CHIROPTERA

Bats are mammals of the order Chiroptera, which means handwing. Bat's forelimbs form webbed wings, making them the only mammals capable of true and sustained flight. Bats do not flap their entire forelimbs, like birds, but instead flap their spread-out digits, which are very long and covered with a thin membrane (patagium).

Bats are present throughout most of the world in most temperate and tropical regions of both hemispheres, performing vital ecological roles of pollinating flowers and dispersing fruit seeds. It also known that bats eat insects and other pests and do not normally pose a threat to humans. They represent about 20% of all classified mammal species worldwide, with about 1,000 bat species. The order Chiroptera is divided into two suborders: Megachiroptera and Microchiroptera.

Members of Megachiroptera are commonly referred to as flying foxes because of their fox-like faces. They are less specialized than Microhiroptera and all feed primarily on plant material, largely fruit, nectar or pollen. They are found only in the Old World tropics. Megachiroptera includes one family (Pteropodidae) and about 166 species.

The remaining 16 families (~ 759 species) belong to Microchiroptera. The Microchiroptera are more highly specialized than the Megachiroptera. They are highly varied in appearance, and occur worldwide. They majority of species are largely insectivores, which they locate by emitting ultrasound pulses and listening to the returning echoes (**echolocation**). Their teeth, like other insectivores, are very sharp to bite through the exoskeleton of insects or the skin of fruit.

A small number of bats are carnivorous, hunting such small vertebrates as fish, frogs, mice and birds. Another three species are vampire bats feeding on the blood of birds or mammals. With the exception of three species of nectar-feeding bats that live along the Mexican border of Arizona and Texas and the Jamaican fruit bat in the Florida Keys, all bats in the United States and Canada are insectivorous.

Like humans, bats give birth to poorly developed young and nurse them from a pair of pectoral breasts. In fact, Linnaeus, the father of modern taxonomy, was so impressed by the similarities between bats and primates (lemurs, monkeys, apes, and humans) that he originally put them into the same taxonomic group. Today's scientists generally agree that primates and bats share a common shrew-like ancestor, but belong to separate groups.

Evolution

Bat's ancestors were likely small insectivorous animals that walked on all fours. The appearance and flight movement of bats 52.5 million years ago can be found in the fossil records with ***Onychonycteris*** as the most primitive genera of bat. *Onychonycteris* had claws on all five of its fingers, whereas modern bats have at most two claws appearing on two digits of each hand. It also had longer hind legs and shorter forearms, similar to climbing mammals that hang under branches such as sloths and gibbons. This palm-sized bat had broad, short wings, suggesting it

could not fly as fast or as far as later bat species. Instead of flapping its wings continuously while flying, *Onychonycteris* likely alternated between flaps and glides while in the air. Such physical characteristics suggest this bat did not fly as much as modern bats do, rather flying from tree to tree and spending most of its waking day climbing or hanging on the branches of trees. Echolocation was not evident in the structure of the inner ear.

Habitat
Bats can be found living throughout most temperate and tropical regions, living in almost any conceivable shelter, such as caves, crevices, tree cavities, buildings and some sleep in exposed trees. Tropical species occupy a wider range of roost sites than other species. Despite the wide variety of roosts used by bats, many species have adapted to living in roosts of only one or a few types and cannot survive anywhere else.

In temperate 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. Bats usually are very loyal to their birthplaces and hibernation sites.

Bat Physical and Behavioral Adaptations
As a mammal, the bat's entire body is covered with fur helping to keep it warm. There are five toes on the feet of bats with sharp, curved claws. They also have very short legs with knees. The claws on their feet are very strong and bats have one-way valves in their arteries preventing the blood from flowing backwards. Both of these adaptations allow them to hang upside down while they sleep without the blood rushing to their heads.

They have webbing across their digits creating wings. This thin skin is very elastic and it is able to stretch. The limbs of the bat usually feature two sharp claws. The shorter claw resembles a human thumb. It is often used for clinging to surfaces when the bat alights. The bones in their wings work like fingers making the wings very flexible which allows the bat to have a full range of movement and the ability to fly. With the exception of the thumb, the digits help to extend the wing. Because the digits are cartilaginous with small amounts of calcium and the wings are thin, bats have a wider range of motion and thus are able to fly faster than birds.

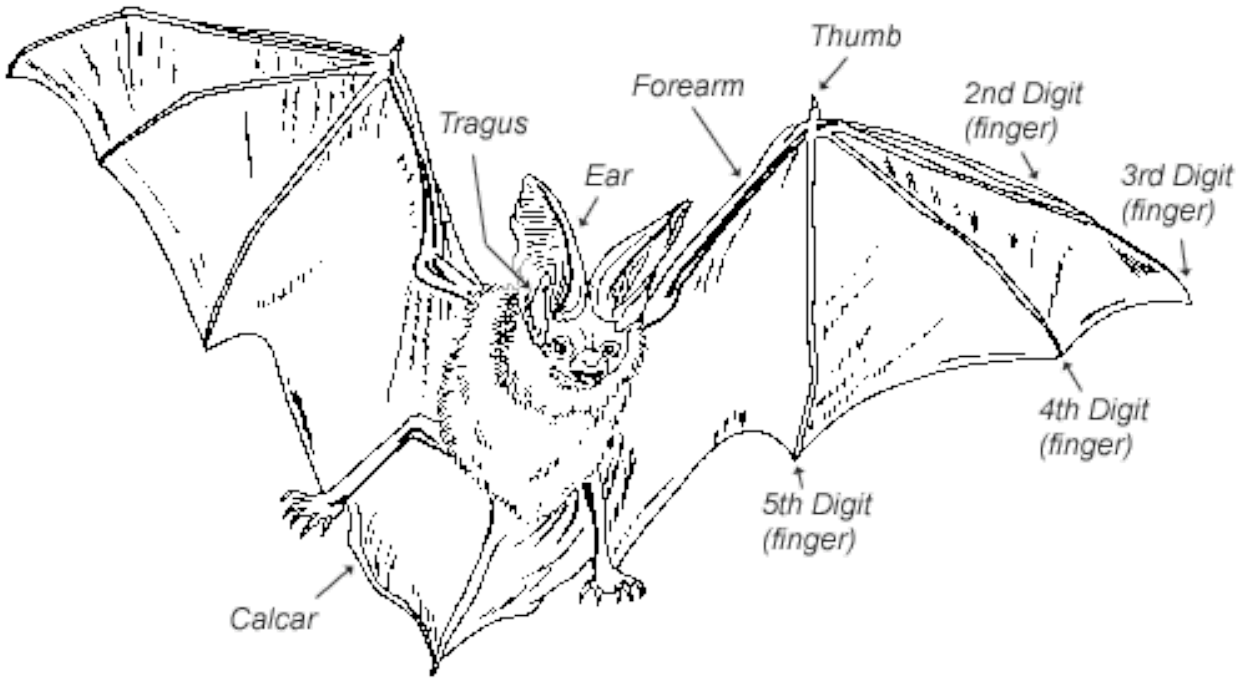
They have a small dot like nose but they have an excellent ability to smell with it. All bats have very tiny teeth that are razor sharp. They can easily bite through the skin of fruits or prey. They also have a very long tongue that they use for eating, drinking, and pollination. They can roll that tongue up around their rib cage too when not using it.

The eyes of the bat will vary depending on which species you happen to be talking about. Some species of bats have quality vision, and are able to detect ultraviolet lighting. Megachiroptera have a good sense of sight and are thought to have color vision, whereas Microchiroptera have very small eyes, which aren't well developed. They are able to rely on excellent hearing and smell to make up for vision pitfalls.

Echolocation
One of the significant forms of evolution for bats was the ability to communicate and navigate with high-frequency sounds (**echolocation**). Microchiroptera emit ultrasonic pulses and by analyzing the echoes that bounce back know detailed information about what is going on around them in their environment. These sounds are very diverse with species producing different calls

according to the habitats they live in. A fast-flying species that hunts in open spaces uses a lower frequency call that travels farther whereas a slower-flying species that hunts in a more covered area, emits a higher frequency to get detailed information. These sounds are produced in their larynx emitting the sound through their mouth, with a few species having the sound come through their nose. These species tend to have elaborate nose ornamentations.

To pinpoint the sounds these bats may have large, forward facing ears with an additional projection called a **tragus**. About 70% of bats are insectivores and echolocation allows these bats to hunt insects in complete darkness and avoid collisions at night. Because these calls are loud, the bat contracts muscles in the middle ear when emitting the call and when silent, relaxing these same muscles allowing him to hear the return echo. When potential prey has been located, the rate of calling increases, allowing the bat to hone in on its prey.



Bat Anatomy Glossary
Calcar: A long, bony spur on the bat's ankle that helps support the tail membrane and helps to spread it out.
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. This adaptation emita or augmenta echolocation sounds. (some species)
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. This aids echolocating bats in finding prey. (some species)
Wing membrane: A thin double layer of skin that forms the bat's flying surface.

Courtship & Reproduction

More research needs to be done on courting, but some bats attract mates by singing or wing displays. Most bats of temperate regions mate in the fall just before entering hibernation. The female then delay fertilization until spring with the sperm being dormant in the reproductive tract. As the female emerges from hibernation, ovulation and fertilization occur, giving their young the best possible chance of survival. Birth occurs approximately a month and a half to two months

later. The young grow rapidly, often learning to fly within three weeks. Most bats have only one young per year. In the non-hibernating bats, ovulation and breeding occur in the spring.

Benefits of Bats

Bats are considered a "keystone" component of ecosystems in parts of the tropics and deserts. They play a crucial role in the pollination of flowers and to the distribution of fruit seeds. As they are so effective in their seed dispersal, bats are key players in restoring vital forests. Many more bat species consume vast amounts of insects, including some of the most damaging agricultural pests. With fewer insects, there is less of a need for agricultural pesticides. Bats are among the least studied and most misunderstood of animals. Losing bats would have devastating consequences for natural ecosystems and human economies.

The baobab tree of the East African savannah is critical to the survival of so many wild species that it is often called the "African Tree of Life." 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.

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. The dung was also used during the Civil War to make gun powder. Even vampire bats are useful: an enzyme in their saliva is among the most potent blood-clot dissolvers known and is used to treat human stroke victims.

Conservation

Bat populations have declined greatly since the 1950s. Numerous species of bats are endangered or threatened, and more than a dozen species may already be extinct. The main threat to bats is the loss of their habitats and food sources due to a growing human population.

Other human activities, such as pest control programs, cave exploration, and the destruction of old mines result in many bat deaths each year. In some cases, people deliberately kill large groups of bats. They regard these bats as dangerous carriers of disease or as threats to their crops or livestock. In caves, vandals have destroyed large colonies of bats using sticks, stones, and guns.

In eastern North America, the white-nose syndrome (WNS) has killed more than 5.7 to 6.7 million bats and is currently spreading west and north into Canada. A white, cold-loving fungus appears on the faces and wings of hibernating bats, putting these infected bats in imminent danger. WNS causes infected bats to uncharacteristically awaken during hibernation and as a result use up the stored fat reserves that are needed to get them through the winter. These infected bats are often seen flying around in midwinter causing them to usually freeze or starve to death.

Sources created 10/12
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