TEXAS WILDLIFE ASSOCIATION

CONSERVATION LEGACY

Bats-A-Billion

The Texas Wildlife Association is a nonprofit organization dedicated to promoting natural resource literacy in youth and adults across the state of Texas. With nature at the center of our educational focus, TWA is creating a legacy of conservation in generations of Texans.

Bats-A-Billion Discovery Trunk

Name: _____

ANSWER KEY

(Designed for grades 3 and above.)

1. Bats are what kind of animal?
   A. Reptile
   B. Mammal
   C. Bird
   D. Amphibian

2. How many foods from the below list can bats eat?
   Fruit, nectar, insects, fish, blood
   A. None
   B. 1-2 only
   C. 3-4 only
   D. All 5

3. What does the order name for bats, Chiroptera, mean?
   A. Hand-wing
   B. Blind-eye
   C. Night-mouse
   D. Rodent-flight

4. Bats are geographically found everywhere except for _____ regions.
   A. Mountain
   B. Polar
   C. City
   D. Jungle

5. Bats can find their prey in the dark using a method called _____.
   A. Audio visualization
   B. Ultrasound
   C. Echolocation
   D. Radar

Bats-A-Billion Discovery Trunk PRETEST

Name: _____

(Designed for grades 3 and above.)

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    D. Radar

Bats-A-Billion Discovery Trunk POSTTEST

Name: _____

(Designed for grades 3 and above.)

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   Fruit, nectar, insects, fish, blood
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		Bats-A-Billion											
		How a Bat Compares to Me, 3-8	Bat Names and Faces, 2-5	Echolocation, 3-8	Seeing With Your Ears, 3-8	Where's My Baby?, 3-8	Bats on the Move, 3-8	Benefits of Bats Activity, 3-8	Bat Mask Activity, K-5	Bat Coloring Pages, K-5	Crossword 1, 3-8	Crossword 2, 3-8	Critter Connections - Bats Edition, 2-8
K1	A								x	x			
	B								x	x			
K2	A												
	B												
	C												
	D												
	E								x	x			
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2.1	A								x	x			
	B		x						x	x			x
2.2	A												
	B												
	C												
	D												
	E		x						x	x			x
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3.1	A	x		x	x	x	x	x	x	x			
	B		x	x	x	x	x	x	x	x	x	x	x
3.2	A	x		x	x	x	x	x					
	B	x											
	C												
	D	x		x	x		x	x					
	E												
	F	x	x	x	x	x	x	x	x	x	x	x	x
3.3	A	x	x	x	x	x	x	x	x	x	x	x	x
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3.9	A			x	x	x	x	x			x	x	x
	B												
	C				x		x						
3.10.	A	x	x	x	x	x	x	x	x		x	x	x
	B												

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4.1	A	x		x	x	x	x	x	x	x			
	B		x	x	x	x	x	x	x	x	x	x	x
4.2	A	x		x	x	x	x	x					
	B	x											
	C												
	D	x		x	x		x	x					
	E												
	F	x	x	x	x	x	x	x	x	x	x	x	x
4.3	A	x	x	x	x	x	x	x	x	x	x	x	x
	B												
	C				x	x							
4.4	A	x		x	x	x			x	x			
4.5	A												
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4.7	A												
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5.1	A	x		x	x	x	x	x	x	x			
	B		x	x	x	x	x	x	x	x	x	x	x
5.2	A												
	B	x		x	x	x	x	x					
	C	x											
	D	x		x	x		x	x					
	E												
	F	x	x	x	x	x	x	x	x	x	x	x	x
	G												
5.3	A	x	x	x	x	x	x	x	x	x	x	x	x
	B												
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		How a Bat Compares to Me, 3-8	Bat Names and Faces, 2-5	Echolocation, 3-8	Seeing With Your Ears, 3-8	Where's My Baby?, 3-8	Bats on the Move, 3-8	Benefits of Bats Activity, 3-8	Bat Mask Activity, K-5	Bat Coloring Pages, K-5	Crossword 1, 3-8	Crossword 2, 3-8	Critter Connections - Bats Edition, 2-8
6.1	A	x		x	x	x	x	x					
	B			x	x	x	x	x			x	x	x
6.2	A	x		x	x	x	x	x					
	B												
	C	x					x						
	D												
	E	x		x	x	x	x	x			x	x	x
6.3	A	x		x	x	x	x	x			x	x	x
	B												
	C												
	D				x	x							
6.4	A	x		x	x	x							
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6.5	A												
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7.1	A	x		x	x	x	x	x					
	B			x	x	x	x	x			x	x	x
7.2	A	x		x	x	x	x	x					
	B												
	C	x					x						
	D												
	E	x		x	x	x	x	x			x	x	x
7.3	A	x		x	x	x	x	x			x	x	x
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	D				x	x							
7.4	A	x		x	x	x							
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8.1	A	x		x	x	x	x	x					
	B			x	x	x	x	x			x	x	x
8.2	A	x		x	x	x	x	x					
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	D												
	E	x		x	x	x	x	x			x	x	x
8.3	A	x		x	x	x	x	x				x	x
	B												
	C												
	D				x	x							
8.4	A	x		x	x	x					x		
	B												
8.5	A												
	B												
	C												
	D												
	E												
8.6	A												
	B												
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8.7	A												
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BAT CLASSIFICATION

Bats represent approximately 25 percent of all living mammals in the world today. There are over 1,100 species of bats worldwide with 47 of those in the United States and 34 in Texas. Fossilized remains of bats have been found on every continent except for Antarctica. The oldest fossil record of a bat is from the early Eocene era, approximately 52 million years ago. This insect-eating bat was capable of flight, but not echolocation. Little is known about ancestors and relatives of bats. In fact, people are more closely related to bats than rodents.

KINGDOM: Animalia
The animal Kingdom.

PHYLUM: Chordata
Animals with a dorsal hollow nerve cord down the back.

SUBPHYLUM: Vertebrata
Animals that have a vertebral column (backbone) surrounding their spinal cord.

CLASS: Mammalia
Mammals are fur-bearing organisms that give birth to live young and produce milk.

ORDER: Chiroptera
All bats are in the order Chiroptera, which means hand-wing. Bats are the only mammals that are capable of true flight.

SUBORDER: Microchiroptera
This suborder contains small, mostly insectivorous bats that are able to echolocate. There are 18 different families in this suborder consisting of 135 genera.

SUBORDER: Megachiroptera
This suborder contains larger bats that eat fruit, nectar, and pollen. The majority of these bats do not echolocate. There is only one family in this suborder (Pteropodidae) consisting of 42 genera.

BAT BASICS

A PowerPoint Show of pictures from this document can be found on the included CD.

BATS ARE MAMMALS

Bats are endothermic (warm-blooded) animals with fur. They give birth to live young and produce milk for their pups just like other mammals. They can live as long as 20 to 30 years in most cases. The main difference between bats and all other mammals is that bats can fly.

BATS ARE EVERYWHERE

There are over 1,100 species of bats in the world today, accounting for almost a fourth of the mammal species in the world. They are a very diverse group of mammals with different fur color, feeding habits, body shapes, and facial characteristics. In the United States, there are 47 different species of bats, 34 of which are in Texas.

Bats live all across the globe. The only places you will not find bats are in the very cold Polar Regions and the very driest deserts.

BATS COME IN A VARIETY OF SHAPES AND SIZES

Bats can be small, like this bumblebee bat, which weighs as much as a penny (about 2 grams).

Bats can also be large like this flying fox, with a wingspan up to six feet.

BATS ARE NOCTURNAL

Bats are active at night and sleep during the day. They are the most important natural predator of night-flying insects.

BATS CAN FLY

Most instectivorous bats will feed within six (6) to nine (9) miles of their daytime roost, althrough some will travel as far as 50 miles. Larger fruit eating bats may travel up to 31 miles away from their daytime roost to feed. Migrating bats travel the furthest distances, often more than 1,000 miles depending on the species. Bats can fly an average speed of 25 miles per hour, but can approach speeds up to 60 miles per hour with a proper tail wind. A bat's speed generally depends on the size and shape of its wings. Bats with short, broad wings are generally slower fliers, that move through dense vegetation. Whereas bats with long, narrow wings are fast fliers, that move through open habitats.

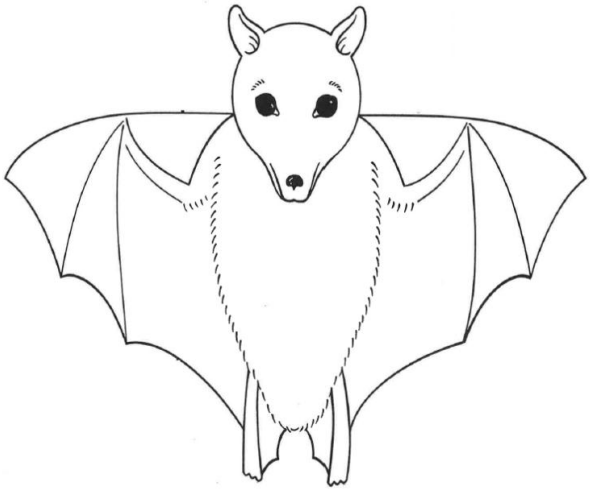
Some bats, such as the Mexican free-tailed bat, are capable of flying at altitudes of nearly 10,000 feet to hunt, nearly two miles up in the air.

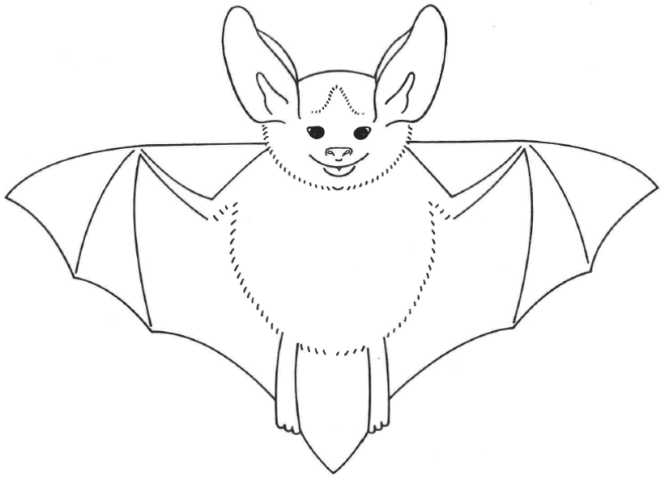
To learn more about bats watch "Bats:Myths and Reality" on the CD included with the trunk.

BAT ANATOMY

A PowerPoint Show of pictures from this document can be found on the included CD.

Bats are classified in two major groups, Megachiroptera and Microchiroptera. The differences in their appearance and classification depend largely on their diet.





Megabats are generally larger, with wingspans over a foot wide. Most bats in this group do not echolocate. They feed on fruit and nectar; therefore, they have an excellent sense of smell and vision. They have large eyes and a long nose to aid them in locating their food during the night. These features make up for the fact that they do not echolocate. Their ears are smaller because they do not rely on sound as much as microbats.

Microbats are generally smaller, on average weighing less than half an ounce. They all use echolocation to navigate at night and catch their prey. The majority of the bats in this group eat insects, with a few preying on vertebrates or drinking blood. These bats have specially adapted noses and large ears to pick up the noises made through echolocation. They have small eyes because they can easily navigate using echolocation.

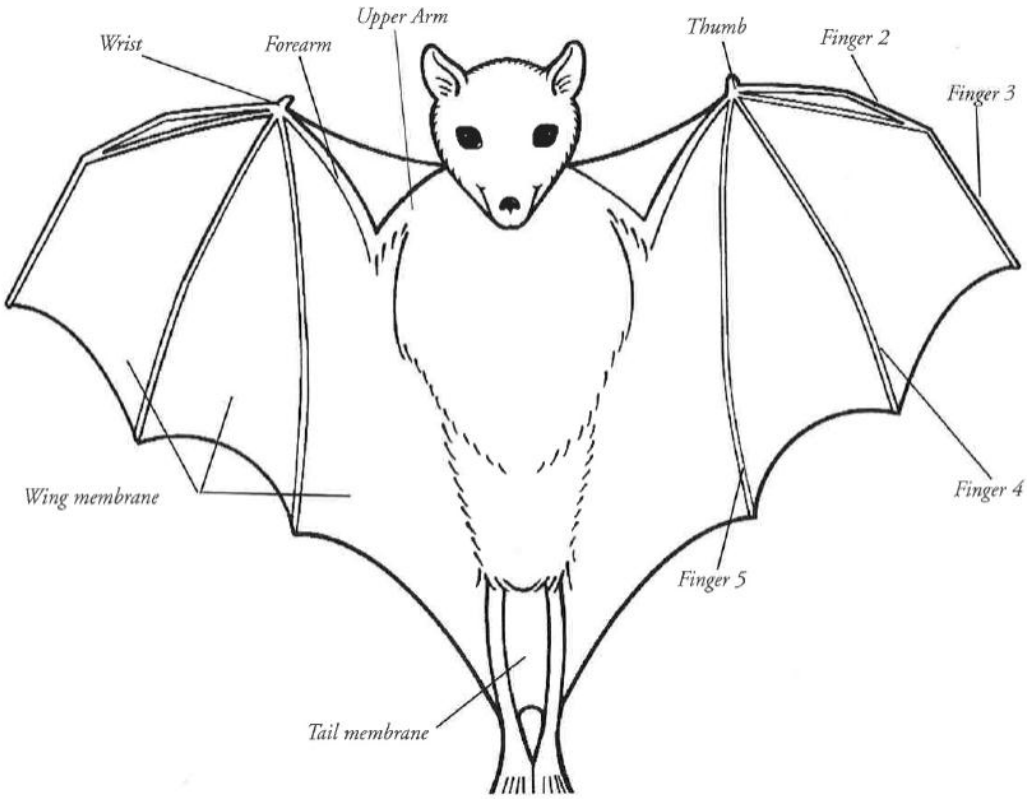
SKULLS

The differences between the facial characteristics of Megachiroptera and Microchiroptera are even evident in the skull.

The Megachiroptera skull has larger eye sockets and a longer snout to accommodate for enhanced senses of sight and smell. Their back teeth are also large and flat for grinding fruit.

This Microchiroptera skull has smaller eye sockets. They make up for having small eyes by using echolocation. Microbats have a greater amount of sharp teeth for grinding tough insect exoskeletons.

WING STRUCTURE

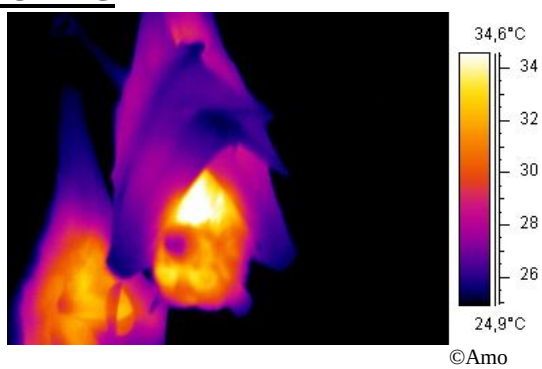


Bats belong to the order *Chiroptera*, which in Greek means hand-wing. As you can see in the above diagram, the wing is made up of the bones of the hand. Elongated finger bones support the wings. A thin double layer of elastic skin that allows for flight covers the arm and fingers.

HEATING AND COOLING

Bats have special ways of maintaining their body temperature. A bat will wrap its wings around itself to stay warm, shown in the infrared image. Bats can also reduce blood flow in their wings to conserve their body heat during cold weather.

Bats also use their wings to stay cool. Bats are able to pump extra blood into the membrane of their wings, which is then cooled by the outside air.



UPSIDE DOWN ADAPTATIONS

Bats have special adaptations that allow them to hang upside down without expending additional energy. Valves throughout the bat's circulatory system, which control the blood flow, are upside down to allow for their roosting behavior. Their legs are rotated 180° so their knees and feet face backwards. This allows them to hang from their feet and aids in navigation when flying. Bats also have unique tendons in their feet that allow their toes to grasp onto surfaces for extended periods of time. Having stabilized toes allows them to cling to the walls of their roost without wasting any energy to hang on. When bats are ready to fly, they must first flex their muscles to release from their roosting position. Hanging upside down allows them to quickly avoid predators. If approached, they can drop from the cave wall and immediately fly away. Hanging upside down also frees up their wings to eat and hold their pups.

BATS-A-BILLION

BAT TAILS

Bats exhibit a great deal of variety in their tail and tail membrane. The tail membrane, or uropatagium, is a stretchy piece of skin that connects the feet and the tail. Insect eating bats generally have a large tail membrane for capturing and holding their prey. A large tail membrane also aids in flight by allowing the bat to change directions. Some bats, such as the Mexican free-tailed bat, have a tail that actually extends past the tail membrane. In these bats, the tail contains rings of cartilage that slide up and down the tail vertebra to stretch or retract the tail membrane. This allows for the great maneuverability seen in free-tailed bats. Fruit and nectar eating bats have little to no tail membrane. They do not need a large membrane for holding prey, as their food is stationary. They also do not need to be as aerodynamic in flight.

Lesser mouse-tailed bat (*Rhinopoma hardwickei*)

This bat has a long tail that is free from the tail membrane. While it may resemble a rodent's tail, bats are more closely related to people then they are to rodents.

Little brown myotis (*Myotis lucifugus*)

This insectivorous bat has a large tail membrane to aid in flight and feeding. It holds its prey using the tail membrane and will also use it to catch any dropped food when eating.

Gambian epauletted fruit bat *(Epomophorus gambianus)*

Fruit bats generally have small tail membranes. They are less aerodynamic than other bats, because they do not catch their food on the wing.

Mexican free-tailed bat*(Tadarida brasiliensis)*

This common Texas bat has a short tail membrane and a free tail. The tail membrane aids with quick movements during flight even though it is small.

BATS-A-BILLION

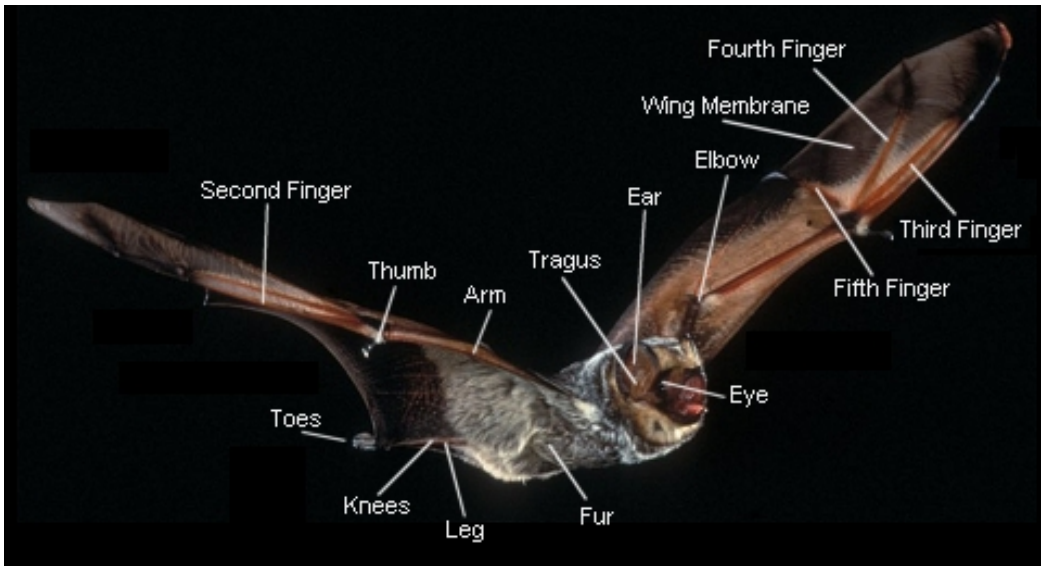
BODY VS. SKELETON

The five hand bones make up the wings of the bat, which is the namesake for the order name: Chiroptera, or hand-wing. The upper photo shows how skin stretches over the bones of the hand creating a wing. Blood vessels running through the wings are also visible.

Lyle's flying fox (*Pteropus lylei*)

Photo ©Skulls Unlimited

Bat Anatomy



Glossary

Calcar: A long, bony spur on the bat's ankle that helps support the tail membrane.

Forearm, fingers, and thumb: Bats' forelimbs include most of the same components as those of other mammals, but the hands and fingers are elongated to support and manipulate the wings.

Nose leaf: A flap of skin above the nostrils of some bats. Among New World species with this feature, it usually is triangular and rises vertically from the tip of the nose.

Tail membrane: Also called the "interfemoral membrane," this spans the area between a bat's legs and tail.

Tragus: A flap of skin at the base of the external ear. It often rises vertically like a small sword.

Wing membrane: A thin double layer of skin that forms the bat's flying surface.

Last Updated: Wednesday, 14 July 2010

HOW A BAT COMPARES TO ME

Objective: *To compare anatomy and physiology of bats and humans*

Grades: *3-5*

Type of Activity:
Taking measurements

Materials:
- *Copies of page 45*
- *Pencils*
- *Clock with second hand*
- *Weight scale for humans*
- *Gram scale*
- *Tape measures*

Background Information

Children can learn a great deal about bats and themselves by comparing various aspects of their anatomy, physiology and behavior. In this activity, children take their own measurements and compare them to those of bats.

Mammals

Even though bats fly and people walk on the ground, bats and people are similar in many ways. That's because both people and bats are mammals. With few exceptions, all mammals give birth to live young, nurse babies with milk and have hair. Other mammals include dogs, cats, chipmunks, raccoons, elephants, monkeys and whales.

Wingspan

Bat wingspans vary from about seven inches to nearly six feet. Most bats are small mammals, although flying fox bats achieve a large size. The world's largest bat is a flying fox from Southeast Asia. The mask on page 30 illustrates why this bat is called a flying fox: Its face is very similar to a fox or dog. It feeds entirely on fruit. Have children outstretch their arms and measure the distance between their fingertips.

Number of Fingers

A bat's wing is actually a modified hand. Refer to the diagram on page 39 and explain how the wing bones are actually greatly elongated fingers. Also point out the thumb. The thumb has a small claw, which aids the bat in crawling around on rough surfaces.

Weight

Have children get on a scale and take their own weight. The world's smallest bat (the bumblebee bat from Thailand) weighs only two grams, less than a penny. The majority of bats weigh less than 57 grams, about two ounces.

Resting Heart Rate

Using a clock with a second hand, demonstrate to students how to find their pulse (by putting your fingers against the carotid artery in the neck). Sitting down, students should take a resting pulse by counting the number of heart beats in a 15-second period and multiplying this by four to determine the total for one minute.

Active Heart Rate

Before taking this rate, have children simulate flight by doing one minute of jumping jacks. Immediately following this, they take their pulse again using the method described above. The bat's heart rate is high because flight is hard work. Its heart must pump rapidly to provide lots of oxygen, which is carried to flight muscles by blood. During hibernation, the opposite extreme, a bat's heart rate slows to only 20 heart beats per minute.

Wing Beats

To determine wing beats per second, have the children flap their arms like wings and count the number they can do in five seconds. The teacher then divides that number by five to find the rate per second. To support a body in the air and overcome the force of gravity, a flying animal must beat its wings very quickly (perhaps 12 times a second) to maintain altitude. How does the children's rate compare to the bat's? Some very large bats are capable of soaring on the wind, just like hawks and eagles.

Food Consumption

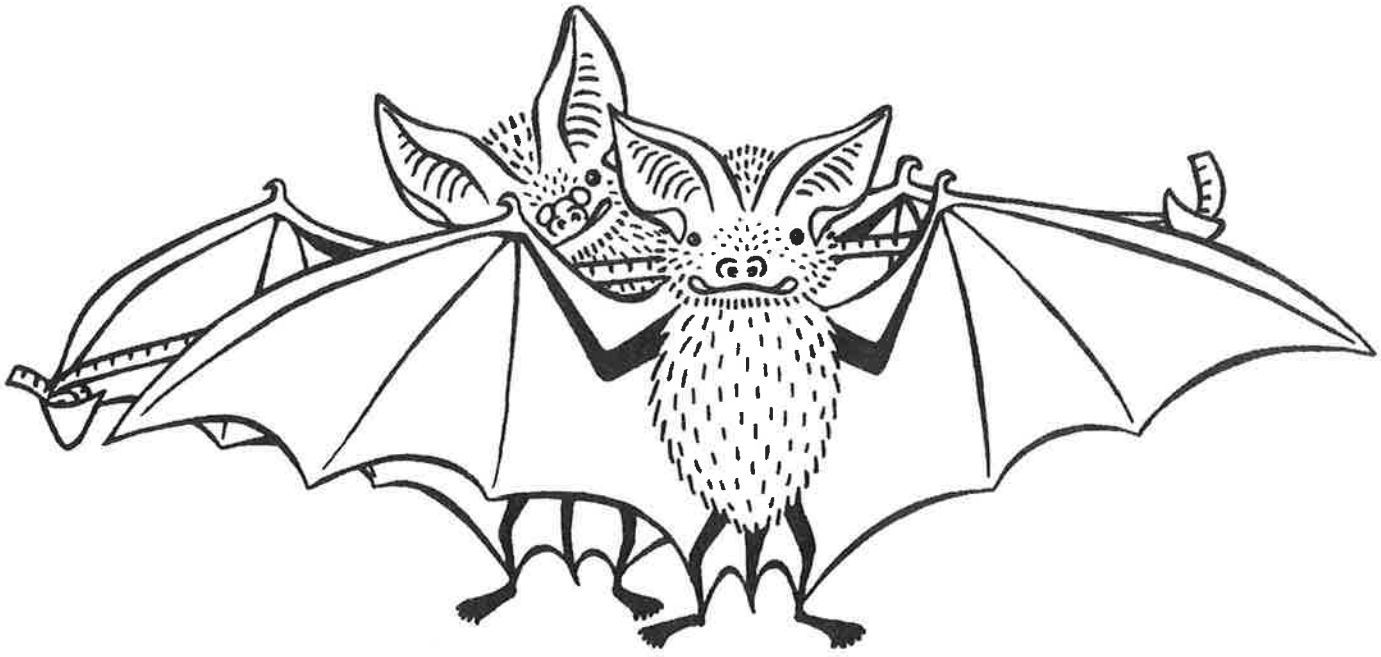
The teacher will need to help students determine this number ($\frac{1}{32}$ of child's weight). Flying fox bats eat about two and a half times their own body weight in fruit in a night. Have the children weigh themselves, and with the help of the teacher, calculate how many pounds of food they would have to eat if they ate like a fruit bat. Insectivorous bats eat about half their weight in insects each night.

Lifespan

The average lifespan for a human is 74 years. Banding records have shown that some insectivorous bats live up to 41 years or more. For their size, bats are among the longest-lived animals. For comparison, most mice have a lifespan of only about two years.

HOW A BAT COMPARES TO ME

	Student	Bats
Kind of Animal	_____	mammal
Wingspan (armspan)	_____	$6\frac{1}{2}$ inches, bumblebee bat from Thailand; almost six feet for the great flying fox from Java
Number of Fingers	_____	four fingers and one thumb
Weight	_____	most bats weigh less than two ounces or 57 grams
Heartbeats/Minute Resting in Torpor	_____	less than 100
Heartbeats/Minute Active	_____	as many as 900
Wing Beats/Second	_____	12 for a little brown myotis
Food Consumption	_____ *one to five pounds, about $\frac{1}{32}$ of body weight*	flying fox bats can eat $2\frac{1}{2}$ times their body weight in one night
Lifespan	_____	some bats live 40 years or more



Bat Names and Faces

There are more than 1,250 different kinds of bats in the world
and they come in all sorts of shapes and sizes.
Color these unusual bat faces, then match them with their names.

1

Chapin's Free-tailed Bat
(Africa)
Known for its "punk" look.

2

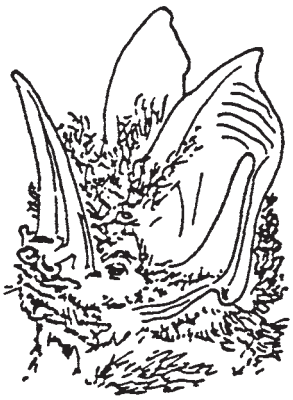
Tomes' Sword-nosed Bat
(Central and South America)
A Latin American bat with a
long, pointed "leaf" on its nose.

3

Hammer-headed Fruit Bat
(Africa)
A fruit bat with a very distinctive head.

4

Spotted Bat
(United States)
A very colorful bat, this one is black
with white spots and large, pink ears.



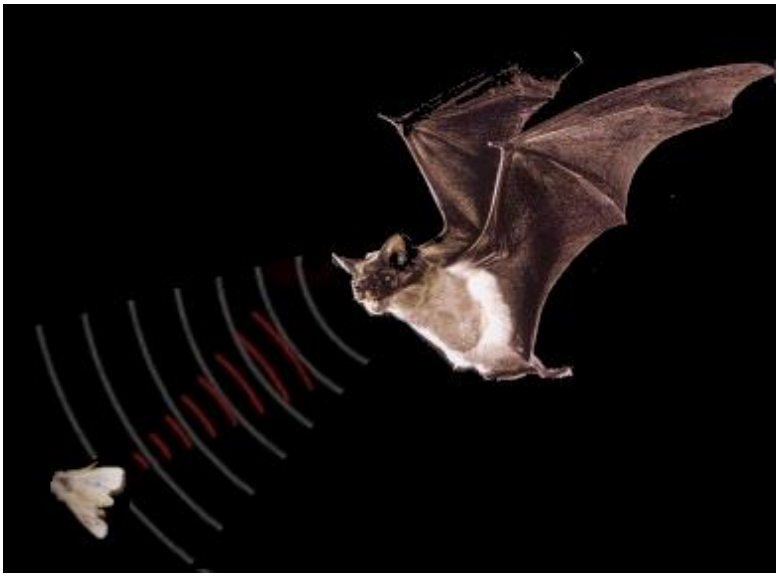
batcon.org
BAT CONSERVATION
INTERNATIONAL

Answers: 3, 1, 4, 2

ECHOLOCATION

A PowerPoint Show of pictures from this document can be found on the included CD.

All bats have perfectly functional eyes, but many have a unique method to sense their prey. Bats in the suborder Microchiroptera use echolocation to avoid objects and hunt their prey at night. Bats emit sound pulses, produced in the larynx (voice box), through the mouth or nose. As these sounds come in contact with objects, they are reflected back as echoes and collected by the bat's ears. Using sound alone, they can detect the size, shape, texture, and distance to the object. In total darkness, they can even detect obstacles as fine as a human hair.



When an insectivorous bat is searching for prey, it initially sends out 10-20 echolocation beeps per second and listens for returning echoes. These calls provide a wide range of information about the objects in the area in which they are flying. Once the bat has identified its prey, it beeps faster and faster in order to recieve more information about the exact location of the insect. It can speed up the beeping calls, up to 200 calls per second, until it hones in for the catch.

For more information, and to hear real echolocation calls, watch "Bat Chat" on the CD included with the trunk.

Echolocation

Audience/Group Setting
Appropriate for a classroom or camp setting.

Goal
To understand how some bats use echolocation to navigate

Objectives
1. Students will rely on their hearing to locate other group members.
2. Students will attribute a bat's open mouth to the use of echolocation.
3. Students will conclude that bats are specialized to rely on echoes for navigation.

Big Idea/Main Message
Bats are highly beneficial to people. Bats play essential roles in keeping populations of night-flying insects in balance worldwide.

Conservation Action/Behavior Addressed
Bats are not scary or evil. In fact, they are an incredibly important part of so many environments. Active at night, bats are seldom seen but surprisingly important parts of people's daily lives. Many bats feed on night flying insects and act as important natural pest control. As a result, corn, cotton cucumber and other farmers save billions of dollars in pesticides. By reducing the need for pesticides, bats not only lower costs for farmers, they also help protect the environment.

Background Information
Bats navigate using reflected sound waves. This process, known as echolocation, allows these animals to "see" in the dark. To uncover objects, bats must first emit a series of sound pulses. These pulses travel outward and strike objects. The pulses are then reflected off the objects and return back to the bats. Detected by their large ears, the sounds are quickly analyzed by the brain's echolocation center.

Materials Needed
- Blindfold

Staff
One staff or volunteer.

Length of Activity
10 minutes.

Set up
Gather necessary supplies.

Procedure

1. Explain that bat use sound waves, echoes and their ears to navigate at night.
2. Form a large circle. Blindfold the bat and lead to the middle of the circle.
3. Appoint others to be moths and step inside the circle. Remaining students will enlarge the circle and be trees.
4. The bat calls for the insect by saying "Moth?" Moths reply "Here!" The bat must listen and tag as many moths as possible using only his or her sense of hearing. Continue for approximately 2 minutes. If a moth is tagged, it becomes a tree.
5. If the bat is too close to the edge, the trees whisper "Tree," and gently steer the bat towards the middle of the circle.
   - Why does the bat call out?
   - Why must the moths respond each time the bat calls out?

Note – This activity was adapted from and used with permission of the Lubee Bat Conservancy

SEEING WITH YOUR EARS

Objective: *To understand how bats use sound to navigate and find food in the dark*

Grades: *3-5*

Type of Activity: *Demonstration and discussion*

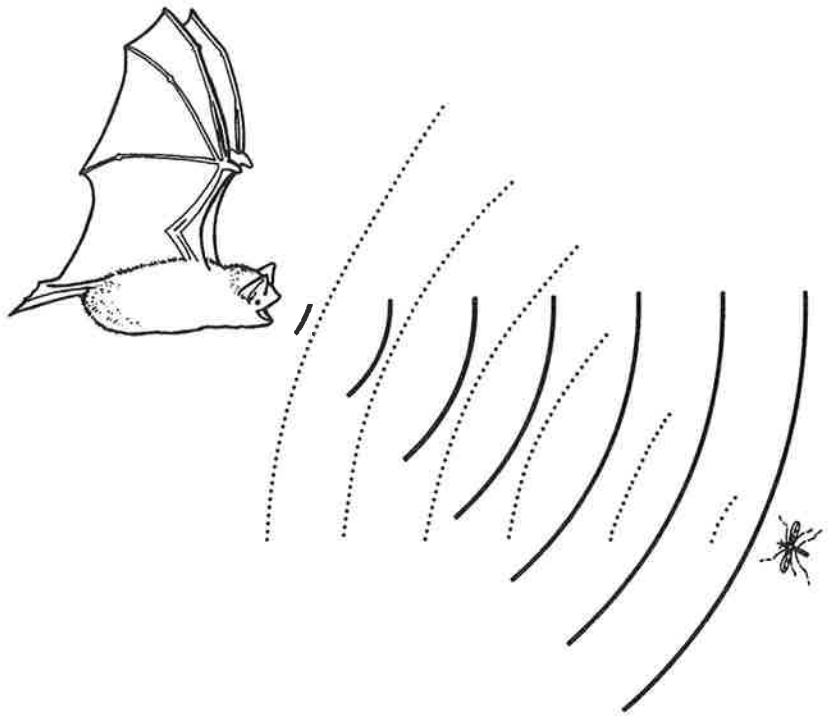
Materials:
- *Basketballs or similar sized bouncing balls*
- *Blindfolds*
- *Ear plugs or cotton balls*

Background Information

Even though no bats are blind, about 70 percent use a sonar system, called echolocation, to navigate in the dark and find food. They can detect the size, texture, even the direction of a moving insect, using sound alone. Bats emit sound pulses, produced in the larynx, through the mouth or nose. As these sounds come in contact with objects – trees, buildings, or potential food – they are reflected back as echoes and collected by the bat's ears. Information contained in the echoes is processed in the bat's brain instantaneously, enabling the bat to fly rapidly through a cluttered environment without a collision. Most of these sound pulses are produced at a frequency too high for humans to hear without the aid of special equipment. Instruments called bat detectors render the calls audible to the human hearing range, enabling people to listen in on the hunt. Using special equipment, scientists can now identify many species of bats who use certain frequencies and characteristic patterns, in the same manner that we can identify bird songs.

For many years, scientists were puzzled about how bats were able to navigate in the dark. In the late 1700s, an Italian naturalist and priest, Lazzaro Spallanzani, made the first attempt to understand the mystery of bat navigation. He put an owl and a bat in a semi-dark room and found both could fly quite well in low light. In complete darkness, the owl was helpless and bumped into everything, but the bat did not. He then put a small hood over the bat's head. With its head covered, the bat also became helpless. Later, Spallanzani reviewed additional experiments by Swiss surgeon Louis Jurine. With renewed interest, he took his research a step further. When placing brass tubes in a bat's ears, he found that its sense of direction totally failed if the tubes were plugged. But it wasn't until about 1938 that Harvard scientist Donald Griffin, with the aid of special recording equipment, learned that bats navigate by transmitting high frequency sound pulses through their mouths or noses and then collect the echoes with their ears.

Not all bats use echolocation. Flying fox bats, from the suborder Megachiroptera (see Activity 8), have very good eyesight and an excellent sense of smell to find food in the dark. They feed on fruit, pollen and nectar and don't need a sophisticated sonar system to chase darting insects. Almost without exception, they usually roost out in the open and not deep in dark places like caves. Hence, flying foxes typically have very large eyes and small ears.



SEEING WITH YOUR EARS

Many children are familiar with some aspects of echolocation. Most have had some experience generating echoes in canyons or among tall buildings. In this exercise, a ball will be used to simulate a sound wave.

Divide the class into pairs in a gymnasium or other large empty room. Each pair gets a large bouncing ball. They need to use two walls and should stand closer to one wall than the other. Each taking a turn, they will throw the ball (sound wave) towards the wall. As the sound wave (ball) hits the wall, it (the echo) will bounce back. As the thrower sees the ball returning he/she points and follows it with a finger as it returns. The partner retrieves the ball. Each partner takes a turn at both the close and far walls. Point out to the students that the ball (echo) returns more quickly from the closer wall.

The second part of the exercise enables each pair to do the exercise like bats. One partner is blindfolded. The other partner orients the blindfolded partner toward the wall and hands him/her the ball to throw. Both partners get a chance to throw against the close wall and far wall, again pointing to the ball (echo) and following it with a finger as it returns. Each student should be able to determine, from hearing alone, which is the close wall and which one is far and indicate the direction in which the ball is moving.

For the third part of the exercise, in addition to the blindfold, the partners will also use a pair of ear plugs, or alternative means of blocking hearing, and repeat the same exercise on the near and far walls. Could the student identify the near and far walls, and could he/she follow the track of the echo (bouncing ball) with a finger? The students should now have a better appreciation of how important echolocation is to navigate in darkness.

Following this indoor exercise, take the class outside for a short hike and discussion. Outside, several questions can be asked. What kinds of obstacles must a bat avoid while it hunts for insects at night? (Buildings, trees, rocks, power lines, moving cars.) Using examples the children can see, ask how the bat knows what is closer, the tree 10 feet away, or the building 100 feet away. (Sound waves return faster if the obstacle is closer.) How does a bat remember where all those obstacles are while it chases a darting insect? (The brain processes and remembers all the information while the bat flies.) What happens if it rains or gets very windy? (Bats may have to stop hunting until the weather improves.) What happens if two bats are chasing the same insect? (First come, first served!) What other kinds of animals hunt for flying insects at night? (Not many. That's why bats hunt at night: They usually don't have to compete for food with animals like birds.)

BAT REPRODUCTION AND LIFESPAN

A PowerPoint Show of pictures from this document can be found on the included CD.

The majority of bat species are capable of producing only a single pup each year. However, there are several species of bat that will produce twins, or up to five bats in a litter. For example, the eastern red bat (*Lasiurus borealis*) (shown below) is a species of bat that will often give birth to twins and can a produce a litter of up to five pups. Bats give birth to babies that look just like them. They inherit structures, such as wings that function exactly the same way as those of their parents. A mother's behavior is instinctive; they know how to care for their young without prior training or practice.. Bat mothers give birth to live, hairless young and will nurse them with milk, just as all mammals do. Microbat pups generally weigh one-quarter (1/4) to one-third (1/3) of the mother's weight. They will stay with their mother and nurse for three (3) to six (6) weeks. Megabat pups weigh about one-fifth (1/5) of the mothers weight and will nurse for up to four (4) months.

Mothers will also provide their young with warmth, sensory stimulation, and often transportation. Mothers of certain species will actually travel with their pup attached to them continuously for up to two (2) weeks. The pup will wrap its wings around the mother to hold on. In some colonial-roosting species of bats, the mother and pup will roost together during the day. Other species, like the Mexican free-tailed bat, will live in the same roost as their young, however, the pups will cluster together (as you can see in the photograph below). The pups will cluster together in groups of up to 400 to 500 bats per square foot. The mother bat will move into the cluster of young to nurse her pup a couple times a day. Unbelievably, a female bat can actually identify her own pup from the hundreds of bats in the roost. She uses smell as well as special echolocation calls to verify the identity of her pup. The mother will call out to her pup and wait for the reply to hone in on its location.

Bats will mate in early autumn, prior to hibernation, and female bats will not give birth until the following spring. They are able to delay the fertilization of their egg, or in some cases delay the implantation of the egg on the uterus wall, until the spring. The gestation period of bats varies between species, ranging three (3) to six (6) weeks. In most colonial bat species, the females will all live together in a maternity colony where they will give birth and raise their young. In this situation, male bats will live in other roosts and do not aid in parental care. There are only 17 species of bat that are monogamous, and in these cases, the male will participate in parental care. Pups must be fully capable of flight by the time they have stopped nursing from their mother. They will reach adult size and learn how to fly in three (3) to five (5) weeks after birth, and will reach sexual maturity at two (2) years of age. Most species of bats will live an average of 20 years. However, there is one bat on record to be at least 40 years old.

WHERE'S MY BABY?

Objective: To learn how mother free-tailed bats find their babies

Grades: *2-4*

Type of Activity: *Game*

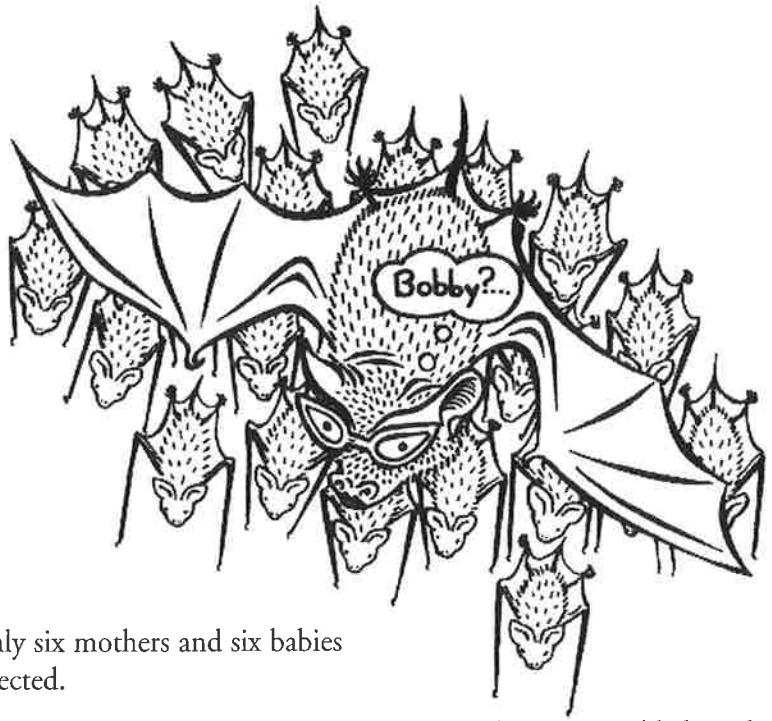
Materials:
- *Cotton balls*
- *Variety of scents from the list*
- *Blindfolds*

Background Information

In the southwestern United States, Mexican free-tailed bats roost together in large numbers. A cave in Central Texas is home to 20 million free-tails. Most of these are females and in early June each produces a single young, approximately doubling the size of the colony. Hundreds of square feet of cave wall space are carpeted with bat pups. Born without fur, the babies pack tightly together in densities of up to 500 per square foot to share body heat and stay warm. Mothers usually roost together in another part of the cave, each returning to nurse her baby several times a day.

For many years scientists believed that mothers probably fed any youngster they found. Recently, a study demonstrated that each mother actually locates her own baby through recognition of its scent and call. This is amazing considering the fact that they must find their own amidst millions of other active mothers and babies.

This game enables children to play the roles of mothers and babies trying to find each other in a dark, noisy situation. The whole class participates,



but only six mothers and six babies are selected.

List of Suggested Scents

Vinegar	Vanilla
Cinnamon	Perfume
Garlic	Banana

Rules

1. Select six mothers and six babies.

2. Each baby is given a cotton ball with a scent (see scent list for suggestions). The mother needs to become acquainted with the smell.

3. The baby is then assigned a call, some simple pattern of a tongue-clicking. Mother and baby should practice several times to ensure recognition of scent and sound.

4. Mothers are then blindfolded.

5. The other students in the class are also babies, but without a scent or assigned call. All babies are arranged in an open space, and the teacher places the six special babies throughout the group. All babies are stationary and must not move. Only the mothers will move.

6. The blindfolded mothers are assisted to the edge of the group. Now they must find their own baby. All babies call, clicking at random without a pattern, except for the six babies who must use the pattern they practiced with the six mothers. Babies are hungry, so they should click loudly.

7. If a mother bumps into a designated "baby," the baby is required to place the cotton ball near the nose of the mother, otherwise no contact is made.

8. The winner is the mother and baby who find each other first. When pairs find each other, they should leave the circle. The game is over when all mothers and babies are reunited.

HABITAT COMPONENTS OF BATS

A PowerPoint Show of pictures from this document can be found on the included CD.

FOOD

Insects: Bats are primary predators of night-flying insects, including many of the most damaging agricultural pests. More than two-thirds of bat species hunt insects and they have healthy appetites. Some bats can detect, catch, and eat two or more mosquito-sized insects in one second, and over 1,000 insects in one hour.

Throughout the United States, scientists estimate that bats are worth more than $3.7 billion a year in reduced crop damage and pesticide use.

Pallid bat *(Antrozous pallidus)*

Fruit or Nectar: Almost a third of the world's bats feed on the fruit or nectar of plants. In return for their meals, these bats are vital pollinators of countless plants and essential seed dispersers, with a major role in regenerating rainforests.

A few commercial products that depend on bat pollinators for wild or cultivated varieties include bananas, avocados, dates, figs, peaches, durian, cloves, cashews, carob, and balsa wood.

Mexican long-tongued bat (*Choeronycteris mexicana)*

Vertebrates: Approximately one percent of bats eat fish, mice, frogs, or other small vertebrates.

Fisherman bat *(Noctilio leporinus)*

Blood: Only three species of bats are vampire bats and they all live in Latin America. They typically feed on blood from sleeping mammals or birds. They create a small incision with their teeth and lap (not suck) blood from the wound. Vampire bats only take about 2 tablespoons of blood while the host animal continues to sleep. Even vampire bats are useful to humans; an enzyme in their saliva is among the most potent blood-clot dissolvers known and is used to treat human stroke victims.

Vampire bat (*Desmodus rotundus*)

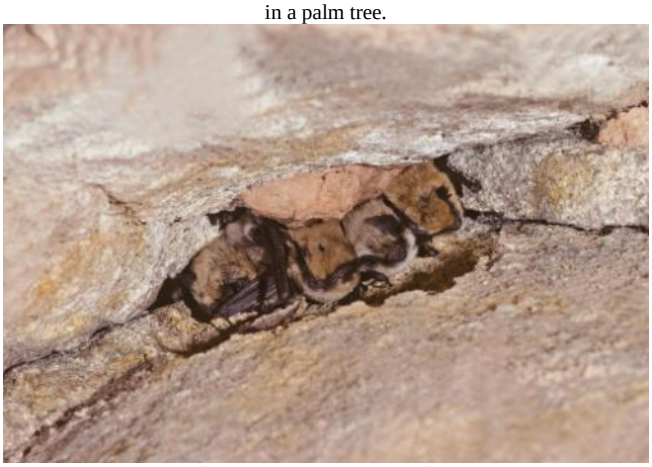
SHELTER

Bats can be found living in almost any conceivable shelter, such as hollow trees, bridges, attics, and barns, but they are best known for living in caves. Caves provide a suitably cool and humid environment with lots of space where bats are safe from predators. Many species that live in buildings do so, at least in part, because of shrinking natural habitat. Some species, such as this northern yellow bat, roost year round beneath the dead, hanging fronds of fan palm trees.

Tropical species occupy a wider range of roost sites. Several species have suction discs on their wings and feet that enable them to live in the slick-walled cavities formed by unfurling leaves, such as those of the banana plant. Others live in animal burrows, flowers, termite nests, and even in large tropical spider webs.

Northern yellow bat (*Lasiurus intermedius*) in a palm tree.

Pallid bats (*Antrozous pallidus*) in a barn.



California myotis (*Myotis californicus*) in a cave crevice.

WATER

Bats, like humans, need water in order to survive. Bats sometimes lose up to 50% of their body weight daily, due to evaporative water loss. Even the most desert-adapted bat species periodically need water, and the loss of a single source can threaten the survival of local populations.

To drink water, bats must fly down to the waters' surface, scoop up a drink, and keep flying up and away from the pool. Obstacles in the flight path can prove deadly. Like many other animals, bats are very susceptible to drowning if they are trapped in a water tank without an escape route.

Townsend's big-eared bat (Corynorhinus townsendii)

SPACE

Worldwide there are more than 1,100 species of bats, nearly a fourth of all mammal species. Bats are one of the most widely distributed groups of mammals in the world, due largely in part to their ability to fly. They occupy every area on earth other than Polar Regions and extreme deserts.

In Central Texas alone, an estimated 100 million Mexican free-tailed bats will eat roughly 1,000 tons (2 million pounds) of insects each night during the summer. They can ascend to altitudes of 1,000 to 10,000 feet to feed on these agricultural pests. Most instectivorous bats will feed within six (6) to nine (9) miles of their daytime roost, although some will travel as far as 50 miles.

Bracken Cave emergence.

Most cave-dwelling bats require temperatures of 40° F to 50° F for hibernation and 57° F to 85° F for rearing young. In order to stay warm when they are roosting, bats huddle together. In just one square foot of a cave wall, you can find 250 to 300 bats.

In some regions, cold winters force bats to migrate or hibernate. Most travel less than 300 miles to find a suitable cave or abandoned mine, where they remain for up to six months or more, surviving solely on stored fat reserves. However, several species such as the Mexican Free-tailed bat will migrate as far as 1,000 miles to a warmer climate.

A cluster of southeastern myotis (*Myotis austroriparius)*.

FEEDING ADAPTATIONS

A PowerPoint Show of pictures from this document can be found on the included CD.

INSECT EATER (INSECTIVORE)

Approximately 69% of the bats in the world and 32 of the 34 bats found in Texas eat insects. All insectivorous bats echolocate to find food. Insectivorous bats are generally small bats with large ears to pick up echolocation calls. They typically have an enclosed tail membrane that aids in flight and capturing their prey on the wing. Their teeth are sharp for grinding the tough exoskeletons of insects.

Yuma myotis (*Myotis yumanensis*)

FRUIT EATER (FRUGIVORE)

Approximately 24% of the bats in the world eat fruit. Frugivorous bats are often large, brightly colored bats with little to no tail membrane. Most fruit-eating bats do not echolocate because they have a strong sense of smell and sight to find their food. They have large, keen noses to smell ripe fruit and strong jaws for biting. Their teeth are generally wide and flat for grinding fruit. They also have large eyes and excellent vision. Their wings are wide, adapted for carrying heavy fruit.

Hammer-headed bat (Hypsignathus monstrosus)

NECTAR EATER (NECTARIVORE)

Five percent (5%) of the bats in the world and two (2) of the 34 bats in Texas drink nectar. Nectarivorous bats are small bats with short, wide wings adapted for hovering above flowers. They have a long slender snout and jaw that fits into flowers. They also have a long scaly tongue to collect nectar. Nectar-eating bats have an excellent sense of smell and sight to help them find night-blooming flowers. Their teeth are small and not used much because nectar is a liquid.

Woermann's bat (*Megaloglossus woermanni)*

MEAT EATER (CARNIVORE)

Only one percent (1%) of the bats in the world are meat eaters. Carnivorous bats are large with a wide wingspan allowing them to carry off small animals. They have a strong jaw for killing their prey and sharp, long teeth to chop and tear apart their food. Carnivorous bats also have large ears allowing them to hear a frog's call or a mouse's footsteps from far away.

Fringe-lipped bat (*Trachops cirrhosus*)

FISH EATER (PISCIVORE)

Less than one percent (0.7%) of the bats in the world eat fish. Piscivorous bats are fairly large bats with long, narrow wings adapted for flying quickly over water. They have long legs with very large, flat feet and sharp, hooked claws to catch fish. Their oily fur helps them stay dry by deterring water. They have strong jaws and sharp teeth to tear and grind their prey. Fish-eating bats also have a special echolocation call that can detect ripples or fins on the surface of the water.

Fisherman bat *(Noctilio leporinus)*

BLOOD EATER (SANGUIVORE)

Only three bats in North America and three-tenths of a percent (0.3%) of the bats worldwide drink blood. Sanguivorous bats have strong legs, allowing them to walk along the ground and climb onto their prey. Their wings are broad, allowing them to fly on a full stomach. Vampire bats have a heat sensitive nose that helps them locate the blood vessels closest to the surface of their prey's skin, and a short pug-like face that makes it easier for them to bite. They have small, very sharp teeth and a grooved tongue adapted for lapping up blood. They also have special saliva that prevents blood from clotting and acts as a numbing agent so they may continue drinking without disturbing the sleeping animal.

Common vampire bat (*Desmodus rotundus*)

CAVE ENVIRONMENT

A PowerPoint Show of pictures from this document can be found on the included CD.

Caves provide a suitable habitat for many Texas bats. They are underground and maintain a fairly stable temperature. These factors are important for both hibernation and raising young. If the cave temperature is constantly fluctuating, then the bats must expend extra energy to acclimate. Caves also tend to have higher humidity than the outside air, which prevents bat dehydration. Additionally, the high cave walls provide perfect roosting areas for bats to stay safe from most predators.

CONDITIONS

Cave-dwelling bats usually do so for one of two reasons, to raise their young or hibernation. Bats require different cave conditions for each of these purposes, and a single cave is not usually suitable for both. Because of this, bats will often migrate between their hibernation cave and the one in which they raise their young.

Mexican free-tailed bat (*Tadarida brasiliensis*)

Raising Young

Bat pups are born without hair and must huddle together to stay warm while their mothers are out hunting. Caves in which bats rear their young must be warm (60°F to 80°F) with places that slant up to trap heat.

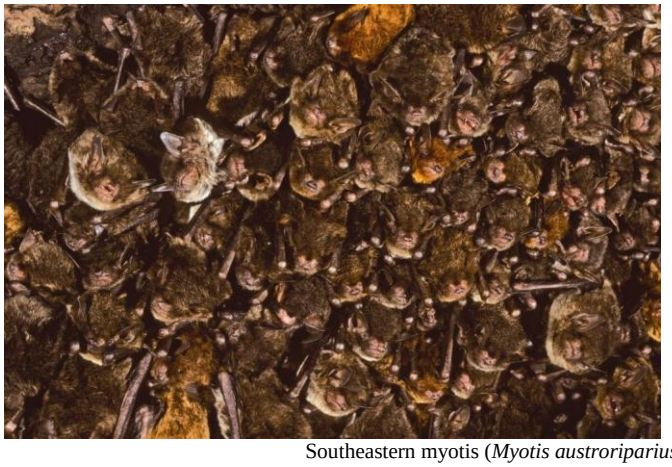
Tri-colored bat (*Perimyotis subflavus*)

Hibernation

Hibernating bats need a cool cave (40°F to 50°F) where they are safe from freezing**.** These caves must have areas that slant downwards to trap cool air. If a bat is too warm and awakens early from hibernation, it may die.

SPACE

California myotis (*Myotis californicus*)



Southeastern myotis (*Myotis austroriparius*)

Bats are able to fit into tight crevices and huddle together to help save space as well as conserve body heat. As many as 300 adult cave-dwelling bats or 500 bat pups can fit in a square foot area.

CAVE DWELLERS

Dermestid beetles cover the floors of bat caves. They are flesh-eating insects that will devour a bat in minutes.

Commonly, caves house additional invertebrates as well. There are numerous species of crickets, spiders, beetles and many more that are well suited to cave life. They will commonly feed on the nutrient rich guano.

Other mammals will also use caves as shelters. Northern raccoons often raise their young in caves.

GUANO

Guano is the term used to describe bat droppings. Believe it or not, guano is beneficial to plant growth. It is rich in phosphorus and nitrogen, both of which are common ingredients in plant fertilizers. Guano enriches the soil and will not leech away like many chemical fertilizers. People will enter caves during times of the year when bats are not present and will mine the guano for this purpose. It is also a great source of nutrition for many cave organisms like insects, crustaceans, fungi, bacteria, as well as some small amphibians.

People have found many other uses for guano too. It contains many beneficial kinds of bacteria used to make natural insecticides, detoxify industrial waste, and improve the power of detergents. It also contains a substance known as saltpeter (potassium nitrate), which in the 1860s was commonly used to make gunpowder.

CAVE GEOLOGY

The most common caves are made of limestone, dissolved by natural acid found in groundwater, which formed their cavernous shape.

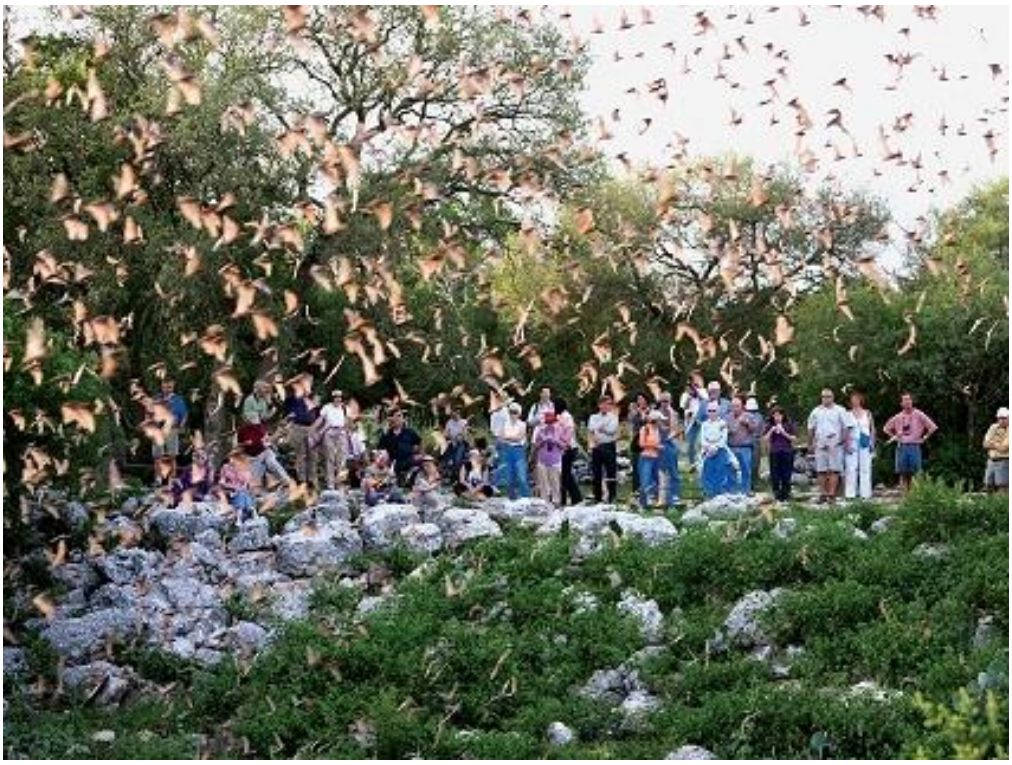
Bracken Bat Cave, Bracken, Texas

A PowerPoint Show of pictures from this document can be found on the included CD.
To see a video of the bats emerging from Bracken Bat Cave watch the "Bracken Emergence" on the CD included with the trunk.

Bracken Bat Cave is the summer home of the world's largest bat colony. With millions of Mexican free-tailed bats living in the cave from March thru October, Bracken holds one of the largest concentrations of mammals on earth.

The emergence of these millions of bats, as they spiral out of the cave at dusk for their nightly insect hunt, is an unforgettable sight.

The cave and 697 acres of the surrounding Texas Hill Country land is owned and protected by Bat Conservation International. The cave is on the suburban fringe of San Antonio, in an area of rapid population growth. If not for the generous donations of BCI's members and friends, the cave and its remarkable bats likely would have been engulfed by subdivisions.



In addition to conserving the cave bats, BCI stewards the entire property, protecting endangered birds and rehabilitating the land by removing invasive vegetation and reviving native plants. Go here (http://batcon.org/bracken) for information on how to visit Bracken cave.

Congress Avenue Bridge, Austin, Texas

A PowerPoint Show of pictures from this document can be found on the included CD.

A Little History

Every summer night, hundreds of people gather to see the world's largest urban bat colony emerge from under the Congress Avenue Bridge. These 1.5 million bats are fun to watch, but they are also making our world a better place to live.

When engineers reconstructed downtown Austin's Congress Avenue Bridge in 1980, they had no idea that new crevices beneath the bridge would make an ideal bat roost. Although bats had lived there for years, it was headline news when they suddenly began moving in by the thousands. Reacting in fear and ignorance, many people petitioned to have the bat colony eradicated.

About that time, BCI stepped in and told Austinites the surprising truth: that bats are gentle and incredibly sophisticated animals; that bat-watchers have nothing to fear if they don't try to handle bats; and that on the nightly flights out from under the bridge, the Austin bats eat from 10,000 to 20,000 pounds of insects, including agricultural pests.

As the city came to appreciate its bats, the population under the Congress Avenue Bridge grew to be the largest urban bat colony in North America. With up to 1.5 million bats spiraling into the summer skies, Austin now has one of the most unusual and fascinating tourist attractions anywhere.

The Austin American-Statesman created the Statesman Bat Observation Center adjacent to the Congress Bridge, giving visitors a dedicated area to view the nightly emergence. It is estimated that more than 100,000 people visit the bridge to witness the bat flight, generating ten million dollars in tourism revenue annually.

A Little Background

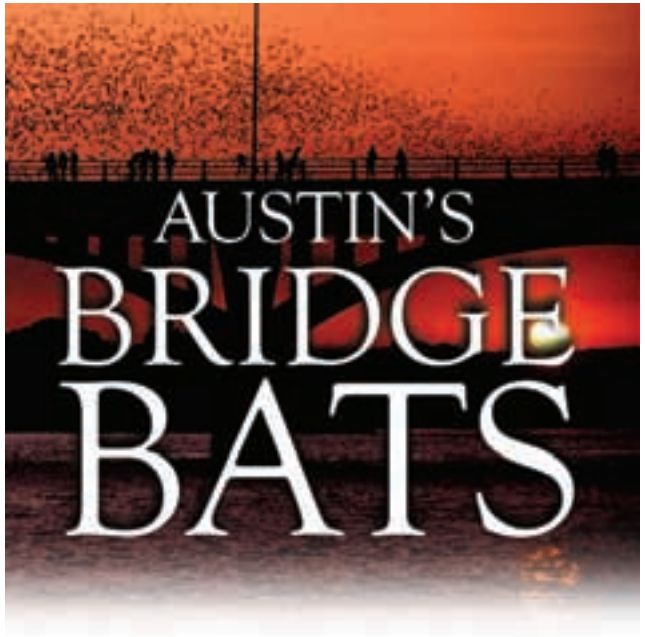
Austin's bridge bats are Mexican free-tailed bats. They migrate each spring from central Mexico to various roosting sites throughout the southwestern United States. Most of the colony is female, and in early June each one gives birth to a single baby bat, called a pup. At birth, the babies weigh one-third as much as their mothers (the equivalent of a 130 pound woman giving birth to a 40 pound child!).

The pink, hairless babies quickly grow. In about five (5) weeks, with the help of their mothers they learn to fly and begin to hunt insects on their own. Until that time, the mothers nurse their babies, each locating her pup among the thousands by its distinctive voice and scent.

A Big Challenge

Bat Conservation International (BCI) has been instrumental in protecting and promoting the now famous Congress Avenue Bridge bat colony as an eco-tourism destination, but as our name indicates, we work worldwide to protect bats and their habitats. Despite the popularity of the bridge bats in Austin, bats are still among the world's least appreciated and most endangered animals. Like other wildlife, bats suffer from habitat loss and environmental pollution, but persecution from humans remains a primary cause of their decline.

BCI addresses this challenging and often neglected area of conservation by changing attitudes, not by confrontation. We work cooperatively with all sectors of society and emphasize broad ecosystem health. Approximately 87 percent of our contributions are used for direct conservation action and educational outreach.



How the Bats were Saved

Austin reveres its bridge bats. Bats are Austin's official animals. A statue celebrates them. The city calls itself The Bat Capital of America. But it was not always so.

What's now the world's largest urban bat colony once was on the verge of extermination. Austin's bats suffered from the same misperceptions and fears that plague bats around the world.

The story begins in 1980, when the bridge across Town Lake was renovated. Engineers inadvertently created an ideal bat roost by adding a series of long, thin joints – about an inch wide and 17 inches deep – along the underside of the bridge.

By 1984, bats by the hundreds of thousands had discovered the joys of those cozy crevices. The public response was near-panic. "Mass Fear in the Air as Bats Invade Austin," screamed a newspaper headline of the time.

A public-health crisis was declared (needlessly, of course, since not a single case of bat-transmitted disease has been reported in Austin since the bats arrived). Many Austinites wanted the bats gone and eradication seemed imminent.

Then Bat Conservation International came to town...

BAT CONSERVATION INTERNATIONAL
www.batcon.org

Bat Conservation International and the Bridge Bats

BCI Founder Merlin Tuttle moved the nonprofit's headquarters from Milwaukee to Austin in 1986, partly to save the besieged bridge bats.

He and his staff immediately launched a vigorous public-education campaign. They met with media, community groups, schoolchildren and city leaders. BCI gradually convinced Austinites that they have little to fear and much to gain from the bats in their midst. Not only do the bridge bats delight tourists, they also help control destructive insects and reduce the need for pesticides.

A little truth goes a long way. Now these once-feared little mammals enjoy a warm welcome when they cruise into Austin each spring. These are fortunate bats, with a whole city looking out for them. Around the world, most bats are at great risk from habitat loss, destruction by humans and now the devastating wildlife disease called White-nose Syndrome.

Bats find snug summer homes in narrow joints beneath Austin's Congress Avenue Bridge.

About the Bats

About 1½ million Mexican free-tailed bats spend their summers under the Congress Avenue Bridge. This is a maternity colony of female bats that give birth and raise their young while snuggled into the bridge's crevices.

Each night, the bridge bats come streaming out to patrol the city in search of flying insects. By morning, they will have eaten about 20,000 pounds of pests. This twilight "emergence," with the urban skyline as a backdrop, is a dramatic sight that draws tens of thousands of visitors each summer.

The bats arrive each spring after spending the winter in Mexico. They return south after the first cold fronts of fall.

A Year in the Life of Austin's Bridge Bats

January: Nearly all of Texas' Mexican free-tailed bats are spending the winter in caves of northern Mexico. Freetails don't hibernate like many other bats, but remain active year-round.

February: The bats mostly begin their northward migration. They usually return to their home areas, although they may use various roosts in each area.

March: The migration is in full force. Freetails usually travel in groups, cruising as high as 10,000 feet.

April: Most freetails settle into their summer roosts, including about 750,000 pregnant females under the Congress Avenue Bridge.

May: Mothers-to-be prepare to give birth by feeding heavily each night. The echolocation (biosonar) beeps that bats use for hunting in the dark create quite a din, although it is too high-pitched for humans to hear.

June: Baby freetails, each weighing barely a tenth of an ounce, are born in early June as the underside of the bridge becomes a nursery. The bridge-bat population reaches about 1.5 million.

July: This is a tough month for night-flying insects. A nursing mother bat can eat almost her weight in insects nightly. The bridge bats eat as much as 140,000 pounds of bugs a week.

August: The pups are weaned and learn to fly. They join their mothers on nightly bug-hunts, making for spectacular emergences at the bridge.

September: Downtown bat watching is often outstanding, as long as rain and cold fronts stay away.

October: The bridge bats usually start migrating southward. Fall migrations, triggered by strong cold fronts, can vary by several weeks from year to year.

November: Migration continues and the bats move into the caves of Mexico. With tailwinds, the migrating freetails can hit speeds of 60 mph or more.

December: Most Central Texas freetails are roosting in caves south of Texas, and some mating likely begins. Several thousand, however, remain in Texas all winter.

BAT CONSERVATION INTERNATIONAL

www.batcon.org

BATS ARE ESSENTIAL TO MAINTAINING HEALTHY ECOSYSTEMS and economies. Yet they are also among the most misunderstood and needlessly feared of the world's creatures. And their populations are declining worldwide.

Bat Conservation International is the world leader in defending these beleaguered flying mammals and the habitats they so ably serve. From our headquarters in Austin, we have achieved major conservation successes, dispelling myths and educating the public and decision-makers of many countries about the benefits of bats, and winning protection for key bat populations and habitats.

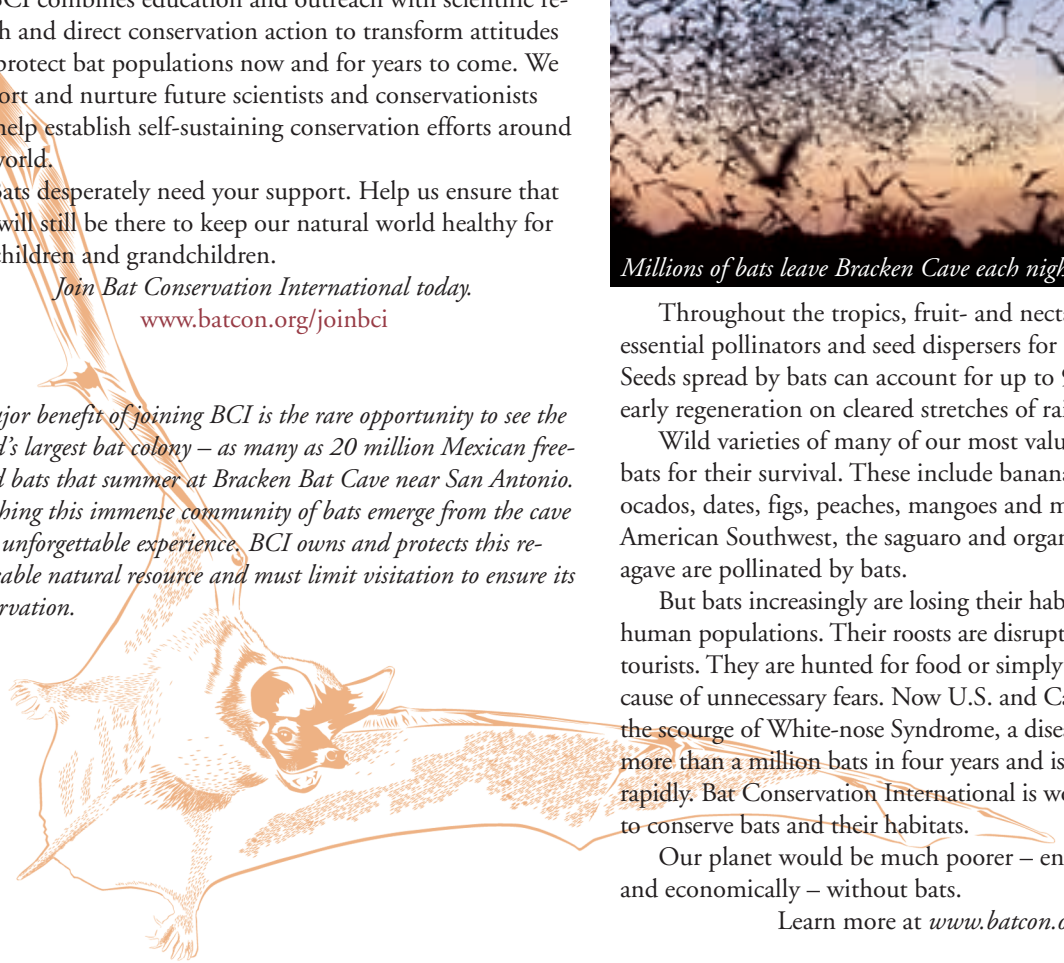
BCI combines education and outreach with scientific research and direct conservation action to transform attitudes and protect bat populations now and for years to come. We support and nurture future scientists and conservationists and help establish self-sustaining conservation efforts around the world.

Bats desperately need your support. Help us ensure that bats will still be there to keep our natural world healthy for our children and grandchildren.

Join Bat Conservation International today.

www.batcon.org/joinbci

A major benefit of joining BCI is the rare opportunity to see the world's largest bat colony – as many as 20 million Mexican free-tailed bats that summer at Bracken Bat Cave near San Antonio. Watching this immense community of bats emerge from the cave is an unforgettable experience. BCI owns and protects this remarkable natural resource and must limit visitation to ensure its conservation.



Why You Should Care

Bats are at risk around the world. More than half of the 46 species of U.S. bats are either officially endangered or face declining populations.

Bats are among the most beneficial of animals. They fill vital roles in maintaining healthy ecosystems, and their presence pays cash dividends to humans in many ways.

Bats are primary predators of night-flying insects. They consume enormous quantities of bugs, including moths and beetles that cost farmers and foresters billions of dollars a year. The millions of free-tailed bats in Central Texas' Bracken Cave consume up to 200 tons of insects each summer night. Without bats, pesticide use inevitably would increase.

Millions of bats leave Bracken Cave each night to hunt insects.

Throughout the tropics, fruit- and nectar-eating bats are essential pollinators and seed dispersers for countless plants. Seeds spread by bats can account for up to 95 percent of early regeneration on cleared stretches of rainforest.

Wild varieties of many of our most valuable crops rely on bats for their survival. These include bananas, breadfruit, avocados, dates, figs, peaches, mangoes and many others. In the American Southwest, the saguaro and organ pipe cacti and agave are pollinated by bats.

But bats increasingly are losing their habitats to expanding human populations. Their roosts are disrupted by miners and tourists. They are hunted for food or simply slaughtered because of unnecessary fears. Now U.S. and Canadian bats face the scourge of White-nose Syndrome, a disease that has killed more than a million bats in four years and is still spreading rapidly. Bat Conservation International is working worldwide to conserve bats and their habitats.

Our planet would be much poorer – environmentally and economically – without bats.

Learn more at *www.batcon.org*.

Fun Facts About Freetails

- With tailwinds, Mexican free-tailed bats have been clocked flying at speeds up to 60 miles per hour.
- Freetails can reach altitudes of up to 10,000 feet as they pursue migrating corn earworm moths.
- Freetail droppings (guano) were once commonly used to make gunpowder and are still widely used as fertilizer.
- Freetails may cover 50 miles or more one-way to find food each night .
- As many as 20 million freetails spend their summers at San Antonio's Bracken Bat Cave, home of the largest bat colony in the world.
- Freetails, like all bats, are not blind. They do, however, use echolocation (a biological sonar system) to hunt flying prey in total darkness.
- Freetail migrations can cover 1,000 miles.
- Mexican free-tailed bats are found across most of the southern half of the United States, south through Mexico and Central America and deep into South America.

Mexican free-tailed bats are voracious insect-eaters. The bridge bats eat up to 20,000 pounds of bugs each night

Never Handle a Bat

Do not touch a bat or any wild animal!

The vast majority of bats do not have rabies, but a bat on the ground or one that can be approached by humans is likely to be sick or injured. No one has ever gotten rabies from bats at the Congress Avenue Bridge. But don't take any chances. Remember the rule: Don't ever touch a bat!

(If you see a bat on the ground, tell people to stay away from it. If a person or pet has direct contact with a bat, call Animal Control at 311.)

HIBERNATION OR MIGRATION

TORPOR

Bats that live in more temperate climates, such as the Mexican free-tailed bat (*Tadarida brasiliensis*), are able to conserve energy in the winter by becoming inactive for short periods of time. This sleep-like state is known as torpor. The bat will drop its body temperature to that of the surrounding air and its respiration and heart rate will slow. Their heart rate will slow from a normal resting heart rate of 250 to 450 beats per minute down to approximately 40 beats per minute. Doing this lowers the bat's metabolism and allows it to conserve energy for a short period of time, usually a few days to a week. If temperatures allow, torpid bats are able to wake up and become active again much easier than hibernating bats. A torpor shelter must be close to the ambient conditions, allowing the bats to determine the outside temperature, without having to wake up and waste their fat reserves. Generally, bats that live further north will hibernate instead of going into torpor, however, torpid bats and hibernating bats are commonly found in the same place. There are colonies of bats in Central Texas that will go into torpor if the temperature gets too low. Some bats will go into torpor as well as hibernate; this choice depends on the weather conditions and the time of year. If the temperature gets too low and it is close to winter, then a bat will be more likely to go into hibernation instead of torpor.

HIBERNATION

Hibernation is a deep sleep-like state that lasts most of the winter. This method of conserving energy and surviving through the cold winter months is a much deeper state than torpor and is more difficult to sustain. The heart rate of bats in hibernation can drop to as little as 10 beats per minute. Bats that hibernate will typically do so in caves or abandoned mines in the same area as their summer range. These shelters must have a constant temperature and relatively high humidity to keep the bats from dehydrating. There are hibernation colonies across the Unites States, including in Texas. When a bat is in hibernation, it lives off fat that it has accumulated and reserved during the summer months. Some bats will store so much fat that they will actually double their body weight prior to hibernation.

The act of waking up actually uses more of a bat's fat reserves than does hibernation. Many bats die each year because humans are disturbing their hibernation caves. This disruption causes the bats to wake up and waste a vital amount of their reserved energy, which is necessary to make it through the entire winter. Bats are able to go back into hibernation, but the process of waking up uses two to four weeks of its stored fat reserves each time they awaken. If this happens too frequently, the bat will die.

Bats will hibernate the majority of the winter and will naturally awaken from their slumber when spring returns and the temperature increases. Their heart and respiratory rates will increase and their blood flow will begin to warm the bat's body temperature. This process takes 10 to 20 minutes for the bat to be warm enough to fully awaken from hibernation.

MIGRATION

Many species of bats will leave their roosts during the colder months and travel to a place with readily available food and warmer weather. This is known as migration. Some migratory bats will go into torpor or hibernation after migrating, but bats generally migrate to avoid having to do this. Some species, such as the tri-colored bat (*Perimyotis subflavus*) which range throughout the eastern United States including Texas, will migrate short distances (up to 70 miles) between their summer and winter roosts. When spring arrives and insects are available, the bats will wake up from hibernation and travel back to their summer roosts. Other bats, such as the Mexican free-tailed bat, which live in the southern United States and South America, will travel long distances (over 600 miles) to find warmer roost sites in the fall. All of the summer colonies of Mexican free-tailed bats in Texas are considered migratory.

BATS ON THE MOVE!

Adapted from *The Great Migration Challenge* © Council for Environmental Education
Grades 2-8

Objective

Students will explore the hazards and resources bats encounter on their journeys throughout Texas. They will identify basic needs of bats and how they are beneficial to farmers and ranchers.

Materials:

Provided
Bats on the Move! cards (CD)
Bats on the Move! teacher page
Bats on the Move! results chart
Dice – one per group

Vocabulary:

Please reference Glossary for definitions.

conservation, echolocation, ecosystem, habitat, land stewardship, mammal, migration, roost, trough

Activity Setup Procedure:

1. Print and set out the *Bats on the Move!* cards around the classroom, or outside, in a circular pattern. Note: There is a teacher page with all of the steps listed, so you can follow along with your students.

2. Search for the PDF story, Frankie the Free-tailed Bat, on Texas Parks and Wildlife website (http://tpwd.texas.gov/). Print or download story to read to students.

3. Split the students into groups of two (2) or three (3) in each group. Each group only needs one (1) die.

4. Have the students follow the procedures on the cards.

5. Once the students have completed the challenge course, discuss the number of "bats" that survived life in Texas, including migration, and the number that did not. Continue the discussion to include why they did not survive or what obstacles were in the pathway.

Background:

Mexican free-tailed bats are the official flying mammal of Texas, residing in colonies of millions. Being mammals, a young bat or pup knows the sound of its mother and every mother recognizes the cry of her young pup. As dusk occurs every evening, these bats leave their roosts to search for prey. They use echolocation to navigate and to locate and catch insects. The bats make sounds that bounce or echo off of objects. They are capable of listening to these echoes and to judge distance, movement, and size of all objects in their path.

Bats eat approximately one-third of their weight every night, making them invaluable to ranchers and farmers; consuming pests that would otherwise destroy their crops. In turn, healthy crops provide food for humans. Bats also require water as a basic need. However, the act of drinking water is not easy. Rather than landing to get a drink, bats remain in flight, stick out their tongue, and swoop down to get a sip of water.
Some colonies of bats, dependent on the species and location, will leave their roosts and migrate during October and November, traveling to Mexico where food is available and temperatures are warmer. This journey is over 600 miles. Around the end of February when insects become available, the bats will wake up from hibernation and travel back to their summer roosts.

Procedure & Activity:

Engage students by reading the book, *Frankie the Free-tailed Bat* by Nyta Hensley and Patricia Morton. This book provides background information on Brazilian-free tailed bats (very similar to Mexican-free tailed bats) and should alleviate any fear of bats that children might have developed. The book and the activity that follows both convey a conservation message, providing students with the realization that bats are beneficial to agriculture, the environment, and to humans.

The Game

Begin by choosing a migratory bat team name for your journey. Stand by the START card and follow the below procedure.

1. To start your journey, roll the die, and move forward the corresponding number of cards/spaces.

2. Follow the instructions on each card. When conditions are favorable, the card will tell you to move ahead. When you encounter a hazard, you may be delayed or have to go back. Sometimes, you will need to roll the die again.

3. Remember, not all bats survive. Some will live and some will die. Fill out the chart at the end of the journey.

4. Return your die at the end of your journey.

5. Ask students the following questions.
    - Can you identify both biotic and abiotic things that bats encounter on their nightly quest for food?
    - How do different environments support different organisms?
    - What are some ways you think landowners can help bats?
      How are bats important to farmers and ranchers?

      Make a point of making sure students understand that farmers and ranchers are using their land to grow crops for us at the lowest cost possible. Bats help keep the cost down because they eat insects. This cuts down on the expense of having to treat crops with costly insecticides. We as Texans are privileged to have food and clothing that originates from local farms and ranches.

BATS ON THE MOVE!

Class Results Chart

Write each team name and check the box, successful or not successful, that describes the team's journey throughout Texas and migration into Mexico.

Team Name	Successful	Not Successful

BATS ON THE MOVE!

TEACHER PAGE

1. You know the time is near for you to find food on your own. Practice flapping your wings as you hang on to the cave ceiling. If you fall to the bottom of the cave, the beetles that live on the bottom will eat you. *Roll the die and move ahead that many stations.*

2. It is time for your first flight. Your mother reminds you to fly over cotton fields where there are plenty of tasty insects. *Fly ahead to the next station.*

3. Be careful! As you swoop down and stick out your tongue to get a drink from a water trough, you realize that a family of raccoons is drinking nearby. Luckily, they did not see you. *Fly ahead 1 station.*

4. Watch out for the Red-tailed Hawk! It wants to eat you! *Speed up and fly ahead 2 stations.*

5. Using echolocation, you make calls into the environment and your ears hear the echoes of your calls. The echoes bounce off an object – it is a yummy mosquito. *Make an echolocation sound,* r*oll your die and move ahead that many stations.*

6. You have flown many miles tonight and need a break. Find a place to rest and watch out for predators such as owls, snakes, hawks, and raccoons. They want to eat you! *Rest your wings and carefully move ahead 3 stations.*

7. While flying you see an outdoor learning center with a pond, so you swoop down for a quick drink. Thankfully, the kids at that school care for the basic needs wildlife. *Count to 15 while using your tongue to get a drink, and then move ahead 4 stations.*

8. You use echolocation and find delicious boll weevils in cotton fields. Boll weevil larvae eat cotton plants, so farmers are thankful you protect their crops from these harmful insects. *Roll your die and move ahead that many stations.*

9. It's raining, it's pouring, and a thunderstorm is nearby. You have eaten 600 insects per hour tonight and are feeling quite full. *Roll the die, and move back that number of stations to find shelter until the storm passes.*

10. The cornfield you visited last year is full of corn stalks. By eating earworm moths, you saved the farmer's crops, which provide food for humans. *Wow, you are important to farmers and the environment! Roll your die and move ahead that many stations.*

11. You escape capture by a predator, but slightly twist one of your hand-wings in the escape and must seek shelter. *Roll your die and go back that many stations while you recover.*

12. The cotton field ahead is full of tasty insects. When bats eat insects, it helps the environment by preventing the use of chemicals that may harm plants, animals, and even humans. *Slowly flap your wings 10 times, and then move ahead 1 station*

13. You see a farm ahead with a water trough. As you swoop down to get a drink, you accidentally fall in. Thankfully, the farmer is a wildlife steward and placed a ramp at one end of the trough to help you and other wildlife climb out. *Go back 3 stations to dry off.*

14. After flying a long distance in one night, you are still hungry. *Roll the die, spread out your wings, and soar ahead that number of stations to find food*.

15. You are in need of water before returning to your cave at the end of the night - carefully swoop down to get a quick drink from a stream. *Fly safely ahead 2 stations.*

16. Brrr! Nights are becoming much cooler with fall approaching. Finding food is becoming more difficult and you will soon migrate south into Mexico. *Take air into your lungs and go back 1 station to rest inside a hollow tree.*

17. Good news! There are tons of insects out tonight because they are seeking a warmer climate. This is a signal that it is time for you to migrate. Enjoy a large meal as you prepare for migration. *Roll the die and move ahead that many stations.*

18. Stop to rest and wrap your wings around your body to keep warm. *Roll the die and fly back that many spaces!*

19. A Great Horned Owl catches you and eats you. The game is over for you. SORRY! You died. *Die dramatically, and then go back to the beginning and mark the chart.*

20. Thankfully, the north wind is helping you fly south. Swoop down to enjoy a fast drink of water from a river in south Texas. *Move ahead 3 stations.*

21. While hanging upside down under a bridge, you escape a predator, but you are tired from having to leave your roosting position so quickly. *Spin around 3 times and then go back 1 station as you recover.*

22. As your journey to Mexico continues, a strong wind blows you off course. You land on the ground, and can no longer fly as one of your wings is badly torn. SORRY! You are dead. *Go back to the beginning and mark the chart.*

23. Spend the day hanging upside down, and resting in the spaces underneath a highway bridge. *Count to 40. By nightfall, you are strong enough to fly to the finish! Move ahead one station.*

24. Congratulations, you made it to the overwintering cave in Mexico!

THREATS TO BATS

A PowerPoint Show of pictures from this document can be found on the included CD.

WHITE-NOSE SYNDROME

White-nose Syndrome (WNS) is a disease found in hibernating bats, caused by the cold-loving fungus *Geomyces destructans*. The fungus requires a cold body in order to survive, which is why it only affects hibernating bats. This rapidly spreading disease is a spore-producing fungus, spread via contact. However, there is concern about transference from cave to cave by other mammals and people. The fungal spores are in the air and there is a chance that cave-dwelling mammals can transfer them on their hair, and people can transfer them on their clothes, and equipment. This is a problem if people are visiting multiple bat caves without thoroughly decontaminating their equipment. There are currently nine (9) known species of bat that have contracted WNS including the endangered Indiana myotis (*Myotis sodalis*). The biggest impact so far has been seen with the little brown bat (*Myotis lucifugus*) (as pictured), but it has the potential to affect any North American bat that hibernates. The fungus grows on their nose, ears, and wing membranes causing flight problems. It also irritates the bats, causing them to emerge too soon from hibernation. Awakening too early or too frequently depletes their fat reserves and they often freeze or starve to death.

Since its discovery in 2006, WNS has killed over an estimated 5.7 million bats. Originally detected in New York, WNS has spread across the eastern United States through 21 states and four (4) Canadian provinces.

WIND FARMS

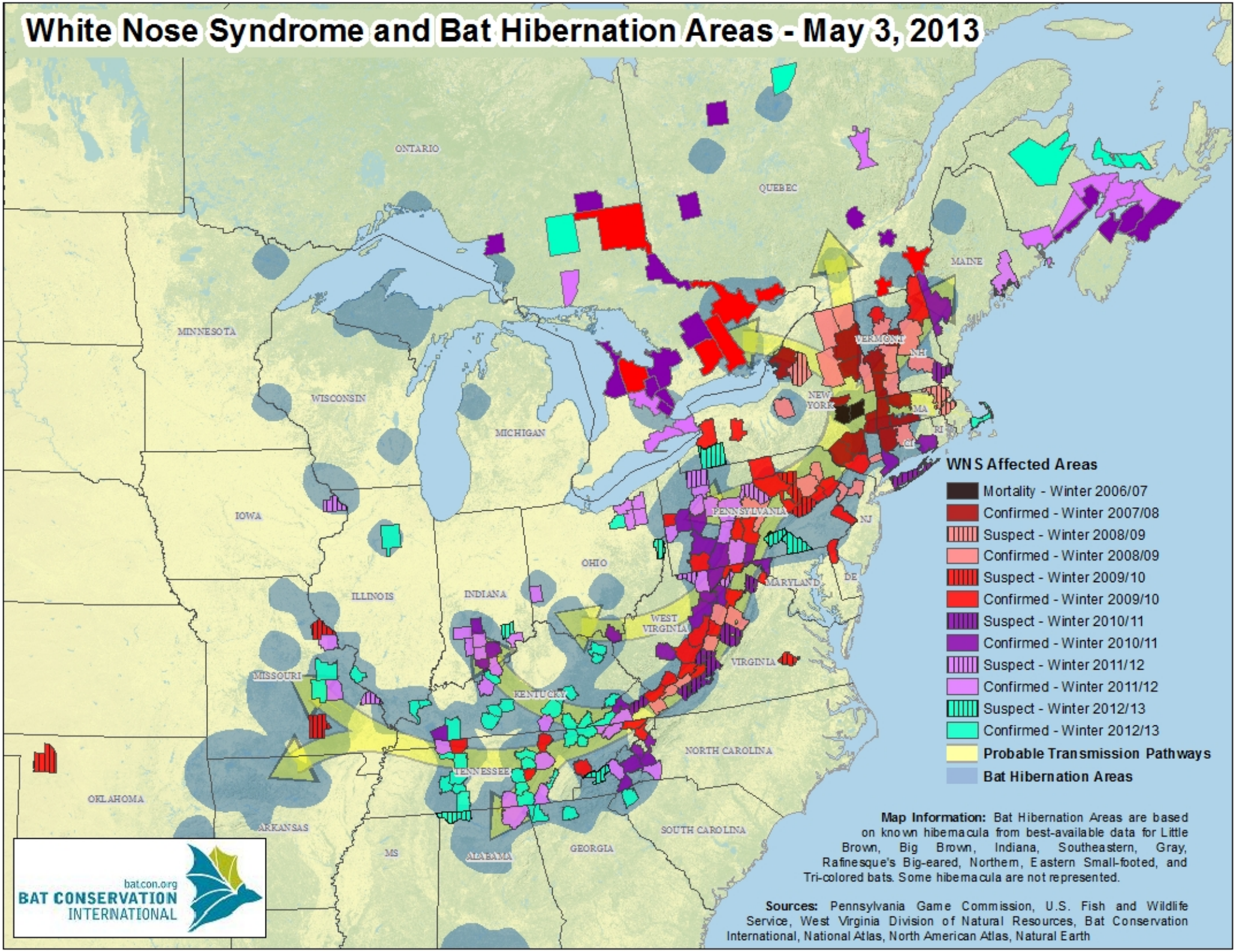
While humans are always looking for a renewable source of energy, wind farms can be a problem for wildlife. Up to 250,000 bats are killed annually due to wind energy turbines.

Little is known about why this is occurring, but Bat Conservation International (BCI), the U.S. Fish and Wildlife Service, the American Wind Energy Association (AWEA), and the National Renewable Energy Laboratory of the U.S. Department of Energy (NREL) teamed up in 2003 to form the Bats and Wind Energy Cooperative (BWEC). Their goal is to understand, and hopefully prevent future fatalities.

HABITAT LOSS

Loss of habitat is a growing concern for bat populations, especially in Texas. Over 90% of the land in Texas is privately owned. This means that the people own their own land and are responsible for taking care of the land and the wildlife on that land. To decrease the loss of bat habitat, people, both landowners and non-landowners alike, need to be aware of bat colonies and need to avoid bothering roosting colonies. Usual bat roosting habitats, such as old growth forests, caves, and rock shelters are being disturbed and destroyed. Additionally, bats are often displaced from buildings and bridges they choose as an alternative shelter.
Drought problems cause bats to travel twice as far to find a non-polluted water source.
Pesticides can harm insectivorous bats and will reduce the number of insects that are available to eat.
All of these problems will affect the overall health and stamina of bats, which in turn make them more exposed to predators and weather extremes.

White Nose Syndrome and Bat Hibernation Areas - May 3, 2013



PREDATORS OF BATS

A PowerPoint Show of pictures from this document can be found on the included CD.
A video of a Red-tailed Hawk hunting Mexican free-tailed bats can be found on the included CD.

Due to their nocturnal nature and ability to fly, bats do not have many natural predators. The only two birds in the world that feed primarily on bats are the Bat Falcon (*Falco rufigularis*) found in Mexico, Central and South America, and the Bat Hawk (*Machaeramphus alcinus*) found in Africa and New Guinea.

Some raptor species such as the Red-tailed Hawk (*Buteo jamaicensis*) (shown in the left picture) found nationwide, are often seen circling the funnel of bats emerging from their roost. They are swift, acrobatic birds that are able to catch the bats on the wing.

Certain species of snake, like the Texas rat snake (*Elaphe obsoleta*) (shown in the right picture) are able to catch bats emerging from caves. The snake will wait by the entrance of the cave or on a nearby branch until a bat flies close enough for it to snatch out of the air.

Even some mammal species prey on bats, such as the northern raccoon (*Procyon lotor*) and Virginia opossum (*Didelphis virginiana*). These species are commonly seen in caves, waiting for a bat to fall, or leave the cave.

BATS AND RABIES

A public health guide

What is rabies and how do people get it?

Rabies is an infectious viral disease that affects the nervous system of humans and other mammals. People get rabies from the bite of an animal with rabies (a rabid animal). Any wild mammal, like a raccoon, skunk, fox, or bat, can have rabies and transmit it to people. It is also possible, but quite rare, that people may get rabies if infectious material from a rabid animal, such as saliva, gets directly into their eyes, nose, mouth, or a wound.

Because rabies is a fatal disease, the goal of public health is, first, to prevent human exposure to rabies by education and, second, to prevent the disease by anti-rabies immunization if exposure occurs. Tens of thousands of people are successfully vaccinated each year after being bitten by an animal that may have rabies. However, a few people die of rabies each year in the United States, usually because they do not recognize the risk of rabies from the bite of a wild animal and do not seek medical advice.

Why should I learn about bats and rabies?

Most of the recent human rabies cases have been caused by rabies viruses associated with bats. Awareness of the facts about bats and rabies can help people protect themselves, their families, and their pets. This information may also help clear up misunderstandings about bats.

There are many rumors and legends about bats which are not true. Bats are not blind. They are neither rodents nor birds. Only three species in Latin America feed on blood after inflicting small bite wounds – and most bats do not have rabies. Bats play key roles in ecosystems around the globe, from rain forests to deserts, especially by eating insects, including agricultural pests. The best protection we can offer these unique mammals is to learn more about their habits and recognize the value of living safely with them.

Cover photo: Eastern red bats, like this mother and her pups roost in trees across most of eastern North America. Most bats bear only one pup each, but red bats often give birth to twins and have as many as five offspring. Adults usually roost alone.

DEPARTMENT OF HEALTH & HUMAN SERVICES USA
BAT CONSERVATION INTERNATIONAL www.batcon.org
CDC CENTERS FOR DISEASE CONTROL AND PREVENTION
U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

Mexican free-tailed bats roost in caves, mines and under bridges, forming colonies that can number in the millions. They eat enormous amounts of insects, including many costly agricultural pests.

How can I tell if a bat has rabies?

Rabies can be confirmed only in a laboratory. However, any bat that is active by day, found in a place where bats are not usually seen (for example, in a room in your home or on the lawn), or unable to fly, is far more likely than others to be rabid. Such bats are often the most approachable. Because there is no guarantee that a rabid bat will behave any differently than a normal one, it is best never to handle any bat.

What should I do if I come in contact with a bat?

If you are bitten by a bat – or if infectious material (such as saliva) from a bat gets into your eyes, nose, mouth, or a fresh wound – wash the affected area thoroughly with soap and water and get medical advice immediately. Whenever possible, the bat should be captured and sent to a laboratory for rabies testing (see "How can I safely capture a bat in my home?").

People usually know when they have been bitten by a bat. However, because bats have small teeth which may leave marks that are not easily seen, there are situations in which you should seek medical advice even in the absence of an obvious bite wound. For example, if you are a deep sleeper or using sleep medications and find a bat in your room of if you see a bat in the room of an unattended child or near a mentally impaired or intoxicated person, seek medical advice and have the bat tested.

People cannot get rabies just from seeing a bat in an attic, in a cave, or at a distance. In addition, people cannot get rabies from having contact with bat guano (feces), blood, or urine, or from touching a bat on its fur (even though bats should never be handled!).

What should I do if my pet is exposed to a bat?

If you think your pet or domestic animal has been bitten by a bat, immediately contact a veterinarian or your health department for assistance and have the bat tested for rabies. Remember to keep vaccinations current for cats, dogs, and other animals.

Big brown bats usually live under the bark or in cavities of trees, as well as in various buildings. They feed mostly on beetles, but also hunt an assortment of night-flying insects.

How can I keep bats out of my home?

Some bats live in buildings, and there may be no reason to evict them if there is little chance for contact with people. However, bats should always be prevented from entering rooms of your home. For assistance with "bat-proofing" your home, contact an animal-control or wildlife conservation agency. If you choose to do the "bat-proofing" yourself, here are some suggestions. Carefully examine your home for holes

that might allow bats entry into your living quarters. Any openings larger that a quarter-inch by a half-inch should be caulked. Use window screens, chimney caps, and draft-guards beneath doors to attics, fill electrical and plumbing holes with steel wool or caulking, and ensure that all doors to the outside close tightly.

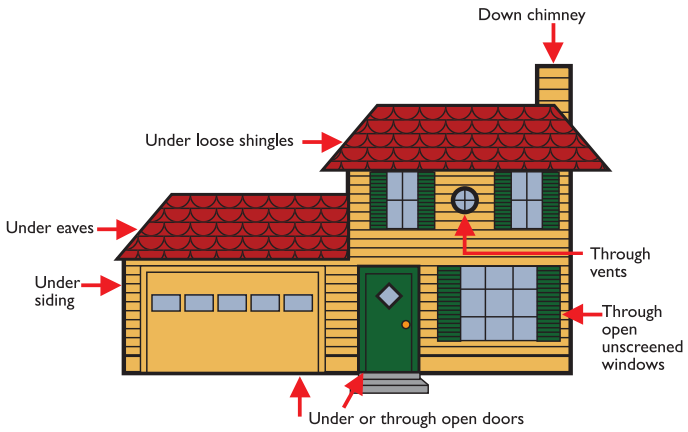
Additional "bat-proofing" can prevent bats from roosting in attics or buildings by covering outside entry points. Observe where the bats exit at dusk and exclude them by loosely hanging clear plastic sheeting or bird netting over these areas. Bats can crawl out and leave, but cannot reenter. After the bats have been excluded, the openings can be permanently sealed. For more information about "bat-proofing " your home, visit Bat Conservation International's website (see end of brochure).

Things to remember when "bat-proofing"

- During summer, many young bats are unable to fly. If you exclude adult bats during this time, the young may be trapped inside. Thus, if possible, avoid exclusion from May through August.

- Most bats leave in the fall or winter to hibernate, so these are the best times to "bat-proof" your home.

Common Bat Entry Points

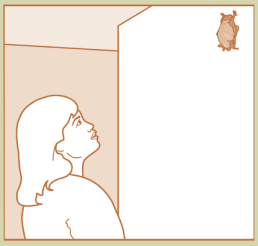


How can I safely capture a bat in my home?

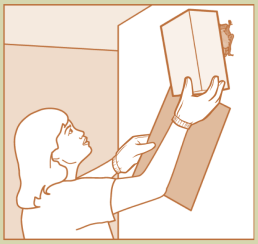
If a bat is present in your home and you cannot rule out the possibility of exposure, leave the bat alone and contact an animal-control or public health agency for assistance. If professional help is unavailable, use precautions to capture the bat safely, as described below.

What you will need:

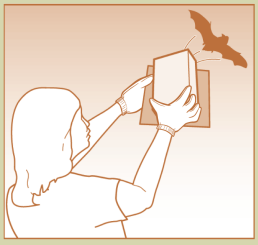
- leather work gloves (put them on)
- small box or coffee can
- piece of cardboard
- tape



When the bat lands, approach it slowly, while wearing the gloves, and place the box or coffee can over it. Slide the cardboard under the container to trap the bat inside. Tape the cardboard to the container securely, and punch small holes in the cardboard, allowing the bat to breathe. Contact your health department or animal-control authority to make arrangements for rabies testing.



If you see a bat in your home and you are sure no human or pet exposure has occurred, confine the bat to a room by closing all doors and windows leading out of the room except those to the outside. The bat will probably leave soon. If not, it can be caught, as described, and released outdoors away from people and pets.



Silver-haired bats often roost in hollows and cavities of old-growth trees. Their unique coloration makes them difficult to spot.

How can rabies be prevented?

- Teach children never to handle unfamiliar animals, wild or domestic, even if they appear friendly. "Love your own, leave other animals alone" is a good principle for children to learn.
- Wash any wound from an animal thoroughly with soap and water and seek medical attention immediately.
- Have all dead, sick, or easily captured bats tested for rabies if exposure to people or pets occurs.
- Prevent bats from entering living quarters or occupied spaces in homes, churches, schools, and other similar areas where they might contact people and pets.
- Be a responsible pet owner by keeping vaccinations current for all dogs, cats, and ferrets. Keep your cats and ferrets inside and your dogs under direct supervision, call animal control to remove stray animals from your neighborhood, and consider having your pets spayed or neutered.

Case Study

During October 2008, a 55-year old man and his family noticed a bat that roosted in the rafters of their porch for several days before it flew into their house. The man captured the bat and allowed it to crawl up his arm and neck where it bit him on the ear. At the time, the man mentioned the possibility of rabies to his family, but did not report the incidence to public health authorities or seek medical advice. The man left the bat unrestrained in the house for two days before releasing the bat after concluding that it was not sick. Four to six weeks later, the man became sick and died of rabies. Diagnostic testing confirmed a rabies virus variant associated with bats.

This case demonstrates several points:

- Unlike cats, dogs, and ferrets there is no observation period that can safely rule out the possibility of rabies transmission from a bat or other wild animal exposures.
- Persons should never handle wild animals. If contact with the bat had been avoided the bite most likely would not have occurred. If a wild animal is easily approachable, rabies should be suspected.
- If the bat had been submitted for rabies testing instead of released, a positive test could have led to life-saving rabies vaccination.

Remember, in situations in which a bat is physically present and you cannot reasonably rule out having been bitten, safely capture the bat for rabies testing and seek medical attention immediately.

The little brown bat is one of America's most abundant and widespread species. It is often found roosting in attics or barns.

Hoary bats have long, white-tinged fur that gives them a frosted appearance. They eat moths and a wide range of other insects.

Are bats beneficial?

Yes. Worldwide, bats are a major predator of night-flying insects, including pests that cost farmers billions of dollars annually. Throughout the tropics, seed dispersal and pollination activities by bats are vital to rainforest survival. In addition, studies of bats have contributed to medical advances, including the development of navigational aids for the blind. Unfortunately, many local populations of bats have been destroyed and many species are now endangered.

Where can I learn more about bats?

Contact your state or local wildlife conservation agency or Bat Conservation International:

Bat Conservation International, Inc.
P O Box 162603Austin, Texas 78716
www.batcon.org

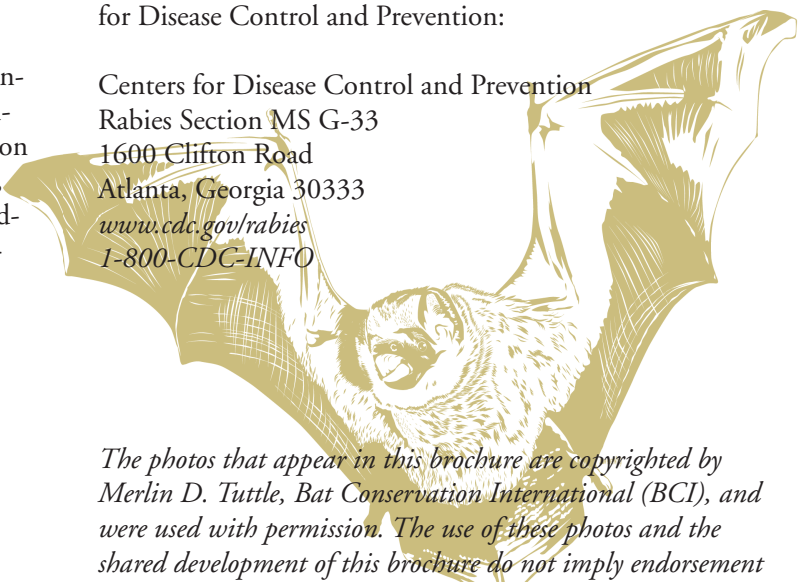
To learn more about endangered bats and the Endangered Species Act, contact the U S Fish and Wildlife Service:

U S Fish and Wildlife Service
Division of Endangered Species
4401 N. Fairfax Drive, Room 452
Arlington, Virginia 22203
www.fws.gov

Where can I learn more about rabies?

Contact your state or local health department or the Centers for Disease Control and Prevention:

Centers for Disease Control and Prevention
Rabies Section MS G-33
1600 Clifton Road
Atlanta, Georgia 30333
www.cdc.gov/rabies
1-800-CDC-INFO



Here's what to do

If There's a Bat in my School!

First, don't panic. NEVER TOUCH A BAT OR ANY OTHER WILD ANIMAL.
Notify a teacher or other school official immediately.

- Bats are usually shy and gentle animals, and you cannot get rabies from just seeing a bat or being in a room or hallway with one.

- A bat that is being handled might bite in self-defense. A bat that you can approach – one that cannot fly, is on the floor or clinging to a wall – is much more likely than other bats to be sick or injured and might have rabies.

- Again: Never touch any wild animal.

- If you see a bat in your school, do not approach it or touch it. Don't pet it, catch it, comfort it, kick it aside or try to shoo it away. Stay back and call an adult.

- If you are bitten or come in direct contact with a bat, don't wait: Tell an adult immediately and get medical attention. A doctor's treatment after a bite is simple and effective.

Remember: Bats are usually excellent neighbors that just want to be left alone. Most of them spend their nights eating huge amounts of moths, beetles, mosquitos and other bugs that pester us in our backyards and damage crops that farmers grow. Other bats pollinate plants, just as bees and hummingbirds do, and scatter seeds that help forests grow.

Many people fear bats because they don't know anything about them. And a lot of what people think they know about bats is just wrong: Bats are not blind, they aren't flying mice and they certainly won't get tangled in your hair. Bats are very handy to have around.

Just don't ever touch a bat.

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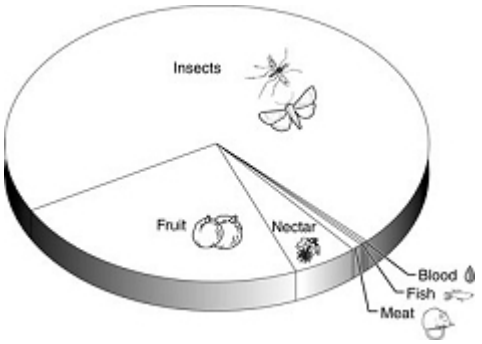
Benefits of Bats



Bats are hard at work around the world, fulfilling tasks that are vital to healthy ecosystems and human economies. Many of the more than 1,100 bat species consume vast amounts of insects, including some of the most damaging agricultural pests.

Others pollinate countless plants, ensuring the production of fruits that support local economies, as well as diverse animal populations. Fruit-eating bats in the tropics disperse seeds that are critical to restoring cleared or damaged rainforests. Even bat droppings (called guano) are valuable as a rich natural fertilizer. Guano was a major natural resource in the United States a century ago, and it's still mined commercially in many countries.

Some biologists consider bats a "keystone" component of ecosystems in parts of the tropics and deserts. Without bats' pollination and seed-dispersing services, local ecosystems could gradually collapse as plants fail to provide food and cover for wildlife species near the base of the food chain. Consider the great baobab tree of the East African savannah. It is so critical to the survival of so many wild species that it is often called the "African Tree of Life." Yet it depends almost exclusively on bats for pollination. Without bats, the Tree of Life could die out, threatening one of our planet's richest ecosystems.

Pest control

Insectivorous bats are primary predators of night-flying insects, and many very damaging pests are on their menu. Pregnant or nursing mothers of some species will consume their body weight in insects each night. A single little brown bat can eat more than 1,000 mosquito-sized insects in just one hour.

The millions of Mexican free-tailed bats at BCI's Bracken Cave in Central Texas eat up to 200 tons of insects each summer night. And a favorite target of Mexican freetails in the United States and Mexico is an especially damaging moth called the corn earworm moth (aka cotton bollworm, tomato fruitworm, etc.) that attacks a host of commercial plants from artichokes to watermelons. Worldwide crop damage from this moth is estimated at more than $1 billion a year, and recent research concluded that freetails are so effective that they save farmers in south-central Texas up to $1.7 million a year in pesticide costs. That, of course, means fewer pesticides enter the ecosystem.

Pollinators

From deserts to rainforests, nectar-feeding bats are critical pollinators for a wide variety of plants of great economic and ecological value. In North American deserts, giant cacti and agave depend on bats for pollination, while tropical bats pollinate incredible numbers of plants.

Most flowering plants cannot produce seeds and fruit without pollination – the process of moving pollen grains from the male part of the flower (the stamen) to the female part (the pistil). This process also improves the genetic diversity of cross-pollinated plants. Bats that drink the sweet nectar inside flowers pick up a dusting of pollen and move it along to other flowers as they feed.

A few of the commercial products that depend on bat pollinators for wild or cultivated varieties include: bananas, avocados, dates, figs, peaches, mangoes, durian, cloves, cashews, carob and balsa wood.

Seed dispersers

Vast expanses of the world's rainforest are cleared every year for logging, agriculture, ranching and other uses. And fruit-eating bats are key players in restoring those vital forests. Bats are so effective at dispersing seeds into ravaged forestlands that they've been called the "farmers of the tropics."

Regenerating clear-cut forests is a complex natural process, one that requires seed-scattering by birds, primates and other animals as well as bats. But birds are wary of crossing large, open spaces where flying predators can attack, so they typically drop seeds directly beneath their perches. Night-foraging fruit bats, on the other hand, often cover large distances each night, are quite willing to cross clearings and typically defecate in flight, scattering far more seeds than birds across cleared areas.

And many of the bat-dispersed seeds are from hardy pioneer plants, the first to grow in the hot, dry conditions of clearings. As these plants grow, they provide the shelter that lets other, more delicate plants grow. Seeds dropped by bats can account for up to 95 percent of the first new growth. The pioneer plants also offer cover and perches for birds and primates, so they can add still more, different seeds to the mix that can lead eventually to a renewed forest.

Last Updated: Wednesday, 06 October 2010

The Benefits of Bats

Audience/Group Setting
Event setting

Goal
To nurture respect and caring attitude/behavior toward bats by helping people understand more about their nature and benefits bats bring to nature and people.

Objectives
After the interpretive program, 85% of guests will have enjoyed the program and be able to do at least one of the following:

1. List at least 1 way people benefit from bats (pest control, pollination, bananas, mangoes, tequila)
2. Describe why it is never a good idea to pick up or disturb bats. (i.e. rabies)

Big Idea/Main Message
Bats benefit people.

Conservation Action/Behavior Addressed
Become more aware of bats and what to do to help save them.

Background Information
Bats may be associated with ghosts, goblins and Halloween, but they don't have much in common. Bats are not scary or evil. In fact, they are an incredibly important part of so many environments. Active at night, bats are seldom seen but surprisingly important parts of people's daily lives. Anyone who has ever eaten bananas, mangoes, cashews or even agave, the plant used to make tequila, should thank the fruit bats for helping farmers pollinate and disperse seeds for these plants. Other bats feed on night flying insects and act as important natural pest control. As a result, corn, cotton, cucumber and other farmers save billions of dollars in pesticides. By reducing the need for pesticides, bats not only lower costs for farmers, they also help protect the environment.

Materials Needed
Crops that benefit from bat pollination or seed dispersal (any number of the following):

- Mangoes
- Peaches
- Bananas
- Dates
- Tequila bottle (only use if presenter is over 21)
- Cashews

Crops protected by insect eating bats (any number of the following):

- Corn
- Pickles
- Cucumbers
- Cotton (boll & t-shirt)

Staff
2-3 volunteers

Length of Activity
5-10 minutes

Set up
On a table, group the materials into items benefited by bat pollination or seed dispersal and items protected by insect eating bats.

Procedure
1. Ask guests if they enjoy consuming any of the products on the table.
2. If they reply "yes" discuss some of the benefits of bats (choose which facts to provide based on which items they find interesting):
    a. FRUIT AND NECTAR EATING bats help pollinate and/or disperse seeds for bananas, mangoes, cashews, tequila, peaches, figs, dates. Tequila is produced from agave plants whose seed production drops to 1/3,000th of normal without bat pollinators.
    b. INSECT EATING bats help protect cucumbers, corn, and cotton. This saves farmers billions on pesticides and helps protect the environment.
3. Discuss other ways bats benefit people:
    a. BAT DROPPINGS in caves support whole ecosystems of unique organisms, including bacteria useful in detoxifying wastes, improving detergents, and producing gasohol (fuel mixture of 10% anhydrous ethanol and 90% gasoline that can be used in internal combustion engines) and antibiotics.
    b. RAINFOREST RENEWAL - Tropical bats are key elements in rain forest ecosystems which rely on them to pollinate flowers and disperse seeds for countless trees and shrubs.
    c. DRACULIN - An anticoagulant used to treat human heart attack and stroke patients was developed from VAMPIRE bat saliva (many people are afraid of vampire bats – it is important to note that there are no vampire bats in the U.S. – of the over 1,100 species of bats, only 3 species are vampire bats – all vampire bats live in tropical climates in the new world (Mexico, Central/S America) - feed mostly on sleeping livestock who often have no idea they've been bitten.)
    d. Navy researchers have patterned some SONAR systems after the bats' ECHOLOCATION. (By making high frequency calls either out of their mouths or noses and then listening for echoes to bounce from the objects in front of them, bats are able to form pictures in their brains. In this way, bats are able to comfortably move around at night, avoiding predators, maneuvering around obstacles, locating their food, and capturing insects in total darkness.

e. Bats can be a TOURIST ATTRACTION. It is estimated that more than 100,000 people visit Congress Ave Bridge in Austin, TX to witness the bats leaving the bridge on their nightly flight. This generates $10,000,000 in tourism revenue annually.
f. BATS OFTEN GET A BAD RAP - Contrary to popular misconception, bats are not blind or dirty. They do not become entangled in human hair and seldom transmit disease to other animals or humans. Like dogs, cats and all other mammals, bats can contract RABIES. However, it is estimated that less than a half of one percent of bats may contract rabies. Even rabid bats normally bite only in self-defense and pose little threat to people who do not handle them. NEVER PICK UP ANY BAT – IF YOU CAN CATCH IT, IT'S LIKELY SICK.
g. WE NEED BATS AND THEY NEED US - Bats are exceptionally vulnerable to extinction, in part because they are the slowest reproducing mammals on earth for their size, most producing only one young annually. More than 50% of American bat species are in severe decline. Scientists are baffled by a disease called White-Nosed Syndrome that is affecting cave bats in the US.

Attracting Bats

What are my chances of attracting bats? How will bats find my bat house? How long does it take? Can I "bait" my bat house with something to speed up the process? These are just some of the most frequently asked questions about bat houses. This page will help answer the basics about attracting bats and about being a responsible bat house landlord. For more information, please consult the *The Bat House Builder's Handbook*, available at Bat Conservation International's online catalog: *www.batcatalog.com*.

The odds of attracting bats are very good for well-designed, well-built bat houses mounted according to recommendations developed by the Bat House Project during 12 years of bat house research by BCI and its volunteer Research Associates across the U.S., Canada and the Caribbean. Here are a few of our latest results:

•Bats inhabited an average of 60 percent of all reported bat houses (both good and bad houses and installations) in BCI's 1999 to 2001 annual surveys.

•Occupancy in rural areas was 61 percent, compared to 50 percent for urban and suburban areas.

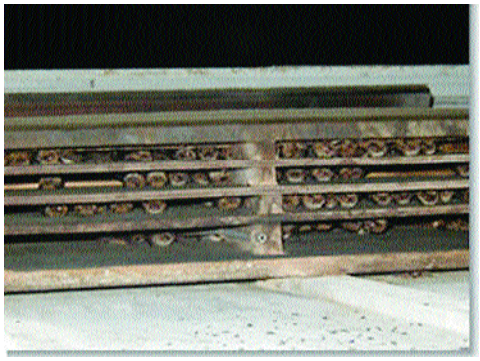
•90 percent of occupied bat houses were used within two years (with 50 percent occupancy in the first year). The rest needed three to five years for bats to move in.

•Tall designs like the multi-chamber (nursery) and rocket-style houses performed best in our surveys. For example, 80 percent of 123 houses with chambers at least 25 inches tall were occupied in 2000.

Attracting bats – Bats have to find new roosts on their own. Existing evidence strongly suggests that lures or attractants (including bat guano) will *NOT* attract bats to a bat house. Bats investigate new roosting opportunities while foraging at night, and they are expert at detecting crevices, cracks, nooks and crannies that offer shelter from the elements and predators. Bat houses installed on buildings or poles are easier for bats to locate, have greater occupancy rates and are occupied two and a half times faster than those mounted on trees.

Unlike domestic animals, bats are wild and free-ranging. It is usually illegal to buy or sell them, and permits to capture and possess bats are generally limited to researchers, zoos, wildlife rehabilitators and educational organizations. Catching and relocating bats to new areas is, in any case, highly unlikely to succeed. Bats have strong homing instincts, and once released into a bat house, will attempt to return to their former home area. Consequently, placing bats in a bat house is usually futile and is not recommended. If a bat house remains unoccupied after two full years, consider repositioning of modifying the house.

Temperatures – Maintaining proper roost temperatures is probably the single most important factor for a successful bat house. Interior temperatures should be warm and as stable as possible (ideally 80º F to 100º F in summer) for mother bats to raise their young. Some species, such as the big brown bat, prefer temperatures below 95º F, while others, such as the little brown bat, tolerate temperatures in excess of 100º F. Bachelor bats are less picky and may use houses with cooler temperatures. The sides of wooden or masonry structure are the best mounting sites, especially in colder climates, because temperatures are more stable than for houses attached to poles.



Bat house temperatures are influenced directly by the exterior color, compass orientation (east-, southeast-, or south-facing are generally good bets for single houses in most climates), the amount of sun exposure, how well the house is caulked and vented, and the mounting and construction materials. You may have to experiment to get the right placement and temperature range. You can always use a thermometer taped to a pole to see if temperatures are suitable inside the bat house (check the chambers high and low, and front and back).

Installation sites – Pick installation sites with care so you don't have to move it after it is occupied. Most bat houses have open bottoms, which keeps guano from accumulating inside. Guano will, however, end up on the ground underneath, so avoid placing bat houses directly above windows, doors, decks or walkways. Bat urine may stain some finishes. Two- or four-inch spacers between a bat house and the wall, a large backboard or a longer landing area below a bat house may reduce guana deposits on the wall. A potted plant or a shallow tray or plant saucer can be placed underneath a bat house to collect bat guano for use as fertilizer in flower beds or gardens. Do not use a bucket or deep container (unless 1/4-inch or smaller mesh covers the entire top of the container), as any baby bats that fall from the bat house could become trapped inside.

Maintaining your bat house – Once you have attracted bats, you must maintain the bat houses to keep bats coming back year after year. Wasp and mud dauber nests should be cleaned out each winter after bats and wasps have departed. New caulk and paint or stain may be required after three to five years to guard against leaks and drafts. Bat houses should be monitored at least once a month (preferably more often) to detect potential problems such as predators, overheating, wood deterioration, etc. Any repairs or cleaning should be performed when bats are not present.

We wish you the best of luck with your bat houses.

BAT CONSERVATION
INTERNATIONAL
www.batcon.org

Criteria for Successful Bat Houses

Whether you build or buy a bat house, make sure the dimensions meet the criteria below. Following these construction and installation guidelines will greatly increase your odds of attracting bats. These recommendations are based on 12 years of bat-house research conducted across the U.S, Canada and the Caribbean. Small, poorly made houses commonly sold in stores or any house improperly installed are likely to fail. Much more information is available in BCI's *Bat House Builder's Handbook*, available online at *www.batcatalog.com*.

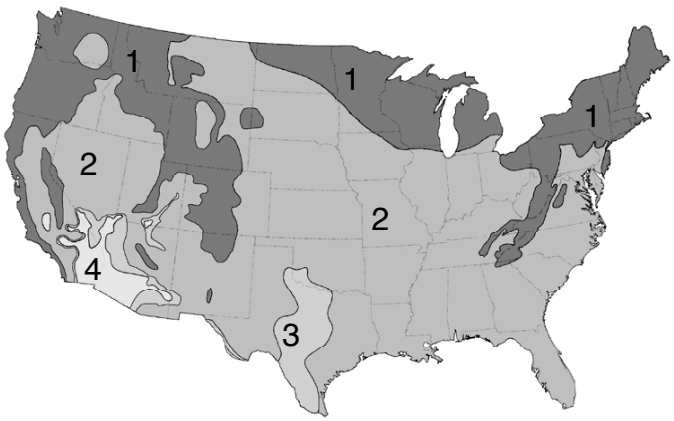
1. Design – All bat houses should be at least 2 feet tall, have chambers at least 20 inches tall and 14 inches wide, and have a landing area extending below the entrance at least 3 to 6 inches (some houses feature recessed partitions that offer landing space inside). Taller and wider houses are even better. Rocket boxes should be at least 3 feet tall and have at least 12 inches of linear roost space. Most bat houses have one to four roosting chambers – the more the better. Roost partitions should be carefully spaced 3/4 to 1 inch apart. All partitions and landing areas should be roughened. Wood surfaces can be scratched or grooved horizontally, at roughly 1/4- to 1/2-inch intervals, or covered with durable, square plastic mesh (1/8- or 1/4-inch mesh).

Where average July high temperatures are 85° F or more, include vents approximately 6 inches from the bottom of all houses that are 24 to 32 inches tall. Front vents should be as long as a house is wide, side vents 6 inches tall by 1/2-inch wide. Houses 36 inches tall or more should have vents approximately 10 to 12 inches from the bottom.

2. Construction – For wooden houses, a combination of exterior plywood (ACX, BCX or T1-11 grade) and cedar is best. Plywood for bat-house exteriors should be at least 1/2-inch thick with at least four plies. Do not use pressure-treated wood. Any screws, hardware or staples used must be exterior grade (galvanized, coated, stainless, etc). To increase longevity, use screws rather than nails. Caulk all seams, especially around the roof. Alternative materials, such as plastic or fiber-cement board, may last longer and require less maintenance.

3. Wood Treatment – For the exterior, apply three coats of exterior grade, water-based paint or stain. Available observations suggest that color should be black where average high temperatures in July are less than 85° F, dark colors (such as dark brown or dark gray) where they are 85° to 95° F, medium colors where they are 95° to 100° F and white or light colors where they exceed 100° F. Much depends upon amount of sun exposure; adjust to darker colors for less sun. For the interior, use two coats dark, exterior grade, water-based stain. Apply stain after creating scratches or grooves or prior to stapling plastic mesh. Paint fills grooves, making them unusable.

Bat house color recommendations and average daily high temperatures in July



Areas	Wooden Houses	Plastic/Stucco Houses
1) Dark areas:	black	dark color
2) Medium:	dark or medium color	medium color
3) Light:	medium color	light color
4) Lightest:	white or light color	light color

4. Sun Exposure - Houses where high temperatures in July average 80° F or less, should receive at least 10 hours of sun, and more is better. At least six hours of direct daily sun is recommended for all bat houses where July's daily highs average less than 100° F. Full, all-day sun is often successful in all but the hottest climates. To create favorable conditions for maternity colonies in summer, internal bat-house temperatures should stay between 80° F and 100° F as long as possible.

5. Habitat – Most nursery colonies of bats choose roosts within 1/4 mile of water, preferably a stream, river or lake. Greatest bat-house success has been achieved in areas of diverse habitat, especially where there is a mixture of varied agricultural use and natural vegetation. Bat houses are most likely to succeed in regions where bats are already attempting to live in buildings.

6. Mounting – Bat houses should be mounted on buildings or poles. Houses mounted on trees or metal siding are seldom used. Wood, brick or stone buildings with proper solar exposure are excellent choices, and houses mounted under eaves are often successful. Single-chamber houses work best when mounted on buildings. Mounting two bat houses back-to-back on poles (with one facing north and the other south) is ideal. Place houses 3/4-inch apart and cover both with a galvanized metal roof to protect the center roosting space from rain. All bat houses should be mounted at least 12 feet above ground, and 15 to 20 feet is better. Bat houses should not be lit by bright lights.

7. Protection from Predators – Houses mounted on the sides of buildings or on metal poles provide the best protection from predators. Metal predator guards may be helpful, especially on wooden poles. Bats may find bat houses more quickly if they are located along forest or water edges where bats tend to fly. However, they should be placed at least 20 to 25 feet from the nearest tree branches, wires or other potential perches for aerial predators.

8. Avoiding Uninvited Guests – Wasps can be a problem before bats fully occupy a house. Use of 3/4-inch roosting spaces reduces the risk of wasps. If nests accumulate, they should be removed in late winter or early spring before either wasps or bats return. Open-bottom houses greatly reduce problems with birds, mice, squirrels or parasites, and guano does not accumulate inside.

9. Timing – Bat houses can be installed at any time of the year, but they are more likely to be used during their first summer if installed before the bats return in spring. When using bat houses in conjunction with excluding bats from a building, install the bat houses at least two to six weeks before the actual eviction, if possible.

10. Importance of Local Experimentation – It is best to test for local needs before putting up more than three to six houses. Compare houses of different colors or shades and sun exposure.

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Bat Mask Activity

California leaf-nosed bat

Materials:
- Heavy paper
- Crayons or color markers
- Scissors
- Hole punch
- Elastic band or Popsicle stick

Background Information
One of the most fascinating aspects of bats is their facial anatomy. The great diversity of face types is due to differences in lifestyle and diet. For example, some bats that feed on nectar need long, thin faces to insert into flowers, while insect-eating bats have shorter muzzles and stronger jaws to chomp down on insects.

Copy the mask on heavy paper or card stock, cut out the bat face, punch holes on both sides and attach elastic band to keep it in place. Or, you can glue Popsicle-type sticks to the inside bottom of the mask so the child can hold it in front of his or her face. Children can use their imaginations when coloring the masks.

California leaf-nosed bat

This bat is called a “gleaner” because it snatches crickets, grasshoppers, beetles, moths and other insects off leaves or the ground as it flies above the desert floor. It has larger eyes than most insectivorous bats. Its huge ears, which give it excellent hearing, enable it to hear even the footsteps of walking insects. The California leaf-nosed bat lives in the western United States and Mexico.

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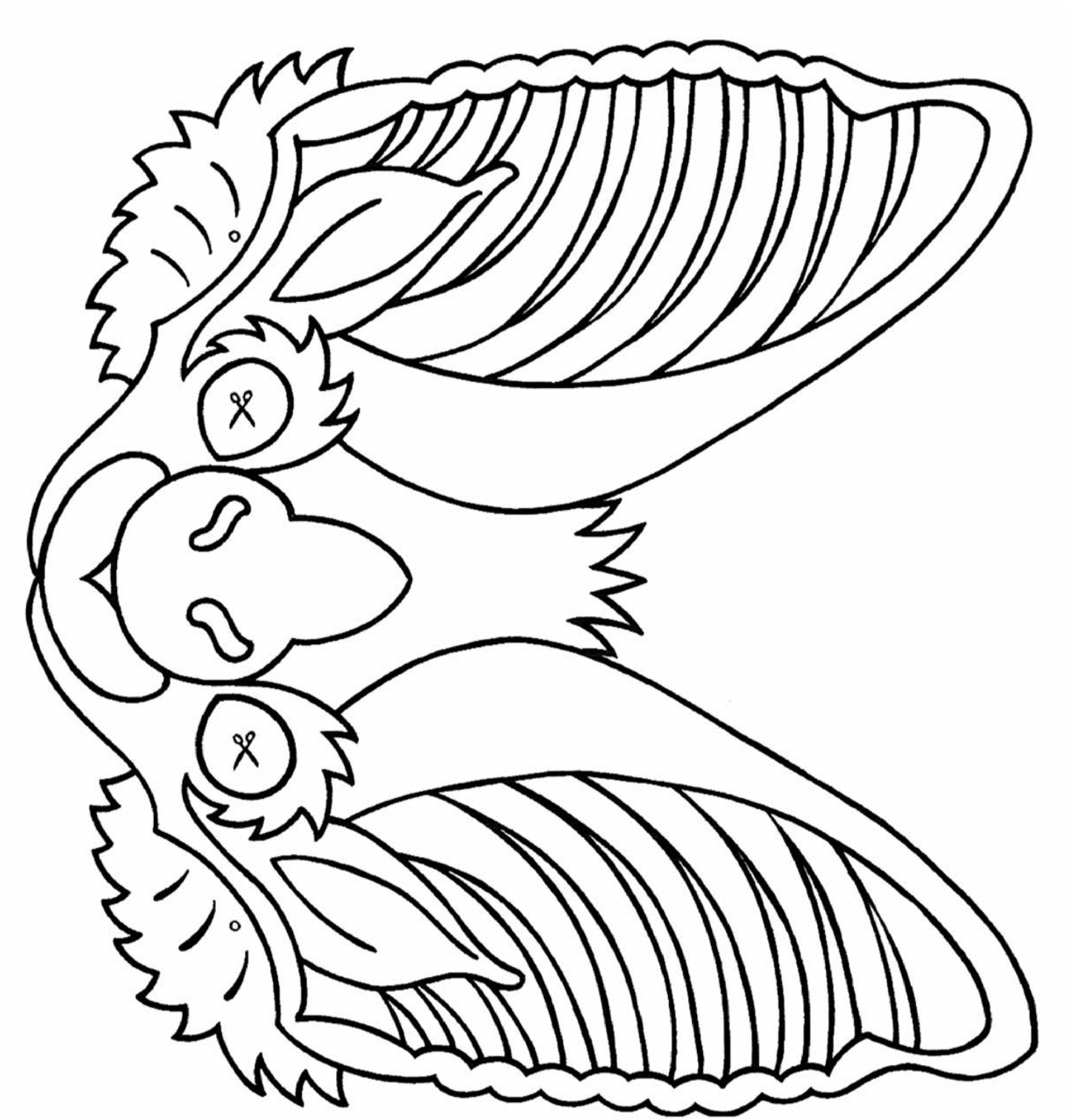

California leaf-nosed bat

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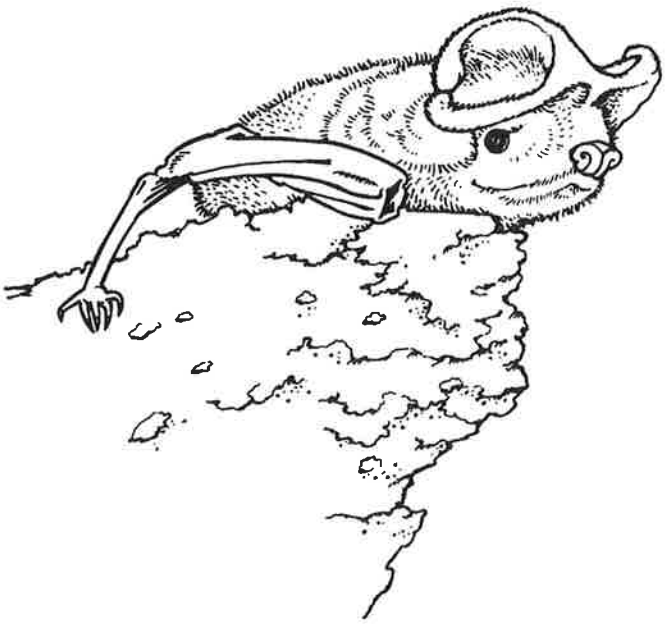

Eumops perotis, **greater bonneted bat**

Leptonycteris yerbabuenae, **lesser long-nosed bat**

Myotis grisescens, **gray myotis**

Corynorhinus townsendii,
Townsend's big-eared bat

Choose your answers

blind
caves
chiroptera
colony
echolocation
endangered
fox
insects
insectivorous
mammal
nocturnal
one
pollinate
pup
sonar
thousand

Across

1. An animal that is active at night is called _____.
2. All bats can see; no bats are _____.
3. The scientific name for bats, which means hand-wing, is _____.
4. A kind of bat whose face looks like a dog is a flying _____.
5. A bat that feeds on insects is called _____.
6. Most mother bats produce only _____ (how many) baby a year.
7. Many bats spend part of the year living in _____.
8. Echolocation used by bats is a kind of _____.

Down

1. The process of navigating and locating food using sound is called _____.
2. A bat is a _____.
3. Nectar bats _____ flowers, just like hummingbirds.
4. An animal that is disappearing is said to be _____.
5. There are more than a _____ (how many) kinds of bats.
6. A baby bat is called a _____.
7. About 70% of all bats eat_____.
8. A group of bats living together is called a _____.

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Answers
Across: 1. nocturnal; 2. blind; 3. chiroptera; 4. fox; 5. insectivorous; 6. one; 7. caves; 8. sonar.
Down: 1. echolocation; 2. mammal; 3. pollinate; 4. endangered; 5. thousand; 6. pup; 7. insects; 8. colony.

Choose your answers

caves
sound
blind
night
hand
mammal
one
pup
endangered
bats
fly
insects

Across

1. Bats are the only kind of mammal that can _____.
2. An animal that is disappearing is said to be _____.
3. Most mother bats produce only _____ (how many) baby each year.
4. A bat is a _____.
5. Most bats are active only at _____.
6. Many bats use _____ to navigate and find food.

Down

1. Most bats in the world eat _____.
2. _____ are the only mammals that truly fly.
3. A baby bat is called a _____.
4. A bat's wing is very similar to our own _____.
5. All bats can see, no bats are _____.
6. Many bats spend at least part of the year living in _____.

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Answers
Across: 1. fly; 2. endangered; 3. one; 4. mammal; 5. night; 6. sound.
Down: 1. insects; 2. Bats; 3. pup; 4. hand; 5. blind; 6. caves.

Texas Wildlife Association presents....

Critter Connections

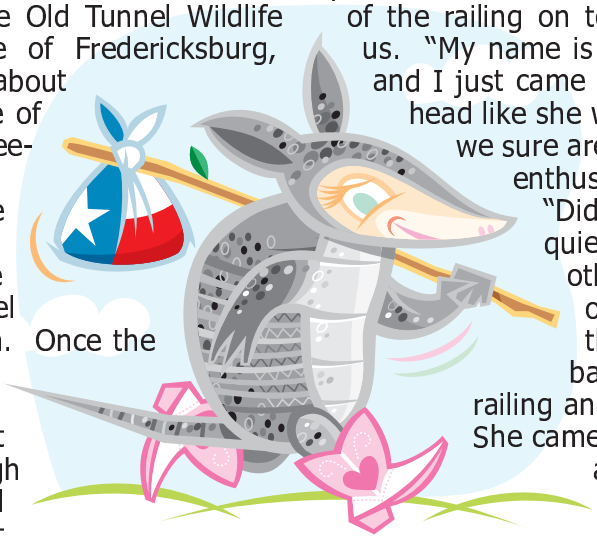
March 2010 | Kid's Quarterly Mini-Mag! | Vol. 4 No. 1

Postcards from Nancy... By Sarah Stannard

Howdy TWA,

Grant and I just arrived at the Old Tunnel Wildlife Management Area, just outside of Fredericksburg, Texas. We are here to learn more about bats and the Old Tunnel has one of the largest colonies of Mexican Free-tailed Bats in the whole state!

This afternoon we explored some of the trails of the area and learned that the cave the bats inhabit here is actually an old railroad tunnel that trains used to travel through. Once the railroad tracks were removed in 1942, the bats decided to use it as a second home when they visit from Mexico every March through October. Each year, the tunnel hosts up to three million bats at a time!



Tonight, we sat along the rim of the tunnel entrance and waited for the sun to go down to see if we could see any bats coming out to feed. The bats are nocturnal so they sleep in the tunnel during the day and head out at night to catch insects. We waited patiently and soon saw a few dark shadows swooping high above our heads. We stared in awe at how awesome they were at flying—zig-zagging in between the tree branches and rock walls so effortlessly.

I guess they saw us looking at them because soon we heard a high-pitched "Hellllllooooo, down there!" I screamed "Hello, up there!" excitedly and waited to see if the shadow I was talking to would move closer. "Hola!" a shadow squeaked as it landed squarely on the side of the railing Grant and I were leaning against. I looked excitedly over the edge to see a tiny furry brown-bodied creature with blackish, leathery looking wings. "Hola!" I said. "My name is Nancy and this is my buddy, Grant. What is your name?" The little bat climbed carefully up the side of the railing on to the top to get a better look at us. "My name is Frida," she whispered. "My family and I just came in from Mexico." Frida turned her head like she was listening for something. "Well, we sure are glad to meet you!" Grant shouted enthusiastically. "Shhhhhhh!" said Frida. "Did you hear that?" she questioned quietly. Grant and I looked at each other and listened carefully. Neither of us could hear anything except the wind. "Hear what?" I whispered back. Suddenly, Frida leapt off the railing and swished away into the darkness. She came back less than a minute later with a big, juicy moth in her moth.

"Wow! How did you find that fella?" Grant asked. "I heard him flying in those trees over there," said Frida. "How in the world could you hear a moth flying?" I inquired. "They are pretty quiet when they move." Frida waved her wings to her ears and explained that she had special hearing called echolocation that allowed her to send sounds out and then catch the echoes that bounced off prey insects or other objects. The bouncing echoes help her to navigate and zero in on flying prey. "That is really cool!" I said. "I wish I could echolocate! I bet you are awesome at hide and go seek!" Frida giggled. "I am VERY good at that game!" she chuckled.

...go to page 7 to finish reading this great story!

Conservation LEGACY
A Texas Wildlife Association Stewardship Venture

Critter Connections is made possible by a grant from the San Antonio Livestock Exposition.

San Antonio Stock Show & Rodeo®

continued from front page...

We told her about some of our adventures and that we had come to Old Tunnel specifically to learn more about bats. She told us about her trips to and from Mexico each year and how exciting it was to migrate. She said that she could fly as high as 10,000 feet in the air and as fast as 60 miles per hour when she was making the long distance trips! She explained how the bats come to Texas each year to find a good place and nice climate for the mother bats to have and raise their pups. When the weather gets colder in the fall, there aren't as many insects in Texas so they fly south to Mexico where the weather is warmer and food is more plentiful. Frida was beginning to explain to us how crowded Old Tunnel can be during mid summer when Grant reached down and picked up a ladybug off the branch of a nearby tree. "Look!" he said, as he held the ladybug up on the edge of his paw. "It's the first one I've seen so far this season." "Eeeeek!" shrieked Frida. "Get it away! Get it away from me!" Grant looked puzzled but carefully held the ladybug behind his back as he took a few steps away from Frida. "What's wrong?" he asked. "Don't you like ladybugs?"

"I'm sorry!" apologized Frida. "I thought you had a dermestid! They are shiny beetles that live along the bottom of our caves. They eat bats that fall from the walls and can turn a whole bat into a skeleton really quickly. They are scary!" "Oh my!" I shouted. "That is a little creepy! Who knew something so small could be so frightening?"

We chatted for a while longer with Frida and then she showed us a nice little place near the edge of the tunnel where we are burrowing in for the night. Tomorrow evening, we are going to meet back up with Frida and her sisters to play some "Hide and Echolocate." It should be lots of fun even though I have a pretty good feeling that we won't win!

Your Friend,

Nancy Nine-band

Critter Corner

Mexican free-tailed bats leave Bracken Cave in the evening to feed on flying insects.

Texas Bats

Some of the most amazing and beneficial animals in Texas are bats. That's right: those furry little mammals that fly around at night and have such a bad – and unfair – reputation are actually essential to the state's natural environment and to Texans.

Most of our state's 32 bat species eat huge amounts of insects, both the bugs that annoy us in our backyards and the pests that cause so much damage to corn, cotton and other major farm crops. Pallid bats even have a taste for scorpions. Two species, in South and West Texas, are essential pollinators for cactus and agave plants.

Most people rarely notice bats flying overhead and almost never see them up close, since bats are very shy and come out after dark. And that's too bad because bats are remarkably diverse and unusual animals. Red, silver-haired and spotted bats are strikingly colorful. Ghost-faced bats look as exotic as any dinosaur. Mexican free-tailed bats have narrow wings for jet-like flight, while long-nosed bats use their broad wings to hover over plants and flowers almost like helicopters.

And about that unsavory reputation: it's completely undeserved. Many people still believe bats are blind, carry diseases and suck blood like vampires. In truth, bats generally have excellent eyesight. They rarely transmit disease to people or pets, and even sick bats almost never bite unless they're handled. Just don't ever handle a bat or any other wild animal. Worldwide, there are more than 1,100 species of bats, and only three of them are vampire bats. They do, indeed, feed on the blood of birds or mammals, but all three live only in Latin America – not in Texas.

Mexican free-tailed bat babies in a nursery space at Bracken Cave.

So go ahead and enjoy the world of Texas bats. There's no reason to fear these fascinating creatures. They make great neighbors.

Mexican free-tailed bat with a captured moth

Mexican free-tailed bats

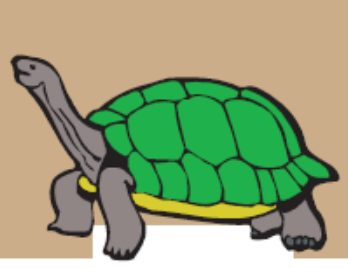
Each summer evening near San Antonio, 20 million Mexican free-tailed bats come swirling out of a hole in the ground called Bracken Cave. This is the world's largest bat colony and it takes them hours to emerge in a dense stream. Their flapping wings spread a whispered "whoop...whoop...whoop" over the area. The bats spread out across the farms, ranches and towns of the Hill Country in search of insects. Before they return around dawn, these bats will have eaten about 400,000 pounds of flying bugs.

These are the most common bats in Texas. They're found throughout the state, with up to 100 million of them in Central Texas, where they eat huge numbers of corn earworm moths and other insects that cause great damage to farm crops. Mexican free-tailed bats are generally less than three inches long, with wingspans of around 12 inches. They've been clocked flying at 60 mph with tailwinds and at altitudes of up to 10,000 feet.

Most Mexican free-tailed bats spend the winter in warmer caves in Mexico. They return to Texas in the spring. The females form big maternity colonies in caves, abandoned mines, buildings and under bridges. About 1½ million of these bats live under the Ann Richards Congress Avenue Bridge in downtown Austin. Males split off into much smaller bachelor colonies.

Mexican free-tailed bats in Bracken Cave.

In June, each female usually gives birth to a single pup that weighs less than a pecan. The mothers clean and nurse their babies, then place them in nursery areas of the cave, with as many as 500 pups jammed into a square foot of space. As thousands of pups squeak,

jostle and crawl over one another, the cave walls are alive with constant motion and sound. Yet, remarkably, each mother bat finds and nurses her own pup amid all that confusion. Scientists say the moms and pups recognize each other's voices and scents.

Pups learn to fly and join their mothers on insect-hunting expeditions when they are four to five weeks old. When it first tries its wings, a young free-tail must avoid several mid-air collisions per second in a pitch-dark cave. Unlucky pups fall to the cave floor, which often swarms with carnivorous beetles that can reduce a bat to a skeleton in seconds. It is a hard life, and as many as 50 percent of pups will not survive their first year.

Peters's ghost-faced bat


Peters's ghost-faced bat

Peters's ghost-faced bats get their name from their rather bizarre appearance. They have conspicuous flaps of skin on the chin. Large, round ears join across the forehead, and their eyes seem almost to be located in their ears.

These bats live in semiarid and desert areas in South and West Texas. They do not migrate and remain active year-round. They usually roost in caves, rock crevices and abandoned mines, although they occasionally move into old buildings. These insect-eating bats hunt large, soft-bodied moths, although scientists do not know much about their diet.

Peter's ghost-faced bats are very rarely encountered by people.

Mexican long-tongued bat


Mexican long-tongued bat pollinating an agave

Mexican long-tongued bats are pollinators. They feed on the nectar and pollen of night-blooming plants, especially agaves, as well as on cactus fruit. They dip their long, slender noses into flowers and extend their tongues (which can be up to one-third of their body length) to reach all the sweet nectar. In return for the meal, their snouts become dusted with pollen, which they deliver to other flowers as they feed. This pollination helps the plants bear fruit and maintain genetic diversity.

In Texas, Mexican long-tongued bats are found only in the state's southern tip. They use a range of habitats, including deserts, semi-desert grasslands and oak woodlands. These bats seem to spend their winters in Mexico, then migrate up to Texas in the spring as they follow the flowering cycles of cacti and agaves.

These and other nectar bats hover as they dip their noses into flowers. They sometimes visit backyard hummingbird feeders. Mexican long-tongued bats roost in caves, mines, rock crevices and abandoned buildings, forming colonies of about 15 bats.

Eastern red bat


Eastern red bat

Eastern red bats are "tree bats" that live in forests throughout most of Texas and roost in the foliage of trees. Despite their bright red color, these bats are actually well-camouflaged: in trees, they look like dead leaves or pine cones as they hang by a single foot, gently swaying in the breeze.

These are mostly solitary bats – even females roost alone while rearing their young. Unlike most bats, eastern red bats often give birth to twins and can have litters of up to five pups.

In the summertime, red bats typically feed around the edges of forests, in clearings or even around streetlights where they pursue insects, especially moths. In Texas, these bats seem to remain in the same areas year-round. They hibernate during the winter in tree hollows and even amid the bunchgrass and leaf litter on the ground.

Articles and all photos courtesy of Bat Conservation International.

Pallid bat


Pallid bat prepares to eat a scorpion

Pallid bats don't pursue their prey in the air. They are "gleaning bats" that snatch their food off rocks or leaves. With their huge ears, these bats can hear the dainty footsteps of an insect from up to 16 feet away. Pallid bats mostly eat such things as katydids, crickets, beetles and moths. They will also catch and consume scorpions and centipedes, and they are immune to a scorpion's sting.

Texas' pallid bats live in arid grasslands and deserts in the Panhandle and in parts of southwest Texas. They roost in rock crevices, tree hollows, buildings and bridges, and hibernate through the winter in deep crevices.

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Bats are unsung heroes of Texas. They are essential to ensuring the health of the ecosystems and agriculture of the Lone Star State. But not many people realize just how much we depend on bats to help control pesky and damaging insects and even to pollinate cactus and agave. Most of the 32 Texas bat species face numerous threats, from disappearing habitats and pollution to senseless vandalism – usually because of harmful myths and misinformation. Many populations are declinining. Bat Conservation International is working to protect bats and their habitats in Texas and around the world through education, science and conservaton. But we need your help. Join us to help ensure a healthier state and a better world for the future.

Adopt-A-Bat

Who says bats aren't lovable?

Show your commitment to bat conservation by adopting a bat and we'll send you one of these cuddly bat toys. Proceeds from these symbolic adoptions help protect bats and their habitats to ensure a healthy ecosystem.

Adopt-A-Bat makes a great gift for a great cause!

ADOPTIONS OF $25 RECEIVE:

- One furry toy bat of your choice (suitable for ages 3 and up)
- An adoption certificate
- Species info

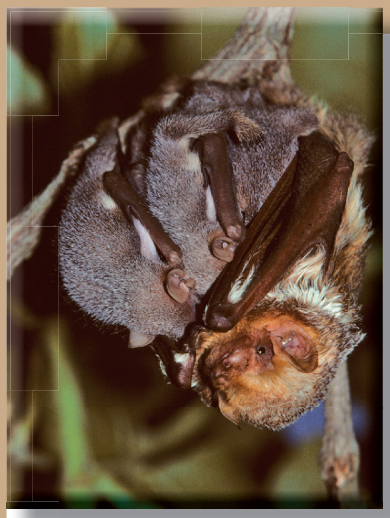
ADOPTIONS OF $50 (FOR NEW MEMBERSHIPS ONLY) ALSO RECEIVE:

A one-year membership in Bat Conservation International, which includes a new-member packet, *BATS* quarterly magazine and the chance to see the bats at the world's largest bat colony, Bracken Cave, on special member-only nights

Go to www.batcon.org to adopt a bat from the BCI website.

Approximate size: 12 inches (wingspan).

Contributions are deductable to the extent allowed by law.



Eastern red bat mother with pups

Articles and all photos courtesy of Bat Conservation International.

Did you know that...

...bats use an amazing navigation system, called echolocation, to fly and hunt in total darkness? The bats emit a series of beeps, then analyze the echoes that bounce back off objects in their path. With this precise "biosonar," they can "see" well enough in the dark to avoid collisions and capture flying insects.

...a single little brown bat can catch more than 1,000 mosquito-sized insects in just one hour?

...Mexican free-tailed bats use an elaborate "language" of chirps, trills, buzzes and other sounds that they combine in various ways to create many different meanings?

...the world's smallest mammal is the bumblebee bat of Thailand? It weighs less than a penny. Giant flying foxes that live in Indonesia have wingspans of up to six feet.

Most bats, including this Townsend's big-eared bat, must drink on the fly, swooping down over the water for each sip.

Spotted bats, which live in West Texas, have long, silky fur and distinct markings.

Color Me...

Mexican Free-Tailed Bat

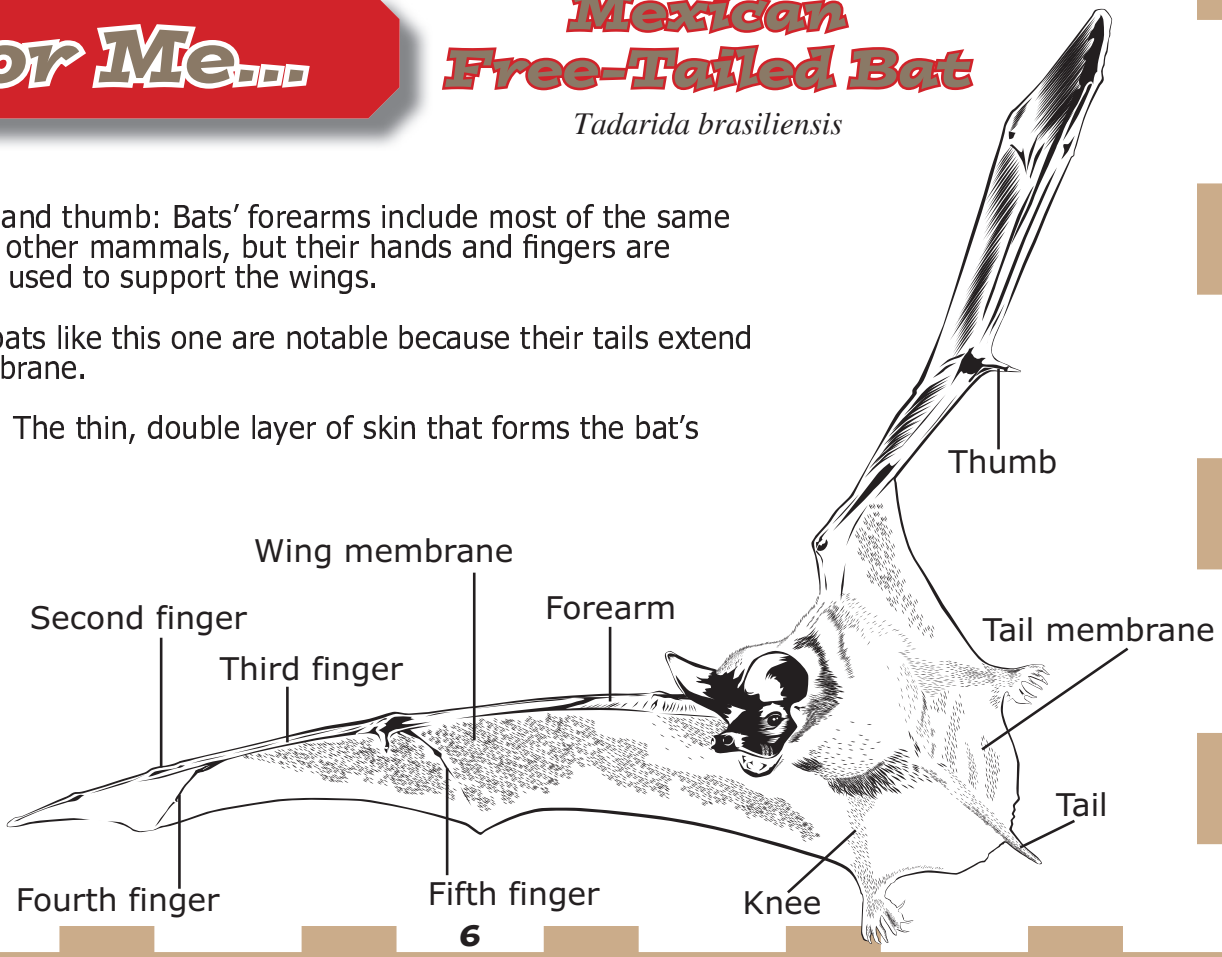
Tadarida brasiliensis

Glossary

Forearm, fingers and thumb: Bats' forearms include most of the same parts as those of other mammals, but their hands and fingers are much longer and used to support the wings.

Tail: Free-tailed bats like this one are notable because their tails extend beyond the membrane.

Wing membrane: The thin, double layer of skin that forms the bat's flying surface.



BATS-A-BILLION GLOSSARY

Abiotic - non-living components within an ecosystem

Adapt - to adjust or change for survival

Adaptation - a characteristic that helps living things adjust or change in order to survive in their environment

Adult - the final stage in the life cycle of living things

Agricultural pest - an insect that eats, and therefore causes damage to agricultural crops

Altricial - newly hatched young that are relatively immobile and require parental care; opposite of precocial

Basic needs - what all organisms need to survive; food, water, shelter, space

Binocular vision - vision using two eyes simultaneously, which makes it possible to perceive distances between objects (known as depth perception)

Biodiversity - the variety of organisms that live in Earth's many ecosystems

Biome - an ecosystem having a distinct combination of organisms

Biotic - living organisms within an ecosystem

Birth - the act or instance of being born

Camouflage - the coloration or design of an animal that allows it to blend in with its environment

Canine tooth - the long, sharp teeth at the front of the mouth of meat-eating animals, used for capturing and tearing the meat of prey

Carnivore - an animal (consumer) that eats mostly meat

Cell - the basic structural and function unit of living organisms

Characteristic - distinctive quality, attribute, or trait of a place or thing

Chiroptera - the taxonomic order to which all bat species belong; meaning hand-wing in Greek

Classification - the assignment of organisms into groups, based on their similarities

Cold-blooded (ectothermic) - living things whose blood temperature ranges in accordance with the temperature of the surrounding medium

Colony - term to describe a group of bats living together

Communicate - to share information

Community - all populations living together in the same area or ecosystem

Conservation - the wise use of natural resources through maintaining, protecting, and managing

Consumer - any living thing that eats or receives its energy from other living things

Diurnal - most active during the day

Domain - the highest taxonomy rank of organisms (Bacteria, Archaea, Eukaryota), which are above kingdoms

Dormancy - period of little or no activity

Echolocation - a sonar-like system used by certain animals to detect or locate certain objects

Ecological value - a monetary value given to certain species based on how they benefit humans

Ecosystem - all living and non-living things in an area, functioning as an ecological unit

Ectothermic (cold-blooded) - living things whose blood temperature ranges in accordance with the temperature of the surrounding medium

Embryo - an unborn or un-hatched offspring in the process of development

Endangered - a species that is at a high risk of becoming extinct

Endothermic (warm-blooded) - living things that are able to maintain a constant body temperature

Energy - required by all living things to function; is transferred through the food chain and cannot be destroyed

Environment - all aspects of an organism's surroundings

External - the outermost part of an object

Extinct - a living thing no longer in existence

Flower - part of the plant that houses the reproductive organs

Food chain - the path of energy transferred from one organism to another within an ecosystem

Food web - overlapping of food chains within an ecosystem

Frugivore - an animal (consumer) with a diet consisting mainly of fruit

Function - the job or purpose of something

Guano - bat feces or droppings

Habitat - a specific environment in which an organism lives; consists of food, water, space, and shelter

Herbivore - a animal (consumer) that eats mostly plants

Hibernation - a deep, sleep-like state during the winter in which the metabolism is extremely slow

Inherited trait - a genetic characteristic that is passed down from parent to offspring

Insect - an invertebrate organism characterized by having an exoskeleton, three main body parts (head, thorax, and abdomen), and six legs

Insectivore - a animal (consumer) with a diet consisting mainly of insects

Interdependence - when different living things depend or count on each other to survive

Internal - the inside part of an object

Kingdoms - level of taxonomy whereby organisms are divided into one of six (6) groups, depending on characteristics

Land stewardship - responsible planning and management of natural resources such as land, water, and animals

Life cycle - the sequence of life stages organisms undergo, from birth to reproduction

Limiting factor - a factor that restricts the growth, abundance, or distribution of an organism or population

Living thing - a plant or an animal with basic needs and the ability to reproduce

Lung - the respiratory organ that allows air-breathing animals to transport oxygen within the body

Mammal - warm-blooded vertebrate, characterized by gibing birth to live young, producing milk, breathing air, and having fur

Mandible - the lower bone of the jaw

Maxilla - the upper bone of the jaw

Megachiroptera - a suborder of Chiroptera that contains larger bats that eat fruit and nectar; the majority of which do not echolocate

Microchiroptera - a suborder of Chiroptera that contains small, mostly insectivorous bats which are able to echolocate

Migration - the seasonal long-distance movement of some animals; often occurring seasonally

Molar - the broad and flat teeth located at the back of the jaw, used for grinding and chewing

Monocular vision - vision in which both eyes are used separately as they are usually positioned on opposite sides of the head; therefore the field of view is increased, while depth perception is limited

Native - a living thing originating from a specific region

Natural resource - materials and components that can be found within the environment, such as plants, trees, animals, rocks, metal, water, gas, soil, oil, etc.

Nectar - the sugary liquid produced by flowering plants

Nectarivore - an animal (consumer) with a diet consisting mainly of nectar

Niche - the function or position of a species within an ecological community

Nocturnal - most active at night

Nonliving - an object that does not have basic needs and cannot reproduce

Non-renewable resource - any natural resource that cannot be replenished naturally with the passage of time

Nutrients - substances needed by living things to grow and survive

Observation - an act gathering information using the senses

Offspring - the young of a plant or animal

Omnivore - an animal (consumer) that eats plants and meat

Orbit - the cavity or socket of the skull in which the eye is situated

Organism - a single living thing

Piscivore - an animal (consumer) with a diet consisting mainly of fish

Pollinator - an organism that aids in flower reproduction by carrying pollen from one flower to another

Population - the grouping of a single species living in a given area

Posterior - situated behind or toward the rear

Precocial - newly birthed or hatched young that are active and require little parental care; opposite of altricial

Predator - an animal that hunts and eats other animals (prey)

Prey - an animal that is hunted and eaten by other animals

Producer - any living thing that is able to produce its own food from inorganic substances, such as plants

Pup - a juvenile or young bat

Rabies - a viral disease of the nervous system that can occurs in mammals

Renewable resource - any natural resource that can be replenished naturally with the passage of time

Reproduce - the ability to produce offspring

Resemble - to possess some similarity

Roost - a perch upon which birds rest at night

Sanguivore - an animal (consumer) with a diet consisting mainly of blood

Scat - the excrement or feces of an animal

Scientist - an expert in science, especially one of the physical or natural sciences.

Shelter - something that provides cover or protection for an organism

Sonar - a system developed by scientists to locate objects underwater by sending out signals and listening to the echo; echolocation in bats works much the same way

Species - basic category of biological classification, composed of related individuals that resemble one another, are able to breed among themselves

Structure - the pattern, shape, or form of a given object, such as a tooth or an arm

Survive - to stay alive

Taxonomy - the scientific study of how living things are classified

Thermoregulation - the ability to maintain body temperature independent of the environmental temperature

Torpor - a sleep-like period of time where the bodily functions slow down to survive cold weather; deeper than sleep and not as deep as hibernation

Vampire bat - a bat whose diet consists of blood

Vertebrate - a living thing with a backbone

Warm-blooded (endothermic) - living things that are able to maintain a constant body temperature

Water - a transparent, odorless, tasteless liquid, a compound of hydrogen and oxygen, that in a more or less impure state constitutes bodies of water

White-nose syndrome - a disease found in hibernating bats, caused by the cold-loving fungus Geomyces destructans

Wildlife - plants and animals that live in nature without having caretakers

Wildlife biologist - a scientist that studies and manages wild animals, their habits, and habitats

The Truth About Bats

Bats are not:

Blind – Bats not only have excellent vision, but they also use a biological sonar called echolocation to hunt fast-flying insects in total darkness.

Flying rodents – Bats are mammals, but they are not rodents. In fact, they are as closely related to humans as they are to rats and mice.

Dirty – They groom their fur like cats and kittens.

Blood-suckers – Only three of more than 1,250 bat species are vampire bats that feed on blood – and all of them are in Latin America. Only one targets mammals, and it prefers domestic livestock.

Bats are:

Plant pollinators – Bats pollinate wild bananas, cashews, dates, figs, peaches, avocados, agaves and many other important plants.

Seed dispersers – Seeds spread by bats can account for up to 95 percent of "pioneer plants" that begin the regeneration of cleared rainforests.

Insect hunters – More than two-thirds of bat species feed on insects. A mother bat can eat up to her body weight in insects every night, and a million bats can eat as much as 10 tons of bugs!

Economically vital – Bats eat so many insects that they save American farmers more than $3.7 billion a year.

Important – More than 1,250 species of bats account for about 22 percent of the world's mammal species. Bats live on every continent except Antarctica.

Vulnerable – Bats reproduce slowly. Most species have only one pup per year. This makes them exceptionally vulnerable to extinction.

batcon.org
BAT CONSERVATION
INTERNATIONAL

BATS
We need them...

...and they need us.

Why you should care

Bats are some of the most misunderstood and least appreciated animals, yet they are an essential part of nature. Bats hunt insects, pollinate plants and disperse seeds to grow our forests. They are vital for maintaining healthy ecosystems and many human economies. And they face grave threats around the world.

Right now, bats are vulnerable because people needlessly fear them. They lose their homes to urban sprawl, and they are killed by wind-energy turbines. Now a new wildlife disease, White-nose Syndrome, is killing millions of North American bats.

Bat populations are declining, and we are all poorer for it. But you can help turn the tide – before it's too late.

Bats need us more than ever!

Bats are in Danger!

Bats are losing their homes

- Forest-dwelling bats lose their roosts and feeding areas as forests are cleared or improperly managed.
- Bats are driven from caves and abandoned mines by human disturbance, closures and changes in air circulation.
- Fruit bats are often victims of unregulated commercial hunting.

A disease called White-nose Syndrome is killing millions of bats

- WNS is the gravest threat ever faced by North American bats.
- WNS has killed more than 5½ million bats, and the disease is still spreading rapidly across the continent.
- Once-common little brown bats have been so devastated that regional extinctions are predicted.
- BCI is working with state and federal agencies and other partners to stop this disease and restore the decimated bat populations left in its wake.

Bats are vulnerable to wind turbines

- Tens of thousands of bats are being killed each year by wind-energy turbines.
- They are killed in collisions with spinning turbine blades and by the rapid pressure change caused by the turbines, which can rupture delicate blood vessels and organs.
- BCI strongly supports renewable energy and is working with government agencies and wind-energy providers to reduce bat fatalities.

You Can Help Save Bats!

- Learn more about bats (*batcon.org*) and educate your friends and family about the benefits of bats
- Encourage your state and federal representatives to support bat conservation efforts (*batcon.org/takeaction*)
- Volunteer and donate to help protect bats (*batcon.org/volunteer*)
- Install a bat house (*batcon.org/bathouse*)
- Find us on Facebook (*Facebook.com/BatCon*)
- Sign up for our e-newsletter (*batcon.org/getnewsletter*)
- Become a member of Bat Conservation International (*batcon.org/joinbci*)

Whether it's time or money, your investment is the solution to saving bats.

Facts on the Fly!

BAT CONSERVATION INTERNATIONAL
www.batcon.org

THINGS **YOU** CAN DO TO PROMOTE BAT CONSERVATION

You don't need to travel far or have a degree in biology to help bats. You can make a difference for bat conservation by working on local projects. Every community has unique needs. These suggestions may apply to the bats where you live.

Much more information and downloadable publications are available at BCI's website: *www.batcon.org*.

Things EVERYONE can do for bats:
After centuries of myths and misunderstandings, bats have acquired a poor public image. You can help counter these myths by raising public awareness about bats in your community. Because bats are mammals, they are susceptible to the rabies virus, making sick individuals a possible risk to people who know little about them. Due to fears that are often greatly exaggerated, many bats are needlessly killed. You can help save bats from misguided persecution by:

- **Joining** Bat Conservation International and obtaining the most up-to-date information about bats and bat conservation. To join, visit *www.batcon.org*.
- **Giving** bat lectures to local schools, nature centers, zoos, museums or libraries. Presentations and videos are available through BCI's catalog.
- **Donating** books and other educational materials about bats to local libraries, resource centers or schools.
- **Writing** a positive article about bats for your local newspaper (especially for Halloween).
- **Helping** people safely remove stray bats from living quarters. This can be done easily by covering the bat with a coffee can when it lands and slipping a piece of cardboard between the wall and the can. Then the bat can be released outside. Do not attempt to handle bats without gloves, as they may bite in self-defense.
- **Answering** questions or directing people to BCI during public health scares.
- **Educating** local pest-control operators about humane exclusion techniques. Exclusion is the only effective way to remove a nuisance colony of bats from a building. Poisons, naphthalene flakes and harmless repellant devices do not deter bats and may actually harm humans.
- **Providing** facts about bats and rabies to local health departments, veterinarians and personal physicians. To obtain detailed information about bats and public health issues, visit *www.batcon.org*.
- **Installing** a bat house as part of an exclusion project or just to bring bats into your backyard. BCI's website provides designs and detailed instructions for building and installing bat houses. You can also order a ready-made bat house, the *Bat House Builder's Handbook* or the *Building Homes for Bats* DVD from BCI's online catalog.
- **Learning** more about the bats in your state by visiting the 'Species Profiles' section of *www.batcon.org*.
- **Volunteering** to advocate for bats in your community.

Things TEACHERS and STUDENTS can do for bats:
Bats rank among the world's most diverse and fascinating mammals, yet few people know anything about them. People must first understand bats before they can really care about their survival. You can increase bat awareness by:

- **Teaching** a unit on bats. Exciting curricula aids are available through BCI.
- **Learning** more about the bats in your state by visiting the 'Species Profiles' section of *www.batcon.org*.
- **Researching** specific bat-related topics. Archived issues of BATS magazine issues can be found at *www.batcon.org*.
- **Organizing** a bat-appreciation day at your school and educating other students about the importance of bats.
- **Promoting** the "Look, but do NOT touch" approach of respecting wild animals.
- **Adopt-A-Bat** for the classroom. Students can take part in conservation efforts, learn about a bat species of their choice and receive a certificate and photo of the bat.

Things LANDOWNERS can do for bats:
Bats are losing their natural habitats around the world because of increasing land development, agriculture and deforestation. In many cases, bats can adapt to such changes if their needs for water, insect prey and roosts are taken into consideration. To mitigate the loss of natural roosts, many people also now provide bats with alternative roosts, such as bat houses. All this and more is available online at www.batcon.org. You can help by:

- **Planting** or preserving native vegetation that attracts and supports a diversity of non-pest insects for bats to feed on.

- **Decreasing** disturbance and destruction of cave and abandoned-mine roosts via education, fencing or gating.

- **Protecting** roosting bats in abandoned buildings or providing artificial alternatives when such buildings must be torn down. BCI can provide suggestions for construction of artificial roosts.

- **Leaving** snags in forests and woodlands to serve as natural homes for wildlife. Bats often roost in tree hollows, under loose bark and in old snags, which are frequently removed.

- **Supplying** open water resources where bats can drink on the wing. Even a pool just ten feet by five feet can be a big help to bats in need of a drink if the approaches are not obstructed by vegetation.

- **Constructing** and **installing** a bat house. BCI's website provides designs and detailed instructions for building and installing bat houses. You can also order a ready-made bat house, the *Bat House Builder's Handbook* or the *Building Homes for Bats* DVD from our online catalog.

- **Modifying** a bridge to serve as a home for bats by working with your local highway department.

Join Bat Conservation International – Our members and donors make our conservation successes possible.
Bat Conservation International is a nonprofit organization dedicated to conservation, education and research initiatives involving bats and the ecosystems they serve. For more information visit: www.batcon.org