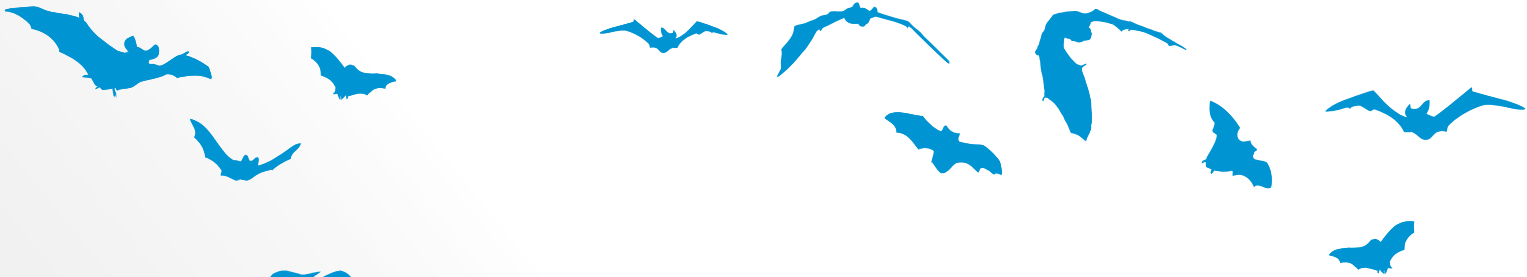




# BATS

A CONSERVATION GUIDE





**B**ats are perhaps the most misunderstood animals on Earth yet they play vital roles in many of the planet's ecosystems.

The goal of the Toronto Zoo's Bat Conservation Programme is to educate people about the importance of bats and to eliminate the misconceptions that contribute to negative human views and actions towards these animals.

We also hope that this booklet will encourage people to accept the bats living in or near their homes. Although it is preferable to leave bats to their traditional roosts, we can offer bats alternative housing by installing a bat box. Bat boxes are not meant to encourage the eviction of bats from existing locations, but offer temporary housing when available roosting sites are few or after they have been evicted from their present location.



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Bats first took to the skies over 50 million years ago yet today's bats are virtually indistinguishable from their ancient ancestors. Their wings and their ability to fly separate bats from other mammals, but even among the world's bats there is great physical variation. Bats truly are a unique and striking group of animals.

Bats come in a wide range of sizes, from the 1.2 kg golden-crowned flying fox (right) to the 2 g bumblebee bat (left).



Over 70% of bats are insectivorous but many others consume fruit, nectar and pollen. A few species feast on fish, frogs, flowers, and leaves. There are even three bat species, the vampire bats, which survive solely on the blood of other animals. Don't be alarmed though – vampire bats much prefer the blood of cattle and horses to that of sleeping humans!



## Threatened, not Threatening

Misconceptions have played a primary role in the persecution of bats. These animals are often thought of as blind, rabies-infested, blood-sucking monsters. In reality, bats are gentle, beneficial and interesting creatures that unnecessarily suffer due to our fears and unfounded beliefs.

With the exception of the Antarctic, bats inhabit all regions of Earth. With over 1,200 species worldwide it's no wonder that bats are of great ecological importance. Insectivorous bats often keep insect populations in check while bats that feed on fruits and nectar disperse seeds and pollinate flowers in a wide range of ecosystems, from rainforests to deserts.

Eastern Canada is home to eight species of insectivorous bats, three of which are endangered. The destruction of bat roosts, pesticide use, and habitat destruction have all contributed to bat population declines in Canada. However, a deadly fungal disease, White Nose Syndrome, is currently the most serious threat to our bats.



# Eastern Canadian Bats

## Big brown bat (*Eptesicus fuscus*)

Fur ranges from tan to dark brown. Communal roosts can contain up to 700 bats. Inhabits forested areas and often roosts under tree bark, in hollow trees, rock crevices, and man-made structures such as cabins and barns. Widely distributed in southern Canada from B.C. to New Brunswick. Hibernates in caves and mines.

Wingspan: 28-33 cm, Length: 11-13 cm, Weight: 14-25 g



## Northern long-eared bat (*Myotis septentrionalis*)

Fur is dull, yellow-brown. Large, black ears extend beyond tip of nose. Solitary. Prefers boreal forest habitat and roosts under bark, in tree cavities and in buildings. Distributed from the eastern Rockies through south and central Ontario, southern Quebec, and the Maritimes. Hibernates in caves and mines.

Wingspan: 23-26 cm, Length: 6-10 cm, Weight: 6-9 g

## Little brown bat (*Myotis lucifugus*)

Fur is uniformly glossy brown. Communal roosts can include thousands of bats. Inhabits a wide range of habitats. Roost sites include buildings, trees, wood piles and caves. Widespread throughout Canada. Hibernates in caves and mines.

Wingspan: 22-27 cm, Length: 6-10 cm, Weight: 5-14 g



## Eastern Small-footed bat (*Myotis leibii*)

Fur is glossy, golden brown. Feet small in comparison to other Canadian bats. Roosts communally with 10-30 individuals. Prefers forested habitat with hilly terrain. Roosts in hollow trees, under bark, and on buildings, cliffs and bridges. Found only in southern Ontario and Quebec. Hibernates in caves and mines.

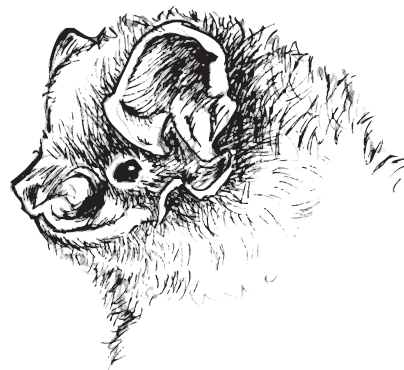
Wingspan: 21-25 cm, Length: 7-9 cm, Weight: 3-6 g



## Silver-haired bat (*Lasionycteris noctivagans*)

Heavily-furred bat species. Fur is predominantly black or dark brown but hairs on its back have white tips, giving it a silver or “frosted” appearance. Solitary. Primarily inhabits forested areas and roosts under loose tree bark, but can also be found in urban and rural areas. Widely distributed in southern Canada from B.C. to eastern Nova Scotia. Migratory.

Wingspan: 27-31 cm, Length: 9-11 cm, Weight: 8-12 g



## Eastern red bat (*Lasiurus borealis*)

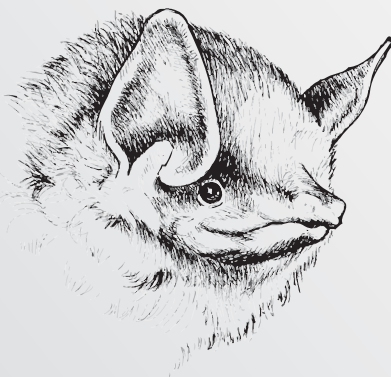
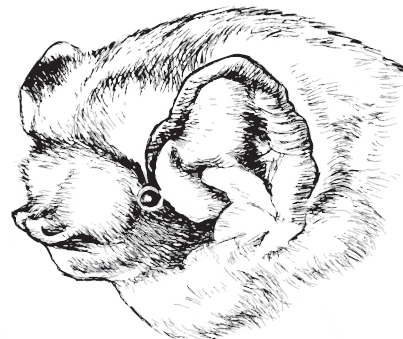
Fur colour ranges from yellow-red to orange to yellow-grey. Solitary. Inhabits forested areas and nearby grasslands. Roosts in dense tree foliage. Distributed in southern Ontario, Quebec, New Brunswick and in parts of Nova Scotia. Migratory.

Wingspan: 27-33 cm, Length: 9-12 cm, Weight: 7-13 g

## Hoary bat (*Lasiurus cinereus*)

Canada’s largest bat. Fur is long, thick, and mostly black. Fur on back and tail is brown-grey with white tips. Distinct yellowish fur on head and throat. Solitary. Preferred roosts include dense tree foliage on the edges of clearings. Common and widespread in Canada east of the Rockies. Migratory.


Wingspan: 34-43 cm, Length: 13-15 cm, Weight: 20-35 g



## Tricoloured bat (*Perimyotis subflavus*)

Also known as the Eastern Pipistrelle. Fur appears brown-yellow but individual hairs are tricoloured - dark grey base, yellowish middle, dark brown tips. Roosts communally. Inhabit open woodlands near bodies of water and roost in rock crevices, caves, trees and buildings. Distributed in southern Ontario, Quebec, New Brunswick and in parts of Nova Scotia. Hibernates in caves and mines.

Wingspan: 19-26 cm, Length: 7-9 cm, Weight: 4-8 g



## Bat Attitudes – Common Misconceptions

### Bats are not Mice!

As a matter of fact, bats are more closely related to humans than to rodents. Bats are mammals and therefore share many common characteristics with both humans and mice. Bats have fur, give birth to live young, and feed their newborns milk until they are old enough to find food for themselves.



Bats belong to the order Chiroptera, which means “hand-wing”. Their wings are much the same as human hands, with a thumb and four fingers, except their digits are connected by a double layer of skin. Although a bat's hand is very large in proportion to its body, it contains the same number of bones as a human hand.

### No Need to Duck

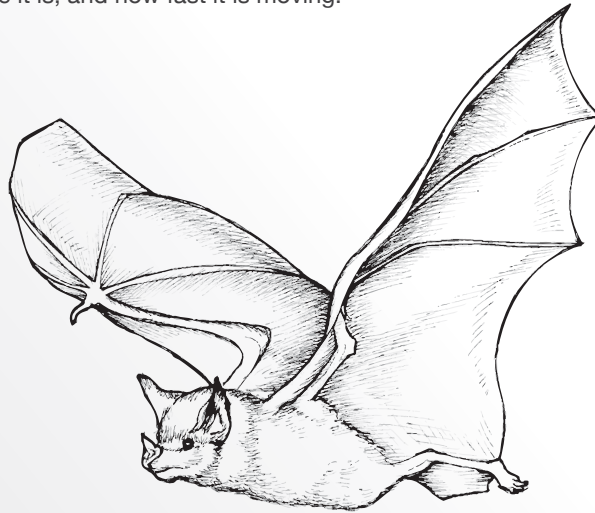
Insects often hover around people and a hungry bat might swoop down in hot pursuit of a meal. But don't worry, a bat's sonar ability is so sophisticated that it can detect objects smaller than a human hair and intercept those objects at speeds greater than 30 km/h. Bats are far too agile to get caught in someone's hair.





## Blind as a Bat

All bats can see. Some can see very well. Flying foxes (types of fruit bats) have excellent vision and use it with their acute sense of smell to locate ripe and juicy fruit. Most bats also have the ability to echolocate, or use sound to "see". Because bats hunt at night when it is dark, this biological form of sonar is essential for locating prey. Bats emit sound pulses that bounce off objects and return as echoes. The returning sound waves tell the bat where the object is, how large it is, and how fast it is moving.



### Did You Know...

Bats are the primary predators of nocturnal, flying insects and play a vital role in limiting their numbers. A single little brown bat is capable of eating its own body weight in insects in a single night – up to 600 bugs per hour! A few bats can go a long way to reduce the amount of annoying insects around your home or cottage during the summer months.




## Questions about Bats

### Is rabies a concern when attracting bats?

Like most mammals, bats can contract rabies. However, it is a common misconception that most bats are rabid. In reality, less than 1% of wild bats are infected with the virus and rabies rates are higher in skunks and raccoons. More people die from bee stings each year than from rabies, and you have a better chance of being struck by lightning than being bitten by a bat. Bats found on the ground are usually sick, but rarely due to rabies. As with any wild animal, you should not take any chances and avoid contact with it. If you must handle a bat, do so wearing leather gloves.

### Don't Take Any Chances

It is essential that people, especially children, learn about the potential dangers of contact with unfamiliar animals. They should be warned that any bat that can be easily caught is likely to be sick and should not be handled. The same rule applies to all wild animals. If you must handle a bat, wear leather gloves. Remember that the bat will likely be frightened and, like most wild animals, may bite in self-defence.



### Can bats transmit histoplasmosis?

Histoplasmosis is a lung disease caused by inhaling the spores of the fungus *Histoplasma capsulatum*. This fungus grows in highly organic soils such as those found below bat roosting sites and in caves. The fungus cannot survive in hot and dry conditions and is almost non-existent in Canada. Human infection from bats occurs most frequently in hot and humid caves where bat numbers are in the thousands. Bat researchers and guano (bat droppings) collectors appear to be the people most at risk. To be on the safe side, you should always wear a properly fitted facemask or respirator when in contact with, or cleaning, a significant amount of bat guano.



## What to do when a bat is in your house

**If the bat is almost hairless** it cannot fly and still depends on its mother to look after it. If possible, place the youngster near or in the roost so its mother can retrieve it. Otherwise, it is likely to die.

**If the bat is flying about** try to contain it in one room. If this happens at night, open a window and turn off the lights. Turning on an outside light can help guide the bat out of the dark room. The bat will usually find its own way out. If this method does not work, try throwing a tea towel or lightweight blanket over the flying bat, capturing it, and taking it outside.

**If the bat is roosting** take a waste paper basket, put it over the bat, slip a magazine between the ceiling/wall and the basket, and gently push it along to get the bat to drop into the basket. You can then take the bat outside. Regardless of the reason for being in your house, the bat's main objective is to find the quickest way out.

## Why would a bat enter my house or cottage?

Depending on the time of year, there may be several explanations as to why a bat has found its way into your home. If the bats are roosting in the walls or attic, they may exit the roost into your house instead of outside. An unscreened chimney also gives bats easy access to your home. If you find a bat during the summer, chances are that it is a youngster learning to fly whose navigation and "sense of direction" are not fully developed.

Sometimes during the winter, temperatures will increase enough to wake the bats from hibernation. During this time a bat may find its way into your home and often into the bathroom or laundry room sink. Bats can become dehydrated during the over-wintering process and are probably seeking water inside your home.

If you want to remove a bat from your home use the capture method discussed below. Place the bat in a cardboard box with a suspended towel for it to hang from and hide behind. Place a small bowl of water on the bottom of the box and make sure it is able to climb down the towel to reach it. Close the lid, keeping it dark and quiet. At dusk, release the bat outside and it should find its way back to the roost. If you must remove the bat immediately, take the bat outside and place it on the trunk of a tree. Don't leave it on the ground where it may become an easy meal for predators.





## A Year in the Life of a Bat

### Hibernation

All Canadian bats are insect eaters. The cold winter temperatures limit the number of active insects, so bats must find a way to survive the winter without food. Although three bat species (hoary, eastern red, silver-haired) migrate, the majority of Canadian bats survive the winter by hibernating.

As winter approaches, bats begin returning to their hibernacula where they can wait out the colder months. A suitable location is not easy to find as it must meet several criteria. Humidity must be high and the temperature must remain stable, just above freezing. Suitable hibernacula include caves, abandoned mines, storm sewers, or cellars with cave-like conditions.

### Energy Saving Survival Strategy

Bats survive due to a remarkable energy-saving strategy. By slowing down their heart rate, breathing and metabolism they can cool their body temperature down to approximately the same temperature as their surroundings. This physiological state is known as “torpor”. Normally a bat's heart rate ranges between 400 and 1000 beats per minute. During torpor the heart rate is reduced to less than 25 beats per minute. Body temperatures also experience dramatic declines. Normal bat body temperature is 36°C but while in torpor the temperature drops to 3-6°C. Hibernation lasts approximately from October to April. In autumn, 35% of the bat's weight may be fat, all of which will be gone by spring.

Every 12-30 days during hibernation, bats will become active in order to drink and rid their bodies of waste products. Humidity levels in the hibernation sites are very important because torpid bats can quickly dehydrate in dry conditions.



## Do Not Disturb!

Hibernating bats are extremely vulnerable because it takes them such a long time to become active. They are easily disturbed by noise and light and will begin to use up some of their valuable fat reserves as they wake up. Bat populations often collapse when hibernation is interrupted. Therefore, hibernacula should be free from disturbances.



## Wake Up, Wake Up, Wake Up

The arousal procedure is the most expensive part of hibernation because the bat must internally generate enough heat to raise its body temperature from the ambient air temperature ( $\sim 3^{\circ}\text{C}$ ) to normal body temperature ( $36^{\circ}\text{C}$ ). The stored fat from the summertime is the fuel used to rouse the bats. By early spring, the fat reserves are nearly exhausted. This is a critical time because bats must either feed or starve. Poor spring weather could limit the amount of available food and result in the deaths of many bats.



## Delayed Fertilization: A Unique Feature



Although mating takes place in the autumn, before hibernation, fertilization of the egg does not occur until spring. The female carries the live sperm in her body all winter! After the rigours of hibernation, she ovulates and fertilization takes place. This feat of reproductive biology is unique to only a small group of animals, including bats. After fertilization, the embryo develops at a rate dependent upon diet and temperature. If the weather is cold, the female becomes torpid and embryonic development slows dramatically, lengthening pregnancy. While females are pregnant they roost away from males in all-female nursing colonies. Baby bats are born into these colonies, usually between late May and late June. The nursing colonies may contain several hundred females and their offspring. During this time males tend to roost in cooler areas, usually alone or in small groups.





## Baby Bats

Female bats usually produce one offspring per year with the exception of the hoary, big brown, silver-haired and tricoloured bats, which regularly have twins. Red bats frequently have up to four babies in a litter! At birth, the young weigh about a quarter of the adult weight but by three weeks baby bats are nearly full-size and some will already have learned to fly. The mother will provide milk for another few weeks until the juveniles are able to catch insects on their own. By August, the offspring are almost fully independent but move around with adults to learn the locations of quality roosts and feeding areas. After the birth of the young, the female must quickly begin to build up fat reserves for her next hibernation. As the summer comes to an end, the female must also search for a mate. The life cycle begins again with both males and females searching for suitable hibernacula, often the same place they occupied the previous year.



## The Problems that Bats Face

Many bat species are experiencing population declines at the hands of humans. Deforestation, pesticide use, unnecessary eviction procedures and mine closures are reducing populations dramatically. Some bat species have attempted to adapt to the loss of habitat and roosting sites by relocating into wood-framed buildings, attics and eaves. However, renovations to older buildings and the use of modern, tighter construction methods rapidly reduce the availability of roost sites for bats.



## Toxic Food

Bats often become victims of the war against unwanted insects. Toxic chemicals are passed up the food chain from insects to bats. When a bat consumes a contaminated insect, the chemicals are stored in fat and remain neutral. However, as the bat uses its fat reserves it is exposed to concentrated doses of pesticides. Bats tend to use up their fat stores during migration and hibernation and show signs of poisoning during these times. Nursing infant bats are affected as well when they acquire pesticides from their mother's milk. While milk is their main food the young gain weight, but as they are weaned they start metabolizing their fat reserves and the pesticides within.



## White Nose Syndrome

In 2006, hibernating bats in New York state were photographed with an unusual white fungus (*Pseudogymnoascus destructans*) on their muzzles. Since then, millions of bats have died from this 'White Nose Syndrome'. The fungus has been shown to damage wing and skin tissue but does not directly kill the bats. Instead, it interrupts their hibernation and causes them to use up their fat reserves to stay warm. Infected bats often emerge too early from their hibernation roosts when the weather is still cold and there is no food available. These bats usually succumb to freezing or starvation. White Nose Syndrome mortality rates in caves can approach 100% making it one of North America's most destructive wildlife diseases in the past century.

### An Unprecedented Decline

The little brown bat is one of the most common and well-studied bats in North America. However, scientists believe that White Nose Syndrome may soon cause this species to disappear from the northeastern region of the continent. In 2012, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) classified three eastern Canadian bats, including the little brown, as Endangered. In their report, COSEWIC cited "catastrophic declines" due to White Nose Syndrome and predicted that the little brown bat would no longer exist in Canada by 2025. White Nose Syndrome has already been described as one of the most destructive wildlife diseases in recorded history and one can only imagine the potentially disastrous effects that the fungus will have on other, less common bat species.



## Cave Danger

Caving is a popular recreational activity yet it often disturbs bats during their hibernation. Disturbing a bat during this time can cause them to consume up to two months supply of stored energy, which may result in death by starvation. Today, certain caves are closed seasonally to protect the hibernating bat colonies within.

Recreational caving may promote the spread of White Nose Syndrome as the fungus can cling to clothes and equipment. If equipment is not properly disinfected between outings, the fungus could potentially follow cavers into every cave that they visit.

Finally, the permanent closure of mines and caves can mean the loss of hundreds or thousands of bats. When caves and mines are blocked or destroyed, bats are deprived of essential shelter and quality hibernation sites.



## Why Protect Bats?

Unknown to many, bats play vital roles in maintaining the balance in ecosystems. Colonies of bats are capable of consuming tons of bugs each evening and farmers are among the biggest beneficiaries. The presence of bat colonies near orchards can decrease pesticide requirements by 50%. Bats are so important that they are estimated to save the North American agricultural industry billions of dollars each year! A bat's immense appetite for insects can reduce the burden of unwanted insect pests around your cottage or home too. Bats can also help our gardens grow – due to its high phosphorus and nitrogen levels, bat guano can be an effective fertilizer.

In other countries, bats are pollinators and seed dispersers. Bananas, peaches, dates and mangoes are just a few examples of fruits that depend on bats for pollination. Some plants, such as certain cactus species, rely solely on bats for their pollination. If it weren't for bats, these plants would never be able to reproduce.

In North America, bats pollinate more than 60 species of agave including those used by the Mexican tequila industry! Fruit-eating bats in tropical regions also contribute to the process of forest regeneration by spreading seeds and initiating germination, as some seeds will not germinate unless they have passed through the digestive tract of a bat!





## Bat Habitat

### Roosts

Bats spend the daylight hours in a refuge called a day roost. Warm temperatures are an important feature of these roosts, especially for reproductive females, and many species of bats will occupy the same high-quality roosts year after year. Day roosts often include mines, caves, hollow trees, bat boxes and buildings such as home or cottages.

A night roost is a temporary shelter for periods of rest between feeding and grooming. Piles of droppings in spots where bats are not seen during the day will alert you to the night roost location.





## Protecting Bat Habitat

If bat populations are to survive in their natural environment, mankind must protect the following habitats where bats find food and shelter. Canadian bats are most often found near bodies of water as their primary source of food, insects, are also found in high densities in these areas.

### FORAGING AREAS

- Beaver ponds
- Marshes
- Streams
- Farm ponds
- Large drainage ditches
- River drainages

### ROOSTING SITES

- Caves
- Dead, hollow snags
- Tree cavities
- Abandoned homes
- Old stone chimneys
- Crevices in rocks

## Urban Bats

With the ever-increasing development of natural bat habitat, bats have adapted well to sharing homes with humans. In some cases, there is no reason why bats should not roost in a building, especially if no one else lives there. Bats do not gnaw or cause structural damage. If sharing your home with bats is not in your best interest, offering bat boxes as alternative housing is a great option. Bat boxes increase the available roosting sites and may eliminate any unnecessary killing or eviction of bats.



## Relocating Bats

Although getting bats to move out of a manmade structure is a simple procedure, there are important guidelines to follow to ensure that the bats are not harmed and that they are unable to return. First, **a bat colony should never be evicted during the breeding season**. Young bats that cannot fly will be trapped in the roost to die and decay. If necessary, eviction should be performed in April before the young are born or in late August to mid-September when the colony is dispersing.

### Step 1: Observing

The only effective way to resolve a bat problem in a building is to determine how they are getting in and to block the entrances. Regularly used openings are easily recognized by the strains around the edges. Watch at dusk for a few evenings. Take note of where the bats exit and count them as they leave. If possible, take a count for a few consecutive nights. It is very important for you to know how many bats you have so that you don't seal any inside the building.

### Step 2: Installing a bat box

Bats require a predator-free shelter so the higher you place your bat box, the better. We recommend that, wherever possible, bat boxes should be placed near the bats' entry and exit ports before eviction procedures start. In some cases, bat boxes have been incorporated right into the dormers where the bats were roosting. Once you have hung the boxes you are ready to evict the bats. The number and size of the bat boxes will depend on the size of the colony, but installing more than one box is recommended.

### Step 3: Limiting the number of holes

Begin sealing the holes with silicone caulking, steel wool, mortar, or even temporarily with duct tape. Keep in mind that small bats can squeeze through a 2 cm gap. Leave one or two holes unsealed for several days so the bats can get used to using these openings.



## Choose the Right Specialist

If you decide to choose a professional bat evictor, a few words of caution — not all pest control organizations or individuals have a great deal of experience with bats. Some may attempt to poison or fumigate them, which are illegal procedures. In fact, the only sure way to evict bats is to prevent them from re-entering after their nighttime exodus. Be sure you have read the prior procedure before hiring anyone to do the job.

The following are a few questions you should be sure to ask prospective bat evictors:

1. What method will be used to evict the bats and is the time of year suitable for eviction?
2. Will the company make an initial assessment of the building and how long will the procedure take?
3. How many bat boxes will you need to supply prior to beginning the eviction process?
4. Is there any guarantee provided by the evictor in the event that bats return?

## Step 4: Eviction

Finally, hang polypropylene bird netting or ¼" steel screening (hardware cloth; available at hardware stores and nurseries) above the emergence holes using duct tape or staples. Drape the material over the holes, leaving the bottom edge free. This way any stragglers can crawl down the cloth and get out, but returning bats cannot get in. When you are sure they are all evicted, seal the last holes permanently.

*IMPORTANT: Eviction techniques such as leaving on bright lights or a fan, spreading moth balls, or using pesticides are not effective methods. People have tried everything, but unless you spend time plugging all the holes the bats will be back. They are very picky about their roosting sites.*

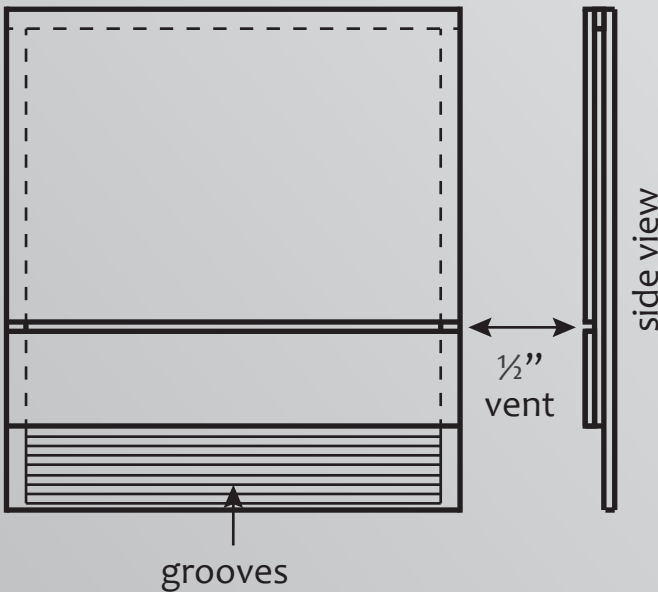
# Bat Box Plans

Bats need a rough surface to hang from. Don't forget to use rough-cut wood or score the inside of the box. Alternatively, you can line the inside of the box with 0.3 cm plastic mesh netting which is available in hardware stores.

You may also lengthen or add a partial bottom to the box to ensure that predators, such as cats and raccoons, cannot reach inside. Longer vertical partitions allow for greater temperature variance within the box. Bats can move up for maximum warmth or climb down to cool off.

Research indicates that bats seem to occupy boxes whether you evict them or not. Therefore, boxes are multipurpose and may be used before evicting bats or to offer housing for bats in the area. A large box or boxes with several partitions have greater occupancy rates than smaller or simpler boxes.

The boxes are bottomless so fecal material drops out. No cleaning necessary!



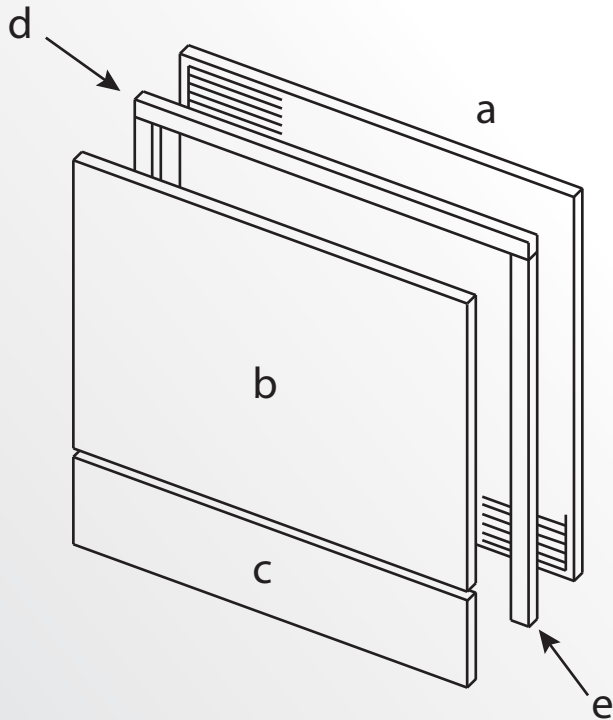
## Single-chamber Bat House

This basic house will accommodate a small colony of bats. Small houses like this should be mounted on the side of a heated building to obtain a sufficient amount of heat to attract bats.

### Materials

- $\frac{1}{4}$  sheet of  $\frac{1}{2}$ " plywood (outdoor grade)
- 1" x 2" x 8' furring strip
- latex caulk
- 1" exterior-grade screws
- dark coloured, water-based, exterior-grade paint



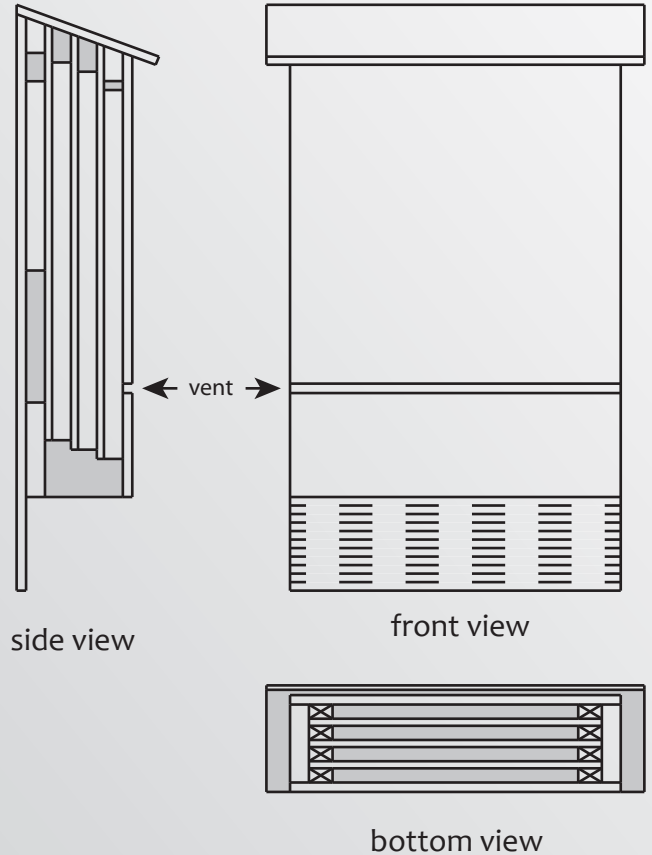
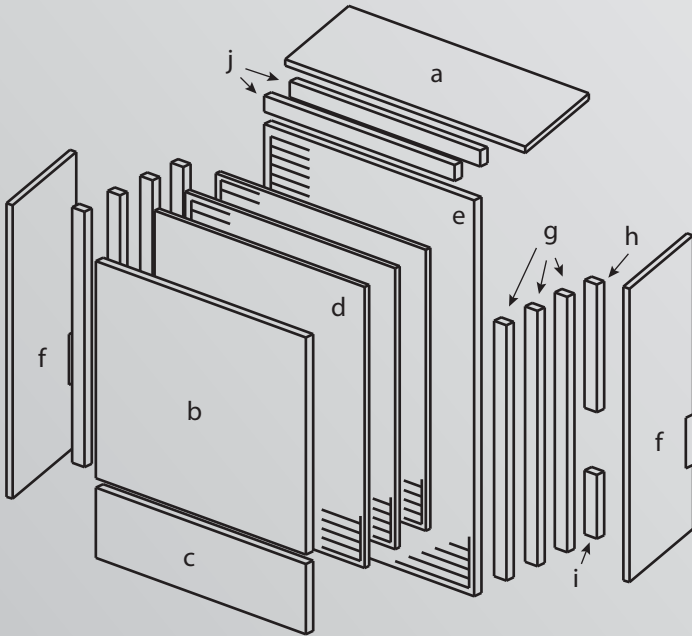


## Assembly

- Cut the following pieces of plywood:
  - backboard 26½" x 24"
  - front (upper) 16½" x 24"
  - front (lower) 5" x 24"
- Cut the furring strip into the following pieces:
  - top spacer 24"
  - side spacers (2) 20½"
- Roughen the inside of the backboard by cutting shallow horizontal grooves, ½" apart
- Apply caulking to the back side of each furring strip and screw them to the backboard. Use at least three screws for each strip.
- Apply caulking to the front side of each attached furring strip, and screw the front pieces (upper and lower) to the strips. Leave a ½" vent between the upper and lower pieces.
- Apply caulking to all gaps along the sides and top of the house to fully seal the chamber.
- Apply up to three coats of paint to the exterior of the bat box. Do not paint the inside of the house as the paint will fill in the backboard grooves.
- Mount the bat house on a vertical surface, such as the side of a building.

## Four-chamber Bat Nursery

This house will accommodate a larger colony of bats or act as a nursery for mother bats and their offspring.

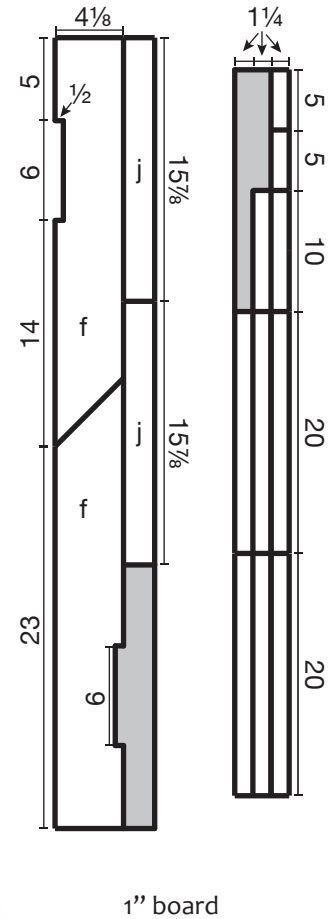
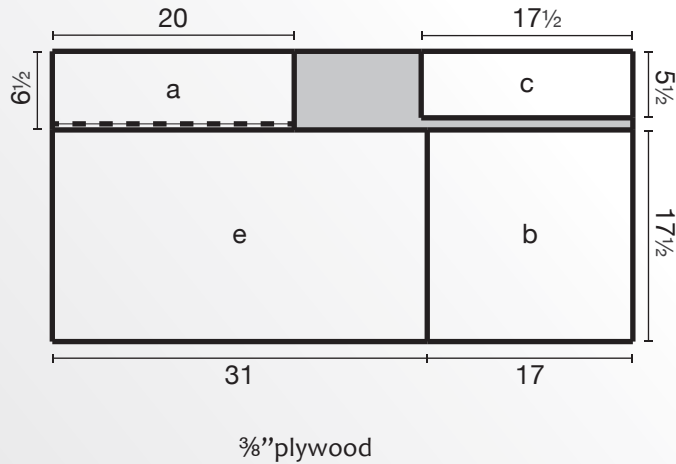
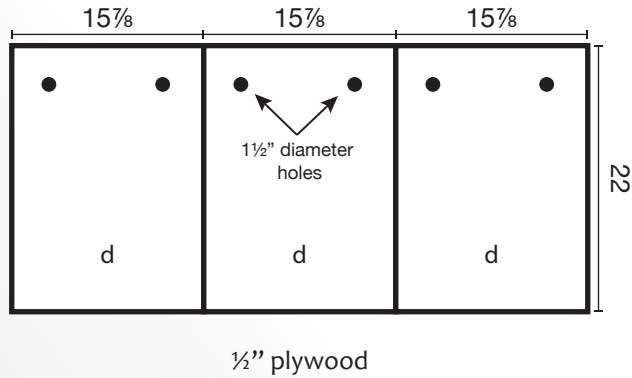


### Materials

¼ sheet of ½" plywood (outdoor grade)  
¼ sheet of ¾" plywood (outdoor grade)  
1" x 6" x 8' board  
exterior-grade screws, 1⅝"  
exterior-grade screws, 1¼"  
exterior-grade screws, 1"  
latex caulk  
water-based, exterior-grade primer  
water-based, exterior-grade paint/stain  
black asphalt shingles  
roofing nails, 7/8"

### Assembly

1. Cut the plywood and board according to the directions on the opposite page. All dimensions are in inches.
2. Roughen the interior surfaces (b,d,e) by cutting shallow, horizontal grooves approximately ½-¼" apart,
3. Apply caulking and screw the side pieces (f) to the uppermost sides of the backboard (a), using 1⅝" screws.
4. Using 1" screws, attach the 5" (i) and 10" (h) spacers to the backboard as seen in the side view on the opposite page. Do not block the vents in the side pieces (f).



5. Place a partition (d) on the already-mounted spacers (h,i) even with the bottom edge of the roof. Place a 20" spacer (g) on each side of the partition and attach them by screwing through the spacer (g), partition (d) and into the already-mounted spacers. Use 1 3/8" screws. Repeat for the remaining partitions (d) and spacers (g).
6. Attach the front pieces (b,c) to the sides (f). Attach the upper front (b) first and leave a 1/2" vent in between the upper and lower pieces. Caulk the seams.



## Bat Box Q & A



### Can bats be introduced artificially to an area?



Bats have strong homing instincts. When bats are removed from an area against their will, they frantically attempt to make their way back. For this reason, artificial introduction into a new bat box is discouraged. However, if you wish to attract bats to a new area, there is nothing to stop you from installing a box. Many people have had success simply by mounting a bat box and letting the bats move in on their own.

### When is the best time to install a bat box?

Bat boxes should be installed in March or early April so that female bats have a safe, warm shelter before giving birth in May-June. Once bats inhabit a box, they generally prefer to stay there. In the late summer months, most bats would not be looking for a new home unless theirs had been destroyed. However, you could build and install your bat box in late summer or fall for early occupancy the following spring. In late summer, some Canadian bats move out of their summer roosts and migrate to a warmer climate, while others migrate to locate suitable hibernation sites in caves or mines.

### Where should I install my bat box?

Bats require a shelter that is free from predators, so they prefer their dwellings a fair distance from the ground. Generally, the higher you mount the box, the better. However, for practical purposes, 5-7 metres is sufficient. It is suggested that boxes be mounted to either a pole or the side of a building, as long as exposure to sunlight is adequate. Bats prefer fairly hot conditions, so installing your box on a southerly-facing brick wall as opposed to a wooden wall will increase heat absorption. In order to provide sufficient sunlight, it is important that your box be located away from dense woods or shrubbery, preferably along the edge of a woodlot or clearing. It is not recommended that bat boxes be installed on trees where they are sheltered from the sun and flight is hindered by branches.



## 5 Bat Box Rules

1. Bat boxes require a minimum of 7 hours of direct sunlight
2. Caulk or seal all cracks, joints etc. to weather- and light-proof your box.
3. Paint the exterior of your bat box dark brown or black to increase heat absorption.
4. Bat boxes should be mounted 5-7 metres above the ground, preferably on a pole or building.
5. Install your bat boxes close to a water source.

## How much sunlight and heat are required?

Sun exposure is one of the most important criteria for determining use of boxes. Mount your bat box facing south, free from obstacles and wind, to provide a minimum of 7 hours of direct sunlight each day. The temperature inside the box should not exceed 27-38°C (80-100°F). Ideally one would install two boxes back to back, or three boxes facing different directions: south, southeast and southwest. This provides bats with an alternate refuge in case the temperature in one box becomes inhospitable. Often, in a nursery situation, the female bats may move to a cooler box during the day leaving their babies in the warmer roost.

## Will the age or type of wood affect occupancy of my bat box?

According to studies, bats are more likely to occupy a bat box in the first year if it is made from aged wood but there is no evidence that bats prefer a particular type of wood. Non-chemically treated plywood or barnboard have been shown to work well.



## Will painting the bat box decrease the chances of occupancy?

It was initially believed that painting or staining the bat box would deter occupancy. However, bats living in cool climates, like Canada, may show a significant preference for dark-coloured boxes. Painting your bat box dark brown or black will increase heat absorption, creating an interior temperature suitable for bats.

### Porch Problems

Occasionally, bats use porch rafters as a night roost. Some people are not bothered by these bats but sometimes the presence of bat guano causes concern. In such cases, there are three methods that have been used to discourage bats from roosting in the rafters. First, hanging plastic strips from the rafters may prevent bats from stopping there to roost. A second suggestion is to install plastic sheets across the ceiling. This blocks the bats' access route to the rafters, and the plastic can be removed once the bats have realized that this location is no longer available for their use. The third option is to hang a mobile from the rafters, which seems to deter bats.

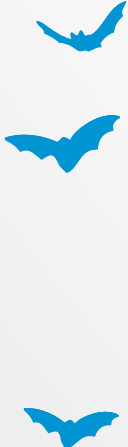
## Do I have to clean the bat box?

No. Most bat box designs have an open bottom so waste should drop right out. Boxes with semi-closed bottoms can have the bottoms hinged for easy cleaning, or install ¼" mesh partially across the bottom of the box. The mesh allows fecal material to fall through but keeps baby bats from dropping out and predators from getting in. If you choose a box design with an attic you may open the hinged top after the bats leave for the year and simply whisk the droppings away.



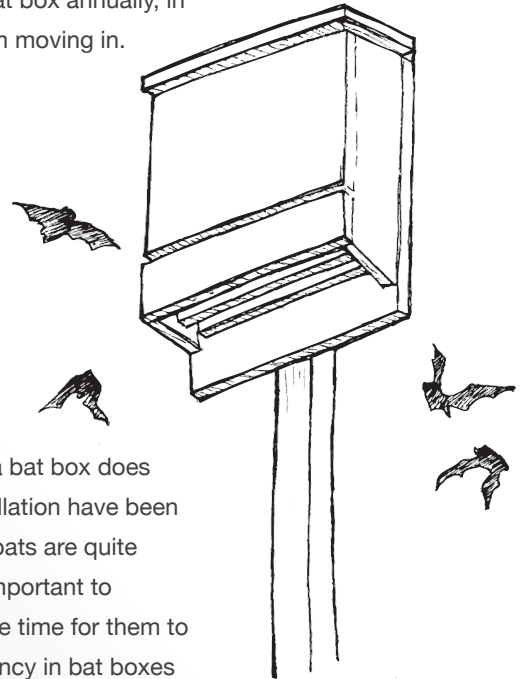
## When can I inspect my bat box?


Use of your bat box should be obvious by the presence of droppings underneath. If you wish to check for occupancy, simply shine a flashlight up into the box during the day without touching or disturbing it in any other way. To determine actual numbers, count the bats as they emerge at dusk. To check for a nursery colony, shine a flashlight up into the bat box one hour after dusk and you should see young bats left behind by their mothers who are out foraging for their evening meal. You should also check the bat box annually, in the fall or early spring, for any structural damage that may deter bats from moving in.



## Why might bats not use my bat box?

This can be a difficult question to answer. Sometimes it is not clear why a bat box does not become occupied when all of the rules for design, location, and installation have been followed. If bats are in your area, a simple explanation might be that the bats are quite happy in the roost site they are in and see no reason to move. It is also important to remain patient. Bats are naturally inquisitive animals, but it may take some time for them to find your box and move in. Occasionally hornets or wasps take up residency in bat boxes and must be removed. They will certainly deter bats from using your box. If your box contains any cracks in the wood, it may be necessary to seal these spaces with caulking or some other form of sealant as light disturbs bats while they roost during the day.





## What are the chances of bats actually moving in?

The success rate for bat box occupancy varies. Research indicates that it depends to a greater degree on location rather than bat box design. If you have evicted bats, the chance of occupancy increases by installing your bat boxes as close as possible to the bats' former entry/exit points. On the other hand, they are not likely to move into a box that is entirely shaded no matter how close to their original home it may be. Mounting boxes back to back on tall poles appears to increase your chances of bat occupancy. You must consider many angles when deciding on a particular location.

One critical requirement for bats seems to be the close proximity to a water source. Most North American bats prefer to roost less than 300 metres from water and like to be near marshes, streams or lakes. This is a direct consequence of their insectivorous diets and their need to drink soon after they leave their roost.

## Where to Buy a Bat Box

If you would prefer to purchase a bat box rather than build one, the following list includes stores in Eastern Canada that have bat boxes for sale. Before you buy one, ensure that the box interior is made of rough or scored wood.

For the Birds Nature Shop  
[www.forthebirdsnatureshop.ca](http://www.forthebirdsnatureshop.ca)

Wild Birds Unlimited  
[www.wbu.com](http://www.wbu.com)

Urban Nature Store  
[www.urbannaturestore.com](http://www.urbannaturestore.com)

Canadian Bat Houses  
[www.canadianbathouses.com](http://www.canadianbathouses.com)

Bat House Guy  
[www.bathouseguy.com](http://www.bathouseguy.com)





## Bat Box Surveys

During the 1990s, the Toronto Zoo and Bat Conservation International conducted independent studies on the use of bat boxes by North American bats. The objectives of the studies were to determine (1) which bat box designs and mounting techniques resulted in the highest occupancy rates, and (2) which environmental factors affected the use of bat boxes. The findings of the studies were clear – bat box location, temperature, and size are the most important factors for attracting bats.

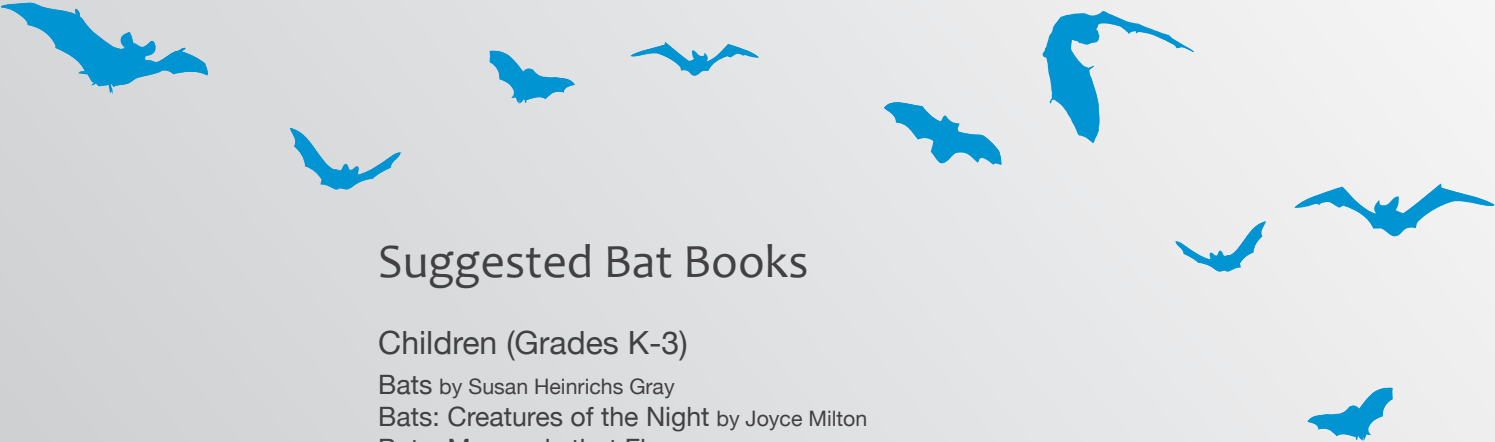
### Results

1. Large boxes with multiple partitions had the highest occupancy rates. Bats roosted in multi-chamber boxes more often than single-chamber boxes.
2. Heat from direct sunlight was very important. Boxes should face south and be mounted in the open, away from any shade structures (e.g. trees)
3. Boxes erected in areas containing natural vegetation and near a body of water had the greatest success.

Relatively few tree-mounted boxes were used as bat roosts. Boxes mounted more than 3 m (10') above the ground on poles or on the sides of buildings had the highest occupation rates. Tree-mounted boxes had two major problems. First, tree branches obstructed the box making it difficult for bats to access the entrance. Secondly, tree branches and leaves shaded the boxes, reducing their internal temperature and making them undesirable for bats.

Large, multi-chambered boxes received the highest occupation rates. Boxes at least 50 cm (20") wide and 65 cm (25") tall had very high success. If smaller boxes were used, mounting multiple boxes together resulted in a significant increase in occupancy. Similarly, a larger number of chambers in a single, large bat box had good success at attracting bats.

The location of the erected bat box also affected occupancy. Not surprisingly, bat boxes in rural areas had greater success than those in urban/suburban areas and boxes mounted in areas containing natural vegetation were well used. It was also important to mount boxes within 400 m of water – boxes farther away had very poor success. The larger the water body, the greater chance that bats used the box.



## Suggested Bat Books

### Children (Grades K-3)

Bats by Susan Heinrichs Gray  
Bats: Creatures of the Night by Joyce Milton  
Bats: Mammals that Fly by Marlene Sway  
Bats: Mysterious Flyers of the Night by Dee Stuart  
Extremely Weird Bats by Sarah Lovett  
Stellaluna by Janell Cannon  
Zoobooks Bats by Linda C. Wood and Deane Rink

### Children (Grades 4-6)

Batman: Exploring the World of Bats by Laurence P. Pringle  
Bats: Swift Shadows in the Twilight by Ann C. Cooper  
Bat Watching by Diane Bair and Pamela Wright

### Teens (Grades 7-9)

The Bat Scientists by Mary Kay Carson  
The Bat: Wings in the Night Sky by M. Brock Fenton

### Young Adults (Grades 10-12)

America's Neighbourhood Bats by Merlin D. Tuttle  
Bats by Phil Richardson

### Adults

Bats by M. Brock Fenton  
Bats in Question by Don E. Wilson  
World of Bats by Klaus Richarz and Alfred Limbrunner



## Bat Conservation Organizations

### **The Bat Conservation Society of Canada**

P.O. Box 56042  
Airways Postal Outlet  
Calgary, Alberta, Canada T2E 8K5  
(403) 860-BATS  
[cancaver.ca/bats/canada.htm](http://cancaver.ca/bats/canada.htm)

### **Bat Conservation International**

P.O. Box 162603  
Austin, Texas, USA 78716  
(512) 327-9721  
[batcon.org](http://batcon.org)

### **Organization for Bat Conservatiion**

Cranbrook Institute of Science  
39221 Woodward Avenue, P.O. Box 801  
Bloomfield Hills, Michigan, USA 48303  
(248) 645-3232  
[batconservation.org](http://batconservation.org)

### **Bat Conservation Trust**

5th Floor, Quadrant House  
250 Kennington Lane  
London, United Kingdom  
SE11 5RD  
[bats.org.uk](http://bats.org.uk)

## Things you can do to help bats

- Support legislation that protects natural habitats and wildlife
- Educate yourself about bats using books, video and the internet
- Educate and reassure others who are afraid of bats
- Write letters to editors that print inaccurate material about bats
- Join a conservation organization that works to protect bats
- Put up a bat box
- Visit and support facilities that have bats on display and are involved in bat conservation
- Become a bat biologist or volunteer for a bat research project
- Support sustainable forestry, plant a tree
- Keep your property as natural as possible, restrict the use of pesticides
- Reduce, reuse, recycle

