Bat-Friendly Communities

A guide for managing and enhancing bat habitat in British Columbia

Inside this handbook:

- Bat Basics
- Protecting Habitat
- Managing Hazards
- Getting Involved

Version

This version was last updated September 18, 2018. Regular updates may be made as new material is developed or information becomes available. Please check www.bcbats.ca for the latest version. Comments, corrections, or suggestions for new material may be emailed to info@bcbats.ca.

Bat habitat near Revelstoke, BC Photo by Harry van Oort

Acknowledgements

This document was based on the Alberta Bat-Friendly Communities document and many of the original BC Community Bat Program and Kootenay Community Bat Program documents. Modifications for the BC version were written and compiled by Cory Olson, Mandy Kellner, and Susan Holroyd with funding from the BC Ministry of Environment through the Land Based Investment Strategy. Thank-you to Orville Dyer, Cori Lausen, Leigh Anne Isaac, Peter Ommundsen, Lorraine Andrusiak, and Helen Davis for their reviews.

The Alberta version of this guide was written by Cory Olson and Susan Holroyd in conjunction with the Alberta Community Bat Program (Wildlife Conservation Society Canada). The previous BC documents were written by Juliet Craig and Mike Sarell. Special thanks to the many reviewers of past documents, including Lorraine Andrusiak, Doug Burles, Katie Calon, Orville Dyer, Christine Godwin, Purnima Govindarajulu, Jared Hobbs, Margaret Holm, Leigh Anne Isaac, Mandy Kellner, Cori Lausen, Tanya Luszcz, Inge-Jean Hansen, Peter Ommundsen, Aaron Reid, Helen Schwantje, Katharine Staiger, and Adam Taylor.

We are grateful to Jared Hobbs and many regional coordinators for the use of photos, and we are indebted to our provincial partners, the BC Conservation Foundation and BC Ministry of Environment and the many regional stewardship groups working to conserve bats.

The BC Community Bat Program network recognizes the Habitat Conservation Trust Foundation and anglers, hunters, trappers and guides who contribute to the Trust for making a significant financial contribution to support the BC Community Bat Program. This program is also supported by the Habitat Stewardship Program of Environment and Climate Change Canada. Finally, thank you also to our many regional partners and funders. Without their support, this program would not be possible.

BRITISH COLUMBIA
www.gov.bc.ca

HABITAT CONSERVATION TRUST FOUNDATION

BRITISH COLUMBIA CONSERVATION FOUNDATION

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Contact the BC Community Bat Program

Email: info@bcbats.ca
Phone: 1-855-922-2287
Web: www.bcbats.ca
Facebook: www.facebook.com/bcbats













Why Build Bat-Friendly Communities?

Bats are an important part of the wildlife fauna in British Columbia. BC has 16 species of bats, and many of these are 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).

Bats in BC have low reproductive rates and face many threats to their existence. 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 decades. One bat in western Canada 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 to many regions, such as collisions with wind turbines and vehicles, introduction of new predators (such as cats), entrapment, and extermination. Two of British Columbia'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. This disease is spreading across North America, and has already been confirmed in Washington, just south of the BC border.

Many bats live in close association with human communities, and a few species, such as the Little Brown Myotis, rely extensively on human-made structures as sites for roosting and raising offspring. Few other wild animals 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 bats 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, and the diversity of habitats that are important for ensuring the success of our bats. While buildings and bat houses may provide important shelter for bats, this is not sufficient to sustain our bats if they cannot access drinking water or food in the form of insects.

This guide provides information to individuals, communities, and organizations that are interested in maintaining and enhancing bat habitat and building bat friendly communities. The focus is on ecosystems as a whole, going beyond previous guidelines for buildings and bat houses. 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 is a living document that will be continually revised and expanded as new information becomes available.

What's in this guide?

Planning for Bat Conservation

Incorporating a bat-friendly approach and habitat features for bats at the planning level is the most effective way to conserve bat habitat. Bat habitat requirements overlap with those of many other species, and can likely be addressed within established planning processes. Provincial, regional, and municipal conservation planning is implemented through a variety of strategies and working groups, including the following examples:

- Regional Growth Strategy (BC)
- Official Community Plans and local municipality environmental advisory groups
- Species and Ecosystems at Risk Local Government Working Group
- BC Bat Action Team

There are many existing resources and programs available to guide bat conservation efforts by the public, communities, and professionals in British Columbia. A few recommended resources are included below.

Conservation and management programs operating in BC

- BC Community Bat Program
- North American Bat Monitoring Program
- BatCaver Program (Wildlife Conservation Society Canada)

BC Community Bat Program resources (www.bcbats.ca)

- Got Bats? A BC Guide for Managing Bats in Buildings
- Got Bats? A Bulletin for Builders in BC
- Got Bats? A Bulletin for Roofers and Chimney Professionals in BC
- Got Bats in a House for Sale? A Bulletin for Realtors in BC
- Building Homes for Bats: A Guide for Bat Houses in BC

BC Best Management Practices (BC Ministry of Environment)

- Best Management Practices for Bats in British Columbia
- Develop with Care (Environmental Guidelines for Urban and Rural Land Development)

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)

Protections for Bats in British Columbia

Before beginning any conservation planning, consider that bats are protected in British Columbia under several pieces of legislation, including those described below.

BC *Wildlife Act*

All bats in British Columbia are protected under the *Wildlife Act* from being hunted, captured, possessed, killed, transported, and harassed. It is ineffective to attempt to remove bats using any of the following:

- Pesticides
- Loud Music
- Ultrasonic Devices
- Mothballs
- Bright Lights
- Sticky tape and other traps

Federal *Species at Risk Act* (SARA)

The *Species at Risk Act* provides protections to bats on federal land if they are listed as Threatened or Endangered under Schedule 1 of the act. This includes three species found in British Columbia: Little Brown Myotis, Northern Myotis, and the Pallid Bat. Examples of federal land include, but are not limited to: national parks, Department of Defence lands, national wildlife areas, and First Nations reserve lands.

SARA prohibits any of the following to a species listed as Endangered or Threatened under the act:

- the killing, harming, harassing, capturing or taking of an individual
- the possession, collection, buying, selling or trading of an individual or any part or derivative of an individual
- the damage or destruction of the residence of one or more individuals

Additional protections may be implemented, and up-to-date information should be obtained from the Species at Risk Public Registry and reviewed prior to undertaking any work that may affect bats. Applicable federal agencies should be consulted if you are undertaking a project that may fall within the jurisdiction of SARA.

Other legislation

Depending on the area and type of work being completed, additional protections may apply to work involving bats or bat habitat. Some of these include:

- BC Parks' Legislation (various acts and regulations)
- Riparian Areas Regulation (*Riparian Areas Protection Act*)
- *Forest Act*
- *Forest and Range Practices Act*
- *Local Government Act*
- Municipal By-laws

White-Nose Syndrome

White-nose syndrome is a disease of bats caused by the fungus *Pseudogymnoascus destructans*. Although it does not affect people or other animals, millions of hibernating bats in North America have already died from this disease. The fungus was accidentally brought over from Europe by people and does not occur naturally in North America. The first known case was in New York State in 2006. As of 2018, white-nose syndrome has spread to at least 31 states and five Canadian provinces. Three bat species found in Canada—Little Brown Myotis, Northern Myotis, and Tri-Coloured Bat (not in BC)—are now Endangered in Canada because of white-nose syndrome. Several additional BC species are likely susceptible to the disease.

Until recently, white-nose syndrome was primarily a disease affecting bat populations in eastern North America, but in 2016, white-nose syndrome was confirmed in Washington State. Although the disease has not yet been confirmed in western Canada, there is a very high risk that it will reach BC within the next few years.

Large geographic movements of this disease are likely from people transporting bats or bringing contaminated equipment, clothing or soils into bat habitats, such as caves and mines occupied by bats. Once established within a region, the disease spreads mainly from bat-to-bat, or else by bats coming into contact with contaminated surfaces. We likely cannot stop the natural spread of this disease to BC, but we can slow its progression by preventing human-induced spread. This will allow more time to develop more effective management approaches and for scientists to research potential treatments.

What can I do?

- Ensure you follow appropriate decontamination protocols whenever you are working with bats or in bat habitat.
- Report bats that are flying or found dead during the winter and early spring (Nov through May) to the BC 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 webpage for information on what you can do.
- Participate in the BC Annual Bat Count to help monitor our bats.
- Consider contacting the BC Community Bat Program about guano collection in spring for white-nose syndrome surveillance.
- 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.

Hibernating Little Brown Myotis with white-nose syndrome.

For more information, see:

- *British Columbia white-nose syndrome fact sheet*
- *British Columbia white-nose syndrome 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)*

Bats and People

Never handle living or dead bats with your bare hands. If a bat must be handled, wear thick leather gloves and use another object, such as a pillow case, towel or box, to gently move and contain 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.

Ouch! 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 rarely 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 British Columbia.

Millions of bats live near people and provide tremendous benefits because of their control of insect pests. When left alone, bats are not a danger to people. However, as with all wildlife, there are important procedures and safety considerations you should be aware of to ensure both you and bats remain safe.

Never touch bats with your bare hands. Although very rare, there is potential to contract rabies from a bat bite or scratch, usually from accidental contact or deliberate handling of bats. Like many wild animals, bats will defend themselves by biting if they feel threatened, such as when someone attempts to pick them up. Rabies is a virus that occurs at very low levels in bat populations throughout BC (about one in every thousand bats). **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. The best prevention is to never handle bats with bare hands.** 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 gloves do not provide protection from bat bites as most bats can bite through thin materials. Researchers handling bats have been immunized against rabies, and wear disposable gloves to prevent accidental transmission of microbes (e.g. fungal spores causing white-nose syndrome) from one bat to another. **Thick leather gloves** must be worn to protect yourself from bat bites.

Have you or your pet been bitten?

If you come into contact with a bat, immediately wash the wound well with soap and water under moderate pressure (e.g. a running tap). This lessens the chance of any infection. Seek immediate medical attention from your doctor or local public health unit even if you are unsure whether you were bitten (visit http://www.immunizebc.ca/finder or call HealthLink at 811). Check in with your veterinarian to ensure your pet's vaccinations are up-to-date if your pet has come into contact with a bat. Bat bites often do not leave visible wounds on people or pets, so the absence of bite marks does not mean there was no rabies exposure.

Bats and People

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 while in torpor.

Many bats fall victim to house cats. Often cats will kill the bat, but leave the carcass, making the homeowner wonder how it died.

If you are confident the bat is dead, call the BC Community Bat Program or your local Fish & Wildlife Office. Dead bats may be collected and 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 BC Community Bat Program.

Bat guano and urine

Bat guano and urine are typically not health hazards, but in some regions of Canada, bat guano and bird droppings have been associated with a lung disease known as histoplasmosis.

Histoplasmosis is caused by the inhalation of *Histoplasma capsulatum* fungal spores that can grow in humid 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. Histoplasmosis has yet to be reported in BC, and the risk is likely very low in most areas of the province.

Appropriate respiratory protection, gloves, and coveralls should be worn if disturbing the feces of any 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 during cleaning.

Buildings with bats are often old and may have other health risks that require additional precautions, such as to prevent exposure to mould, asbestos, and rodent-associated diseases (e.g., hantavirus).

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.

At least a class N-100 (high efficiency) respirator should be worn when cleaning the feces of wild animals (note that this is not adequate protection for asbestos or for other high risk situations).

Distressed Bats and Rehabilitation

Contact the BC Community Bat Program 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. Be sure to release the bat in an area away from people.

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 and large numbers of bats are migrating to their winter habitat. During this period, bats may be found in 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 crows, magpies, dogs and cats. Suitable locations could include a decaying tree that can provide hiding spaces for bats (e.g., loose bark, cavities and cracks). 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 (contact the Community Bat Program). Be sure to always wear thick leather gloves if handling bats.

It is important to note that 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 you need to be particularly careful not to touch them. That said, bats may also fly during the day if they are dehydrated and need water or if their roost is disturbed. If you find a bat on the ground, 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 people and pets. Alternatively, place an upturned box or bucket over the bat to contain it temporarily while you seek advice.

If you are confident the bat is injured or sick, contact the BC 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 difficult without extensive experience and knowledge of animal care. The best option is to contact a wildlife rehabilitation centre.

Bats Basics

Where are bats found?

Bats occur throughout British Columbia. They are among the most common wildlife in cities, especially in river valleys and parks where there is water and old trees that provide roosts. Some bats have ranges that span the entire province—such as the Silver-haired Bat, Big Brown Bat, Little Brown Myotis, and Long-legged Myotis—while others may only be found in particular habitat types or regions of the province. BC has the greatest diversity of habitats of any province in Canada, and not surprisingly bat communities change markedly across the province. Table 1 lists regions of BC where the various bat species may be found. Detailed species descriptions can be found in Appendix A.

BC Ministry of Environment Regions

TABLE 1. BAT SPECIES FOUND IN EACH REGION OF BRITISH COLUMBIA

	Scientific Name	Status	BC Ministry of Environment Region									
			Vancouver Island	Lower Mainland	Sunshine Coast	Thompson	Kootenay	Cariboo	Skeena	Omineca	Okanagan	Peace
Spotted Bat	*Euderma maculatum*	SC[1]; Blue (BC)				x		x			x	
Pallid Bat	*Antrozous pallidus*	T[1]; Red (BC)									x	
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue (BC)	x	x	x	x	x	x			x	
Hoary Bat	*Lasiurus cinereus*	Not at risk	x	x	x	x	x	x	x	x	x	x
Eastern Red Bat	*Lasiurus borealis*	Red (BC)					?				x	x
Silver-haired Bat	*Lasionycteris noctivagans*	Not at risk	x	x	x	x	x	x	x	x	x	x
Big Brown Bat	*Eptesicus fuscus*	Not at risk	x	x	x	x	x	x	x	x	x	x
Yuma Myotis	*Myotis yumanensis*	Not at risk	x	x	x	x	x	x	x		x	
Californian Myotis	*Myotis californicus*	Not at risk	x	x	x	x	x	x	x		x	
Western Small-footed Myotis	*Myotis ciliolabrum*	Blue (BC)				x	x	x			x	
Northern Myotis	*Myotis septentrionalis*	E[1]; Blue (BC)					x	x	x	x		x
Long-legged Myotis	*Myotis volans*	Not at risk	x	x	x	x	x	x	x	x	x	x
Little Brown Myotis	*Myotis lucifugus*	E[1]	x	x	x	x	x	x	x	x	x	x
Fringed Myotis	*Myotis thysanodes*	Blue (BC)	?	?	?	x	x	x			x	
Long-eared Myotis[2]	*Myotis evotis*	Not at risk	x	x	x	x	x	x	x	x	x	x
Canyon bat	*Parastrellus hesperus*										(x)[3]	
Mexican Free-tailed Bat	*Tadarida brasiliensis*		(x)[3]	(x)[3]	(x)[3]							

[1] COSEWIC Status (federal): E = Endangered, T = Threatened, SC = Special Concern, [2] Long-eared Myotis (*Myotis evotis*) includes the species formally known an Keen's Myotis because genetic evidence indicates these are the same species. [3] Acoustic records only; currently considered Accidental in BC.

Modified from: Craig, V. J., and S. L. Holroyd. 2004. Bat Conservation Strategy for BC and Alberta. Draft. Prepared for BC Ministry of Water, Land and Air Protection. 112 pp.

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 each thumb and their hind feet. They require rough surfaces for traction.

How do bats make a living?

Bats have similar needs as people—water, food, and shelter. Areas 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. 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, crows, magpies). To reduce predation, bats typically select well-hidden and/or well-protected spaces to rest (called roosts; winter roosts may also be called hibernacula). Roosts are often in narrow cracks and crevices or other difficult-to-reach sites. 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 the claws on their hind feet. However, they often crawl to access roosts or to reach take-off locations for flight. Crawling is aided by a single claw on each 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. The best locations are those with stable temperatures, which do not overheat during the day or become too cold at night.

How do bats survive the winter?

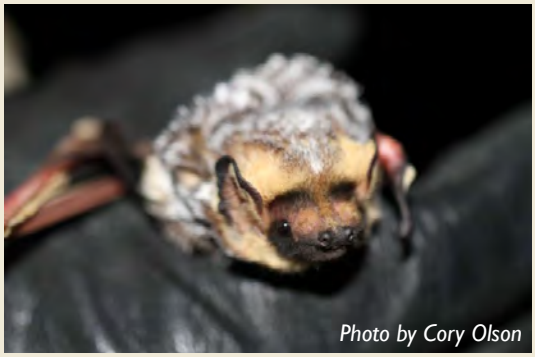
All bats in Canada are insectivores, meaning they eat insects and spiders, which are inaccessible during our prolonged Canadian winters. So how do bats survive the considerable portion of the year when there is no food? There are two strategies that bats use to survive the winter: migration and hibernation.

Migrate: While all bats are migratory to some extent, two species appear to leave the province altogether—the Hoary Bat and Eastern Red Bat. Silver-haired Bats also migrate long-distances in some regions, but do not necessarily leave BC during the winter. Long-distance migration to warmer climates may allow these bats to forage for a greater portion of the year, reducing the need to accumulate large fat stores to survive the winter. This gives pups more time to grow, which might explain why many long-distance migrants give birth to more than one pup per year. Red Bats can have up to four pups in a litter (highly unusual for bats). 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: Nearly all bats that regularly occur in British Columbia appear to hibernate in the province during the winter, except the Hoary Bat and Eastern Red Bat. Southern British Columbia is the only location in Canada where Silver-haired Bats are confirmed to hibernate, but winter records are known from southeastern Alaska, suggesting this species may hibernate over a wider area than is currently known.

Bat species hibernating in the province may undertake short to long-distance migrations (up to hundreds of kilometres) to reach suitable hibernation habitat. Because several bat species are known to mate near their hibernation sites, these movements may also be important for mating.

Migration and winter habitat use are poorly understood for most bats. Where the vast majority of bats in the province go during the winter is mostly unknown (see also Hibernacula).



The Hoary Bat is one of two bat species that migrate out of the province during the winter.

A group of hibernating bats (Little Brown Myotis or Long-legged Myotis)

BC is the only province in Canada where hibernating Silver-haired Bats are frequently found.

Aquatic habitats support rich prey communities, and provide 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 in 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.

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 the dry interior, water is 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 riparian 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 clean 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 species 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 water for drinking. Large water bodies like dugouts, lakes and ponds are good water sources for these bats. For bats that 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 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 to roosting habitat (under 2 kilometres is a good rule of thumb but closer is better and some species are more likely to travel long-distances); (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 access to water.

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 container 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 the air. 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 (and other wildlife) 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, Long-eared Myotis and Fringed Myotis) can use small ponds and troughs—in the range of about 1 metre in diameter. 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.

How can people help provide drinking water for bats?

- Maintain water quality by avoiding 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.

A bat unfriendly water trough—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.

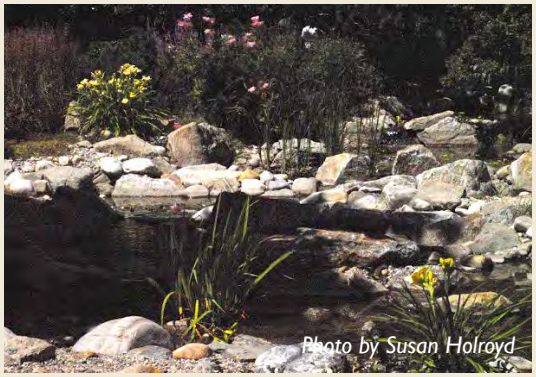
The eutrophication of wetlands, caused by the runoff of fertilizers and other nutrient sources, may cause thick vegetation mats to develop, thereby depleting access to drinking water.

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

Where Do Bats Drink?

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.

- 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.
- 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.
- 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.
- To the extent that space allows, provide a length of open water that meets the requirements of the target bat species (see previous page).
- 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. For example, removing log jams or beaver dams can often restore water flow and make the water inaccessible to bats for drinking.
- Avoid stocking ponds with fish as this may reduce aquatic invertebrates and can 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 from water and nearby vegetation.

What Are Roosts?

Roosts are sites where bats rest when they are not active. They can be broadly categorized as day roosts or night roosts, depending on when they are used. Maternity roosts are locations where bats give birth and raise their pup, and are often used as both day and night roosts. Hibernacula are roosts used during the winter to hibernate.

Bats in BC are reliant on pre-existing structures in their environment for roosting (e.g., tree cavities, sloughing bark, rock crevices, buildings). They do not build nests, chew holes, or otherwise modify the structure of their roosts. A variety of structures are used, but they all have a few 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. Surfaces made from rough wood, rock, brick, or fabric (screen door; patio umbrellas) provide suitable locations for bats to land and crawl.

Night roosts

Night roosts are places that bats use during the night—often for an hour or two—to rest between feeding bouts. Groups of both male and female bats are often present at these sites. Night roosts are typically in warm, 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 will often observe droppings in the morning where the bats were the night before. If night-roosting bats are creating a mess, consider placing a flower pot or planter below their roost to collect the guano (but make sure it won't trap bats).

Day roosts

Day roosts are sites where bats rest during the day. They can be used by lone bats (often males or non-reproductive females) or a colony of females and their pups (maternity roosts). Day roosts are usually within enclosed spaces, well-protected from weather and predators. Common locations include well-concealed spaces of buildings, bridges, bat houses, as well as natural roost sites such as tree cavities, under sloughing bark, among tree-foliage, and within rock crevices.

Occasionally a bat will choose a day roost in the open, which is a behaviour more often seen with inexperienced pups learning to fly. Open day roosts may be located on an outside wall or under a patio umbrella. Day roosts used by males and non-reproductive females tend to be in cooler locations than maternity colonies. Some day roosts may be used temporarily, with a bat coming and going over the summer and fall, while others may be used consistently throughout the summer and potentially over many years.

Night roosting bat on the outside wall of a building.

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

A maternity colony occupying a bat house. View is looking up from the bottom into the bat house.

Where Do Bats Roost? Roosting Habitat

Rock crevice roost used by hibernating Californian Myotis and Silver-haired Bats.

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.

Maternity roosts

Maternity roosts are locations where females gather to raise pups and are characteristically very warm locations. Bats may be present during both the day and night. Female bats and their pups may roost in groups ranging from two to several thousand individuals. Although mother bats typically leave their pup behind in the maternity roost while they forage, they are capable of carrying their pup between 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 (e.g., buildings, bat houses, large rock crevices) are likely to be used more often and for longer periods than smaller more temporary roosts (e.g., sloughing bark, 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. Bats in BC have been found hibernating in caves and mines, deep rock crevices, wood piles, rock piles, under house trim, and inside buildings. Elsewhere in Canada, they have also been reported to hibernate in old wells and transportation tunnels. In the Pacific northwest, bats have been reported to roost in the hollows created by tree root wads in the ground.

Only a small number of bat hibernacula have been located in BC, mainly in caves and mines, and these account for a minor portion of the overall bat population. We do not know where the majority of bats in BC hibernate. However, the very specific conditions bats require to survive the winter limits the possible locations they can be found. Bats need stable, cool temperatures to conserve enough energy to survive the winter, but it cannot be so cold that they will experience freezing conditions. They also generally require high humidity. Such conditions can be found in caves, but may also be found in deep rock crevices (extending below the frost line), mines, tree root wads, and occasionally buildings. Ideal hibernation locations for bats may not be common in many of the regions of BC they occupy.

Living in groups

Bats as a group are among the most social of all mammals. 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. Having many bats in a single roost can greatly increase the roost temperature, providing warm conditions needed to support

growing pups. Most large groups are mothers raising offspring, while males typically roost alone or in small groups. Bats living in large groups require large roosting structures, which may be especially hard to find in some locations. An exit count at a roost at disk can tell you how many bats are inside and provide insight into how bats are using a structure.

Roosting habitats used by bats in British Columbia

Some species in BC 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 cavities in live trees or standing dead trees (known as 'snags').

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 BC may be found. However, many roosting locations have not yet been discovered. This list will continue to evolve as new roosts are reported.

TABLE 2. SUMMER AND WINTER ROOSTS USED BY BRITISH COLUMBIA BATS

Common Name	Summer Roosts			Winter Roosts
	Buildings	Bat House User	Natural roosts	
Spotted Bat			Cliffs	Cliffs, mines (assumed)
Pallid Bat	Potentially		Cliffs, rock outcrops, snags	Rock crevices?
Townsend's Big-eared Bat	Common	Big ones	Cliffs, caves, mines	Mines, caves, rock crevices
Hoary Bat			Foliage of trees	Migrates
Eastern Red Bat			Foliage of trees	Migrates
Silver-haired Bat			Trees, snags (cottonwoods)	Snags, live trees, mines, buildings, wood piles, rock crevices
Big Brown Bat	Common	Yes	Snags, cliffs, rock crevices	Buildings, mines, rock crevices
Yuma Myotis	Common	Yes	Snags, rock crevices, mines, bridges	Mines, rock crevices, caves
Californian Myotis	Occasional	Yes	Snags, mines, bridges, rock outcrops & crevices	Buildings, mines, caves, rock crevices, tree root wads
Western Small-footed Myotis	Occasional		Cliffs, rock crevices, mines,	Mines, cliff crevices
Northern Myotis	Rarely		Snags	Mines, caves, rock crevices
Long-legged Myotis	Occasional		Cliffs, rock crevices, snags, stumps	Mines, caves, rock crevices
Little Brown Myotis	Common	Yes	Snags, rock crevices, cliffs, mines	Mines, caves, rock crevices, tree root wads
Fringed Myotis	Occasional		Cliffs, rock crevices, trees, mines	Mines, rock crevices
Long-eared Myotis	Occasional	Yes	Cliffs, snags, stumps, talus slopes, rock outcrops, crevices, mines	Mines, buildings, rock crevices
Canyon Bat[1]			Cliffs, rock crevices	Rock crevices, caves?
Mexican Free-tailed Bat[1]	Common	Yes	Trees, Caves	Migrates?

[1] Canyon Bat and Mexican Free-tailed Bat only detected acoustically in BC; extent of habitat use in BC is unknown.

Tree Roosts

Trees are some of the most widespread and important natural roost structures used by bats in BC and are used by most of our bat species 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, smaller trees, and other places may occasionally be used.

All other tree-roosting bat species in BC 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 begins to decay.

Bats can use any tree species, but some species are more likely to be used than others (see Appendix B for a list). Black cottonwood, balsam poplar, trembling aspen, western redcedar, western hemlock, and others are susceptible to heart rot fungus, which often produces large well-protected cavities that are ideal for maternity colonies. Mature cedar, pine (particularly white pine), cottonwood and poplar often have large sheets of sloughing bark that can house many 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 or clearings may also be used.

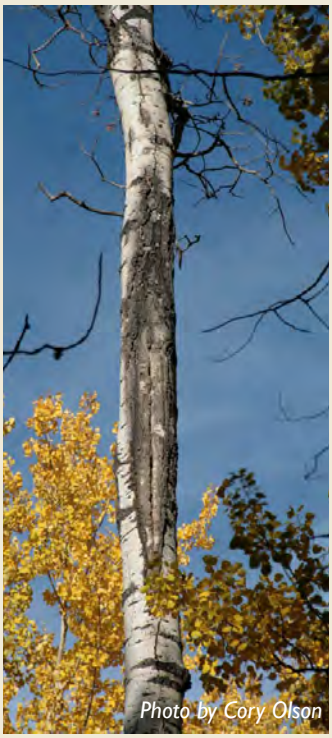


Photo by Cory Olson


Photo by Cory Olson


Photo by Cory Olson


Photo by Tanya Luszcz

Tree roosts used by bats.

Rock Roosts

Many bats in BC rely on rock features as sites for roosting and raising their pups. This is especially true within the dry interior of BC, which supports some bat species seen nowhere else in Canada. Even bats that rarely use rock-crevices for raising pups, may still rely on rock features as sites for hibernation during the winter.

Rock features used for roosting include a wide variety of structures, many of which are difficult to locate without special tracking equipment. Locations must be well protected from predators and inclement weather, while still providing conditions that meet the physiological requirements of bats. Pregnant and lactating mothers typically require warm conditions during the spring and summer months. Locations deep within caves and mines are often too cold to support reproductive bats, but may be critical during hibernation.

Rock-features used for maternity roosts include:

- The cracks and crevices of cliffs, canyon walls, and boulders
- Under slabs of rock along rock-faces
- Interstitial cavities in scree of talus slopes or other rock piles
- Volcanic rock formations
- Erosion cavities of rock or solidified mud
- Caves and mines

Many species have flexible roosting strategies and will adapt to what is available in their habitat. However, each species has its own unique requirements and preferred habitats. Some species, such as the Townsend's Big-eared Bat, appear to prefer more open roost structures, especially mines. Other species, such as many of the Myotis bats, are often found within narrow cracks and crevices, barely wider than their head.

The majority of species in BC will roost in rock features to at least some extent. Most of these species will also use trees, where available. However, a few species—including the Spotted Bat, Western Small-footed Myotis, and Canyon Bat—roost almost exclusively in rock features. Spotted bats primarily roost in the crevices and cracks along high cliffs and canyon walls. Canyon Bats have similar behaviour, although it is unknown whether this species breeds in the province. Western Small-footed Myotis are found almost exclusively roosting within rock features found along the valleys of river systems in the dry interior. Townsend's Big-eared Bats may have historically roosted in caves or rock fields, but now frequently use mines and buildings.

Cliffs along the Fraser River where Spotted Bats are known to roost.

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

Small cliff used by roosting bats in BC.

Roosting Habitat

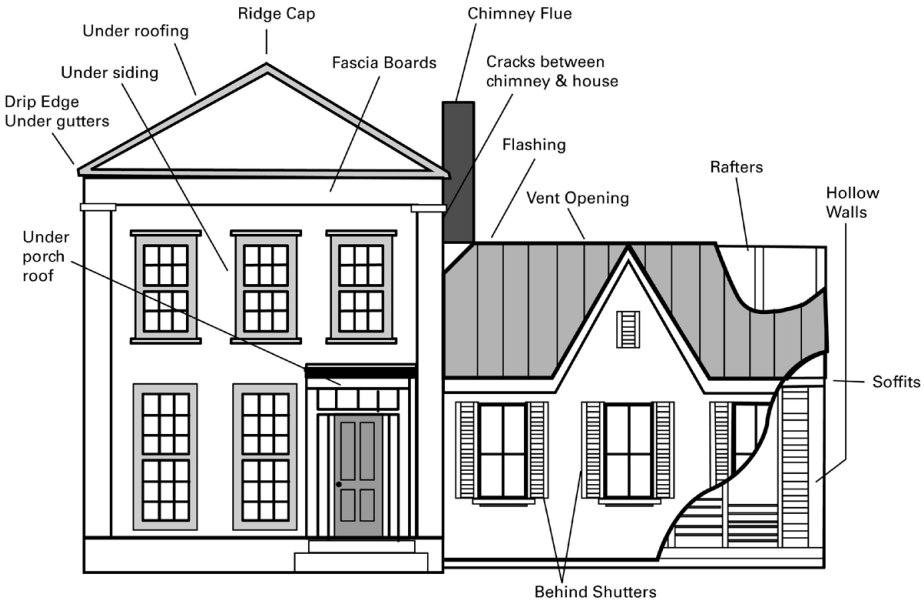
Bats will seek out cinder block, brick or stone chimneys as roosting sites. These are often found in older buildings and picnic shelters.

Townsend's Big-eared Bat maternity roost in a BC barn. This species typically selects large, open structures as roosts.

Not all bat species will occupying buildings. However, for three species, in particular, these structures have become especially important resources. These include the Little Brown Myotis, Yuma Myotis, and Big Brown Bat. Colonies of Little Brown Myotis and Yuma Myotis can exceed 1,000 individuals, but more often consist of fewer than 100 individuals. Big Brown Bat colonies are generally smaller, typically less than 100 bats. Buildings may also be important resources for other less common species, such as Townsend's Big-eared Bats and Long-eared Myotis, and Californian Myotis.

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 offsetting other sources of human caused mortality. Appropriate management of building roosts is important for the survival and successful reproduction of those species that have come to rely on these structures.

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. Bats 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

Bridges often have many crevices, and can province great roosting habitat. 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 preferred foraging habitats like rivers and wetlands.

Depending on the type of microclimates available at a bridge site, the location could be used as a night roost and/or a day roost by reproductive or non-reproductive bats. 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.

For day-roosts, bats like crevices that are deep and narrow (1.9-2.5 centimetres wide and 30 centimetres or greater deep). Any appropriately-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, or behind signs and railings. Concrete bridges with expansion joints provide excellent crevices for roosting bats.

In contrast to day-roosts, night-roosts at bridges are generally open surfaces where bats can easily land to rest and digest food. There may be 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 a night roost, but bats will generally not be seen 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.

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 harming 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

See the 'Bats and Transportation Infrastructure (MOTI)' website for more information on the use of transportation infrastructure by 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 roosting and foraging habitat for bats, especially around lakes and rivers, which are some of the best habitat available for bats. Shown above is Osoyoos Lake.

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 in some regions may influence the species composition in the area. 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 do not need to be as 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 urban and industrial uses. Trees that begin to decay near areas that people occupy are often removed for safety or aesthetic 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 rivers and wetlands and are slowly disappearing. These forests often have difficulty re-establishing because of altered flood regimes and grazing patterns. Damming, in particular, dampens flood cycles, which are important for allowing tree seedlings to establish.

Anthropogenic roosting habitat, such as houses and outbuildings, can provide habitat for some species when natural habitats are lacking. However, even building-roosting species may find it hard to locate suitable roosts as building methods change and older buildings are torn down or renovated.

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 starting at sunset (in June or July) to see if bats are flying out (do this on a warm, dry night).

Roosting Habitat

- Contact the BC 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 guide 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 BC's bat species rarely use typical bat house designs.
- Re-vegetate formerly treed habitat with native species, such as aspen or cottonwood.
- Restore or 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.
- 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 as intact as possible, retaining 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.

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.

Old trees surrounding lakes, rivers, and wetlands provide important roosting and foraging habitat for bats.

Roosting Habitat

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

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.

Avoid disturbance or modifications to the roost

- Avoid any structural changes that may trap bats inside the roost. If modifications to buildings are necessary, wait until October when the bats have left (see BC Community Bat Program guides)
- 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 some bat species and are popular among homeowners. They are a great 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 are routinely cut down for safety or aesthetic reasons. Bat houses can also help mitigate the effects of excluding bats from buildings, provided they are installed well in advance of the exclusion. Another option is to enhance existing buildings where the presence of bats will not be a problem.

Although bat houses can potentially be an effective addition to conservation plans and can provide a focal point for education and outreach, we do not yet know if 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 the 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, Yuma Myotis, and Big Brown Bats, which historically have been among British Columbia'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 and situated to provide different conditions. Try to face them different directions and have different sun exposures (e.g., full sun, partial sun, and full shade). Multiple bat houses should be installed within about 100 metres of each other.

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

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

Bat Houses and Condos

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.

Bat condo in Creston, BC installed to support a large maternity colony of thousands of Yuma and Little Brown Myotis that had to be evicted from a collapsing barn.

Visit the BC 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 British Columbia.

www.bcbats.ca

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.

What can landowners and the public do to ensure bat houses are effective?

- **Use an approved design and size for the species of interest.** There are several designs of bat houses that are effective in BC. Large bat houses are recommended because they not only provide added roosting space (Table 3), 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.
- **Follow recommended installation guidelines for your region.** All bat houses and condos need to be installed correctly to effectively provide bat habitat. The BC Community Bat Program has created several guides on building and installing bat houses and managing bats in buildings. To access this content, visit the BC Community Bat Program webpage at www.bcbats.ca.
- **Maintain and monitor.** Bat houses and condos should be maintained and monitored for use, and data on characteristics of the structure and its occupancy can be contributed to the BC Community Bat Program. This information will contribute to our understanding of bat roost preferences and help improve recommendations. See the Annual Bat Count section for more information on monitoring and submitting count information.

TABLE 3. CAPACITIES OF BAT HOUSE DESIGNS

Bat House Design	Approximate Capacity[1]	Potential Roost Quality[2]
Single-Chamber[3]	100	Very Low - Low
Four Chamber Nursery-House[3]	300 (382)	Moderate
Two-Chamber Rocket Box [3]	300+ (264)	Moderate
Mini-Condo[4]	1,000+ (137)	High
Full Condo[5]	3,000+ (3,078)	High to Very High

[1] Numbers in parentheses are maximum reported occupancy (number of bats) in BC
[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] Based on designs in The Bat House Builder's Handbook (2013) by M.D. Tuttle, M. Kiser, and S. Kiser
[4] Based on the Wisconsin DNR (mini) Bat Condo design
[5] Based on Bat Conservation International Bat Condo designs used in Creston, BC

Managing Bats in Buildings

About bats in buildings

Some of British Columbia's most common bats often roost 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 have impacts on 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. Consult with the BC Community Bat Program for advice.

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 according to the BC Annual Bat Count protocols to determine how many bats are involved and if it is a maternity colony. Identify the species of bat, with the assistance of your local community bat program. This will affect the type of bat house you should install.

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.

Large Yuma Myotis maternity colony in BC.

A plastic sheet is used to collect guano dropping from bats roosting overhead in the rafters of a barn.

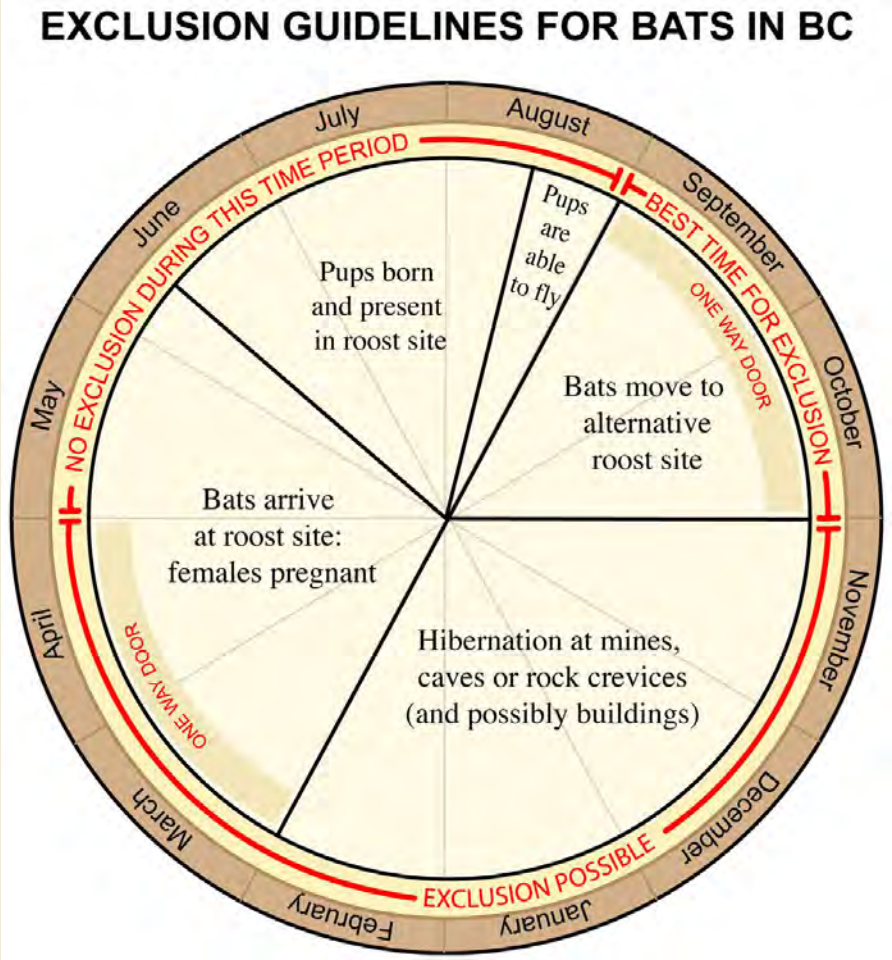
See our guide on managing bats in buildings for advice on how to live with bats, or how to safely exclude bats from your home.

Managing Bats in Buildings

Townsend's Big-eared Bat colony roosting in a barn. This species requires large, open roost chambers, which are not provided by most bat house designs.

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.

Monitor: After your exclusion, do an Annual Bat Count and identify species at new and old structures to determine if you have been successful.



Approximate timing guidelines for bats in BC. Beware that the timing of bat activity varies among regions and years. Whenever possible, management decisions should be based on local knowledge and monitoring at the site.

Providing foraging habitat for bats

Bats in BC eat nothing but bugs (insects and arachnids), 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.

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 British Columbia 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, regularly 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; bats will also make a return flight. Hoary and Big Brown Bats have been tracked flying up to 26 kilometres in a single 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, wetlands and plants of a diverse landscape provides valuable roosting and foraging habitat for bats.

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.

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

Volunteers plant trees and shrubs as part of a restoration project.

See Appendix B for a list of plant species beneficial to bats

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.
- 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 have some areas clear of vegetation to allow for straight flight-paths of bats skimming the water to drink.
- Protect and restore wetlands and riparian areas. Use fencing to keep livestock out of sensitive riparian areas.
- 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 aquatic habitats and can be taken up by larval 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.
- When gardening or landscaping, use plants that provide food for larvae or adult insects, especially moths (see 'Gardening for Bats' below and Appendix B).
- 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 adults 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.

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 B 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 B 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, choke cherry, and pin cherry.
- **Native conifers**—The various native species of pine, spruce, fir, larch, hemlock and juniper, along with western redcedar, yellow-cedar, and Douglas fir, are important host plants for many moth species. Several of these 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.), 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 provide particularly high levels of nectar for nocturnal pollinators. Notable examples include night-scented stock, purple coneflower, tobacco plant, moonflower, and apple. Always ensure the variety you select is non-invasive. Traditional varieties of garden flowers are preferred—some hybrid varieties (e.g., double petunias) produce low amounts of nectar and attract fewer insects.
- **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*) on showy milkweed (*Asclepias Speciosa*).

For more information, see these resources:

Native Plant & Propagation

- *E-Flora BC*
- *Native Plant Network*

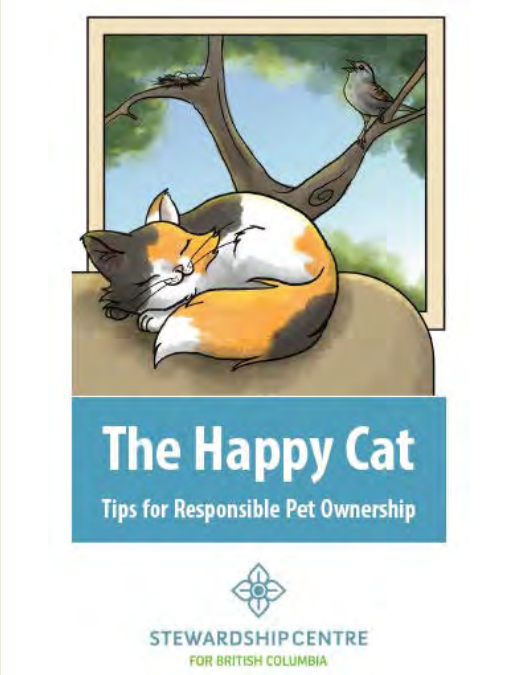
Invasive Species Information

- *PlantWise Program (Invasive Species Council of BC)*

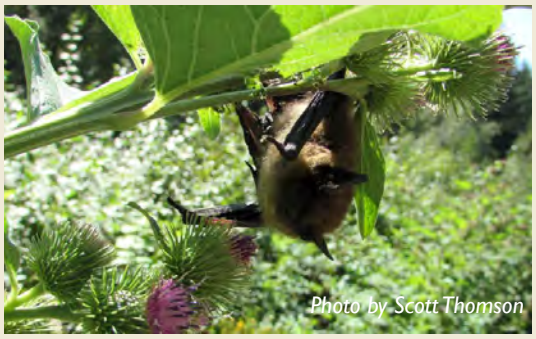
Gardening Guides

- *Gardening with Native Plants guide (Southern Vancouver Island)*

Rain barrels and other tanks should be covered to avoid trapping bats.



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



The clinging burs of Burdock may entangle bats. This is an invasive species in BC and should be controlled.

Human communities and potential hazards to bats

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 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 metre above the ground).

Predation

Bats reproduce slowly and live long lives to make up for this slow reproductive rate. Bats are vulnerable to higher levels of predation related to human activities. Cats and corvids (ravens, crows, jays, and magpies) are common predators of bats and tend to be more abundant near human communities. Consider these precautions to reduce the risk of human-induced predation on bats:

- Keep cats indoors or within outdoor enclosures (e.g., Catios). If possible, prevent cats, dogs and other predators from accessing

roosts, such as by keeping the bottom access doors to attics and haylofts closed (but don't 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 perches 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.
- Keep an eye on pole-mounted bat houses and rocket boxes to ensure they are not used as perches by owls or other birds that may prey on bats. Bird spikes may prevent use by perching birds, but should be monitored to ensure they do not ensnare bats.

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 sticky 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. Control burdock infestations—bats contacting this plant occasionally become entangled.


Photo by Jeff Parfitt


Photo by Juliet Craig


Photo by Juliet Craig

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 could disrupt ecosystems on which bats depend.

The effects of artificial lighting on 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. This could cause bats to miss out on peak feeding periods, reducing available foraging time, and possibly affecting the energy available for reproduction. Bats may also abandon the roost.

Lights can affect foraging bats. Moths and other insects are attracted to lights, especially white and blue-white lights and any lights in the ultraviolet spectrum. Some bats (Hoary Bats, Eastern Red Bats, Big Brown Bats, Silver-haired Bats, and Little Brown Myotis) are tolerant of lights and will use them as prey patches. However, while there are some bats that readily forage on insects attracted to lights, the long-term effect of artificial lighting on bat populations are more complex. Nocturnal predators can take advantage of these lit locations, possibly increasing the risk of bats being captured. Light may reduce prey availability in dark areas if moths are drawn out of dark habitats. Lights may also disrupt normal insect behaviours, such as feeding and mating, leading to a net reduction in insect prey.

Lights can affect bat movement patterns. Some species (such as 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. 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. Although poorly understood at present, artificial night lighting may also interfere with migration patterns of some bat species.

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 measures 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, lighting on some roadways and parking lots may not be needed 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.


Photo by Cory Olson

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.

Photo by Cory Olson

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 work areas, 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 nanometres.
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 have 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. Call frequencies of most bats in British Columbia are above 20 kHz (kilohertz), well beyond the hearing range of people (although the Spotted Bats has unusually low frequency echolocation calls that many people can hear). Calls can be up to 140 dB (decibels) leaving the bat's mouth, which is louder than what the audience hears at 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 go deaf.

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 Pallid Bats, Townsend's Big Eared Bat, Spotted Bats, Northern Myotis, Fringed Myotis, and Long- eared Myotis) will avoid areas with noise. Noise may simply overwhelm their hearing so they cannot 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.

Primary issues with noise emissions

- Noise 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
- It 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 may be used to limit sound emissions from roads and other sources.

Human developments affect more than just bats. Fortunately, many of the recommendations that help bats also benefit other wildlife as well as people. Be sure to read the Develop with Care guidelines for a broader range of considerations for managing urban and rural developments.

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. These methods not only reduce disturbance to bats and other wildlife, but will reduce the risk of project activities negatively affecting human communities.

Roads and Bats

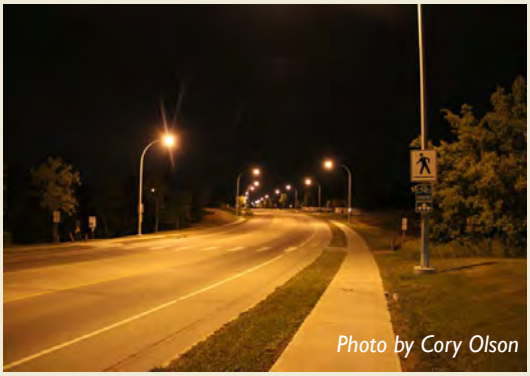
The effects of roads on bats

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-long 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 readily cross openings this large. The result is a loss of habitat connectivity. A road constructed between a roost and foraging habitat may inhibit the movement of bats between these areas, potentially decreasing the value of these areas for bats. 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 are most at risk of direct collision with cars as they cross roadways. Fatalities may be especially high in locations where there is high quality habitat on both sides of the road, such as where roadways cross forested watercourses and wetlands, or where building roosts and foraging habitat occur on opposite sides of a highway. Collisions can potentially be mitigated by encouraging bats to follow particular crossing routes using lines of tree and shrub cover to funnel bats to a particular point where it is safe to cross. Natural funneling of flying bats may occur along river valleys and ravines. 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 harm's way. This has been tried in Europe with mixed results 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

Participants counting bats exiting a roost.

Photo by Cory Olson

Unlike mouse droppings, bat guano is often concentrated in a localized area.

Photo by Cory Olson

Most bat species can be identified to species using a relatively inexpensive genetic test. Submitting a guano sample along with your report can greatly increase the value of information received.

Interested in getting involved with the study of bats?

Participate in the BC Annual Bat Count

The BC Annual Bat Count is a citizen science program to annually monitor bat populations at roost sites. Abandoned houses, barns, church steeples, and even occupied buildings, can provide a summer home to female bats and their young. Monitoring these "maternity colonies" can give biologists a good idea of how bat populations in an area are doing from year to year. With the occurrence of white-nose syndrome in North America, monitoring these colonies has become especially important as a means of monitoring disease impacts and recovery efforts.

Ideally, the bat count includes four counts during the summer - two before pups can fly and two more when pups are flying and exiting the roost with their mothers. Check bcbats.ca to confirm dates. Doing all four bat counts allows us to best compare data from year to year and between sites. However, if you don't have time, you can choose your own level of participation.

Level 1: Bat Reporter - One count (between June 1 - 21)

Level 2: Bat Tracker - Two counts (both between June 1 - 21)

Level 3: Bat Enthusiast - Four counts
(two between June 1 - 21 and two between July 11 - Aug 5)

Generally, these bat counts are a lot of fun and are pretty simple:

- Please respect private property. Ask permission if the bat roost is on someone else's land.
- Be in place by sunset (bats emerge soon after the sun goes down).
- The air temperature should be at least 12°C with wind ≤ 20 km/h.
- Sit or stand outside so that the bats' exit point is visible from a comfortable distance, ideally with a clear sky background that highlights bat silhouettes. More than one person might be needed if bats are exiting from multiple points.
- Tally the bats as they fly out for their nightly insect-eating. We can provide you with a hand "clicker" to make counting easy. Record your observations on the data sheet (see download below).
- Mail us your data sheet at the end of the summer.
- Do not enter bat roosts or handle the animals.

For up-to-date information, instructions and to submit data visit the BC Annual Bat Count website

Public Outreach & Community Involvement

There is strong public interest 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 BC Community Bat Program or other organizations can be a great way to improve public outreach in the province.

Restoration and conservation projects

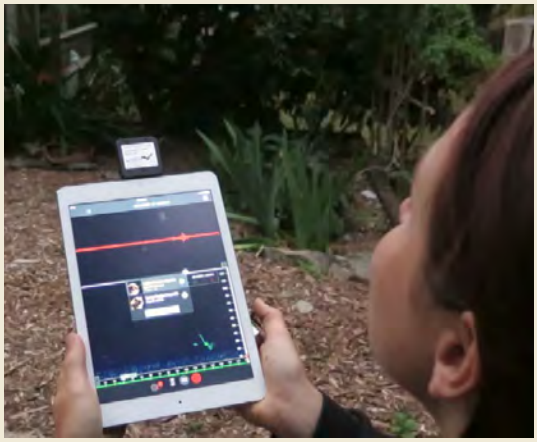
Projects aimed at controlling invasive species and restoring tree cover around aquatic habitats are likely to benefit all bat species by providing foraging habitat, and may eventually provide important roosting habitat, including for species that do not use buildings or bat houses.

Restoration projects should use native plant species that would have occurred naturally in the area. Suitable roost trees have a large diameter that take time to grow, and bats especially like deciduous species. However, shrubby vegetation, such as willow, may still benefit bats by supporting rich insect communities. Native moth-friendly plants may be especially good at attracting food for bats. See Bat-Friendly Gardening for more information. Invasive weed pulls are another option for public involvement in habitat conservation. 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.

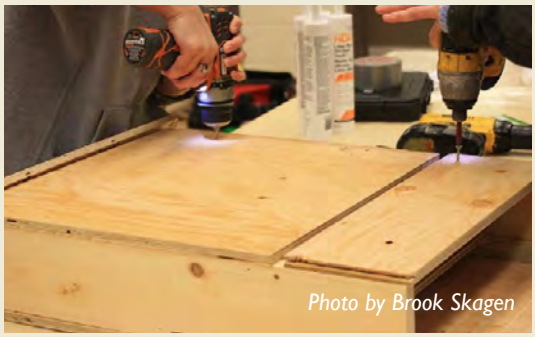
During the summer (especially July - August), bats are common near aquatic habitats, particularly along the treed perimeters of lakes, rivers, and wetlands. Aquatic habitats surrounded by old trees are often excellent locations for bat walks. Bats are typically tolerant of people, and may even come closer to forage on the insects that people



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

Volunteers plant native plants as part of a restoration project.

attract. Bats will come out around a half hour after sunset. 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 being built at a public workshop.

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 BC Community Bat Program's Building Homes for Bats guide for more information).

Preparing kits is very labour intensive, and previous experience in 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 BC Community Bat Program (www.bcbats.ca) and to monitor occupancy in the houses during the BC Annual Bat Count periods.

Display booth at public event.

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 BC 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 that are commercially available.

Becoming a Bat-Friendly Community

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. Sources of information include this guide, other resources of the BC 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 BC, and involves working with your regional Community Bat Program coordinator to develop a community plan that works for you. Contact us at info@bcbats.ca for more information.

Proclamation

The 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;

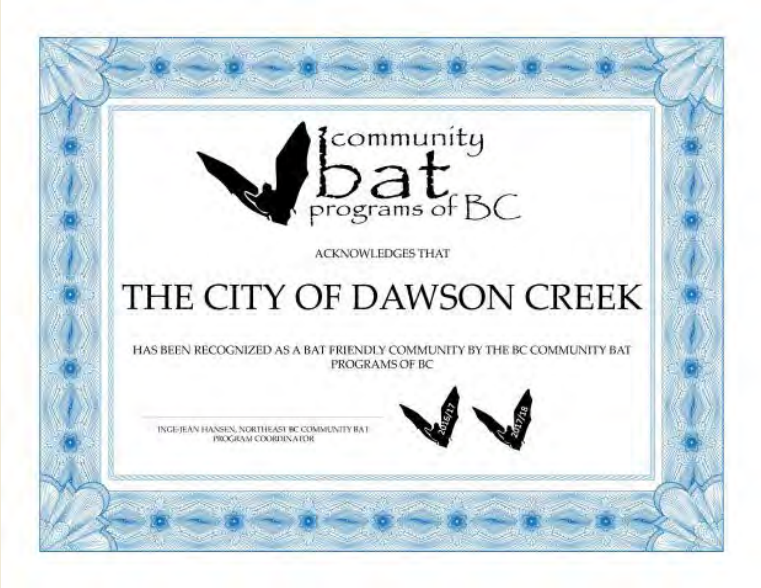
AND WHEREAS, the Governments of Canada, the United States and Mexico have entered into an agreement to strengthen cooperation, coordination, and information sharing related to the conservation and management of all bat species throughout North America;

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



community bat programs of BC

ACKNOWLEDGES THAT

THE CITY OF DAWSON CREEK

HAS BEEN RECOGNIZED AS A BAT FRIENDLY COMMUNITY BY THE BC COMMUNITY BAT PROGRAMS OF BC

INGE-JEAN HANSEN, NORTHEAST BC COMMUNITY BAT PROGRAM COORDINATOR

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*)

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. Recordings of bat echolocation calls can sometimes be used to determine species, but requires equipment capable of recording ultrasound, and identification should be reviewed by a qualified biologist. Recent advances in genetics techniques allow the species to be determined from a sample of guano (bat feces). The BC Community Bat Program can assist with species identification using guano samples. See the web page or contact the program directly for more details and for protocols on how to collect guano samples.

Silver-haired Bat

Silver-haired Bats (*Lasionycteris noctivagans*) are among the most common, wide-ranging and easily recognizable bats in British Columbia. They are slightly larger than the Myotis bats, and are mostly black except for a silvery frosting to their hair (the silver-colouration is sometimes subdued). They are best 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, and along the edges of forests, with treks of up to 10 kilometres or more per night being common.

Roosting occurs primarily in crevices and under exfoliating bark of large diameter decaying trees, but is more variable during migration (and can include the side of buildings or under patio umbrellas). A variety of structural defects in trees may be used for roosting, and use of old woodpecker holes is common. Females may produce twins and groups of mothers and pups roost in small groups of up to 35 individuals in BC (but more often closer to 10).

Silver-haired Bats are long distance migrants, and in some parts of their range may undergo long-distance movements to find suitable hibernation habitat. Overwintering Silver-haired Bats are regularly found in southern regions of British Columbia, where they hibernate in deep mines, rock crevices, trees, and wood piles. There is growing evidence from banding records that males are typically year-round resident bats, but females are likely to move locations between summer and winter.

Hoary Bat (*Lasiurus cinereus*)

Eastern Red Bat (*Lasiurus borealis*)

Hoary Bat

Few bats in the world are as colourful as the Lasiurine bats, which in BC, includes both the Hoary Bat (*Lasiurus cinereus*) and the Eastern Red Bat. Hoary Bats have a distinctive yellow mane and their cinnamon-coloured coats are frosted with white tips like "hoar-frost", which is why they were given the name *Hoary* Bat. Weighing approximately 35 grams, they are the heaviest bat in Canada. They are fast, long-distance fliers 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 is available—including beetles and dragonflies. Foraging flights of up to 20 kilometres per night (plus return flight) are not uncommon.

Hoary Bats roost 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. They roost alone, except for mothers roosting with their twin pups. Hoary Bats are long-distance migrants, and likely leave BC during the winter, with migrations that may be well over a thousand kilometres. Migratory behaviour is poorly understood, but they likely overwinter in the southern United States and Mexico, sometimes undergoing periods of hibernation when they reach these locations.

Eastern Red Bat

Eastern Red Bats (*Lasiurus borealis*) are medium-sized bats with long, narrow wings for high, fast flights. Like many bats in British Columbia, moths are the main component of their diet, but they will eat a variety 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 deciduous 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. The few in-hand observations are of males and non-reproductive females, making it uncertain whether they actually breed in these locations.

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. Red bats are long-distance migrants. 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.

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).

Big Brown Bat

The Big Brown Bat (*Eptesicus fuscus*) is one of the larger bats in the province, weighing an average of 15 grams. This species has been found in the southern two-thirds of the province as far north as Fort St. John, and may range as far north as the Yukon. This bat has a broad head and nose and long fur which varies from pale to dark brown. Unlike other brown coloured bats, Big Brown Bats have swellings on each side of their nose that may help identify them in photos where size is often hard to determine. They roost in buildings (commonly around chimney flashing) as well as in snags, cliffs, rock crevices and mines. In buildings, this species forms relatively small colonies of up to 50 individuals but typically fewer than ten. Big Brown Bats may hibernate in buildings in some parts of their North American range, and are frequently active on warm winter nights. They are also known to hibernate in caves, mines, and deep rock crevices. They have strong jaws that are well-adapted to eating beetles as well as moths, carpenter ants, termites, lacewings and various flies.

Little Brown Myotis

The Little Brown Myotis (*Myotis lucifugus)*, also called the Little Brown Bat, is a common species found throughout British Columbia, and was one of the most abundant and widespread across North America. This species has recently been listed as Endangered in Canada due to the devastating impacts of white-nose syndrome in parts of North America.

Little Brown Myotis commonly roost in buildings, in groups ranging anywhere from a couple of individuals up to over a thousand. Other roost structures include old trees, rock-crevices, caves, mines, bridges, and bat houses. This bat is a medium-sized species weighing about 6 grams, although they may average up to 8 or 9 grams in some parts of their range. The fur on its back varies in colour, ranging from yellow or olive in the dry interior to dark brown in coastal populations. The fur on its underside is lighter, varying from light brown to tan. It is very difficult to tell apart from the Yuma Myotis without using acoustic equipment or DNA testing. They appear similar to Big Brown Bats, but are much smaller, and do not have the swollen features on the side of the nose that big brown bats have.

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 common occupants of cottages and other buildings that occur near water.

Yuma Myotis

The Yuma Myotis (*Myotis yumanensis*) is a short-eared Myotis species similar in both appearance and behaviour to the Little Brown Myotis. Yuma Myotis average slightly smaller than the Little Brown Myotis, and tend to have a duller and lighter colouration. However, the only reliable method of differentiating these species is to use genetic analysis. Yuma Myotis also tend to produce higher frequency echolocation calls, so a bat detector may help with identification.

In Canada, the range of the Yuma Myotis is thought to be restricted to the southern half of BC, but they are found in southeastern Alaska, so they may also be present in the vast non-inventoried areas of northwestern BC. The species is not known to occur in other provinces, but is widespread in the western United States and parts of Mexico. This is one of the most common species foraging over aquatic habitats. Buildings, especially those located near aquatic habitats, are commonly used as maternity roosts. Maternity colonies in buildings are some of the largest seen in BC, with some having >2,000 individuals. Tree and rock-crevices are also important roosting structures, but typically support fewer individuals.

Yuma Myotis (*Myotis yumanensis*)

Californian Myotis

The Californian Myotis (*Myotis californicus*) is one of the smallest bats in BC, similar in size to the Western Small-footed Myotis.
Their fur colour is variable, ranging from dark brown to blonde. In some parts of their range, they can appear similar to the Western Small-footed Myotis, although Californian Myotis typically lack the dark mask and usually have more fur on their snout.

They range throughout southern BC, and along the Pacific coast up to Alaska. Within the Rockies, their range extends to the eastern border of BC, and they are suspected to cross into Alberta. Their range extends south through the western United States and most of Mexico. They are well adapted to arid environments, but appear to use a greater range of habitats than Western Small-footed Myotis.

A variety of roosting structures may be used throughout the year, including tree-cavities, under sloughing bark, rock-crevices, and buildings. Maternity colonies are generally small, typically less than 100 individuals. Buildings do not appear to be commonly used. This is the most frequently recorded bat in winter, especially in southern and coastal areas. Individuals hibernate for several weeks and then arouse to make brief flights of up to several hours before returning to hibernate. Bats hibernate in rock crevices, trees, and mines.

Californian Myotis (*Myotis californicus*)

Fringed Myotis (*Myotis thysanodes*)

Northern Myotis (*Myotis septentrionalis*)

Long-eared Myotis (*Myotis evotis*)

Fringed Myotis

The Fringed Myotis (*Myotis thysanodes*) is one of three species of long-eared myotis bats that occur in BC, the others being the Long-eared Myotis and Northern Myotis. This is a medium-sized Myotis species, with a Canadian distribution that is restricted to the dry interior of BC (although there are some acoustic records in southern Saskatchewan). The key distinguishing feature, for which this species is named, is a fringe of hairs on the outer edge of the tail membrane. Like other long-eared bats, they are adept at gleaning insects from surfaces, a behaviour that is possibly aided by the fringe of hairs on the tail. They roost primarily in rock-crevices, but also crevices in old dead or decaying trees, and occasionally buildings.

Northern Myotis

The Northern Myotis (*Myotis septentrionalis*) is found in forested regions of North America, including boreal, montane, and eastern deciduous and mixedwood forests. In BC, Northern Myotis are found in forested habitats in the northeast of the province. Their ears are shorter than the Long-eared Myotis and longer than the Little Brown Myotis, but otherwise have similar size and colouration. Like the Little Brown Myotis, this species has been decimated by white-nose syndrome in eastern North America and is now nationally Endangered.

Northern Myotis are better able to hunt close to vegetation than the Little Brown Myotis (with which they share most of their range), and are often found foraging in the understory of forests. Because of this behaviour, they may be particularly sensitive to short-rotation forest harvesting techniques, which deplete the availability of understory habitat. Roosting typically occurs in tree crevices or under loose bark of old, large decaying trees. Building roosting appears rare.

Long-eared Myotis

The Long-eared Myotis (*Myotis evotis*) is a small bat found in western North America. They have especially long ears among Myotis species (about 18-20 millimetres long), but without close inspection may look similar to the other Myotis species. They are highly 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 vegetation. 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, although groups of up to 20 individuals have been observed.

Long-legged Myotis

The Long-legged Myotis (*Myotis volans)* is a relatively large species of Myotis bat, which occurs throughout most of BC. They are particularly common in forested habitats in the mountains, but occupy a variety of habitats across the province. They look superficially similar to Little Brown Myotis, but are slightly larger, have broader shoulders, rounder-tipped ears and uniformly darker fur. Reliable identification requires careful examination by an expert biologist, or genetic confirmation from guano or tissue samples.

Long-legged Myotis roost in a variety of structures, including trees, rock-crevices, and buildings. They may roost in mixed groups with Little Brown Myotis, possibly resulting in them being overlooked in some regions. The typical size of colonies is unknown, but a maternity roost in Alberta 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 forage farther from aquatic habitats than Little Brown Myotis, where they appear to more frequently target moths rather than aquatic insects.

Long-Legged Myotis (*Myotis volans*)

Western Small-footed Myotis

The Western Small-footed Myotis is one of the smallest bats that regularly occur in British Columbia, weighing only about 5 grams, and its body 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 are inhabitants of the dry interior of BC, but occupy a variety of arid and semi-arid habitats in western North America and Mexico. They also occur in badland habitats in Alberta, and possibly Saskatchewan.

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

In Alberta, they were found to roost in matrilineal family groups (i.e., related through common ancestry on their mother's side), which range from 2 to 35 individuals (more often 2-5 individuals). These groups show high roost 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.

Western Small-footed Myotis (*Myotis ciliolabrum*)

Spotted Bat (*Euderma maculatum*)

Pallid Bat (*Antrozous pallidus*)

Townsend's Big-eared Bat (*Corynorhinus townsendii*)

Spotted Bat

The Spotted Bat (*Euderma maculatum*) is one of British Columbia's most impressive—and rarely seen— bats. They have spotted black-and-white fur on their backs, and white fur underneath. Ears are light coloured and enormous. Spotted Bats are the only bats in Canada whose echolocation calls can be heard by some people without the aid of a bat detector. This species weighs about 20 grams, making it one of British Columbia's larger bat species.

In Canada, they are only found in the dry interior of south-central BC as far north as Williams Lake, typically in areas with cliffs. Their range includes much of the western US and northern Mexico, but they are rare in most regions.

Pallid Bat

The Pallid bat (*Antrozous pallidus*) has one of the most restricted ranges in British Columbia, occurring primarily in the southernmost part of the Okanagan region in the far south of BC. Their strong bite, and ability to glean insects (often from the ground), makes the species particularly well suited to prey on large-bodied arthropods, like scarab beetles, moths, crickets, and scorpions. This is the second largest bat species in Canada (after the Hoary Bat), weighing about 25 grams. Fur is pale / light brown, and they have particularly large ears.

They prefer open arid habitats. Much of their former habitat has now been replaced by vineyards and urban developments. Pallid bats may roost in rock-crevices or trees, and are known to use buildings and bridges in some parts of their range.

Townsend's Big-eared Bat

The Townsend's Big-eared Bat (*Corynorhinus townsendii*) is one of three species found in southern BC that have enormous ears (the others being the Pallid Bat and Spotted Bat). They are common in warm, dry regions of south-central BC, but they have a broader range than the Pallid and Spotted Bat, and can also be found in the Kootenays and southern coastal regions. They are mid-sized bats, weighing about 8-9 grams, and have fur that ranges from pale to dark brown/blackish-grey.

Townsend's bats commonly roost in buildings, in groups of up to 100 individuals. Suitable buildings typically consist of large open spaces, such as occurs in attics and barns. They appear less willing to occupy tight crevices than Myotis species. They also commonly roost in caves, boulder fields, and mines, and potentially large tree cavities.

Canyon Bat

Canyon bats (*Parastrellus hesperus*)—formally Western Pipistrelle— have never been captured in British Columbia. However, echolocation calls believed to be of this species were recorded in the southern extent of the Okanagan region. This species is known to occur in Washington and in suitable rocky habitat though the western United States and Mexico. They are found in arid habitats, often in canyons and arid shrublands. Roosts are most likely within rock-crevices; they do not seem to occupy buildings.

This is one of the smallest bats in North America, with some weighing less than 4 grams. They have light coloured (blonde or greyish-brown) fur and a dark facial mask, similar to Western Small-footed Myotis. Flight is slow and erratic.

Canyon bats (*Perimyotis hesperus*)

Mexican Free-tailed Bat

Mexican Free-tailed Bats (*Tadarida brasiliensis*) are only known in BC from a few acoustic recordings from Salt Spring Island, Vancouver, and the Sunshine Coast. In some parts of its range, the Mexican Free-tailed Bat is an abundant species, forming some of the largest congregations seen of any mammal (up to 20 million individuals at a cave in Texas). However, British Columbia has been considered extralimital and no records have been reported from Washington, although several carcasses have been found in Idaho. It has not been found roosting in BC. There is potential that this species is expanding its range, and could become more common in BC. They are adaptable and readily occupy buildings, bat houses, and bridges, but also roost in caves and trees.

Mexican Free-tailed Bats belong to a family known as the Free-tailed Bats (Molossidae). All other bats in Canada belong to the Vesper Bat (also called Evening Bat) family (Vespertilionidae). The characteristic feature of free-tailed bats is a tail that extends beyond the tail membrane. Mexican Free-tailed Bats weigh about 11 to 14 grams, and are known to be fast, long-distance fliers.

Mexican Free-tailed Bat
(*Tadarida brasiliensis*)

Appendix B

Bat-Friendly Plant Species

Native, local plant species can be beautiful, low-maintenance AND bat-friendly planting choices. The following lists include some of the potential options in BC, but plants may not be suitable for all regions. Because BC is so diverse, always check regional information sources for lists of recommended native plants for your area, plus invasive species to avoid. E-Flora BC is a recommended resource when selecting native species suitable for your region, or check with local conservation groups. For example, Habitat Acquisition Trust has an excellent guide for Vancouver Island.

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 BC, and may be considered for projects designed to provide bat roosting habitat.

Common Name	Scientific Name	Relative Suitability for Roosting[1]
Black cottonwood	*Populus balsamifera ssp. trichocarpa*	*Very high*
Balsam poplar	*Populus balsamifera ssp. balsamifera*	*Very high*
Western white pine	*Pinus monticola*	*High*
Ponderosa pine	*Pinus ponderosa*	*High*
Trembling aspen	*Populus tremuloides*	*Moderate - High*
Western redcedar	*Thuja plicata*	*Moderate - High*
Yellow-cedar	*Chamaecyparis nootkatensis*	*Moderate - High*
Douglas-fir	*Pseudotsuga menziesii*	*Moderate - High*
Western hemlock	*Tsuga heterophylla*	*Moderate - High*
Mountain hemlock	*Tsuga mertensiana*	*Moderate - High*
Western larch	*Larix occidentalis*	*Moderate - High*
Grand fir	*Abies grandis*	*Moderate*
Lodgepole pine	*Pinus contorta*	*Moderate*
Paper birch	*Betula papyrifera*	*Low - Moderate*
Garry oak	*Quercus garryana*	*Low*
Sub-alpine fir	*Abies lasiocarpa*	*Low*
Engelman's spruce	*Picea engelmannii*	*Low*
White spruce	*Picea glauca*	*Low*
Black spruce	*Picea mariana*	*Low*
Big-leaf maple	*Acer macrophyllum*	*Unknown*
Arbutus	*Arbutus menziesii*	*Unknown*
Oregon ash	*Fraxinus latifolia*	*Unknown*
Amabilis fir	*Abies amabilis*	*Unknown*
Sitka spruce	*Picea sitchensis*	*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.

Bat-Friendly Plant Species

Plant species beneficial to insect prey

Trees and shrubs

Various native trees and shrubs are among the most important host plants for developing moth caterpillars and other nocturnal insects. Willow (*Salix* spp.) are variable in size and form and there are many species of native willows to choose from. Generally, willows are sun-loving and prefer wet margins along lakes, rivers and other wet areas. Birches (*Betula* spp.) tend to like wet areas including riparian areas. Poplar (*Populus* spp.) are widespread in British Columbia, and these native trees are fast-growing and very important for bats not only because they support breeding moth populations which provide prey for bats, but they are also important roosting trees. In particular, balsam and black cottonwood provide excellent bat habitat. These species prefer richer, wetter sites. Alders (*Alnus* spp.) range in size from full trees to shrubs. This is a hardy group that grows in a variety of habitats and is usually fast-growing. Many of the apple and cherry species (*Malus spp*. and *Prunus spp*.) provide habitat for a variety of butterflies and moths; spring-flowering, these are also considered ornamentals. The non-native species of both apple and cherry trees found across BC also function as forage for moth species. Although native plants are preferable, there are several groups of flowering non-native shrubs that may provide nectar for adult- feeding moths that could be included in a bat-friendly garden. Hydrangea, honeysuckle, jasmine, clematis, lilac, peony, rhododendron, wisteria and magnolia are all great nectar producers and loved by gardeners.

List of recommended trees and shrubs to support insects (adult or larval forms) eaten by bats.

Group	Common Name and Scientific Name
Poplars	Trembling aspen (*Populus tremuloides*) Black cottonwood (*Populus balsamifera ssp. trichocarpa)* Balsam poplar (*Populus balsamifera ssp. balsamifera)*
Birch	Paper birch (*Betula papyrifera*) Water birch (*Betula occidentalis*) Scrub birch (*Betula glandulosa*)
Maple	Douglas maple (*Acer glabrum*)
Conifers	Pine (*Pinus spp.)* Spruce (*Picea spp.)* Fir (*Abies spp.)* Tamarack / larch (*Larix spp.)* Juniper (shrub) (*Juniperus spp.)* *Hemlock (Tsuga spp.)* *Western redcedar (Thuja plicata)* *Yellow-cedar (Chamaecyparis nootkatensis)* *Douglas fir (Pseudotsuga menziesii)*
Mountain-ash	Western mountain-ash (*Sorbus scopulina*) Sitka mountain-ash (*Sorbus sitchensis*)
Saskatoon	Saskatoon (*Amelanchier alnifolia*)

Currants	Skunk currant (*Ribes glandulosum*) Northern black currant (*Ribes hudsonianum*) Black gooseberry (*Ribes lacustre*) Waxy currant (*Ribes cereum*) Sticky currant (*Ribes viscosissimum*) Northern gooseberry (*Ribes oxyacan- thoides*) Red swamp currant (*Ribes triste*) Trailing black currant (*Ribes laxiflorum*)
Spirea	Birch-leaved spirea (*Spiraea betulifolia*) Pyramid spirea (*Spiraea pyramidata*) Pink spirea (*Spiraea douglasii*)
Hawthorn	Black hawthorn (*Crataegus douglasii*)
Prunus spp.	Choke cherry (*Prunus virginiana*) Pin cherry (*Prunus pensylvanica*)
Mallow	Mallow ninebark (*Physocarpus malvaceus*)
Raspberry	Dwarf nagoonberry (*Rubus arcticus*) Red raspberry (*Rubus idaeus*) Thimbleberry (*Rubus parviflorus*) Trailing raspberry (*Rubus pubescens*) Five-leaved bramble (*Rubus pedatus*) Cloudberry (*Rubus chamaemorus*)
Ocean spray	Ocean spray (*Holodiscus discolor*)
Rose	Prickly rose (*Rosa acicularis*) Baldhip rose (*Rosa gymnocarpa*) Nootka rose (*Rosa nutkana*) Prairie rose (*Rosa woodsii*)
Potentilla	Shrubby cinquefoil (*Potentilla fruticosa*)
Antelope-brush	Antelope-brush (*Purshia tridentata*)
Rabbit-brush	Common rabbit-brush (*Ericameria nauseosa*)
Sagebrush	Big sagebrush (*Artemisia tridentate*)
Cascara	Cascara (*Rhamnus purshiana*)
Ceanothus	Redstem ceanothus (*Ceanothus sanguineus*) Snowbrush (*Ceanothus velutinus*)
Penstemon	Shrubby penstemon (*Penstemon fruticosus*)
Sumac	Smooth sumac (*Rhus glabra*)
Silverberry	Silverberry (*Elaeagnus commutata*)
Shepherdia	Soopolallie (*Shepherdia canadensis*)
Oregon-grape	Tall Oregon-grape (*Berberis aquifolium*) Oregon-grape (*Berberis nervosa*)
Falsebox	Falsebox (*Paxistima myrsinites*)

Willow	Salix spp.
Alder	Green alder (*Alnus viridis crispa*) Sitka alder (*Alnus viridis sinuata*) Mountain alder (*Alnus incana*) Red alder (*Alnus rubra*)
Hazelnut	Beaked hazelnut (*Corylus cornuta*)
Dogwood	Red-osier dogwood (*Cornus stolonifera*)
Mock orange	Mock orange (*Philadelphus lewisii*)
Ledum	Trapper's tea (*Rhododendron columbianum*) Labrador tea (*Rhododendron groenlandicum*)
Honeysuckle	Blue elderberry (*Sambucus caerulea*) Red elderberry (*Sambucus racemosa*)
	Common snowberry (*Symphoricarpos albus*)
	High-bush cranberry (*Viburnum edule*)
	Black twinberry (*Lonicera involucrate*) Utah honeysuckle (*Lonicera utahensis*) Orange honeysuckle (*Lonicera ciliosa*)
	Twinflower (*Linnaea borealis*)
False azalea	False azalea (*Menziesia ferruginea*)
Rhododendron	White-flowered rhododendron (*Rhododendron albiflorum*)
Vaccinium	Vaccinium spp.

Herbaceous Plants

The best herbaceous plants for "bat-friendly gardens" are flowering plants that bloom in the late afternoon or evening. Moths are attracted to fragrant, light-coloured, tubular flowers; they use sensory receptors to locate the flowers in the dark (by fragrance and the white/light colour in the dark). Night-blooming flowers often have little fragrance in the day, but emit a strong fragrance at sunset onwards. This list is a only a start; there are many more flowers that would attract moths and other night insects.

The Primrose Family (Oenothera) has many plants which are drought-resistant, and some are pollinated by moths (which means moths are using flowers for food, either using nectar and/or pollen). Only the *strigosa* subspecies of the hairy evening-primrose (*Oenothera villosa ssp. strigosa*) is native to BC.

Common Name	Scientific Name
Hairy evening-primrose	*Oenothera villosa ssp. strigosa*

Phlox (Genus Phlox) has foliage that provides larval food to many moth species. The flowers are fragrant, and may be blue, violet, pink, red or white depending on the type.

Common Name	Scientific Name
Spreading Phlox	*Phlox diffusa*
Long-leaved Phlox	*Phlox longifolia*

Campion (Genus Silene) has many native species in BC. One non-native species is night-flowering catchfly (*Silene noctiflora*).

Common Name	Scientific Name
Moss Campion	*Silene acaulis*
Parry's Campion	*Silene parryi*
Menzie's Campion	*Silene menziesii*
Douglas's Campion	*Silene douglasii*

Milkweeds (Genus Asclepias) have foliage that 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 our local, native milkweed species.

Common Name	Scientific Name
Showy Milkweed	*Asclepias speciosa*

Goldenrod (Genus Solidago) is an excellent addition to a bat-friendly garden. It is 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 or pail with the bottom cut out might be helpful if you are trying to contain them to an area of your garden). . Pollen and nectar are used by insects, including moths; the plant foliage is used by moths and butterflies as larval food (which may cause the formation of galls that maybe subsequently pecked open by woodpeckers that eat the enclosed developing larva).Above-ground parts of the plant are all edible.

Common Name	Scientific Name
Spikelike goldenrod	*Solidago simplex*
Northern goldenrod	*Solidago multiradiata*
West coast goldenrod	*Solidago elongata*
Western Canada goldenrod	*Solidago lepida*
Missouri goldenrod	*Solidago missouriensis*
Field goldenrod	*Solidago nemoralis ssp. decemflora*

Non-native plants

None of the following plant groups are native to British Columbia 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. Most apples and crabapples are not native to British Columbia but are widespread and grow well in many areas. The Pacific crabapple (*Malus fusca*) is British Columbia's only native apple and are a great option in many areas.

Purple coneflower (Genus Echinacea)—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.

Four o'clocks (Genus Mirabilis)—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.

Salvia (Genus Salvia)—The foliage is used as food for developing larva of numerous moth and butterfly species.

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

www.bcbats.ca

1-855-9BC-BATS