community bat programs of BC

Bats 101: All About Bats Appendix

A Supplementary Attachment to the BC Bat Ambassador Handbook

Acknowledgments

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How To Use This Appendix

This *Bats 101: All About Bats Appendix* is designed to be a supplement to the BC Bat Ambassador Handbook. This more detailed information provides a strong background on bats for Bat Ambassadors delivering outreach programs or assisting with other activities. You are encouraged to read this supplement regularly to refresh your information and explore the key resources to enhance your knowledge further.

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Introduction

Bats are an important part of the world's biodiversity. Over a quarter (~26%) of all mammals are bats. There are at least 1,474 different species of bats on the planet (and counting!). British Columbia has the most bat species of any province, with 15 species confirmed through capture plus 2 species known only through acoustic occurrences. Across Canada, we have 17 confirmed species of bats (three of these are migratory; the rest live year-round in Canada).

Morphology: A Bat's Body

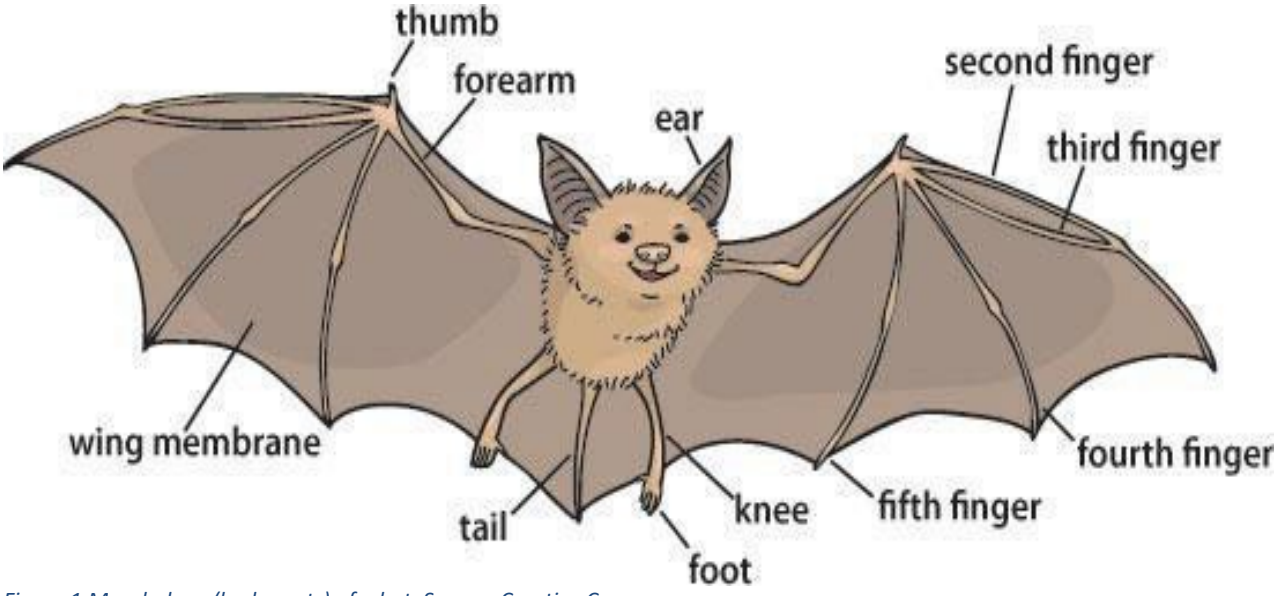

Figure 1.Morphology (body parts) of a bat. Source: Creative Commons.

Wings

Bats belong to the order *Chiroptera,* which literally means "hand-wing". The small claw that sticks out above the wing is the bat's thumb. The other four fingers are elongated with a membrane between the fingers (also called patagium). The fourth finger (the "pinkie" finger) has a wing membrane that stretches from the tip of the finger to the bat's ankle. Hunting bats may sweep insects up into their wing membranes or in their tail membrane and reach down (while flying) to pick out the captured bug (they will curl their tail up like a little bucket). The result is often twists, turns and somersaults in the air. Bats are truly "acrobatic". Bats are the only order of mammals which have evolved the capacity for active flight. They are traditionally divided into two suborders: microbats (Microchiroptera) and megabats (e.g., flying foxes) (Megachiroptera).

ACTIVITY

Have everyone put their arms out to their sides with bent elbows and spread their fingers wide like a bat wing with their thumbs up. Show a photo of a bat wing and point out the arm, elbow, wrist, thumb and fingers as well as the feet and tail membrane. Flap like a bat! Some bats can flap their wings 12 times per second or 120 times per 10 seconds. Can you imitate bats and flap your hands that fast?

Feet

Bat feet are actually **backward**! Well, backward to us. They are rotated 180 degrees from our own feet and have a tendon system that allows them to hold onto things with their feet effortlessly. Normally, in a human hand, we must contract a muscle that pulls on a tendon that pulls your hand closed. Bats have tendons that are attached to their body, so when they are holding on with their feet, the weight of their bodies pulls on the tendon and causes their feet to contract and grip. **This is how bats can still hang on when they are sleeping or hibernating**! They don't have to exert force to contract their gripping feet; however, they do have to contract muscles to release their grip.

Ears

Ears are an important bat body part. Because they navigate the night skies using echolocation, bat ears have evolved to capture sounds, and there is huge variability in bat ear structure across different bat groups. Canadian bats have ears that range from being relatively small and rounded (like hoary bats) to quite large (such as Townsend's Big-eared bat or the Long-eared Myotis) to massive for their body size (such as the Spotted Bat that has the largest ears for its body size of any bat species!). Ear size and shape is often a reflection of the type of echolocation call that bat uses. "Whispering" bats that use very quiet echolocation calls often have larger ears to better hear the echoes of their own calls. Spotted bats have an unusually low-frequency call (low voice), so they need a bigger "satellite dish" type ear to capture those long wavelengths. Aside from differences in the shape of the outside part of the ear (the **pinna**) bats also have another prominent ear structure known as the **tragus** that looks like a little "mini ear" inside its big ear. Humans also have a tragus (and lately, it has been a popular spot for

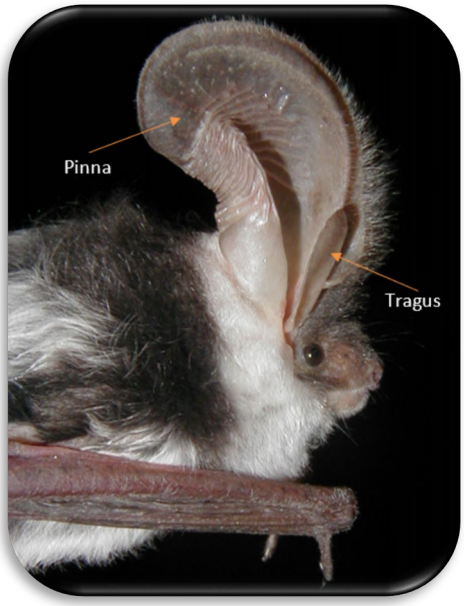

Figure 2. Spotted Bat ear: pinna (the outer ear) and tragus (long projection of the ear in front of the ear canal). Photo by Paul Cryan, USGS.

piercing), but it is not as well developed as it is in bats. This interior structure of ears is also variable amongst bat groups. Sound captured by the ear will bounce off the pinna and hit the back of the tragus and then is reflected into the bat's ear canal to be processed by its brain. This additional information is used to determine where objects are located vertically (up and down) in front of the bat as it flies. It is just another specialized feature they have for analyzing the echoes from their echolocation calls.

ACTIVITY

Have the audience cup their hands around their ears and continue talking at the same volume. Ask them to remove their hands and notice if you sound louder or quieter. Discuss the adaptation of larger ears that allows bats to hear better.

Noses

BC bats belong to the family Vespertilionidae or the "Vesper bats". All our bats are considered "plain-nosed" bats because they have no special structures. Our bats call by projecting sound out of their mouths. This is not true, though, for several other bat families in other parts of the world that project sound through their noses using a "nose-leaf". These special structures evolved to help disperse sound because leaf-nosed bats send their echolocation calls out through their noses! Spear-nosed bats and horseshoe bats all sport a nose-leaf. The common vampire bat (*Desmodus rotundus*) also has a modified nose-leaf that is equipped with a special array of infrared radiation sensors that allow it to detect hot spots on their prey where blood runs close to the surface of the skin. So far, only pit vipers have been found to have this ability. The nose-leaf is also an important morphological feature for identifying some species of bats.

Eyes

Bats are not blind. They have eyes and can see, likely better than we can under dimly lit conditions. Some bats (e.g., flying foxes, which are not found in BC) navigate using vision alone and appear to be able to see even better than owls.

Echolocation

Bats navigate their night world using echolocation. Just as the word implies, they locate objects in space by listening for rebounding echoes of their very loud, high-frequency calls. We cannot hear bats echolocating. Bat calls are at such a high frequency that they are above the hearing range for humans. Cats and dogs can hear them, though, so if you catch your pet staring at the night sky in summer, they aren't crazy – they may be listening to the bats flying and calling as they pass by.

Bats are very loud, with calls measured as high as 120 decibels (dB), which is louder than a symphony orchestra. If there was a bat echolocating 10 centimetres from your ear, it would be like having a smoke detector go off beside your head! They are that loud. It would be interesting if we humans could hear bats - our summer nights would be very noisy.

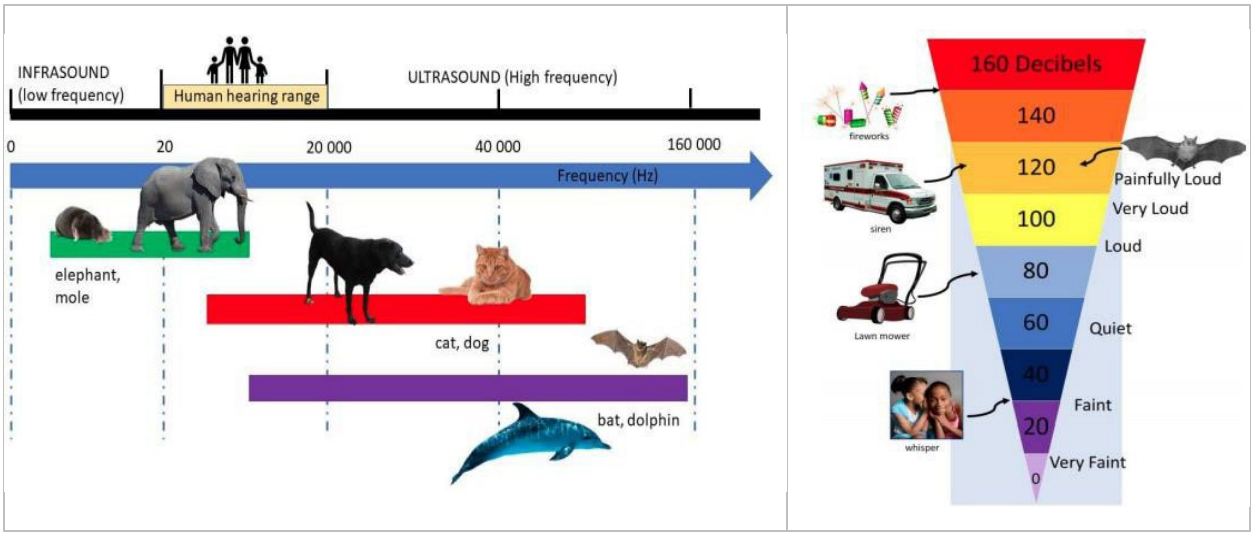

Figure 3. Left - Hearing range of humans compared to several animal groups including bats. Right - Typical intensities of common sounds in decibels (dBs). Source: Alberta Community Bat Program.

Bats use a frequency range of around 20,000 Hertz (Hz) up to 150,000 Hz (or 20 - 150 KHz). The range of human hearing is around 20 to 20,000 Hz. Younger people with sharp ears can sometimes hear bats that echolocate at the lower portions of their range (i.e., around 20,000 Hz), and the sounds are very high-pitched. As we age, we lose the ability to hear these high-frequency sounds. Humans cannot hear infrasound either; these are the very, very low-frequency sounds used by species such as elephants and moles for communication. These low-frequency sounds travel long distances.

There is one Canadian bat species - Spotted Bat (*Euderma maculatum*) found in the South Interior BC - that has a very atypical, low-frequency call (for a bat) that is audible to the unaided human ear. If you camp in the south Okanagan, you might hear a strange "click-click, click-click" sound over your head at night. Those aren't weird birds but rather the calls of Spotted Bats. Their calls range from 9,000-12,000 Hz (9 to 12 KHz), and they have evolved really large ears just to be able to hear their own call echoes (lower frequency sound has much larger

wavelengths, and their ears are like a large satellite dish). In fact, Spotted Bats have the largest ears for their body size of any of the bat species. They even generate some lift from their ears during flight, they are that large! If you would like to seek out the Spotted Bat, you won't be able to see them because they roost in steep cliffs in very high locations. But you could listen for them. Near Gallagher Lake in BC there are some steep cliffs with spotted bats. At around half an hour past sunset, sit near the cliffs and listen for their calls and you will hear them as they leave for their evening hunt.

To hear our other bat species, you would need a "bat detector", which is a device with a microphone that captures the bat's calls, divides the sound and slows it down so we can hear the call with our ears. For more information on bat detectors, see the *Bat Detectors section in the BC Bat Ambassador Handbook*.

Diet

Diet of BC Bats

All the bat species in Canada eat insects (insectivores) and other arthropods (like scorpions). There is variation in diet based on bat species— some species are moth specialists while others favour beetles. Larger bat species tend to eat large insects; smaller bats tend to eat smaller insects (such as midges and mosquitoes). Any insect flying at the same time as a hunting bat is fair game to be consumed!

Traditionally, bat diets were determined by sorting through fecal pellets of bats and identifying insect groups to larger orders. Current methodologies include DNA analysis that allows a more specific determination of the insect groups in their diet (depending on the reference samples of insect DNA available). Bat specialists always assumed that bats eat mosquitoes, but it was difficult to assess. However, recent work using DNA has confirmed that both Little Brown and Big Brown bats do, in fact, consume a considerable number of mosquitoes as part of their regular diet! **In a laboratory setting, one Little Brown Myotis could eat 600 mosquitoes in an hour.** Indeed, bats consume huge numbers of insects. Most will eat their own weight in bugs in a night. Females with young bats that are just learning to fly and hunt on their own will still be nursing those babies; those moms can eat more than their own weight in insects in a night just to keep up with the energy demand!

The impact of bats on insect populations should not be underestimated. Because bats are consuming the flying adult forms of many moths and beetles, they are removing adult, egg-laying individuals that could be responsible for laying thousands of eggs that hatch into caterpillar forms that do the most damage to many crops. Bats consume pest insect species recognized by both the agricultural and forestry industries.

Figure 4. Insect groups eaten by bats (starting from upper right corner, left to right): first row – June bug beetle, Potato beetle, moth; second row – caddisfly, mayfly, lacewing; third row – midge, mosquito, fly. Source: Creative Commons.

Calculations of bat impact on insect control:

- A colony of 150 Big Brown bats can consume enough adult cucumber beetles in one summer to prevent egg-laying that would produce 33 million of their root-worm larvae, a major pest of corn.
- The 20 million bats that live in Bracken Cave, near Austin, Texas eat over 200 tons of insects each night. The Bracken Cave colony represents the largest concentration of mammals on the planet!
- One Little Brown Myotis can eat up to 2,500-5,000 mosquito-sized insects in one night!
- The economic importance of bats to the US agricultural industry is huge. On average, the estimate is that the value of insect control by bats is worth about $22.9 billion per year (with a range of $3.7 to 53 billion/year). Their estimate was that one million bats could consume 660-1,320 tons of insects each summer.

ACTIVITY

Have your audience member think about their weight in pounds (lbs). Then, have them multiply that number by 4. That is how many quarter-pounder burgers they would eat every night if they were eating their own body weight in food.

The importance of a bat's diet is not just in controlling insect populations but also in cycling nutrients. Since bats may eat in one location but poop in another, they move the rich nutrients, essentially fertilizing the soil. For example, if a bat foraged on insects in a wetland but then pooped in a forest, that bat is helping fertilize the forest. Now imagine that times hundreds or thousands of bats!

Bat Diets Around the World

Although bats in BC eat only insects and other arthropods, bats around the world have specialized in other diets. There are bats specialized for eating fish, frogs, nectar, fruit, and small mammals, to name a few. Nectar-eating bats are important for pollinating plants, including sources of cocoa, tequila, and bananas. Fruit-eating bats are important for dispersing seeds and replanting tropical rainforests.

Inevitably, during bat outreach, people will ask about vampire bats. Only three bat species in the world eat blood, and these are the vampire bats of Central and South America. The saliva of vampire bats contains an anti-coagulant (so the blood will flow and they can lap it up), which has been used as a treatment for strokes (a drug called 'draculin').

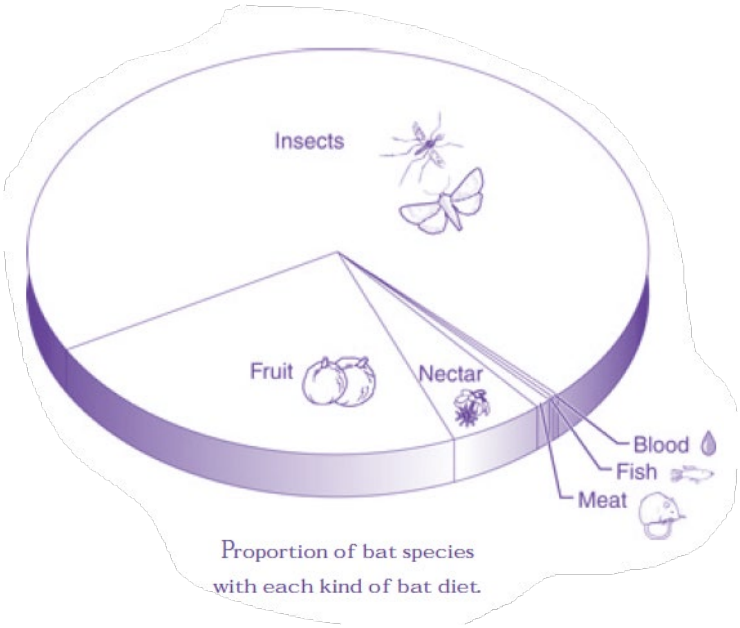

Figure 5. Proportion of bat species with each diet type. Source: "Night-friends America Bat: On-line Activity Guide" by National Wildlife Federation.

Bat Life Cycle

Hibernation

Of the bats in BC, two species migrate (head south for the winter) while the rest hibernate. In BC, bats enter hibernation in late fall (typically by mid- to late October). We know of just a handful of cave sites where bats hibernate, and these sites contain only a few thousand bats. We suspect that most of our bats are hibernating in deep crevices that are located under the frost line in rock faces or other sites. It is a real mystery that bats can be so abundant in summer and yet we really don't know where most of our bats hibernate in BC!

Bats are true hibernators. During hibernation, bats drop their body temperature to the temperature of the environment. They choose sites that are above freezing, generally around 0-9 °C. The analogy is that they are looking for sites that are like your refrigerator, not the freezer!

A resting bat may have a heart rate of about 120 beats per minute. During flight, that heart rate may soar to up to 1000 beats per minute! During hibernation, their heart rate slows to about 5 beats per minute.

ACTIVITY

Place your hand on your chest and tap it at the resting heart rate of a bat (so about 2x every second). Now, increase the heart rate to a flying heart rate (about 16 times per second!). Now, decrease the heart rate to hibernation heart rate (about once every 12 seconds).

During hibernation, bats also lower their metabolic rate (which is the rate at which they use energy). They don't eat during winter (because there are no flying insects available in winter!). They survive on the fat stores they accumulate just prior to hibernation. A 16g Big Brown bat may put on 8-10g of fat in the fall. Bats do wake during hibernation, but only 10-15% of this period is spent awake. Surprisingly, they spend almost 85% of their stored energy reserves to power the re-warming for these awake periods! The reason bats wake up is to have a pee (rid the body of wastes) and to get a drink of water. Dehydration is a problem when hibernating. They also reduce their breathing rate to once every few minutes. And their immune system function is depressed during hibernation. Bats infected with White-nose syndrome need to wake from hibernation to fight the fungal infection. Waking uses up additional, valuable and limited fat stores. Ultimately, too much waking can lead to starvation and death for bats.

IMPORTANT

It is critical that bats remain undisturbed during winter. Never enter a bat hibernaculum in winter. Bat hibernation sites are critical habitats and should always be a priority for protection. Anyone entering underground sites used by bats should employ the latest white-nose syndrome decontamination protocols (www.whitenosesyndrome.org).

Emergence

Bats come out of hibernation in spring when temperatures are consistently warm, and insects become active. This varies from year to year, so there is no set date. When females wake from hibernation, that is the time when they ovulate. Sperm that was stored overwinter (they have a specialized uterus that keeps sperm viable for fertilization) fertilizes the egg, and pregnancy starts soon after the females wake. Successful pregnancy depends on whether a female has enough body mass or can gain enough body mass in spring to support a pregnancy. If they are too thin and in poor condition, the embryo will be resorbed.

Almost all our BC bats have only one pup per summer. Big Brown Myotis bats have twins (but less than 10% of the time). Hoary Bats will give birth to twins; red bats are known to have litters of four, but we know almost nothing about what Eastern Red Bats do in BC (they are quite rare).

Pregnant females of most species (except Hoary and Red bats) band together and form "maternity" colonies. The size of colonies may vary with species. Little Brown Myotis may form small colonies (less than 25) or very large colonies of more than 1,000 bats. Once they give birth, the colonies are often referred to as nursery or maternity colonies. Males and non-pregnant females have few energy demands and nothing to do but hunt and sleep. They choose roost sites that are cool so they can use torpor daily as a way of saving energy. **Torpor** is like hibernation (they lower their body temperature, breathing rate, heart rate and metabolic rate), but they use it over short periods to save energy (usually if the weather is cold or rainy and there are no insects available). Females with young choose much warmer roosts to reduce the expense of keeping babies warm. Warm babies grow faster than babies in cold sites. Nursery colonies are often 37-40^{0}C in the daytime.

Birth

Bat pups are HUGE compared to their mother's body weight. At birth, they range from 25-30% of their mother's mass. Most species are born pink and hairless with their eyes closed but with very large feet that they use to hold on in the roost. Some females will carry their pups with them, but most of the time, they will leave their pups behind in the roost when they leave at night to forage for insects. Bat gestation periods are around 40 days, but this can be longer if they use torpor while pregnant. If a pregnant bat uses torpor, it will slow the fetal growth rate,

which will extend the length of the gestation period! Put the size of a bat pup in human terms. A human baby that is 30% of its mother's body weight would weigh around 30-40lbs at birth!

Fledging

Baby bats reach adult size at around 4 weeks of age but still need to figure out how to fly and how to hunt on their own. Bats are mammals, and the mothers feed their babies milk. At the time of fledging (pups learning to fly), the mothers are feeding the equivalent of an Olympic athlete! Pups are relying on their mothers for food but burning huge amounts of energy while they learn to fly. This is called the period of "peak lactation". At this time, the mothers may be eating one and a half times their weight in insects each night just to keep up with the energy demands of their pups. Shortly after fledging occurs, the nursery colonies begin to disperse. Everybody now has the job of eating as much as they can to get ready for winter hibernation.

Pups often start fledging around mid-July to August. They often are poor fliers and either get tired or crash-land away from the roost. It is this time of year that these youngsters may be found either on the ground or in weird roost sites (on the sides of buildings), or sometimes they will end up inside houses! These little bats just need a bit of help. Using thick leather gloves and a cardboard box, an adult can gently move a stranded bat to a safe spot (they need to be up high so they can take off again). Putting the bat in an open pillowcase and pinning it to a tree will protect the bat from birds and still let them climb out on their own and take off safely.

IMPORTANT

Never handle bats with bare hands. If someone reports a bat on the ground, contact your regional coordinator to share the sighting and follow the directions from your coordinator on the next steps.

Swarming

During fall, bats of many species assemble at sites in a behaviour known as swarming. Autumn swarming behaviour is thought to primarily serve as a promiscuous mating system but may also be related to the localization and assessment of hibernacula. Males are efficient at mating with everybody and anybody in a swarming site. Females store sperm through the winter and become pregnant in spring if they are sufficiently healthy to support a pregnancy. Mating systems for migratory bats are less understood.

BC Species

There are 17 species of bats in BC, but not all of them occur in all parts of the province. Some are restricted to the Okanagan or the coast. Take a moment to determine which bat species are found in your region of BC (*Table 1*, *Table 2*). There is still a great deal to learn about bats in BC, and with increased survey effort and better identification tools, our understanding of bat species distribution may change.

Table 1. Bat species conservation status and distribution in each region of British Columbia. Source: www.bcbats.ca.

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

[1] COSEWIC Status (federal): SC = Special Concern, T = Threatened, E = Endangered, DD – Data Deficient; Provincial: Red, Blue, Yellow, Unknown and Accidental.

[2] Long-eared Myotis (*Myotis evotis*) includes the species formally known as Keen's Myotis because genetic evidence indicates these are the same species.

[3] Acoustic records only.

Table 2. Accounts of Bat Species found in BC.

Little Brown Myotis **Latin name:** *Myotis lucifugus* **Body size:** 6 - 9.5 cm (2.3 - 3.7 in) **Wing span:** 21 - 27 cm (8.2 - 10.6 in) **Weight:** 5 - 12 g (0.17 - 0.42 oz) **Life span:** 5-10 years (max over 30 years)	**Location:** In the north, its range extends from Alaska to Labrador. In the south, its range extends to Southern California and to the Arizona and New Mexico. **Habitat:** In summer, trees, rock crevasses and anthropogenic structures. In Winter, caves and mines as well as talus and holes under root masses.	 *Photo: WCSCbatscanada*
Yuma Myotis **Latin name:** *Myotis yumanensis* **Body size: 8.4 - 10 cm (3.3- 3.9 in)** **Wing span: 24 cm (9.4 in)** **Weight: 5 - 6 g (0.17 - 0.25 oz)** **Life span:** not well documented, most likely similar to Little Brown Myotis. 8.8 years in captivity.	**Location:** Found in western North America, ranging from British Columbia to Central Mexico and eastward to Colorado and as far east as Oklahoma. **Habitat:** Natural roosts include caves, rock crevices, and hollow trees but they are more commonly found today in artificial structures close to water. Their winter roosts are poorly known.	 *Photo: Dan Neubaum*
Big Brown Bat **Latin name:** *Eptesicus fuscus* **Body size:** 11–13 cm (4.3–5.1 in) **Wing span:** 32.5–35 cm (12.8–13.8 in) **Weight:** 15–26 g (0.53–0.92 oz) **Life span:** 6.5 years in average but can survive up to 19 years in the wild and males tend to live longer than females	**Location:** The Big Brown Bat occurs widely throughout the US, Canada, Central America, and the Caribbean. **Habitat:** caves, tunnels, tree cavities, and human structures including mines, caves, tunnels, buildings, bat boxes, tree cavities, storm drains, wood piles, and rock crevices.	 *Photo: NABat*
Townsend's Big-eared Bat **Latin name:** *Corynorhinus townsendii* **Body size:** 9 - 11 cm (3.5 -4.3 in) **Wing span:** 28 -32 cm (11 - 12.5 in) **Weight:** 7 - 13 g (0.25 - 0.45 oz) **Life span:** 4 - 10 years (max recorded 16 years)	**Location:** From southern Canada to southern Mexico. They have significant populations in all Rocky Mountain states. **Habitat:** Live in montane forest. This type of forest is thick with pine, fir and aspen trees and is bounded by shrubs and grasslands. They roost in cavities, in caves and mines, large spaces in abandoned buildings or attics.	 *Photo: Dan Neubaum*
Long-eared Myotis **Latin name:** *Myotis evotis* **Body size:** 7.4 - 10 cm (2.9 - 3.9 in) **Wing span:** 25 - 29 cm (9.8 - 11.4 in) **Weight:** 5 - 8 g (0.18 - 0.28 oz) **Life span:** 20 years	**Location:** From the Pacific Coast to the front range of the Rocky Mountains and western Dakotas. Northward, in the south of BC, Alberta and Saskatchewan and southward to central New Mexico and Arizona. **Habitat:** They roost in a variety of places, including tree cavities, rock crevices, caves, and even abandoned buildings.	 *Photo: Cory Olson*

California Myotis

Latin name: *Myotis californicus*
Body size: 6.5 - 9.4 cm (2.5 - 3.7 in)
Wing span: 20.9 - 25.1 cm (8.2 - 9.9 in)
Weight: 3.3 - 5.4 g (0.12 - 0.19 oz)
Life span: up to 15 years

Location: A western North American bat, range extends from southern Mexico to BC and south Alaska
Habitat: Inhabits arid grasslands, humid coastal forests and montane forests. Range from sea level on the coast to 1280 metres in Glacier National Park.

Photo: Frank Carey

Dark-nosed Small-footed Myotis

Latin name: *Myotis melanorhinus*
Body size: 8.1 - 9.3 cm (3.2 - 3.6 in)
Wing span: 20 - 24 cm (8 - 9.6 in)
Weight: 4.7 - 7 g (0.17 - 0.25 oz)
Life span: 12 years

Location: It mostly occurs west of the Continental Divide but can be found as east as Oklahoma. Northward to south BC and southward to central Mexico.
Habitat: Found near sources of water with a large insect population. Inhabiting cliff faces and rocky outcroppings no further than 2km away from their foraging grounds.

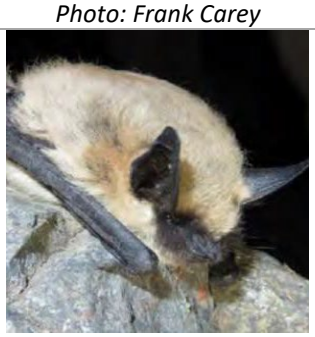

Photo: Cory Olson

Fringed Myotis

Latin name: *Myotis thysanodes*
Body size: 8.5 - 9 cm (3.3 - 3.5 in)
Wing span: 28 cm (11 in)
Weight: 5 - 9 g (0.18 - 0.32 oz)
Life span: 18 years

Location: Mainly in the western United States and can be found as far north as British Columbia and as far south as Mexico
Habitat: caves, mines, rock crevices and cliffs, wildlife trees, and buildings for day retreats and night roosts.

Photo: Jared Hobbs

Long-legged Myotis

Latin name: *Myotis volans*
Body size: 8.3 - 10 cm (3.2 - 3.9 in)
Wing span: 2.1 -2.7 cm (0.8 - 1.0)
Weight: 5 - 10 g (0.18 - 0.35 oz)
Life span: 21 years

Location: From Alaska through the western United States, and into Mexico. They have been recorded as far east as North and South Dakota, Nebraska and Texas.
Habitat: forested regions. Roosts in trees, rock crevices, fissures in stream banks, and buildings. Caves and mines are used during the night

Photo: Cory Olson

Northern Myotis

Latin name: *Myotis septentrionalis*
Body size: 7 - 10 cm (2.7 - 3.9 in)
Wing span: 21 - 26 cm (8.2 - 10.2 in)
Weight: 6 - 9 g (0.2 - 0.3 oz)
Life span: 18 years

Location: Those bats are found through much of the eastern half of the United States and Canada. They are also more rarely found in western parts of Canada (BC and Yukon).
Habitat: Forests including boreal and mixed; roost in buildings, under loose bark and in tree cavities. Hibernates mostly in caves or abandoned mines

Photo: Cory Olson

Silver-haired Bat

Latin name: *Lasionycteris noctivagans*
Body size: 8 - 11.5 cm (3.1 - 4.5 in)
Wing span: 26 - 31 cm (10.2 - 12.2 in)
Weight: 6–14 g (0.2 - 0.5 oz)
Life span: 4 - 12 years

Location: Throughout the United States northward into southern Canada up to Alaska, and southward into Mexico.
Habitat: Forested areas adjacent to water for foraging. Silver-haired bats roost under loose tree bark alone or in small groups.

Photo: Cory Olson

Hoary bat

Latin name: *Lasiurus cinereus*
Body size: 10 - 14.5 cm (3.9 - 5.7 in)
Wing span: 34 - 42 cm (13.3 - 16.5 in)
Weight: 19 - 35 g (0.6 - 1.2 oz)
Life span: 6-7 years

Location: Bolivia, Uruguay, Central Chile, Paraguay, Central Argentina, Brazil, Hawaii, Guatemala, Mexico, Panama, Galapagos Islands, United States and Canada.
Habitat: In summer, normally roosts alone on trees, hidden in the foliage, but on occasion have been seen in caves with other bats. In winter, they migrate south.

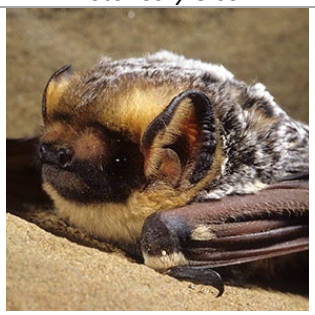

Photo: John MacGregor

Eastern Red Bat

Latin name: *Lasiurus borealis* **Body size:** 8.5 - 12.5 cm (in)
Wing span: 28 - 33 cm (in)
Weight: 7 - 18 g (oz)
Life span: not well documented

Location: Widely distributed in eastern North America and Bermuda. Generally occurs east of the Continental Divide.
Habitat: They roost among foliage in deciduous trees, but sometimes in coniferous trees. When they hang upside down, they look like dead leaves or pine cones.

Photo: WCSCbatscanada

Pallid bat

Latin name: *Antrozous pallidus*
Body size: 6.0 - 8.5 cm (2.3 - 3.3 in)
Wing span: 38 - 40 cm (15 - 16 in)
Weight: 17 - 28 g (0.6 - 1 oz)
Life span: 9 - 11 years

Location: They occur in arid and semi-arid regions across much of the American west, up and down the coast from Canada and Mexico.
Habitat: Pallid bats are also called desert bats because they are mostly found in desert habitats. They roost in a variety of places but favour rocky outcrops.

Photo: Keaton Wilson

Spotted Bat

Latin name: *Euderma maculatum*
Body size : 10.2 - 12.6 cm (4-5 in)
Wing span: 35 cm (13.8 in)
Weight: 16 - 20 g (0.5 - 0.7 oz)
Life span: not well documented

Location: From BC, Canada southward through the western United States and into Mexico. This bat is considered to be one of the rarest bats in North America.
Habitat: prefers arid regions, desert scrub, and open forest in rugged landscapes. They roost on vertical cliffs and in open canyons.

Photo: Lonnie Pilkington

It can be difficult to visualize the size of BC bats. The table below provides comparisons of bat sizes and bat weight in Canadian coins (*Table 3*).

Table 3. Average body size of some BC bat species. Source: Bats of British Columbia book (2nd edition, Lausen et al., 2022).

Species	Wingspan (inches)	Body Length (inches)	Weight (grams)	Weight (Canadian coins)
Hoary Bat	15.4	5.4	27.8	4 toonies
Pallid Bat	13.9	4.1	23.3	3 toonies and 1 dime
Spotted Bat	17.2	4.6	17.4	2 loonies and 2 dimes
Big Brown Bat	12.9	4.6	16.1	2 toonies and 1 dime
Eastern Red Bat	12	4.3	12.9	1 loonie
Silver-haired Bat	11.5	3.9	11.9	1 toonie and 1 quarter
Townsend's Big-Eared Bat	11.3	3.9	10.3	1 loonie and 1 quarter
Yuma myotis	9.4	3.2	5.5	1 loonie
Californian myotis	8.7	3.1	5	1 quarter

Where Bats Live

Many people think bats roost in caves year-round, but that is not the case. Caves, mines and deep rock crevices are important for bats in winter as hibernation sites (because they provide stable, cold temperatures above freezing and high relative humidity), but they are almost always too cold for summer roosts. Roosts can occur in a variety of natural and human-constructed features. Types of roosts used can be specific to the bat species in question. Not all bats will use buildings or bat boxes. Many rely on tree hollows or other spaces created by tree defects (cracks, spaces beneath peeling bark, within furrows of very deep bark). Other bat species may use only rock crevices (cliff faces, rock outcrops, mudstone areas of riverbanks). And a few bat species will roost in all these types of roosts.

Large bat colonies in summer are almost always a "**maternity roost**" or "**nursery roost**" composed of mothers and their pups (*Table 4)*. Mothers select very warm sites that keep pups warm and growing fast (a warm site means that the mother doesn't have to spend energy keeping their baby warm). Living in a group that cuddles also generates heat that helps pups grow. Some bat species will have a few females stay behind at night to "babysit" their friends' pups during the period of nightly insect hunting (although we are not clear on how common this is in BC bats). Maternity colonies are often composed of related individuals with moms and their female pups from previous years all roosting together. Because bats are such long-lived animals (with lifespans of up to 40 years for some species; Alberta has the North American record for a Little Brown Myotis that was found to be 39 years old through band records), these groups form very tight social bonds. We are still just starting to understand colony behaviours, but we suspect that these groups also hunt together and maybe move together to winter sites (but we really don't know for sure).

ACTIVITY

For an audience of parents and children: To demonstrate how bats find their pup using the sound of their voices, line up parents in a row and children in a parallel row about 3 m apart. Have parents turn their backs or blindfold them so they can't see the line of children. Have the children switch around places. Then, one at a time, ask one child to say 'mum' or 'dad.' See if the parent knows their child's voice.

To demonstrate how bats find their pups using smell, get a variety of scents (like almond extract, vanilla extract, or mint extract) and put a scent on a cotton ball in a jar. Have a parent smell the same scent that their child is holding. The children switch around places and hold out their cotton balls. The blindfolded parent goes down the line, smelling the scents until they find their pup.

Males and non-reproductive females will often be found roosting singly ("**day roost**" or "**bachelor roost**") or in very small groups of just a couple of bats (*Table 4*). Males and non-reproductive females have virtually no energy demands during summer, so they just eat and then find a cool place to sleep where they can use daily torpor and with as little effort as possible.

People often report bats roosting against the outside of their houses, under eaves and out of the wind, but this often only happens for short periods during the night. These types of roosts are known as "**night roosts**"(*Table 4)*. We are still unclear on the exact functions of a night roost, but we do know that most species do this for a couple of hours after their first bout of hunting at night.

With full bellies, bats hang up in a warm spot out of the wind with their friends, groom, digest bugs, poop (a LOT of pooping going on) and cuddle with their neighbours. This may be an important social behaviour as well. The only evidence the next morning is often a scattering of **bat guano** on the wall and on the ground beneath the roost. Bat guano is an excellent plant fertilizer (very high in nitrogen, it is considered a specialty fertilizer). Aside from simply sweeping up the guano in the morning, residents can set up a planter beneath these types of roosts that will catch the guano. A wall-mounted version can work well in some locations. We encourage residents to welcome these nightly guests as they do no harm. Having a safe place to night-roost is important for local bat populations.

Table 4. Types of bat roosts.

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

Bat Boxes

Interest in bat boxes has increased substantially in the past few years. It might seem like an easy fix for the "bat conservation problem" (i.e., declining populations from various threats), but it is not. **The truth is that bat boxes may be effective for only a few BC bat species and do not usually provide a very good habitat.** Primarily, Little Brown Myotis, Yuma Myotis and Big Brown Bats will benefit from bat boxes (this is okay because Little Browns are currently listed as Federally Endangered due to White-nose Syndrome). Eight of our fifteen bat species only use natural roosting habitats, so bat boxes are not going to help them. However, bat boxes are a great tool for introducing people to bats and getting them excited and supportive of bat conservation.

It is important to encourage the purchase or building of **bat boxes that are suitable for bats**. Key characteristics are: large, multiple chambers, rough interior for grip, and a landing pad. People should be warned about purchasing bat boxes that are not suitable for bats as many commercial boxes are too small or lack other key characteristics. Very small bat boxes may be cute but are not likely to be functional. Our current recommendation is to use the four-chambered nursery box or multi-chamber rocket box (link to plans is below). These can be built

with about $40 worth of materials but require some special preparation of the interior roosting panels (they need to be scored to increase roost grip for young bats). The outsides of bat boxes are often stained (not painted) brown, but in very hot regions, a lighter colour may be needed to prevent temperatures in the box from spiking above 40C (which is too hot for bats for prolonged periods and may lead to abandoning the box temporarily or even heat-related death). Rot-resistant woods, like cedar, do not necessarily need to be treated.

IMPORTANT

Do not install bat boxes in undisturbed habitats (undisturbed, older forests with cavities and sloughing bark) where natural roosts are likely available. This will avoid concerns about potentially increasing the few bat species that use boxes to the detriment of other bat species.

The BC Community Bat Program guidebook "Building Homes for Bats" provides information on where to install your bat box and HOW to install your bat box. Many colonies of bats like to move around between several roosts, possibly in response to changes in temperature. It is highly recommended that you install several boxes in different locations for bats (if you have the space) or cooperate with neighbours to get them involved in bat conservation. Community Bat Programs in Alberta and British Columbia have ongoing citizen science projects that involve landowners and roost stewards counting bats and registering locations. Information on this project is available for BC at bcbats.ca.

Important documents about bat boxes:

- "Building Homes for Bats": https://bcbats.ca/attachments/Building-Homes-for-Bats.pdf
- Bat boxes building plans: https://bcbats.ca/bat-boxes/bat-box-designs/
- "Best Management Practices for Bat Boxes in BC" https://www.bcbats.ca/attachments/BMPS-for-Bat-Boxes-in-BC-2019.pdf
- "Best Management Practices for the Use of Bat Houses in U.S.and Canada" https://ecos.fws.gov/ServCat/DownloadFile/241311

For more information on bat boxes and how to register them, visit our website at https://bcbats.ca/bat-boxes/.

Bats in Buildings

While several species of bats can use buildings, only a few are regular inhabitants. The most common species using buildings in BC are the Little Brown Myotis, Yuma Myotis, and the Big Brown Bat. In coastal regions, California Myotis also use buildings. The rare Townsend's Big-eared Bat can be found in buildings and is easy to identify because of its long ears and tendency to roost in clusters on rafters in very open spaces. This habit also makes them vulnerable to human disturbance or injury, either by intentional or accidental means. Long-eared Myotis, Long-legged Myotis, Pallid Bats, and Northern Myotis may also use buildings but are not found as often in such roost types.

Bats may roost in many parts of a building structure, including under roofing, siding, fascia boards, flashing and rafters, in cracks of the chimney or walls, behind shutters or under a porch roof (*Figure 6*).

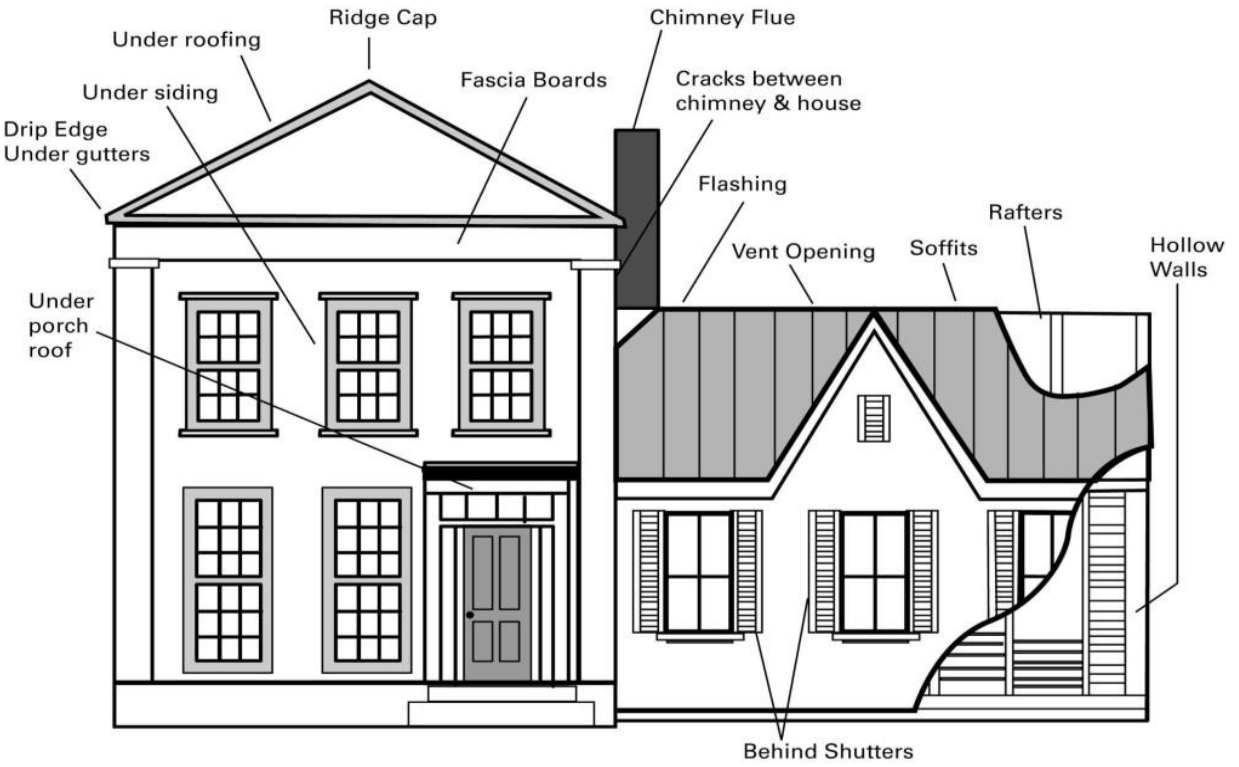

Figure 6. Parts of a building where bats may roost. Source: Drawn for the Kootenay Community Bat Project based on an original drawing by Dr. Stephen C. Frantz, Global Environmental Options, LLC.

Bat colonies can be kept in buildings occupied by humans if the two groups stay in their own spaces. **Bats do not chew or dig holes, they don't bring in nesting material, so they do not create a fire hazard or destroy things.** Bats do poop a lot, and they will urinate in their roosts, both can cause a significant smell if left unattended. Humans can manage the mess by cleaning out their attics (after the bats have left to hibernate), sealing up spaces where bats might move into human living spaces, laying down plastic sheeting to catch future guano and making a schedule of clean up every year or two (depending on the size of the colony). Managing a colony will diminish the chance of damage from excess guano accumulation.

IMPORTANT

Humans sharing spaces with bats should also ensure that their pets are up to date with their vaccinations and that all residents (especially young ones) are clear **that bats are not to be handled** (especially with bare hands). If anyone had contact with a bat, they should seek medical attention.

When a bat colony cannot stay in a building (or if the building is to be demolished), there are specific timing windows when evictions and exclusions should be conducted. Bat-friendly exclusions involve waiting until bats have left the building in late fall, and subsequent

renovations or exclusions occur between late fall and early spring. During mid-summer, maternity colonies are full of mothers and flightless pups that are very vulnerable. One difficulty is that bats are extremely small and can squeeze through spaces as small as 5 mm (¼"). Bats may be very persistent in finding alternate routes into buildings once their primary routes are blocked off, so exclusion can be extremely difficult.

If there is interest in exclusion, landowners can contact their regional Community Bat Program Coordinator for information on timing and site-specific guidance.

Important information can be found here:

- Living with Bats in British Columbia
- Got Bats? A BC Guide for Managing Bats in Buildings

IMPORTANT

It is **ineffective and unsafe** to attempt to remove bats using any of the following:

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

It is **NOT** advised to use any of the above-listed practices on bats. **Bats are protected under *BC Wildlife Act* against any harm or persecution.**

IMPORTANT

Bat Ambassadors should never offer specific bat management advice. There are numerous factors to consider when managing bats in buildings including the bat species present, roost type, impacts to landowners, and impacts to bats, to name a few. Bat Ambassadors may provide printed materials on managing bats in buildings and encourage landowners to contact their regional bat program.

Natural Roosts

Many of our BC bat species roost in trees, especially older trees that have peeling bark, crevices from lightning strikes or other damage, or in cavities such as those created by excavating birds such as woodpeckers. Generally, bats prefer tall, old, dead, large-diameter trees with peeling bark, cracks and crevices. They will use other trees in varying stages of decay as long as the tree provides a suitable crevice, hole or crack for roosting with appropriate thermal characteristics and suitable access. Some bat species prefer rock crevices in large rock faces on cliffs or in rock piles, particularly if they face south.

A few species exhibit flexibility in their roost preferences using cavities in trees or rocks or suitable sites in buildings or bat boxes. Two species (the Hoary and Red bat) prefer solitary roosts hanging from branches and leaves. Hoary and Red Bats are heavily furred (including the tail membrane that they will wrap around themselves like a blanket), and their fur colour allows them to hide amongst the leaves. For all bat species, females with young are looking for warm summer roosts for their babies.

Western bat species (including those in BC) can be lumped together based on the types of roosts they will use and the way they move around the landscape (*Table 5*).

Table 5. Types of natural roosts used by western bat species (in British Columbia) and their typical movement habits.

ROOST TYPES	**ROCKS**	Spotted Bat, Pallid Bat, Western Small- footed Myotis	Uses rock roosts only; cliffs, rock outcrops, boulder fields, erosion crevices in riverbanks (mudstone)	All species will fly in open habitats (crosses gaps easily).
	TREES	Hoary Bat, Eastern Red Bat	Solitary (a single female with pups); roosts on small twigs in open foliage; requires tall trees (generally, 15 meters+) with open space below to "drop and fly".	Uses older, tall, mature trees with open canopy; flies in open habitats. (Note: preferred tree height is variable; often chooses the tallest tree available; open understory is essential).
		Silver-haired Bat	Roosts only in trees (old-growth or mature)	Forages in open habitats, including above the canopy of closed forests (crosses large gaps easily)
		Northern Myotis		Forages along edges or in interior forest habitat (sensitive to fragmentation)
	ROCKS or TREE S	Big Brown Bat, Little Brown Myotis, Yuma Myotis, Long-legged Myotis, Fringed Myotis	Roosts in either rock-type roosts and/or old-growth, mature, tree roosts. Often roost in buildings.	Forages in open habitats (crosses large gaps easily)
		California Myotis, Long-eared Myotis		Forages along edges or in interior forest habitat (sensitive to fragmentation)
		Townsend's Big-eared Bat	Roosts in very large tree cavities (like hollow western red cedar), shallow cave formations, and buildings	Prefers roosts with large entry points that allow them to fly into the roost; roosting bats are in the open; building roosts may require specific conservation strategy; roosts in wide open locations within roosts, easy to locate and identify.

The table above is especially useful for management purposes, but this also helps conceptualize differences and similarities among bat species. Specialist bats who will only use one type of roost may be more vulnerable to habitat change or loss. Bats that will use many types of roosts exhibit behavioural flexibility, which is something that is in their favour when facing threats like climate change or habitat loss.

Habitat connectivity can be an issue for some bat species. Those bats that will not cross open gaps (some bat species may be sensitive to open areas of as small as 10 metres) may find themselves restricted in their movements. This can cause problems if either food or roosting habitat is limited.

Threats to Bats

White-nose syndrome

Figure 7. Little brown bat with White-nose Syndrome. Photo by Marvin Moriarty, US Fish & Wildlife Service.

White-nose syndrome (WNS) is caused by the fungal pathogen *Pseudogymnoascus destructans* (*Pd* for short). Millions of bat deaths have been recorded since 2006, when the fungus was first observed on the noses, tails and wing membranes of hibernating bats of various species. *Pd* is thought to have been accidentally introduced from Europe (where bats co-evolved with the fungus and are not harmed by it). WNS is considered one of the worst wildlife epidemics ever observed in North America. The fungus is spreading from where it was first detected in a cave in New York. In 2016, bats were found with Pd in Washington State, which was a big leap from the current spread (*Figure 8*). *Pd* was predicted to arrive in BC in 2026. In 2022, the presence of *Pd* fungus was detected in bat guano in the Boundary region of BC (yellow circle on the map). As of 2024, WNS has not yet been detected in BC bats, but it is very close. Visit https://www.whitenosesyndrome.org/ to find the most recent update on the spread of Pd fungus and WNS in North America.

Pd is a cold-loving fungus that grows in cool, damp places. It grows on the bare skin of hibernating bats and shows up as a white fuzz (its first appearance on bat faces gave rise to the name “white-nose syndrome”) (*Figure 7*). *Pd* also grows on bat wings and tail membranes while bats are in hibernation. The fungus causes the bats to wake during hibernation, which uses up critical fat reserves. Infected bats are often seen flying in winter and will emerge from hibernation sites well before the appropriate time of year.

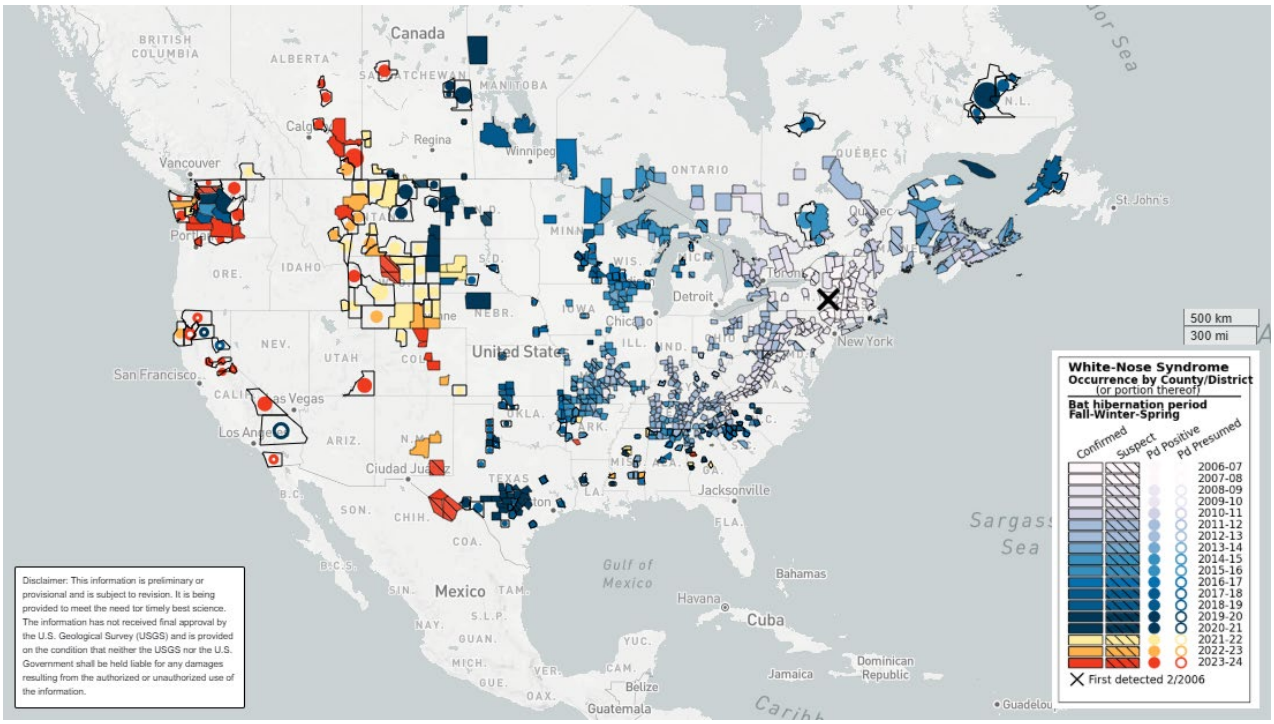

Figure 8. Spread of White-nose Syndrome in North America since 2006. Note the locations that appeared in Washington State in 2016. Source: www.whitenosesyndrome.org.

Pd has affected some bat species more than others. Little Brown Myotis, Northern Myotis and Tri-colored Bats were listed Federally as Endangered in 2014 after populations of these three species dropped drastically due to deaths from white-nose syndrome.

A current theory as to why the disease is so devastating to bats involves bat hibernation physiology. During hibernation, bat body temperature, metabolic rate, and immune response are working at very low levels. Body temperature and metabolic rate drop to save energy; immune response drops because of the drop in the first two conditions. Fungal spores living in cold cave environments attack the bats, and the fungus flourishes because the hibernating bats' immune responses are depressed. The fungal infection also results in bats becoming dehydrated. When bats finally wake because of the infection and thirst in mid-winter, they are without food resources. The result is that bats starve to death because there are no flying insects that can be eaten to sustain them during winter. Millions of dead bats have been found in piles at cave entrances in eastern North America.

It is unclear how WNS will affect western bat species. The fungal spores (conidia) have been detected on several western species, but researchers have not been able to evaluate the impact on populations yet. Some bat species, such as Silver-haired Bats, seem to be able to resist infection but have been found with fungal spores on their wing membranes (which means that these species could carry *Pd* into hibernation sites with more vulnerable bat species and infect them). *Pd* is very hardy. It will remain viable in infected cave sites even in the absence of

bats, growing on any available organic material. Its continued presence endangers any new uninfected bats occupying the site.

Survival of bat species will depend on the long-term response of bats to the fungal pathogen; a long, slow recovery is possible if bats develop immunity to the infection. Western bats may have an advantage over eastern species as researchers have recently presented evidence that western hibernating bats use crevice habitats much more than their eastern counterparts. The lack of large suitable cave systems in the west means that western hibernating bats may be spread out in small groups in crevice habitats across the landscape. Will this make them less vulnerable to WNS? We are unsure at this point. Monitoring crevice habitats is going to be challenging because biologists know of only a few crevice habitats used for hibernation. Winter bat ecology requires much more research, and some is currently underway in North America.

What can people do?

- Limit the spread of the disease.
    - Anyone who goes into underground habitats (such as caves or mines) should follow the latest decontamination guidelines to prevent further spread of the fungus. Equipment that has been used underground in areas with WNS should not be used in areas that are currently free of the disease.
    - Campers and long-haul truckers should check their vehicles for unsuspecting passengers. In 2016, a bat showed up near Seattle, Washington, with WNS. Biologists concluded that it “hitched a ride” across the country and got out in Seattle. WNS is now spreading north towards BC.
    - Do not transport or ship bat guano anywhere. Especially from areas with WNS. The fungal spores can remain active for several weeks in spring after bats come out of hibernation. It is unclear if this has been a route of transmission, but it is a risk that can be managed.
    - If you are conducting a bat exclusion from a building, request that pest control operators use appropriate white-nose syndrome decontamination procedures to minimize the risk of spreading fungal spores from one roost to another.

- Participate in the Annual Bat Count to help track bat summer populations, which will provide valuable data on potential population decline or recovery.

- Help with surveillance by reporting dead bats and winter bat activity in the WNS surveillance period (November 1 - May 31).

- Support bat populations through raising awareness and protecting habitat using Bat-friendly Community approaches and even working with your town towards certification.

Recent research has shown that “fat bats” resist WNS better than ones that go into hibernation or come out with less body fat. Every surviving bat in any of the infected areas will be important as a “founder population” that will rebuild bat populations back up to pre-WNS levels.

Providing great foraging habitat and high-quality roosting habitat can help these survivors. Good foraging means putting on good fat stores. Also, juvenile bats develop faster in high-quality roosts, meaning they mature faster and have more time to pack on the grams before winter. Good roosting habitat decreases energy demands so bats can keep that weight on, and there is some evidence that building-roosting bats may develop faster than those using natural roosts (we are still studying if this is also true for bat boxes). Putting on fat stores is especially critical just before they begin hibernating. **A fat bat is a healthy bat!**

For more information on white-nose syndrome, visit www.whitenosesyndrome.org

Habitat Loss

Stable bat populations primarily depend on four things:

1. Good quality summer day-roosting habitats;
2. Adequate foraging habitat (places that produce patches of insects) and access to drinking water;
3. Connectivity between these two habitats (some bat species will not cross open areas, some may refuse to cross gaps as small as 10 metres, while other bat species have no issue with open spaces); and,
4. Undisturbed hibernation sites over winter.

Urban development, destruction of old buildings, loss of wetlands, and some forestry practices inevitably lead to loss of natural habitat for wildlife. Some forestry practices lead to the loss of trees that would have been used as roosting habitats for bats. Loss of foraging and drinking habitat can result from land reclamation (draining wetlands), channelization and loss of riparian habitats, and contamination and sedimentation of wetlands, ponds, and riparian habitats. Some bat species avoid crossing large open areas. They may travel significant distances to circumnavigate open areas rather than cross an open space by the most direct route. Gaps wider than 10 m (e.g., rights-of-way, gaps in hedgerows bordering fields, gaps in forested riparian edges) may result in bats limiting their movements. Habitat fragmentation could make habitats unsuitable and inaccessible or result in the reduced occurrence of some bat species. Rural structures such as barns and lakeside cabins are often favoured roost sites, especially for Little Brown Myotis and Big Brown Bats. Loss of this roosting habitat could be critical for these species in some parts of BC. New replacement developments may result in the loss of bat habitats because they don't provide the same structures and are often built with no access for bats. Alternate roost habitats, such as bat boxes, could potentially offset this loss for these two species, especially when there is either a planned renovation or a planned demolition of a building occupied by bats.

Forest management practices such as logging or prescribed burning can have positive or negative effects on bats by altering the distribution and abundance of living and dead trees used for roosting or the number of forest openings and edge habitats used for foraging. With proper planning and implementation, forest health can be maintained or improved while

providing a sustainable supply of fibre for forest products. Non-timber values can be protected, and bat -roosting and -foraging habitat and drinking resources can be enhanced, greatly benefiting bat populations.

The BC Community Bat Program has published a Bat-Friendly Communities guidebook that talks about how to improve habitats for bats and how to eliminate hazards that we unintentionally set up for bats. Planting trees, conserving tree stubs of older trees that must come down, planting native shrubs and plants to support native insect populations are all ways to help compensate for habitat loss in urban environments. Water is also limiting in many places, so providing a water source that would be available for bats may also be helpful.

What can people do?

- Learn what habitats bats need.
- Assess your local area for sites of value that may need conservation or enhancement.
- Determine the next steps to improve your local bat habitat.
- Work with your town to incorporate a bat-friendly approach in planning and become a Bat-Friendly Community.

For further information on bats and habitat loss, see our guidebooks: *Bat-friendly Communities Guide*, *Managing Bats in Buildings* and *Building Homes for Bats* (available at www.bcbats.ca).

Wind Turbines

Another threat to bats, particularly the migrating species, is wind turbines. Wind energy facilities can be developed as a line of turbines, or in an array and are usually installed in sites that have high, persistent wind. Typically, there are three types of developments: 1) onshore (on land and more than 3 km from a coastline), 2) nearshore (on land and less than 3 km from a coastline or on the water but less than 10 km from land) and 3) offshore (on the water and more than 10 km from land).

Wind energy facilities negatively affect bats in three ways:

1. **Direct mortality:** bats die from either being hit by the turning blades of the wind turbine or because of barotrauma. The tips of the spinning turbines are moving very fast (even at low wind speeds); tips can be moving at speeds of 240km/hr. This generates a zone of low pressure in the immediate area of the periphery of the spinning blade tips. Bats fly into this zone, and the rapid pressure change causes their lungs to expand, bursting blood vessels and damaging tissues, causing rapid death.

2. **Habitat loss:** wind facilities built in forested areas will require forest clearing. Loss of trees and tree roosts for bats during the breeding season may result in direct mortality of colonies; removal of appropriate tree roosts outside of the breeding season may limit available roosting habitat for bats if forests are not managed to retain a variable stand

structure. Removal of rock features suitable for roosting bats may also impact local bat populations. Crevices in rock outcrops and cliffs can provide important long-term roosting habitat for bats in both summer and winter.

3. **Loss or degradation of foraging and drinking habitat:** any construction activity or development that changes drainage patterns or results in the loss or degradation of riparian areas can negatively affect bats. Wind energy facilities consist of not only turbine sites but networks of roads for access which all require construction that can affect the surrounding landscape. Open water may be a critical resource for bats, especially in dry ecological areas.

The estimates range in the *hundreds of thousands of bats* that may be killed annually at wind energy sites across North America. These estimates are based on carcass searches, which can only be conducted on land; it is unclear what the mortality rates are for bats in facilities located over water. Biologists also estimate that the fatalities of one bat species (Hoary Bat) outnumber all songbird deaths at wind energy developments combined across Canada. However, it should be noted that even a small number of deaths of extremely rare species (such as Ferruginous Hawk) may be significant.

A recent paper authored by many prominent bat biologists in North America modelled several population scenarios based on current and projected mortality rates of Hoary Bats at wind energy facilities and estimates of the North American population size for this species. **Their predictions were that in 50 years, we would see a significant decrease in the population size, and in less than 90 years, Hoary Bats may be driven to extinction.** Myotis species may also be affected by wind energy developments, but likely more so in forested habitats.

What is being done to reduce bat deaths at wind energy facilities?

1. **Pre-construction studies:** surveys for bats and bat habitats in areas that are proposed to develop wind energy are surveyed for bats before development occurs. This informs the developers in choosing a site that is not characterized by high levels of bat activity in the fall and not located near high-quality bat habitat (e.g., large, open water, bat roosting habitat, or a hibernaculum).

2. **Post-construction monitoring:** during the fall migration season, random turbines in each development area are methodically surveyed for dead bats every few days.

3. **Mitigation initiated if dead bats are found includes** using minimum “cut-in” speeds that lock the entire turbine/rotor in place until wind speeds are high enough to efficiently generate power (used especially on nights with low wind speeds as this is when many bat deaths are observed and especially on nights when the front of the low-pressure system passes through the development area during the fall migration period); and “feathering” the blades of the offending turbine.

4. **Developing methods to reduce bat mortality:** several methods have been tried including painting rotors with UV reflective paint to make them more "visible" to bats; strategic lighting to warn bats that rotors are present; and most recently, playing very loud, high-frequency sound to warn/repel bats from the area. It is unclear if any of these methods are truly effective, although some have resulted in a small reduction in bat deaths.

What can people do?

- Be informed. Read up on how wind energy affects bats.
- Keep asking the industry to find better ways to prevent bat deaths and to adequately monitor bat populations to ensure we keep hoary bats flying the skies of North America.

Further information on bats and wind energy:

- Best Management Practices Guidelines for Bats in British Columbia, Chapter 4: Wind Energy Developments https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices

Insect Population Declines

Possibly one of the most alarming things to have been brought to light in the past decade is the decline in insect populations worldwide. It was estimated that 40% of insect species are in decline. In North America, half of all Lepidoptera (moths/butterflies) and beetle species are in decline, with 1/3 threatened with extinction. Half of all bee and ant species are threatened and 63% of caddisfly species are threatened (possibly because their aquatic larval forms are at a higher risk from polluted waters from development).

There has been no single reason found for insect declines – but there are several factors that contribute to their demise. First, the biggest reason is habitat changes. Loss of habitat from urbanization and conversion of natural habitats to agriculture. The loss of the small family farms has meant the loss of hedgerows, open pastures and weedy areas that supported insect fauna. Drawing down swamps and wetlands to increase land availability has also impacted insect production (especially those with aquatic larval forms). Pesticide use, such as herbicides, fungicides and pesticides, all contribute to the loss of insects and their habitats. Climate change also affects insect abundance and may cause the timing of bat activity to desynchronize with insect emergence. Drought, extremes in weather patterns and changes in the frequency and duration of extreme weather events all affect natural populations. And lastly, invasive species, parasites and diseases all contribute to insect losses.

What can people do?

- Stop using pesticides on lawns and gardens. Use organic treatments and spot treatments for pest insect issues.

- Buy organic fruit and vegetables when possible.
- Plant native plants, trees and shrubs; converting lawns to natural habitats would have a huge impact in urban centres.
- Put water out for bees! Bird bath-type structures filled with pebbles will allow access to water for small insects without the risk of drowning.
- Promote local community projects to conserve wetlands and wild habitats. Small acts can have big effects.

Climate Change

Climate change may affect levels of bat activity and bat numbers. Extreme weather patterns, especially drought but also extreme heat, cold, and precipitation; increasing storm intensities; and sea level rise can directly affect bats and the habitats they depend on. Lactating female bats are very sensitive to the availability of water resources for drinking. Declines in available water during times of drought can cause lower bat reproductive success and population decline. Even a diminished water output from a small stream may impact a local bat population, especially in areas with few watering holes for bats. Biologists in Europe found that in dry regions, bats fly long distances to find water and have very large home ranges. Drought conditions brought on by climate change may force bats to fly even farther which increases their daily energetic costs.

Bat reproduction and hibernation are both closely tied to environmental temperatures and conditions. The timing of hibernation in autumn and emergence in spring (with subsequent initiation of pregnancy) is dependent upon cues from temperature and weather. The effects of these changes on bat population sizes are not known, nor are there species-specific effects from such changes.

Because bats are sensitive to environmental change, they may act as early warning indicators of the large-scale ecological effects of climate change, especially in western North America. Bat biologists have advocated for the implementation of a global network for monitoring bat populations allowing the use of bats as bio-indicators of ecosystem changes around the planet.

What can people do?

- Look for ways to reduce your ecological footprint. Drive less, eat less red meat, purchase energy-efficient appliances and vehicles when you are ready to trade up, plant trees, plant native vegetation, support solar farming and other solar energy initiatives, and support municipal, provincial and national initiatives to help reduce human impacts and improve current and future climate conditions.

Check out the BC Community Bat Program Guidebook on *Bat-Friendly Communities* and implement some of the suggestions for bats.

Awnings and Blinds

An unexpected threat to bats is related to exterior roll-up blinds and power awnings commonly used over windows and decks for shade and to reduce heat exposure to buildings. Bats were found to roost on them and discovered by homeowners when blinds were rolled up and down, inadvertently squishing the bats and causing serious injuries and death.

The BC Community Bat Program conducted a study to collect and analyze reports of bats found on awnings and blinds since 2014. Roosting bats were reported at different times of the year, with the majority of observations in the summer. Of 97 reports, 37% noted injuries or fatalities to bats. Since 2014, a total of 88 bats were reported dead from awnings and blinds. In many cases, bats were discovered roosting inside the housing units of awnings, where the fabric is rolled up when not in use.

Figure 9. Injured bat in awning. Photo by Troy Corbin.

What can people do?

- Encourage awning users and homeowners to look for bats and bat signs. If bats are found, follow best management practices on the website. Remember that bats can squeeze into a ¼" gap, sleep during the day, and fly off usually within the first hour after sunset. Bats are protected and cannot be excluded during summer when it is their breeding season.
- To prevent bats from being attracted to awnings, ensure the awnings are closed up daily shortly after sunset.
- If the bats are roosting behind the housing unit of the awning and are not in danger of being accidentally squished, and people are comfortable with wildlife near them, then we encourage awning owners to let the bats stay. Follow guidelines on the website.
- If the bats are going into the housing units of awnings, or bats are roosting on the blinds, and there is a chance that the bats can get accidentally squished, then an exclusion at the right time of year is needed. Please follow the Best Management Practices from the website and contact your regional coordinator for more information.
- Installing a bat box next to the awning will help move them over, as this will provide an alternative place to roost. Contact www.bcbats.ca for more information.

Cats

Cat attacks are a common cause of bat mortality. Bats do have natural predators (such as birds of prey), but cats can learn the location of a bat roost and catch bats as they emerge. They have

been known to eliminate entire colonies of bats. Cats are amazing hunters and can also catch foraging bats. If a bat is injured by a cat, it is more likely to die or be euthanized due to infection from cat saliva. In addition, cats can transmit *Rabies* from bats, which makes it unsafe for pets and humans. Bats attacked by cats need to be tested for Rabies (especially if there is exposure to other pets or humans); to test for Rabies, bats are euthanized and sent to the lab to inspect their brains. Therefore, cat attacks and predation affect bats directly and indirectly, causing unnecessary bat mortality.

What can people do?

- Read and share *The Happy Cat* brochure by the Stewardship Centre for BC. It was developed to promote responsible cat ownership to keep cats happy and safe, while reducing negative impacts of cats on bats, birds and other wildlife.
- Several municipalities have or are considering a no-roam bylaw for cats, requiring outdoor supervision and preventing cats from roaming beyond private property. Consider starting this discussion in your municipality.
- Cat welfare groups, as well as conservationists, encourage keeping cats indoors with only supervised outdoor access (such as leach-walking, cat-proof fencing, catios and other cat-friendly outdoor enclosures). At a minimum, keep cats indoors at dawn, dusk and at night when cats impact most wildlife and are at higher risk of predation by other wild animals.

Laws Protecting Bats in BC

BC Wildlife Act

All bats in British Columbia are protected under the *BC Wildlife Act*, which prevents them from being hunted, captured, possessed, killed, transported, and harassed. Unlike rodents, bats are not considered pests in BC and can't be removed or exterminated by pest control. Pest management operators can assist with bat-friendly evictions if necessary.

Federal *Species at Risk Act* (SARA)

The *Species at Risk Act* provides protection to bats on federal land if they are listed as Threatened or Endangered under Schedule 1 of the Act. This currently includes three species found in British Columbia: Little Brown Myotis, Northern Myotis, and the Pallid Bat. Three other species (Silver-haired Bat, Hoary Bat and Eastern Red Bat) have been recently assessed as Endangered in Canada (by COSEWIC[4]) and are expected to be listed under SARA soon. Examples of federal land include, but are not limited to, national parks, Department of Defence lands, national wildlife areas, and First Nations reserve lands.

[4] COSEWIC - Committee On the Status of Endangered Species In Canada

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

Other Legislation

Depending on the area and type of work being completed, additional protections may apply to 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 (FRPA)
- BC Local Government Act
- Municipal Bylaws

Bats and Human Health

Bats are an extremely low health risk for humans. There are more deaths annually from dogs and bee stings than from bats. Statistically, having an occupied bat box in your yard is safer than owning a dog or planting flowers.

Rabies

Bats have developed a poor reputation as being the main transmitters of rabies, and this is one of the reasons that people fear them. Bats are a reservoir for rabies in BC – meaning they can carry the disease and pass it on without showing signs of the disease themselves. However, the percentage of bats that have rabies has been over-estimated in North America because samples were taken primarily from sick or dead bats. When normal populations of bats are sampled randomly, **less than 0.5% of bats tested positive for rabies.**

Rabies is a serious illness that is fatal without immediate treatment. However, contracting rabies from a bat is extremely rare. Since reporting began in 1924, a total of 28 people in six provinces have died of rabies in Canada. The most recent death of rabies was in Ontario in 2024. In BC, the last case was on Vancouver Island in 2019. Bats should not be feared, but caution must be taken.

Bats with rabies may appear sick and weak and be more likely to be somewhere where people can come in contact – e.g. on the ground. People should beware of bats that act strangely, such as bats flying during the day, and NEVER pick up a sick or dead animal with bare hands; use gloves or a shovel to gently move the animal away from human activity if possible, or call your local Community Bat Program.

Biologists trained to handle bats have preventative rabies vaccinations and specific training on how to handle a bat. When collecting dead bat carcasses, it is important to follow protocols to ensure no contact between human skin and the bat carcass.

IMPORTANT

Never touch or handle bats with bare hands. If a pet or a person comes in contact with a bat, they must immediately contact a vet (for pets) and a doctor or public health office (for humans).

Rabies summary:

- Although the risk of contracting rabies is rare, it is a very serious disease and fatal if not treated immediately.
- Never handle bats or any wildlife unless you can wear protective equipment, and it is necessary.
- Beware of bats that act strangely, such as flying during the day.
- If you are bitten or scratched by a bat, seek medical attention immediately – the vaccine is excellent (a series of small injections in the arm, not shots in the stomach like it used to be decades ago).

For more information about bats and rabies:

- HealthLink BC: https://www.healthlinkbc.ca/healthlinkbc-files/rabies
- BC Centre for Disease Control: http://www.bccdc.ca/health-info/diseases-conditions/rabies

Histoplasmosis

Another disease that is associated with bats is histoplasmosis, a disease of the lungs. The fungal spores can be transmitted through bat guano, although the primary sources of the disease are the droppings of starlings, pigeons and poultry. The disease is most common in the tropics or other humid environments and, in Canada, is thought to be primarily limited to central Canada; however, a cluster of cases was detected in Alberta in 2011. Fortunately, there are no documented cases of locally acquired histoplasmosis in humans or animals in BC, indicating that the risk of acquiring this disease in this province is minimal. However, surveillance for this fungus in bat guano in BC has been limited. Most people who contract the disease have few, if any, symptoms or problems, but some people can develop serious respiratory conditions. To be safe, avoid breathing in dust in areas where there are bat droppings. If you do have to clean up bat guano, particularly in an enclosed space, spritzing the area with water to keep the dust down and wearing a mask is suggested.

For more information, see https://www.ccohs.ca/oshanswers/diseases/histopla.html.

Glossary

Acoustic survey/echolocation survey - a method of detecting bats using an ultrasonic bat detector. Detectors may be handheld (active surveys) or connected to an electronic system (passive surveys) for long periods of recording independent of human observation.

Bat detector - a device used to record the ultrasonic calls of a bat. For example, the Echo Meter Touch from Wildlife Acoustics can be plugged into tablets or smartphones. This device uses software that gives the user an audio call and a visual display of the bat call on the device screen. The automatic identification function will suggest a bat ID as the bat passes by. However, there can be a significant amount of error in identification depending on the reference calls and how the detector settings are adjusted for the geographical region being surveyed.

Bachelor roost - a roost used by one or more males during the day.

Cave - a natural cavity in the earth that connects with the surface, contains a zone of at least partial darkness and is large enough to fit a human. For bats, this term also includes any natural extensions, such as crevices, sinkholes, pits, or any other openings, that contribute to the functioning of the cave system.

Crevice - a narrow crack or opening, or a fissure or a cleft, not large enough to fit a human. In addition to using caves, bats may roost in crevices and other cracks or surface openings within caves, in rocks, in rock outcrops, and on exposed cliff faces.

Day-roost - a roost where bats rest during the day in spring/summer/autumn. Day-roost types include maternity roosts, bachelor roosts, and mixed male/non-reproductive female/yearling groups. The use of a specific day-roost may be seasonal or variable within a season.

Echolocation - the orientation system used by bats, which consists of bats generating high-frequency sounds and listening to their returning echoes to locate obstacles and prey.

Ephemeral roost - a bat roost in a feature where the characteristics important to bats may change quickly and unpredictably. For example, a roost might be found in an area under sloughing tree bark that falls off the tree in only a few seasons and/or the microclimate under the bark may change depending on the widening of the space under the bark or partial bark removal.

Fertilization - the impregnation of the egg by the male sperm cell.

Flyway - any corridor used by bats commuting between roosting and foraging areas. Flyways make excellent sites for capturing bats in mist nets and harp traps, often delimited by physical structures such as vegetation or buildings.

Forage - to hunt for food.

Gestation period - the length of a pregnancy; the time from fertilization until the birth of the fetus. This period may vary depending on the environmental conditions experienced by the pregnant female in spring (torpor use during cold/wet weather will slow fetal growth and lengthen the gestation period). Generally, though, it is 5-6 weeks.

Gleaner - a bat that can capture prey on the leaves and twigs of vegetation or on the ground.

Harp trap - a specialized trap designed exclusively for capturing bats.

Hibernaculum (hibernacula [plural]) **-** a site where one or more bats hibernate in winter. A specific hibernaculum may be used by bats only for part of the winter and may not be used every winter.

Hibernation - a state of lethargy characterized by a reduction in body temperature and metabolic rate.

Inventory - a single enumeration of an ecological system, generally carried either as a basis for estimating potential yield or to establish a benchmark. An inventory may act as one point in time in a monitoring program. Ecological inventories may be more comprehensive and spatially/temporally discrete than monitoring activities.

Lactation - the period of milk production by female mammals nursing young.

Maternity colony - an aggregation of females in spring, summer, or autumn. The colony may include pregnant females (may not be visibly pregnant early in the season), lactating females with or without young-of-the-year, or post-reproductive females. A maternity colony may consist of a group of females within a single maternity roost (e.g., building, cave), or a group of females roosting singly or in small groups in close proximity and maintaining a long-term social relationship, adhering to the fission-fusion model (e.g., in crevices within a cliff or boulder field, in a forest stand under sloughing bark of trees).

Maternity roost - a roost used outside of the winter period by adult females that are capable of reproduction.

Mitigation - measures implemented to control, reduce, or eliminate a potential adverse impact of a project, including restorative measures.

Monitoring - repeated, systematic measurements done with a specific purpose in mind. Monitoring is focused on measurements over time to detect the change toward or away from a stated standard or objective. Monitoring is part of the cycle of assessment and evaluation that is linked to management activities.

Nocturnal - active at night.

Night-roost - a roost where bats rest at night between foraging bouts. Bats may roost singly or congregate.

Nursery colony - a type of maternity colony containing mainly nursing adults with young (summer), or an aggregation of mainly volant pups (late summer/early autumn).

Nursery roost - a roost where females congregate to give birth and raise their young. A nursery roost is a type of maternity roost.

Permanent roost - a roost that is available for bat use over many years and has suitable characteristics (e.g., microclimate, access) that remain stable over time. Examples of permanent roosts include

caves, cliffs, mines, bridges, buildings, and large hollow trees of a slow-decaying species, such as western redcedar (*Thuja plicata*).

Pup - a bat born during the current year.

Resident bat species - species that move relatively short distances between summer and winter habitat, compared to migratory species, which travel long distances (> 1000 kilometres).

Riparian area - three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems. They extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width.

Roost - a daytime retreat or night-time resting place.

Shaft - a vertical mine opening from the surface may also apply to cave systems.

Significant bat roost:

- any hibernaculum or swarming site;
- a roost used by a nursery colony of a listed species (any number of individuals), or a nursery roost used by more than six females of other species (can include mixed species groups);
- a roost used by a maternity colony of listed species (any number of bats), or a maternity roost used by more than four females of other species (can include mixed species groups);
- any permanent type day-roost used by a male or a non-reproductive female of a listed species, or > 10 males/non-reproductive females/juveniles of other species (can include mixed species groups);
- any night-roost used by a listed species or > 10 bats of other species (can include mixed species groups);
- any regularly used roost of a species listed under Schedule 1 of the *Species at Risk Act* (any number of individuals); or
- any other roost deemed significant by an experienced bat biologist.

Stewardship - caring for the land and associated resources so that healthy ecosystems can be passed on to future generations.

Swarming - behaviour associated with nocturnal flights that are made through potential hibernacula by aggregations of bats in late summer or autumn.

Torpor - a short-term (daily) state of inactivity achieved by lowering the body temperature and reducing the metabolic rate in order to conserve energy.

Volant - capable of flying.

Yearling - a bat born in the previous reproductive year.

Young-of-the-year - a bat born during the current reproductive year.