often about the same time that they are cut down because of safety concerns or aesthetic reasons.

Although bats can potentially use any tree species, some species are more likely to be used than others (see Appendix A for a list). Balsam poplar, trembling aspen and a few others are susceptible to heart rot fungus, which often produces large well-protected cavities that are ideal for maternity colonies. Some trees, such as balsam poplar and pine, often have sloughing bark that remains attached to the trunk. Spaces under this bark can provide suitable roosting habitat for supporting groups of bats. Larger trees can support larger groups of bats. Tree species such as cottonwood or balsam poplar grow quickly and reach a large size, and may offer some of the best quality tree roost habitat for bats. Old forests are especially important as roosting habitat for bats, but remnant old trees in younger forests, clearings, and around human communities are also used.

Tree cavities used by Little Brown Myotis in Alberta. Photos by Cory Olson.

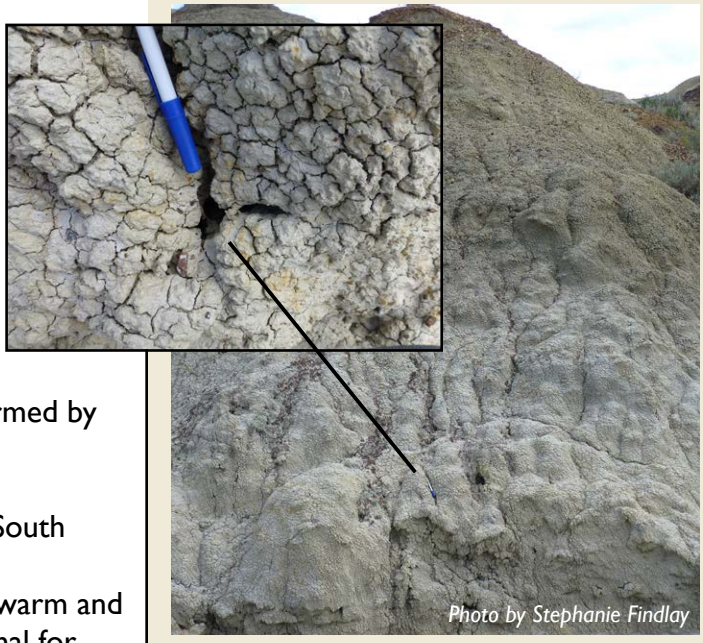
Rock roosts

Bats are known to roost in rock crevices in areas of the province with rugged or rocky terrain. Common sites include river valleys, along the Rocky Mountains, and the Canadian Shield.

Rock crevices are typically narrow spaces where bats are well protected from predators. These include the cracks and crevices along cliffs, under slabs of rock, within caves or mines, among piles of rocks (especially along talus slopes), within boulders, and inside erosion holes (cavities formed by water eroding sandstone or mudstone substrate).

Badland terrain, which occurs primarily along the Red Deer, South Saskatchewan and Milk River valleys offers some of the most important rock roosting habitat in Alberta. These valleys are warm and have many boulders, cliffs, and erosion features that are optimal for bats. The Western Small-footed Myotis is the only species in Alberta that is nearly entirely reliant on rock crevices for roosting. They are only known to occur along the three river systems within badland habitat. This species will use a variety of rock features, including tiny erosion cavities that form within solidified mud (mudstone).

Deep rock crevices extending below the frost line are important for hibernation—Big Brown Bats along the Red Deer River valley are known to hibernate deep within cracks along cliff faces (see section on Hibernacula). Shallower rock crevices that warm with the sun are important during the summer. The ability of rock to retain heat absorbed during the day can make them ideal sites for rearing offspring, which are typically left behind during the night while their mothers forage for insects.



Erosion hole roost used by Western Small-footed Myotis along the Red Deer River valley.

Crevices of sandstone boulder being used as a roost by Long-eared Myotis.

Rock slab in a boulder used as a roost by Big Brown Bats and Western Small-footed Myotis.

Photo by Cory Olson

Bats will seek out cinder block, brick or stone chimneys as roosting sites. These are often found in older buildings and picnic shelters.

Photo by Cory Olson

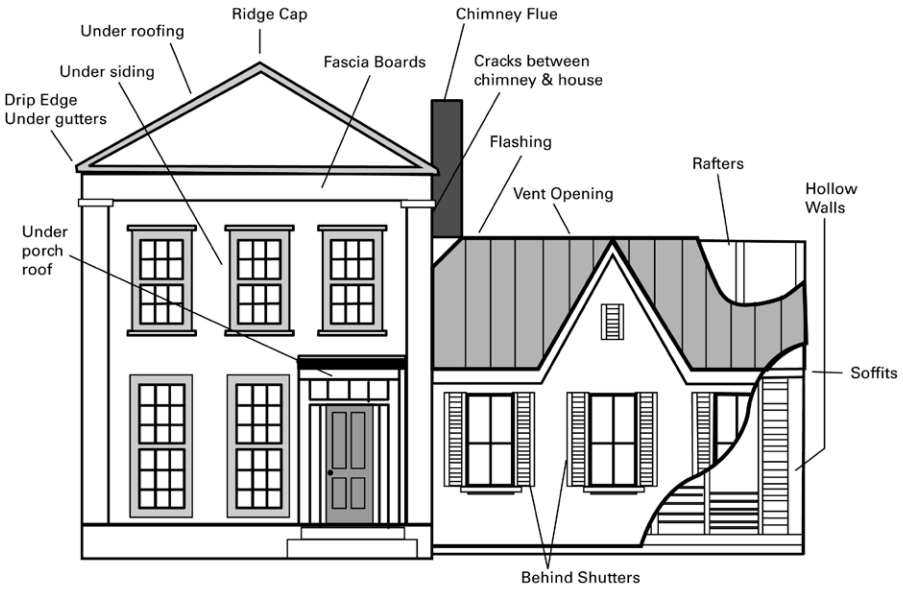
Patio umbrellas are unlikely to support maternity colonies, but are one of the most commonly reported roosts used by bats during fall migration.

Building roosts

Two of Alberta's most common species—the Little Brown Myotis and Big Brown Bat—commonly roost in buildings. In highly developed regions of the province, buildings have likely become the primary roosting sites for these species. Colonies of Little Brown Myotis can exceed 1,000 bats, but more often consist of fewer than 100. Big Brown Bat colonies are generally smaller, typically not exceeding 50 to 100 bats.

Buildings may provide important roosting habitat in areas where natural roosts have been destroyed or degraded. In some areas, buildings and other human structures may offer superior conditions than would have occurred naturally, potentially allowing bats to persist in areas where they would not have otherwise occurred. These locations may also be better protected from predators, potentially helping to offset other sources of human caused mortality. It is clear that buildings have become important roosting habitat for these species and appropriate management of building roosts is critical for the survival and successful reproduction of our bat populations.

A variety of building structures are used by bats. In all cases, bats are exploiting an already existing structural defect or design element that allows entry into the structure. They do not chew through building material to gain entry. The figure below shows some of the locations bats may be found in a building.



Drawn for the Kootenay Community Bat Project based on original drawing by Dr. Stephen C. Frantz, Global Environmental Options, LLC

Bridges

Roosting Habitat

Bats and bridges

Bats love to roost in crevices. This type of microhabitat can be found naturally (in rocks or tree crevices) or it can be found in structures we build (like buildings or bridges). Bridges can be made of concrete, wood or steel (or a combination of these materials). Wooden bridges provide great bat roosting habitat with many crevices and hiding spots. Bridges made of concrete are especially attractive to bats because of the ability of the bridge material to retain heat absorbed through the day from the sun; the warmed concrete retains this heat through the night and bats (especially young ones) benefit from these warm roosts. Bridges are often located over some of their favourite foraging habitats like rivers and wetlands.

Depending on the type of microclimates available at a bridge site, the location could be used as a maternity roost, night roost, day-roost by non-reproductive bats (often solitary), or any combination of these. Night roosts are particularly common at bridges because they typically remain warm at night, occur near high quality foraging habitat, and offer protection from the wind.

Maternity roosts can be identified by groups of bats roosting together (sometimes with pups visible) during the daytime. Young bats that cannot yet fly may be seen at the roost during the night. Non-reproductive females and males tend to roost alone, or with 1 or 2 other bats, during the daytime. Night roosting bats may be solitary or in groups, but only show up at night, typically for only an hour or two.

For day-roosts, bats like crevices that are deep and narrow (1.9-2.5 centimeters wide and 30 centimeters or greater deep). Concrete bridges with expansion joints provide the perfect type of crevice preferred by roosting bats. Any good-sized crevice on a bridge can provide roosting habitat; these may occur in any type of joint that leaves a gap, such as points where pieces are bolted on to the bridge, behind signs or railing.

In contrast to day-roosts, night-roosts are generally open surfaces where bats can easily land to rest and digest food. There may be a social interaction (communication among bats) at night roosts and unlike at maternity roosts, both males and females are often present. H-framed concrete bridges provide ample open surface area for bats to night-roost. Guano stuck to the concrete is one way to detect use as a night roost, but bats will generally not be roosting on these exposed concrete surfaces during the day. Not all concrete is rough enough to allow bats to cling (for landing and roosting), but generally it works well. Bats do not tend to roost on surfaces of wooden bridges that are treated with creosote.

See Best Management Practices for Bats in British Columbia: Chapter 9 for information on managing bridges for bats.

A concrete bridge in BC used as a roost site by Myotis bats.

Bats roosting in an expansion joint of a concrete bridge.

Recommended reading:
Keeley, B.W., and M.D. Tuttle. 1999. Bats in American bridges. Bat Conservation International Incorporated. Resource Publication No. 4.

Roosting Habitat

Human communities can greatly change the availability of treed habitat, as is evident where urban communities border protected areas.

Cottonwood such as these in Calgary provide an important roosting habitat for bats in Alberta. However, few young trees are establishing to replace these trees once they are gone.

Concerns for the safety of bats using bridges arise when bridges require maintenance, repair or expansion. Activities such as power-washing could injure roosting bats; construction and repair activities could disturb bats or result in bat mortality. Working on such sites during the time periods when bats are not present (i.e., avoidance) is the best way to protect bats. Temporarily excluding them from some sites that require extensive repair is another way to avoid hurting or killing roosting bats using these sites. In cases where bridges need to be removed but have housed bats in the past, off-site accommodation can be built (such as a bat house or condo; concrete/rock-based structures are preferred if a concrete bridge is removed). In some bridge locations in the USA, new and old bridges have been purposely modified to accommodate roosting bats. Bridges often offer ideal roosting habitat for bats because many are located over water or wet habitats where bats are either drinking or hunting. In real estate, location is everything!

How important is roosting habitat for bats?

The quality of roosting habitat is an important factor influencing the survival and reproductive success of bats, and may be a determining factor for where bats are found regionally. Bat pups that are raised in higher quality roosts may develop faster, have more time to prepare for winter, and are less likely to die from predation and other hazards. Adult females that use high quality roosts (such as warm attic roosts) are more likely to give birth earlier, produce more milk, and save more energy because they are not trying to remain vigilant for predators.

Natural roosting habitat may be scarce in many human-modified landscapes. Natural roosts are often removed or degraded to make way for human uses. Trees that begin to decay near areas people occupy are often removed for safety reasons.

Even if there is no attempt to remove tree cover, human activities often have indirect effects on forest ecosystems. For example, some of the most important roosting habitat for bats occurs in cottonwood forests along prairie river valleys. These forests often have difficulty re-establishing because of altered flood regimes and grazing patterns, and are slowing disappearing. Damming, in particular, dampens flood cycles, which are important for allowing tree seedlings to establish.

Big Brown Bats and Little Brown Myotis readily roost in some types of buildings and bridges, and these may offer high quality roosting conditions. However, these species may find it hard to locate new roosts as old building are torn down or renovated, and modern building construction methods more effectively exclude bats.

Roosting Habitat

What can landowners and the public do to ensure bats have access to high quality roosting habitat?

Landowners and the public can do many things to protect and enhance bat roosting habitat.

Some key activities include:

Know if you have bats

- Looks for signs of bats, especially guano pellets, which can often be found on the ground, or stuck to the sides of buildings.
- Watch the buildings for at least an hour at sunset (in June or July) to see if bats are flying out (do this on a warm, dark night).
- Contact the Alberta Community Bat Program for assistance and advice if you suspect bats are present.

Protect and enhance roosting habitat

- Do not evict bats from buildings if human conflicts and hazards can be appropriately managed.
- Consider enhancing abandoned or derelict buildings (such as old barns) to allow access by bats. See Managing Bats in Buildings for more information.
- If excluding bats from buildings cannot be avoided, install multiple high quality bat houses or mini-condos well in advance of the planned exclusion. Bat houses and condo could also be considered for areas where natural roosting habitat has been removed because of human activity and is unlikely to be regenerated. See Bat Houses and Condos for more information.
- Prioritize bat houses for areas where roosting habitat has already been lost or degraded, or where an exclusion is planned. Avoid installing bat houses in healthy, intact ecosystems. Do not assume that bat houses are effective mitigation for the loss of natural roosting habitat—most of Alberta's bat species rarely use typical bat house designs.
- Re-vegetate formally treed habitat with native species, such as Balsam Poplar or Cottonwood.
- Restore and protect wetlands, ponds and other areas that provide drinking water (areas of calm open water).
- Think ahead and keep trees that will offer future roosts as old trees disappear. Consider planting new trees every few years so that there is a mix of different age classes. As soon as a tree has a defect (e.g. loose bark) it may be useful to bats, even if it is alive and of small diameter.

It is sometimes difficult to know when bats are roosting in a building, but one important clue is the presence of guano stuck to the outside walls or windows.

While it may take several decades for tree saplings to become suitable for roosting, regular recruitment of new trees is critical for ensuring long-term persistence of bats.

Roosting Habitat

Old decaying trees that need to be removed because of safety reasons may still provide roosting habitat if the lower trunk (at least 3 meters) remains standing.

Building roosts and bat houses (such as the ones shown here) may affect the appropriate timing of roofing and building renovations. These activities should occur once bats have left for the year if they are likely to disturb bats.

- Ensure large diameter decaying trees remain standing when there are no safety risks, or if those risks can be mitigated.
- If potential roost trees must be removed for safety reasons, try to leave as much of the trunk and bark intact as possible, retain a section at least 3 metres tall (taller is better for bats).
- If roosting habitat is removed, consider mitigation options that are most likely to replicate the original structure or substrate. Artificial wood and bark products have been developed that better replicate natural tree-roosting habitat than bat houses. Structures made from rock or concrete products are more likely to replicate natural rock crevices.

Avoid disturbance or modifications to the roost

- Avoid any structural changes that may trap bats inside the roost. Keep in mind that pups are left behind in the roost while their mothers leave to forage, and they cannot leave on their own. If modifications are necessary, wait until after bats leave in late September or October (see Managing Bats in Buildings).
- If a bat roost is present, plan building maintenance (e.g., replacing siding and roofing, painting) for when bats are not present (generally October to March).
- If there is uncertainty whether bats may overwinter in the building, take care to remove boards slowly and examine structural gaps during the renovation process.
- Prevent or minimize access to the roost by people or pets.
- Do not alter environmental conditions of already occupied roosts, such as by permanently opening or closing windows or doors, or adjusting other features that may alter airflow or temperature.
- Minimize unnecessary disturbances to roosting bats, including from sound, lighting, smoke/exhaust, road dust, and other human activities.

Bat Houses and Condos

Bat houses are an easy way to provide roosting habitat for bats and are popular among many homeowners. They are an excellent option in areas where human developments have degraded natural roosting habitat, such as locations where forests can no longer establish, or where decaying living trees and snags have to be cut down for safety or aesthetic reasons. Bat houses can also help mitigate the effects of excluding bats from building roosts, provided they are installed well in advance of the exclusion. An alternative option is to enhance bat habitat in certain buildings where the presence of bats will not cause concerns for property owners.

Although bat houses can be an effective addition to conservation plans, and provide a focal point for education and outreach, there is currently no evidence that bat houses provide the same high-quality roosting conditions that building roosts and natural roosts provide. There are concerns that small bat houses may expose bats to more extreme temperature fluctuations than other roosting options, which could lower reproductive success. Heat extremes can lead to death of non-flying pups who cannot escape hot bat houses. Furthermore, many of our bat species will not use bat houses, and may experience increased competition for resources from bats attracted to these structures. Bat houses are most likely to be used by those species that also roost in buildings—in particular, Little Brown Myotis and Big Brown Bats, which are among Alberta's most common bat species.

Before you install a bat house, try to ensure your bat house will provide a net benefit for bats by considering whether the planned location meets **one or more** of the following criteria:

- ❑ The bat house is installed to help manage bats in buildings, such as to mitigate the effects of a required exclusion. Note that it is preferable to retain bats in buildings, separated from human space.
- ❑ The bat house is intended to compensate for roosting habitat that has been degraded and is unlikely to be restored, such as often occurs in urban areas, farmland, acreages, and industrial lands.
- ❑ The bat house is installed in conjunction with restoration of natural roosting habitat and will help bridge the time until tree roosting habitat becomes available.

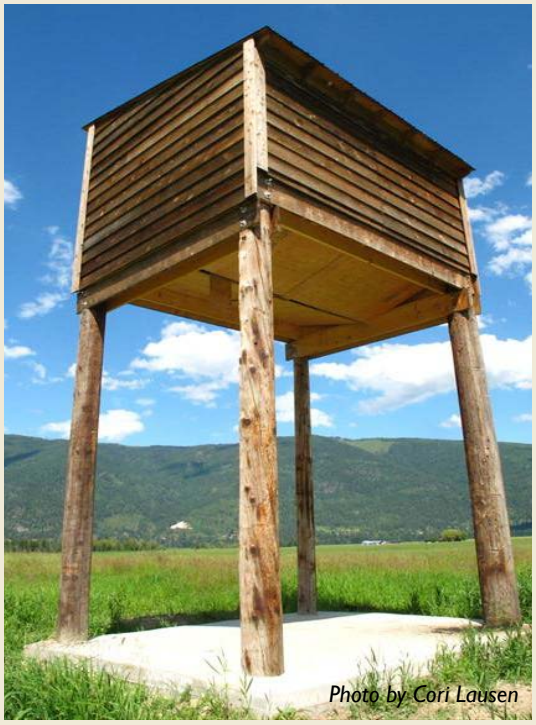
Consider location, colour, and incidence of the sun when planning a bat house project. Multiple bat houses are strongly recommended, with each designed to provide different conditions. Try to face them different directions and have different sun exposures (e.g., full sun, partial sun, and full shade). The bat houses should be within a small area (e.g. 100 metre radius).

Rocket boxes (left) and back-to-back four chamber houses (right) are two recommended bat house designs.

Bats crowding near the ventilated areas of a bat house in British Columbia to escape intense heat. Pink bodies are bat pups, which are more susceptible to heat stress because of their small size.

Not all commercially available bat houses are suitable for bats in Alberta. Before you purchase a bat house, or build your own, ensure it meets minimum design requirements. See Building Homes for Bats: Alberta Bat House Guidelines for more details and installation advice.

Bat Houses and Condos



Bat condo in Creston, BC installed to support a large Yuma Myotis (*Myotis yumanensis*) maternity colony that needed to be evicted from a collapsing barn.

Visit the Alberta Community Bat Program webpage for more information on region-specific bat house recommendations, blueprints for bat house designs, and guidelines for installing bat houses in Alberta.

www.albertabats.ca/bathouses

Bats typically use roosting areas over many years or decades. Therefore, bat house projects are most suited to situations where bat houses will be maintained and made available to bats for several years, and ideally where many potential roosts are available to accommodate natural roost switching behaviour.

How do we plan for a successful bat house project?

- **Use an approved design and size for the species of interest.** Although there are several designs of bat houses that are effective in Alberta, many of those sold commercially do not meet minimum guidelines. Large bat houses are recommended because they not only provide added roosting space (Table 2), but also give bats the opportunity to select more appropriate temperatures by moving among the chambers of the bat house, lowering the risk of pups being exposed to extreme hot or cold temperatures. Refer to the Alberta Bat House Guidelines document for detailed information on choosing suitable designs.
- **Follow recommended installation guidelines for your region.** All bat houses and condos need to be installed correctly to effectively provide bat habitat. Refer to the Alberta Bat House Guidelines for information on suitable installation methods.
- **Maintain and monitor.** Bat houses and condos should be maintained and monitored for use, and data on characteristics of the structure and its occupancy by bats can be contributed to the Alberta Community Bat Program. This information will contribute to our understanding of bat roost preferences, and help improve recommendations in the future. See the Citizen Science section for more information on monitoring and submitting count information.

TABLE 2. CAPACITIES OF BAT HOUSE DESIGNS

Bat House Design	Capacity[1]	Potential Roost Quality[2]
Small Multi or Single Chamber[3]	< ~25	Very Low
Single-Chamber[4]	< 100	Low
Four Chamber Nursery-House[4]	300 (276)	Moderate
Two-Chamber Rocket Box [4]	300 (<10)	Moderate (or Low[5])
Mini-Condo[6]	1,000+	High
Full Condo[7]	3,000+	High to Very High

[1] Numbers in parentheses are maximum reported occupancy in Alberta
[2] Higher quality bat houses are those that have more variation in internal conditions and are more likely to provide suitable roosting conditions regardless of prevailing weather
[3] Refers to designs below minimum size guidelines (< 61 cm [24"] tall and 43 cm [17"] wide)
[4] Based on designs in The Bat House Builder's Handbook (2013) by M.D. Tuttle, M. Kiser, and S. Kiser
[5] Most reports of Rocket Boxes in Alberta suggest low to negligible use by bats; more reports needed
[6] See the Wisconsin DNR (mini) Bat Condo design for an example
[7] Based on the Bat Condo installed in Creston, BC (this condo was found to support 3,078 bats)

What to Do About Bats in Buildings?

About bats in buildings

Some of Alberta's most common bats often roost (and sometimes hibernate) in buildings, and these sites are important for supporting our local bat populations. Evictions and disturbance of colonies in buildings can cause significant harm to bats. Building maintenance, such as re-roofing, or replacing siding, may also impact bat colonies. There is increasing evidence that, once evicted, colonies decrease in size or change in composition. Stewardship of colonies in buildings is therefore one of the most important steps we can take to help bats.

Retaining bats in buildings

Bats can often continue to roost in buildings with few problems for human occupants, provided they are not allowed to enter human living quarters. Bats do not chew like rodents, so will not harm wiring or create holes. However, guano can create an unwelcome mess when in confined areas like attics, and may occasionally discolour surfaces or damage insulation. Problems with guano can often be addressed by strategically placing a drop cloth, plastic sheet, or flower pot to collect the waste, making it unnecessary to exclude the bats. Building maintenance can be planned outside of the time when bats are active at the site. Read the guide on managing bats in buildings for guidelines, or contact the Alberta Community Bat Program for further information.

How can I mitigate a planned bat exclusion?

In some cases, homeowners may wish to exclude bats from buildings. This may occur, for example, if feces cannot be adequately contained or if there are hazards to bats that cannot be addressed. When exclusion is deemed necessary, there are important steps to prevent needless harm to bat populations. The timing of renovations or exclusions is critical to ensure that bats are not inadvertently trapped inside the roost structure.

Steps for excluding bats:

Prepare: Conduct an exit count following protocols published by the Alberta Community Bat Program / Neighbourhood Bat Watch. Exit counts involve watching potential exits at sunset for at least an hour, and counting bats as they leave. This information will help you determine how many bats are involved and if it is a maternity colony. Identify the species of bat, with the assistance of the Alberta Community Bat Program. Knowing the species is important for evaluating the potential for overwintering bats. Also be sure to note all the locations where bats are entering or exiting the structure.

See our guide on managing bats in buildings for advice on how to live with bats, or how to safely exclude bats from your home.

Bats often roost in the open under the overhang of a roof, especially during the night. Sightings of day-roosting bats are also commonly reported during fall migration. These bats should typically be left alone if there is no risk of human contact.

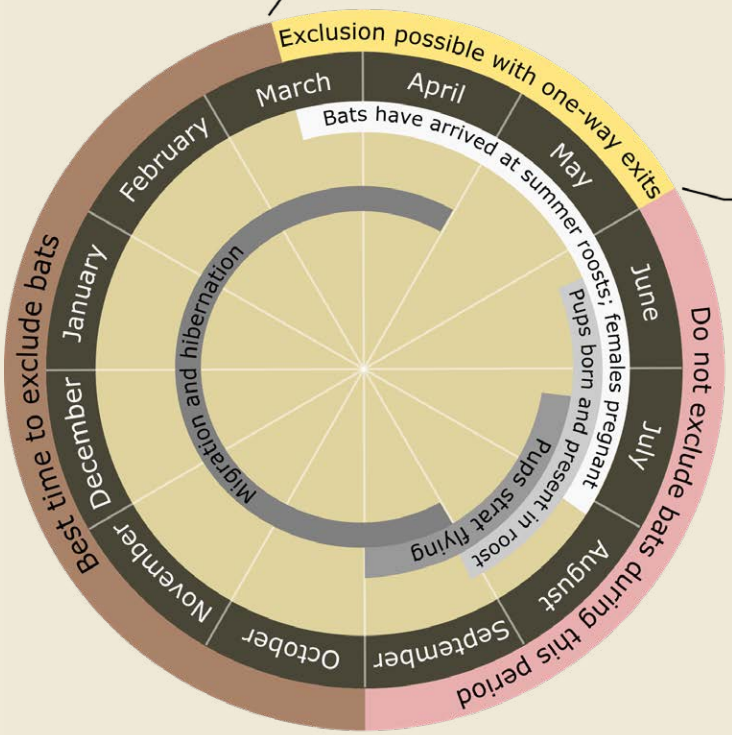
Do not assume disturbed habitats have no value for bats! Bats can often be found roosting in buildings, bridges, trees, and rock crevices, even when people are active nearby.

What to Do About Bats in Buildings?

Provide alternate habitat: It may help to install appropriately-sized bat houses or condos well in advance of the exclusion, so that bats are familiar with their location prior to their return the following year. The number and design of bat houses or condos should be based on the species present and the size of the colony (see Bat Houses and Condos).

Timing is everything: Waiting until October, after bats have left, can avoid most harm to bats from a planned exclusion. See the exclusion calendar (below) for details. Attempts to remove bats before they have left on their own risks serious harm to local bat populations. Bats may leave as early as late August, but there is considerable regional and year-to-year variation, so waiting until winter conditions develop (typically October or November) is preferred. If Big Brown Bats are present, care should be taken to ensure the building is not also used for hibernation—contact the Alberta Community Bat Program for assistance if you suspect this may be the case.

Monitor: After your exclusion, do a bat count and identify species at new and old structures to determine if you have been successful.



Note: overlapping time frames reflects natural variation and uncertainty in the timing of life-history events

Bats may return to maternity colonies as early as March. Structural repairs to buildings after this time risks trapping bats. If exclusion is necessary, make sure to use one way exit devices to allow bats to leave. Exclusions should not occur after June 1st, and are ideally left until the winter months (October - February).

Pups may be born as early as the first week of June. Pups cannot leave the roost on their own, so one-way exit devices will not be effective. Exclusion should not occur while pups are present in the roost.

Maternity colonies will typically have left building roosts by the beginning of October. This period is the best time to make repairs that exclude bats from buildings. However, Big Brown Bats may still occupy buildings after September 30th, and might hibernate there during the winter. One-way exits are advised if this species is occupying a heated building.

Where Do Bats Hunt? Foraging Habitat

Providing foraging habitat for bats

Bats in Alberta eat only insects and other arthropods, but use a wide variety of habitats for feeding. Small bats have amazing acrobatic abilities and may hunt in areas with lots of obstacles—for example, deep inside forests, or close to the vegetation that surrounds rivers, lakes and wetlands. Larger bats are capable of fast flight and choose open habitat above treetops or high above wetlands. Some bats prefer their foraging and roosting areas to be connected (for example with continuous lines of trees or forest) and will avoid flying across wide open landscapes. Biologists think they do this to avoid night predators such as owls, magpies, ravens, or evening hunting falcons and hawks.

Bats are opportunistic foragers. Insects often hatch in localized concentrations at unpredictable times. Bats will shift their foraging strategies to take advantage of those insect hatches when they become available. Bats also target areas where insect concentrations are higher—such as near plants used as food by moths, or the leeward side of forest edges (where insects seek shelter from the wind).

Generally, the more variety in the plant community the more variety (and abundance) there will be in the resulting insect community. Many insects have specific host plants they need to reproduce, and these are most likely to be native species. Deciduous trees (e.g., cottonwood) are especially important in some areas because they are food plants for many insects and provide high quality roosts for bats.

The richest bat habitat occurs where there is an abundance of available roosts, aquatic habitats, and a diverse community of forbs, shrubs, and trees. These habitats are especially important for breeding females with high energy demands during summer pup-rearing periods. River valleys (where most human communities in Alberta are located), and other areas of aquatic or forested habitats represent very high quality habitat for bats.

How far do our bats fly in a night of hunting? It depends on the bat species. Western Small-footed, Northern, Long-eared and Long-legged Myotis tend to be short-range flyers, often staying within a kilometre of their roosts, but sometimes hunting up to 5 to 6 kilometres away. Little Brown Myotis and Eastern Red Bats may fly farther, ranging from 6 to 8 kilometres from their roosts, while Big Brown, Hoary and Silver-haired Bats all regularly fly 10 kilometres or more from their roosts to feed. Those are one-way distances, so bats will also make a return flight. Hoary and Big Brown Bats have been tracked flying up to 26 kilometres in a night. During migration, Hoary, Red and Silver-haired Bats may fly hundreds of kilometres in a night.

Urban backyard environments often eliminate vegetation that would support insects that are eaten by night-hunting bats. Adding native plant, shrub and tree species that support moths and other night-flying insects will help bats and other wildlife.

The rugged terrain, rocks, and plants of these prairie landscape provides valuable roosting and foraging habitat for bats.

Moths are critical for supporting Alberta's bat community. Plants that support either the caterpillar or adult stage of moths are likely to benefit bats.

Foraging Habitat

Volunteers plant trees and shrubs as part of restoration project

Shelterbelts and other treed corridors provide travel routes for bats. In human-modified landscapes, they may help bats by reducing isolation of important habitat features, such as wetlands and forest patches. Filling in gaps will help to ensure connectively between habitat features.

What can landowners and the public do to ensure bats have access to high quality foraging habitat?

People can do many things to protect and enhance bat foraging habitat and support native insect populations, including:

- Reduce or eliminate the use of pesticides on your property.
- Protect and restore wetlands and riparian areas.
- Re-vegetate degraded riparian areas with a diversity of native trees, shrubs, and forbs. Cottonwood or Balsam Poplar are particularly important in many regions.
- Provide a pond with clean and open water for bats to drink from. Ponds should be clear of vegetation to allow for straight flight-paths of bats skimming the water to drink.
- Plant native shrubs and trees along fence lines or in gaps between forested areas and wet areas (such as wetlands, ponds or river areas) to provide safe cover for bats flying between day-roosting areas and foraging and drinking habitat.
- Keep your backyard dark at night to encourage use by foraging bats. See the section on Lighting for more information.
- Reduce pollution. Pollutants (such as PCBs, heavy metals, cyanide and other compounds) settle into ponds, wetlands and lake sediments and can be taken up by larval forms of insects that eventually emerge and become prey for flying bats. They can accumulate in the fat tissue of bats and may cross the placenta into developing bat embryos. Pesticides and pollutants are most likely to have harmful effects on the weakest and youngest bats.
- When gardening or landscaping, use plants that provide food for larvae or adult insects, especially moths (see 'Gardening for Bats' below and Appendix A).
- In urban areas, consider hanging baskets, potted plants, or creating a green roof.
- Provide insects with shelter and locations to overwinter. When gardening for insects, use less hardscaping (less gravel, decking or concrete features) and try to leave more fallen plant matter (such as dead leaves, stems or debris) that gives caterpillars a place to hide from predators or places for adult forms to overwinter. Skip the fall clean-up in the garden and wait until spring to ensure dead plant material is available in the garden. Messy gardens are friendlier gardens for insects! If you are doing a clean-up of dead plant materials, consider piling the plant material in a back-border area for use by insects. Insects and many other types of wildlife do poorly in intensively-groomed and tidy landscapes.

Foraging Habitat

Which plants are beneficial for bats?

In addition to tree species that provide roosting locations for bats, many plant species benefit bats by supporting their insect prey. These include plant species that provide forage for developing larvae, as well as flowers that provide nectar for moths and other nocturnal insects (see Appendix A for a list of bat-friendly plants)

Fragrant plants, especially those with white or pale flowers that bloom and produce nectar in the late afternoon or evening are more likely to attract night-flying moths. Nectar-producing tubular flower structures are often used by moths. Native plant species are preferred because they are more likely to be suitable host plants for moth caterpillars, are less likely to become invasive, and are already well-adapted to local growing conditions.

Plants that are attractive to night-flying insects and/or provide food for larval forms include (see Appendix A for more details):

- **Native deciduous trees and shrubs**—provide abundant forage for insect larvae (caterpillars) and sometimes nectar for adult moths and other nocturnal insects. Some examples that are particularly notable include various species of native poplar (aspen, cottonwood), birch, willow, alder, maple, dogwood, snowberry, and rose, as well as saskatoon, bur oak, choke cherry, and pin cherry.
- **Native conifers**—The various native species of pine, spruce, fir, larch, and juniper are important host plants for many moths and grow well in urban and rural areas.
- **Nocturnal flowing plants**—some plants are especially attractive to moths and other nocturnal insects. Notable examples of native species include: evening primrose (*Oenothera* spp.), honeysuckle (*Lonicera* spp.), phlox (*Phlox* spp.), four o'clocks (*Mirabilis* spp.), goldenrod (*Solidago spp.*) and milkweed (*Asclepias* spp.).
- **Non-invasive garden plants**—Non-native plant species are generally not recommended for restoration of natural areas. However, for gardens, there are a few non-native plants that are particularly well-suited for providing nectar for nocturnal pollinators. Some notable examples include night-scented stock, purple coneflower, tobacco plant, moonflower, and apple trees. Traditional varieties of popular garden flowers may be better for pollinators—some hybrid varieties (e.g., double petunias) produce low amounts of nectar and attract fewer insects. Always ensure the variety of plant you select is non-invasive in your region.
- **Aromatic herbs**—sage, oregano, basil, marjoram and mint. These are mostly non-native but are highly attractive to pollinators.

Polyphemus Moth (*Antheraea polyphemus*) caterpillar feeding on red osier dogwood (*Cornus sericea*)

White-lined Sphinx Moth (*Hyles lineata*) feeding on showy milkweed (*Asclepias speciosa*)

For more information, see these resources:

Native Plant & Propagation

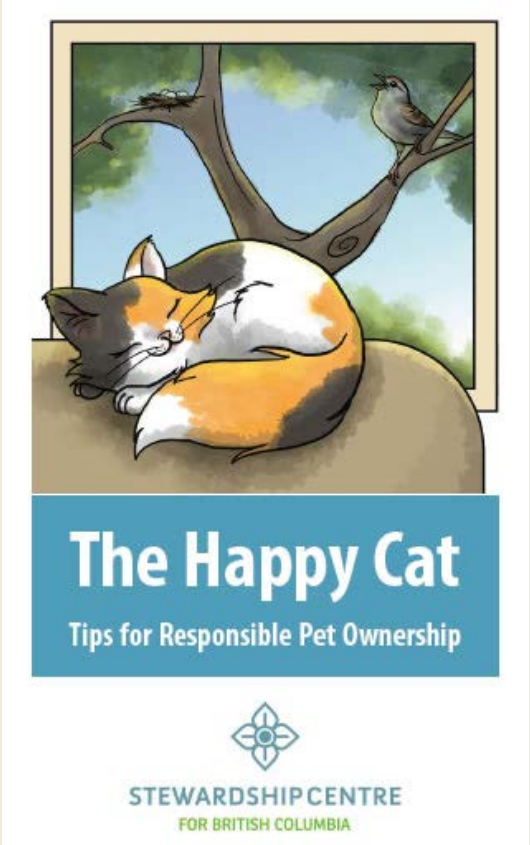
- *Alberta Native Plant Council*

Native Plant Lists

- *Alberta Conservation Information Management System (ACIMS)*

Managing Hazards

Rain barrels and other tanks should be covered to avoid trapping bats, which may unsuccessfully attempt to obtain drinking water.



Cats are a major predator of birds and bats. See "The Happy Cat" brochure for tips on how to be a responsible pet owner.

Bats living in human communities are often exposed to hazards for which they have few natural defences. Because bats are difficult to observe, and most observations go unreported, we have a poor understanding of how these hazards are affecting populations. However, bats dying from drownings, entrapment, collisions, and predation by house cats are reported frequently enough to suggest they may have a significant impact on bat populations. Many of these hazards can be easily controlled by homeowners.

Recommendations for managing hazards to bats

Drownings

While bats are able to swim, they are generally unable to take off from the water's surface, and must be able to climb up out of the water to take flight. Drownings may occur when water is held in uncovered structures with smooth surfaces that bats are unable to climb (e.g., troughs, rain barrels). These steps are recommended to reduce the risk of drownings (also see the Drinking Water section):

- Remove obstacles above the water's surface that may increase the risk of collisions (e.g., fencing wire, boards, etc.)
- Keep rain barrels and other water receptacles covered whenever possible. This also reduces mosquitoes.
- Keep the water level of troughs and other uncovered water receptacles near the top to allow bats to more easily access the water surface to drink, and especially, to escape if they fall in.
- Avoid use of tire troughs. These are particularly difficult for bats to escape because of the overhang of the rim and the smooth sides.
- Provide escape options that allow bats to climb to safety, such as a rough-textured ramp, log, or post. These should reach into the water (near the edge of the tank) and extend at about a 45 degree angle into open flight space (to about 1 meter above the ground).

Predation

Bats reproduce slowly and live long lives to make up for this slow reproductive rate. Historically, few predators would have been able to catch bats. However, in some areas, human activities may have increased the risk of predation to unsustainable levels. For example, cats and corvids (ravens, crows, jays, and magpies) are common predators of bats and tend to be more abundant near human communities. The following precautions should be taken to reduce the risk of human activities leading to more bats being killed by predators:

- Keep cats indoors or within outdoor enclosures (e.g., Catios). If possible, prevent cats, dogs and other predators from accessing the roost, such as by keeping the bottom access doors to attics and haylofts closed (but do not alter access points used by bats).
- Place bat houses in areas that are out-of-reach from cats, and where there are no perches that may be used by other predatory mammals (e.g., squirrels, raccoons, weasels) or birds.
- Do not install perches, or ledges, on bat houses. Bats cannot perch like birds, and these may be used by predators.
- Ensure predators are unable to climb and access bat houses. Using metal poles or tin-wrapped wood posts may reduce the risk of predators accessing these structures.
- Beware that pole-mounted bat houses (or rocket boxes) are likely to create suitable perches for owls and other raptors. Attaching pigeon spikes to the roof could be considered if this is a concern.

Entrapment

Bats becoming trapped in buildings, buckets and other hazards is a major source of mortality around human communities. Consider these precautions to reduce the risk of accidental entrapment:

- Eliminate hazards within and outside buildings that may trap bats, such as empty buckets, barrels, and plant containers.
- Cover the tops of chimneys, stovepipes, vents and shafts (when bats are gone) to prevent access by bats. Allow bats to escape from the bottom of these structures or provide another escape option.
- Remove thin suspended wires and avoid the use of barbed wire near roosts or sources of drinking water.
- Do not use sticky tape or traps in areas where bats (or other wildlife) may encounter them.
- If objects that have potential to trap bats cannot be eliminated, then attach a suitable escape structure (e.g., ramp, log or post that allows bats to climb into open flight space).
- Ensure repairs and renovations to buildings that have roosting bats occur at times of the year when bats are not present. See the section on what to do about bats in buildings for more information.

Other hazards

Keep sources of smoke or other fumes away from bat roosts (e.g., fire pits, barbecues, vehicle exhaust, etc.). Smoke may force bats to abandon roosts, often during the day, which will increase the risk of predation and death of adults and pups.

Accidental bat traps, including fly tape (top), old paint tin (middle), and a chimney with hatch closed (bottom).

Artificial Lighting

Light pollution in North America viewed from space.

Artificial lights attract a variety of nocturnal insects that may be preyed upon by bats. However, the effects of lights on bats are complex, and artificial lighting risks disrupting ecosystems on which bats depend.

Artificial lighting and bats

Bats are nocturnal, which means they are most active at night. Artificial night lighting can affect bats in many ways. Lights shining directly on a roost can disturb bats and delay emergence time, causing bats to miss out on peak feeding periods. Bats may also abandon the roost.

Lights can also affect foraging bats. Moths and other insects are attracted to lights, especially white and blue-white lights and any lights in the ultra violet spectrum. While some bats may readily forage on these insects, the long-term effects on bat populations are more complex. Nocturnal predators such as owls can take advantage of these lit locations, possibly increasing the risk of bats being captured. Lights may disrupt normal insect behaviours, such as feeding and mating, leading to a net reduction in insect prey.

Lights can affect bat movement patterns, and some species are more likely to avoid lights at night. Lines of streetlights along bat commuting routes, such as tree lines, hedgerows and rivers, can act as a barrier to flying bats. This disruption of habitat connectivity can significantly fragment and restrict habitat of some foraging bat species. Artificial night lighting may also interfere with migration patterns of some bat species, but in North America, this is less well understood.

Summary of primary issues with artificial lighting

- Some bat species (Long-eared Myotis, Northern Myotis, and Western Small-footed Myotis) may avoid lights, which can cause them to avoid crossing or foraging in areas with lights.
- Light may remove prey availability in dark areas as moths are drawn out of dark habitats towards lights.
- Some bats are tolerant of lights and will use them as prey patches (Hoary Bats, Red Bats, Big Brown Bats, Silver-haired Bats, and Little Brown Myotis).
- Lights shining on a roost can cause roost abandonment or delay roost emergence, reducing available foraging time and possibly affecting reproductive success if less prey is captured per night.
- Lights may interfere with migration.
- Insect abundance may decline if insects deplete energy while circling lights, and spend less time feeding and reproducing. This could reduce food available to bats.

Artificial Lighting

Smarter lighting is the key to mitigating the effects of artificial night lighting on bats and other wildlife. When implemented into development and conservation plans, these can be very effective at improving the quality of habitat for bats.

Considerations for the placement and design of lights[1]

1. ***Amount of light, direction and height:***

   Try not to use more lighting than necessary and take steps to prevent light spilling out from target areas. In particular:

   - Avoid the tendency to over-light an area because of the higher luminous efficiency of LEDs.
   - Avoid using reflective surfaces under lighting fixtures.
   - Minimize the spread of light from each light source. Keep light at or near horizontal, and directed downwards at a specific area. Use shields or accessories on lights to direct light to the required areas.
   - Evaluate the mounting height for lighting to ensure it is optimal for the task. Lower lights can result in too much light reflecting away from a target or require more lights to cover an area. High lights may also be suboptimal if the task could be completed using lower intensity lighting closer to the target.

2. ***Light placement***

   Do not directly shine light on bat roosts, especially at roost exit or entrance points. Where possible, avoid the installation of light fixtures in ecologically sensitive areas, such as near ponds, lakes, rivers, wetlands, old forest, and other areas used by nocturnal wildlife. Shield sensitive areas from lighting either by using vegetation or close-boarded fencing.

3. ***Let there be Dark:***

   Cycle lighting schedules to provide dark periods, or add motion sensors. For example, roadways and parking lots may be used less after midnight. Vary the lighting levels to reflect the changing levels of use, either by reducing light levels or turning them off completely when not needed. This adaptive lighting strategy can accommodate human occupational safety requirements as well as the needs of local wildlife.

Although some bats will forage for insects attracted to lights, too many street lights can be a major source of light pollution and negatively affect insect communities. Selecting designs that focus light downwards, and light colours that reduce attraction by insects are the best option for bats.

[1] Paraphrased from:

- Bat Conservation Trust. 2014. Artificial Lighting and Wildlife. Interim Guidance: Recommendations to Help Minimise the Impact of Artificial Lighting.
- International Dark-Sky Association. 2018. Light Pollution (website content). Available at www.darksky.org.

Artificial Lighting

If outdoor lighting is required, select designs that direct the light in the required direction, and prevents light escaping upwards or in directions where it is not needed.

4. ***Alternatives to lighting:***

   Consider options other than lighting to achieve goals: reflective paint, white lining, good signage, or reflectors. Limit lighting to areas where it is needed, such as high-risk intersections and pedestrian crossings.

5. ***Hire an expert:***

   Consider hiring a lighting specialist to advise on the best place, use, and type of lighting and lighting control system for each situation.

Technical specifications for lighting

Spectral composition of light may have important impacts on biodiversity. Follow these guidelines to select low impact lighting:

1. Use narrow spectrum light sources to reduce the number of species affected by lights. Use types of lighting that emit minimal ultra-violet light; lights should peak higher than 550 nanometre.
2. Avoid using white, green and blue light wavelengths to reduce attractiveness to insects. Where white light is required, use warm/neutral coloured light with a temperature of <4,200 kelvin. International DarkSky Association (2017) recommends "warm-white" or filtered LEDs (CCT<3,000 kelvin; S/P ratio < 1.2) to minimize blue emission. Lights in the yellow or red spectrum are less visible to wildlife and fewer negative impacts.
3. Pedestrian lighting should be directed towards the ground, as low-level as possible, and less than 3 lux.
4. Look for lighting products with adaptive controls (dimmers, timers, motion sensors).

Noise Emissions

The effects of noise pollution on bats

Bats navigate the world using a sophisticated system known as echolocation, which consists of calling with very loud, high frequency sound and listening for the returning echoes. Calls can range up to 140 dB (decibels), which is 20 dB louder than a rock concert! The hearing apparatus in a bat's ear disengages for about a millisecond while they produce the call just so they do not make themselves go deaf. Call frequencies of most bats in Alberta are above 20 kHz (kilohertz), beyond the hearing range of humans and the reason why we cannot hear them.

When foraging, bats need to hear the echoes of their own calls, and the calls of other bats nearby. Loud, high-frequency, broad-band noise generated by machinery, traffic and other sources can interfere with a bat's ability to hear these calls and may force bats to avoid noisy habitats. In some cases, bats have been found to adjust the frequency of their own calls when in noisy environments, so they can hear themselves or be heard by other bats [1]. This strategy may take additional energy and be costly to foraging bats.

As well as listening to themselves and others, some bats listen for the high frequency sounds produced by their prey (beetles crawling across vegetation or moths vibrating as they warm up for flight). This is known as passive-listening. Passive-listening bat species (such as Northern Myotis and Long- eared Myotis) will avoid areas with noise. Noise could simply overwhelm their hearing so as not to hear prey-generated sounds, such as the scurrying of insect feet or the flapping of moth wings, which some bats depend on to locate their prey. Noise can decrease both foraging success and increase foraging effort. Finally, noisy environments may mask sounds from key features that bats use for spatial orientation, such as the sounds of running water.

Summary of primary issues with noise emissions

- It can degrade foraging habitat for bats or exclude them from hunting in noisy areas. This may occur by:
  - Interfering with their echolocation
  - Reducing the ability of bats to hear the sounds of prey
- May cause bats to abandon roosts or prematurely arouse from hibernation. Bats may also expend additional energy in order to remain alert to dangers (less likely to go into a state of torpor).
- It can mask natural sounds in their environment that are used for navigation.

Bat species that listen for the sounds of insects are more likely to be affected by noise pollution.

[1] Cited from:
Bunkley, J.P., C.J.W. McClure, N.J. Kleist, C.D. Francis, and J.R. Barber. 2015. Anthropogenic noise alters bat activity levels and echolocation calls. Global Ecology and Conservation 3(Supplement C): 62–71.

Bunkley Jessie Patrice, Barber Jesse Rex, and Foster S. 2015. Noise Reduces Foraging Efficiency in Pallid Bats (*Antrozous pallidus*). Ethology 121(11): 1116–1121.

Noise Disturbance

Acoustic walls are often used along busy roads to reduce sound emissions to neighbouring communities. Mobile sound barriers are also available to dampen emissions from industrial facilities, such as compressor stations and drilling rigs. These technologies may help reduce the effects of sound on the quality of bat foraging habitat.

Recommendations for reducing the effect of noise on bats

1. Assess noise production from a bat's perspective. The primary issue is with broadband noise between 10-100kHz, with an intensity greater than 50dB.
2. Keep developments that are expected to exceed the above noise threshold at least 200 metres away from identified bat foraging habitats. Plan developments so that noise sources are as far from productive bat habitats as possible. Additional mitigation may be needed if roosting and hibernation habitat occurs nearby.
3. Bats are most active at night (sunset to sunrise), from approximately March to November. Noise emissions outside this period are less likely to disturb bats, unless they are roosting/ hibernating nearby. Additional mitigation may be needed if roosting and hibernation habitat occurs nearby.
4. If avoidance is not possible, then select methods or equipment that result in lower intensity sound and/or sound frequencies less likely to interfere with bats.
5. Use sound baffles and acoustic barriers (e.g., walls, sound curtains, mobile sound barriers, earth berms) to reduce the intensity of noise emissions reaching bat habitats.

Roads and Bats

Roads impact wildlife in a variety of ways and their impacts on bats are often overlooked. Road construction removes forest cover and roosting features on the landscape, which reduces habitat available to bats. About seven hectares of land are cleared for every 7-metre-wide 10 kilometre stretch of a two lane road. Roads are also often associated with artificial lighting, which is a major source of light pollution in many areas (see Artificial Lighting).

The road right-of-way represents a large opening that bats must cross, and not all bat species will cross openings this large. The result is a loss of habitat connectivity. A road constructed between a roost and foraging habitat may prevent some bats from moving between these areas. Other species may be attracted by roads, and will follow these features for feeding and commuting, thus putting them at a higher risk of colliding with vehicles.

The frequency of bats colliding with vehicles is difficult to measure but we do know it happens. Dead bats are hard to find on the roadways because their small size makes them difficult to see, and they are often taken by scavengers.

Slow, low-flying bats (such as some of the Myotis species) are most at risk of direct collision with cars as they cross roadways. This can be mitigated by encouraging bats to follow particular crossing routes using lines of tree and shrub cover to funnel bats to a particular point. Natural funneling of flying bats may occur along valleys (including river valleys). At points where bats may naturally cross a road, construction of walls or planting trees on either side of the crossing point may force bats to fly up and over the road at a higher than normal altitude, possibly out of harms way. This has been tried in Europe but further testing of this strategy as a mitigation measure needs to be done. Eliminating lighting at crossing points is recommended because some bats will avoid well-lit areas.

Roadways, especially those with excessive lighting, may deter bats that avoid clearings. This road bisects an urban park, potentially isolating large sections of green space from the larger park network.

Citizen Science

Unlike mice droppings, most bat guano is concentrated in a localized area. Look up and you may see roosting bats.

Most bat species can be identified to species using a relatively inexpensive genetic test. The Alberta Community Bat Program may be able to have your sample tested free of charge if a roost report is submitted to the citizen science program.

The Alberta Community Bat Program is now part of the Neighbourhood Bat Watch Research Network. Visit www.albertabats.ca/communityscience and batwatch.ca to learn more.

Interested in getting involved with the study of bats?

There is a great deal we do not know about basic aspects of bats in Alberta. The last large-scale examination of building roosting in Alberta was the 1970's, and since that time, there has been major changes in research techniques, building methods, and the conservation status of bats. Bat houses continue to become more common, with better designs being used, yet there have been no comprehensive studies of their effectiveness for promoting bat conservation in Canada.

Many bats in Alberta appear to use buildings, and for two species, buildings may have become the dominant roost type used in developed regions of the province. Most buildings and bat houses are on private land, so public participation in research and monitoring is essential.

As a greater number of observations are reported, we can begin to develop more comprehensive studies, and answer questions such as:

- What species of bats use buildings and bat houses in Alberta and how does this vary by region?
- What are the geographic ranges of building-roosting bats?
- What structures are bats using for roosting, and will they continue to be available as building methods are changed?
- What bat house designs are effective for bat conservation?
- How does reproductive success differ among bats roosting in buildings, bat houses, and natural roost cavities?
- How does the average size of roosting colonies, and the proportion of each species being reported, change through time?

The Alberta Community Bat Program has a citizen science component where people with roosting bats can submit findings about their roost for inclusion in a provincial database. These data are used to address research and monitoring priorities in Alberta, to improve management recommendations, and prepare for the arrival of white-nose syndrome.

If you do not have any roosting bats, consider putting up a bat house and reporting whether it is being used. Individual bat sightings (e.g., those seen flying at campgrounds, around street lights, etc.) can also be reported to Neighbourhood Bat Watch (batwatch.ca). If you find signs of roosting bats (i.e., guano) in public areas (e.g., buildings and picnic shelters in parks), let us know and we may be able to work with park staff or facility managers to monitor the roost.

For more information on how to get involved with the citizen science program, visit: **www.albertabats.ca/citizenscience**

Public Outreach & Community Involvement

Many bats in Alberta live near people and are strongly affected by how we manage habitats within our communities. Public awareness of bat conservation issues and voluntary support of conservation initiatives are essential for the development of bat-friendly communities.

There is strong interest among the public in learning more about bats, and a variety of public-outreach activities have been successful in changing public perceptions and providing information needed to support conservation initiatives. As more people learn about bats, they become better prepared to engage fellow citizens towards the goal of bat conservation.

Below are some ideas for events to support public education and conservation. Sharing success stories, or lessons learned, with the Alberta Community Bat Program can be a great way to improve public outreach in the province.

Restoration projects

Restoration projects have great potential for improving bat habitats, including for the many species that do not roost in buildings or bat houses. Projects that restore natural vegetation within riparian habitats are particularly likely to benefit bats, because these locations are important habitat for foraging, roosting, and obtain drinking water.

Restoration projects should use native plant species that would have occurred naturally in the area. Bat-friendly trees are good choices, but shrubs and forbs are also important for supporting insect food webs.

Shrubs and trees found near aquatic habitats can often be propagated from cuttings, making it potentially inexpensive to complete a project. A biologist should be consulted before completing a restoration project to ensure other at-risk species are not displaced by the proposed project, and that appropriate vegetation is planted.

Bat walks

Bats produce a lot of sound when they fly. Although we lack the ability to hear these high-frequency echolocation calls, specialized equipment called bat detectors can easily pick up these vocalizations. Guided bat walks, where bat detectors are used to listen to the sounds of foraging bats, are often popular with people of all ages.

During the summer (especially Late June to August), bats are common near aquatic habitats, particularly along the treed perimeters of lakes, rivers, and wetlands. Aquatic habitats surrounded by old trees are

Volunteers plant tree and shrub cuttings as part of a restoration project

Participants using bat detectors to listen to foraging bats at a public bat walk.

Public Outreach & Community Involvement

Bat house being built at a public workshop.

Display booth at public event.

often excellent locations for bat walks. Bats are typically tolerant of people, and may even come closer to forage on the insects that people attract. Bats will come out around a half hour after sunset. Late July to mid August is typically the best time for these events because of the earlier sunset and abundance of migratory and newly-fledged bats. Reasonably-priced good-quality bat detectors are now available that plug into compatible apple or android phones and tablets.

Bat house building workshops

Events where the public can build bat houses are often well-received and may help provide roosts for bats in some areas. Kits are typically pre-prepared for workshops so that participants only need to complete the assembly. Bat houses are larger and more complex than bird houses, and require surfaces to be roughed so that bats have traction to climb inside the structure. Although small, simple bat house designs are available, these are unlikely to provide high-quality roosts and are best avoided (see the Alberta Community Bat Program's Building Homes for Bats guide for more information).

Preparing kits is very labour intensive, and previous experience in Alberta and BC has shown that many bat houses assembled during workshops are never installed, or installed incorrectly and never used by bats. To avoid bat houses being given away that will go unused, event organizers could consider alternative options, such as (1) charging at least a small fee for bat houses to discourage non-committed participants, (2) having a plan in place prior to the workshop for where they will be installed, or (3) encouraging bat houses to be donated back to the program so that they can be reallocated to other conservation projects. Bat house owners should be encouraged to register their bat houses with the Alberta Community Bat Program (www.albertabats.ca/communityscience) and to monitor occupancy in the bat house following standardized protocols.

Public displays

Information tables at natural history events or markets can be a great way for people to learn about bats and ask questions they may have about bats and bat management. The Alberta Community Bat Program, and other organizations, may be able to assist with the delivery of this content. Displays can be made more interesting by adding items such as taxidermied bat specimens (of accidentally killed bats collected and kept under appropriate permits), bat models, nocturnal insect (bat food) collections, bat house examples, research equipment, and crafts. Care should be taken to ensure commercially available skeletons

and preserved carcasses were not deliberately killed to make the specimen, which appears to be the case with many specimens being sold commercially.

Presentations

Public presentations and schools talks are often well received by audiences and are a good means of providing more detailed information about bats and bat conservation. There are many fascinating aspects of bats that can be discussed to make these talks engaging. Consider integrating multi-media into these talks, such as playbacks of bat acoustic recordings or videos of roosting bats. Talks can also be made more engaging by combining with more hands-on events, such as bat walks, workshops, and displays.

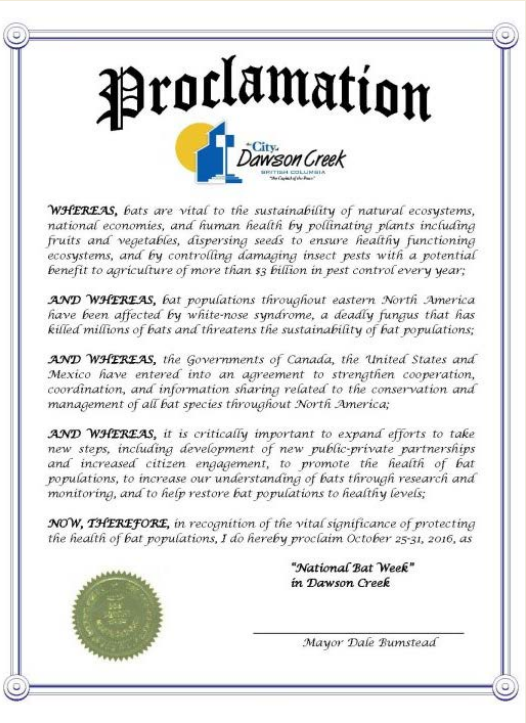
Becoming a Bat-Friendly Community

Where do we go from here? We hope that you will take the information in this guide and be inspired to protect or enhance bat habitat in your community, as well as take efforts to manage bat hazards and promote awareness of bats. Ultimately, we hope you will chose to become a bat-friendly community!

What does a bat-friendly community do?

- Encourages an appreciation of bats among the public, such as by holding talks, bat walk, and workshops.
- Promotes bat-friendly management information among the public. Including this guide, other resources of the Alberta Community Bat Program, and provincial Best Management Practices.
- Reduces pesticide use, as well as noise and light pollution.
- Encourages green spaces, wetlands, and trees, with a focus on native, bat-friendly plants.
- Reviews/revises by-laws to promote bat-friendly practices.

The Bat-Friendly Community program is being developed in towns across Alberta, and involves working with your regional Community Bat Program coordinator to develop a community plan that works for you. Contact us at info@albertabats.ca for more information.



Proclamation

City of Dawson Creek

WHEREAS, bats are vital to the sustainability of natural ecosystems, national economies, and human health by pollinating plants including fruits and vegetables, dispersing seeds to ensure healthy functioning ecosystems, and by controlling damaging insect pests with a potential benefit to agriculture of more than $3 billion in pest control every year;

AND WHEREAS, bat populations throughout eastern North America have been affected by white-nose syndrome, a deadly fungus that has killed millions of bats and threatens the sustainability of bat populations;

AND WHEREAS, the Governments of Canada, the United States and Mexico have entered into an agreement to strengthen cooperation, coordination, and information sharing related to the conservation and management of all bat species throughout North America;

AND WHEREAS, it is critically important to expand efforts to take new steps, including development of new public-private partnerships and increased citizen engagement, to promote the health of bat populations, to increase our understanding of bats through research and monitoring, and to help restore bat populations to healthy levels;

NOW, THEREFORE, in recognition of the vital significance of protecting the health of bat populations, I do hereby proclaim October 25-31, 2016, as

"National Bat Week" in Dawson Creek

Mayor Dale Bumstead

Proclamation by the City of Dawson Creek (BC) recognising bat week (October 25-31).

Appendix A Bat-Friendly Plant Species

Native, local plant species can be beautiful, low-maintenance and bat-friendly planting choices. The following lists are some of the potential options in Alberta, but may not be suitable for all regions. Because Alberta has diverse habitats, always check regional information sources for lists of recommended native plants for your area, plus invasive species to avoid. A list of vascular plants, and information on whether they are native to Alberta, is available through the Alberta Conservation Information Management System (ACIMS). Visit the Alberta Native Plant Council website for a list of suppliers carrying plants that are native to Alberta. The relationship between insects and plant hosts are poorly documented and often unknown. This list should be viewed as preliminary and will change as information becomes available or feedback is received.

Trees species suitable for bat maternity colonies

Most bats that roost in trees will opportunistically use any tree species that provides well-protected, concealed spaces for roosting. However, some species have decay characteristics that result in them being frequently used by bats (e.g., those that retain sloughing bark; remain standing after death; or frequently form large inner cavities). The following trees are native in at least some portions of Alberta, and may be considered for projects designed to provide bat roosting habitat.

Common Name	Scientific Name	Assumed Relative Suitability[1]
Balsam poplar / Black Cottonwood	*Populus balsamifera*	Very High
Plains cottonwood	*Populus deltoides*	Very High
Narrow-leaf cottonwood	*Populus angustifolia*	Very High
Trembling aspen	*Populus tremuloides*	Moderate - High
Alaska Paper birch	*Betula neoalaskana*	Low - Moderate
Paper birch	*Betula papyrifera*	Low - Moderate
Lodgepole pine	*Pinus contorta*	Low - Moderate
Jack pine	*Pinus banksiana*	Low - Moderate
Limber pine	*Pinus flexilis*	Low
White spruce	*Picea glauca*	Low - Moderate
Black spruce	*Picea mariana*	Low - Moderate
Engelmann spruce	*Picea engelmannii*	Low - Moderate
Balsam fir	*Abies balsamea*	Low
Subalpine fir	*Abies bifolia*	Low
Douglas-fir	*Pseudotsuga menziesii*	High - Very High
Tamarack	*Larix laricina*	Low
Subalpine larch	*Larix lyallii*	Low
Western larch	*Larix occidentalis*	Unknown

[1] Relative suitability is the assumed capability of these species to support roosting bats relative to other species on the list, based on previous studies or expert opinion. Any tree species may be locally important depending on the requirements of individual bat species, local growing conditions, and the availability of alternative roosts. These ratings are provisional and may change as better information becomes available.

Plants that attract insect prey

Trees and shrubs

Deciduous trees and shrubs provide leafy forage for moth caterpillars, and some provide nectar for moths and other insects. Native and local species are great planting choices for your backyard. Caterpillars may require specific host plants, and these are typically native species.

Common Name	Scientific Name	Comment
Conifers Pine Spruce Fir Tamarack / larch Juniper (shrub)	 *Pinus spp.* *Picea spp.* *Abies spp.* *Larix spp.* *Juniperus spp.*	The various conifer species are among the most important host plants for moths and other nocturnal insects and are well suited to urban and rural environments. Varieties that grow naturally in an area are best for supporting local moth species.
Native Poplars Balsam poplar / black cottonwood Plains cottonwood Narrow-leaf cottonwood Aspen	 *Populus balsamifera* *Populus deltoides* *Populus angustifolia* *Populus tremuloides*	This is perhaps the most important group for providing tree-cavity roosts in Alberta. And they are among the most important host plants for moth caterpillars and other insect larvae. Aspen and balsam poplar are common throughout Alberta; narrow leaf and plains cottonwood have restricted distributions in southern Alberta. Black cottonwood is a subspecies of balsam popular (*Populus balamifera ssp. trichocarpa*) found in southwestern Alberta. These species are especially fast growing so are often well suited to restoration projects.
Native Birches Alaska paper birch Swamp or bog birch White or paper birch	 *Betula neoalaskana* *Betula pumila* *Betula papyrifera*	Like poplars, this group is among the most important host plants for a moths and other insects. Grow best in moist areas, such as along river edges or wetlands.
Native Willows Various species	 *Salix spp.*	There are 41 species of native willows in Alberta, and these species provide important forage for larval moths and other insects. Willow are easy to propagate from cuttings, making them ideal choices for restoration projects. Cuttings can often be obtained from plants growing on public lands along roadways, and these often need to be cut down anyways (contact the appropriate county or highway department first)—be sure to only take a portion of the plant so that it can regenerate.
Native Alders Green alder River alder / Speckled Alder	 *Alnus viridis* *Alnus incana*	Alders are important host plants for moths and provide forage for a variety of insects groups. A hardy group, they will grow in a variety of habitats and are usually fast-growing.

Bat-Friendly Plants

APPENDIX A

Common Name	Scientific Name	Comment
Native Maples		Many non-native maples are available at garden centres but native species are a better choice. Manitoba Maple are considered native to SE Alberta but are found throughout the province. Mountain Maple is also native to Alberta; it grows to about 20ft, likes shade to partial shade in a sheltered location and will do well in both dry and moist conditions in rich soil.
Manitoba maple (or Box-elder)	*Acer negundo*	
Mountain maple / Douglas Maple	*Acer glabrum*	
Pin cherry	*Prunus pensylvanica*	Pin Cherry likes sun; Choke Cherry is very drought resistant.
Choke cherry	*Prunus virginiana*	
Bur oak	*Quercus macrocarpa*	Native to the eastern prairies. It will grow in many parts of Alberta but not everywhere
Wolf-willow (silverberry)	*Elaeagnus commutata*	Likes sandy sites, or gravelly soils. Several moth species will use this plant as a host plant for larvae.
Beaked hazelnut	*Corylus cornuta*	Several moth families use beaked hazelnut as host plants
Saskatoon	*Amelanchier alnifolia*	Grows well in dry sites with good sun exposure.
Red-osier dogwood	*Cornus sericea*	Found throughout Alberta, likes moist soils often in hardwood forest areas near streams. It has attractive red bark.
Canadian buffaloberry	*Shepherdia canadensis*	Common Alberta shrub, likes forested areas near rivers in well-drained soils. Larval stages of the Cecropia moths will feed on the leaves of this shrub.
Rose		All three prefer open areas and dry sites. Serves as a host plant for several moths, and provides nectar for various beetles and other insects.
Prickly wild rose	*Rosa acicularis*	
Common wild rose	*Rosa woodsii*	
Prairie rose	*Rosa arkansana*	
Currants		This genus includes the currants and gooseberries. There are about 13 native species in Alberta. Moths do not appear to be a commonly reported pollinator, but several use this genus as host plants.
Various species	*Ribes spp.*	
Native Blueberry		Several moth species will use *Vaccinium* species as a host plant for larvae.
Dwarf bilberry	*Vaccinium caespitosum*	
Tall bilberry	*Vaccinium membranaceum*	
Common blueberry	*Vaccinium myrtilloides*	
Low bilberry	*Vaccinium myrtillus*	
Oval-leaved blueberry	*Vaccinium ovalifolium*	
Small bog cranberry	*Vaccinium oxycoccos*	
Grouseberry	*Vaccinium scoparium*	
Bog bilberry	*Vaccinium uliginosum*	
Bog cranberry	*Vaccinium vitis-idaea*	
High-bush cranberry	*Viburnum opulus*	Viburnum may be host plants to various moths, such as the Azalea Sphinx (*Darapsa choerilus*)
Low-bush cranberry	*Viburnum edule*	

Common Name	Scientific Name	Comment
Snowberry		Buckbrush is common in Alberta in dry open areas; Snowberry is more common in wooded areas.
Snowberry	*Symphoricarpos albus*	
Buckbrush (western snowberry)	*Symphoricarpos occidentalis*	
Honeysuckle		Many moth species will use *Lonicera* species as a host plant for larvae.
Twining honeysuckle	*Lonicera dioica*	
Bracted honeysuckle	*Lonicera involucrata*	
Red twinberry	*Lonicera utahensis*	
Mountain fly-honeysuckle	*Lonicera caerulea*	
Meadowsweet	*Spiraea alba*	Spiraea are important host plants for several moth species. Flowers provide nectar for butterflies and possibly moths.
Narrowleaf white meadowsweet	*Spiraea betulifolia*	
White meadowsweet	*Spiraea splendens*	
Rose meadowsweet		

Forbs

Common Name	Scientific Name	Comments
Primrose		Moths are the primary pollinator for some members of this genus, including the common evening-primrose (which means moths are using this species to obtain nectar). Many plants in this Genus are also drought-resistant,
Common evening-primrose	*Oenothera biennis*	
Tufted evening-primrose	*Oenothera caespitosa*	
Long-tubed evening-primrose	*Oenothera flava*	
White-stem evening-primrose	*Oenothera nuttallii*	
Hairy evening-primrose	*Oenothera villosa*	
Phlox		The foliage provides larval food to several moth species, flowers are fragrant, species of plants within this group may be tall or low growing, flowers may be blue, violet, pink, red or white depending on the type.
Blue phlox	*Phlox alyssifolia*	
Moss phlox	*Phlox hoodia*	
Milkweeds		The foliage provides larval food for developing moths and butterflies; these plants are also important for Monarch butterflies and are a recommended plant for butterfly gardens. Be sure to ask for your local, native milkweed species at your garden centre.
Low milkweed	*Asclepias ovafolia*	
Showy milkweed	*Asclepias speciosa*	
Green milkweed	*Asclepias viridiflora*	
Four o'clocks		As the name implies, they bloom in the late afternoon and evening, providing fragrant flowers and abundant nectar to night-flying moths such as Sphinx moths and hawk moths (Sphingidae) that act as pollinators for these multi-coloured flowers.
Hairy umbrellawort	*Mirabilis hirsute*	
Narrowleaf umbrellawort	*Mirabilis linearis*	

Common Name	Scientific Name	Comments
Goldenrod		Tall (up to a metre) with yellow flowers that bloom in late summer. This plant spreads through seed production and rhizome growth (so planting them in a buried pot with the bottom cut out might be helpful if you are trying to contain them to an area of your garden). They do not produce a lot of pollen and that pollen is generally too heavy and sticky to be blown around, so contrary to common perception, they are unlikely a major cause of seasonal allergies. Pollen and nectar is used by insects, including moths; the plant foliage is eated by moth larvae (which may cause the formation of galls that maybe subsequently pecked open by woodpeckers that eat the enclosed developing larva).
Tall goldenrod	*Solidago altissima*	
Late goldenrod	*Solidago gigantea*	
Elegant goldenrod	*Solidago lepida*	
Low goldenrod	*Solidago missouriensis*	
Velvety goldenrod	*Solidago mollis*	
Alpine goldenrod	*Solidago multiradiata*	
Showy goldenrod	*Solidago nemoralis*	
Stiff goldenrod	*Solidago rigida* *(Oligoneuron rigidum)*	
Sticky goldenrod	*Solidago simplex*	

Non-native plants

None of the following plant groups are native to Alberta but they are not considered invasive species, so they are still safe to plant. They can provide nectar for night-foraging moths and other insects.

Apple or crabapple (Genus Malus)— Flowering crabapple trees and apple trees provide habitat for a variety of butterflies and moths; spring-flowering, these are also considered ornamentals. Apples and crabapples are not native to Alberta but are widespread and grow well in many areas.

Purple coneflower (*Echinacea purpurea*)—grows up to a metre in height. The purple flowers are used by butterflies and bees and some moths will use flower heads as food for their developing larva. Drooping flowers may be a sign of moth larva in the cone head; however, they likely will only affect a few of your flowers, so if you are a gardener please hold off with the pesticides. If you are trying to provide habitat for moths, congratulations! You have succeeded in providing moth breeding habitat.

Moonflower (*Ipomoea alba*)—A nocturnal flowing species of the Morning Glory family. They are native to warmer climates but can be grown as an annual in Alberta. Provides a good source of nectar for moths.

Tobacco plant (Genus Nicotiana)—late afternoon, evening the flowers are very fragrant; the foliage is used by many moth species including the families Noctuidae and Sphingidae (hawk moths and sphinx moths).

Hemerocallis/daylilies (Genus Hemerocallis)—There are many fragrant nocturnal daylilies. Hemerocallis varieties to look for include: 'Island Music',' Shades of Darkness','May May','Guidrid','Lady Sundance' as well as *Hemerocallis altissima*, *Hemerocallis citrina* (syn: *H. Vespertina*) and *Hemerocallis flava*.

Aromatic herbs—include many non-native species, but many grow well in Alberta and can be grown in containers. These include: hyssop, thyme, nepeta, sage, rosemary, lavender, oregano, dill, angelica, fennel, coriander, basil and others.

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