



THE AGAVE BAT AND ITS STINKY BACK PATCH

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YOUNG REVIEWERS:



JACK

AGE: 10



NADIA

AGE: 9

MAMMAL

Animals that feed their babies with milk produced by their mothers, their skin is covered in fur completely or partially. Humans, dogs, and bats are some examples of mammals.

Have you ever wondered how bats choose their mates? It turns out that some male and female bats meet in dark caves, with thousands of bats around them. Despite their good eyesight, it can be challenging to find “Mr. Right” in these conditions! Female bats have resorted to using their noses and, surprisingly, they prefer the stinkiest of males. Male long-nosed bats develop a stinky patch between their shoulder blades that they use to attract females, with the aid of bacteria.

BATS: WHAT IS THEIR DEAL ANYWAY?

Bats are neither birds nor mice, although they may look a bit like both. They are a special kind of **mammal**. All mammals give birth to live babies, have bellybuttons, are covered in fur, and feed their offspring with milk. **Chiroptera** is the scientific name given to bats, which are the only mammals capable of true flight. This name is made of two Greek words: “cheir” which means hand, and “pteron,” wing. Therefore, Chiroptera translates to “winged-hands.”

CHIROPTERA

It is a Greek word composed of two elements, the first one is "cheir" that means hand, and "pteron" that translates to wing. Chiroptera literally means winged hands. The wings of bats are actually their hands, with membranes between their fingers that help them fly.

The winged hands of bats evolved over thousands of years to have bones that are as long as their bodies and a thin membrane that connects their fingers, forming the wings that allow them to fly. Bats are only active at night to avoid predators that hunt during the day, and contrary to common beliefs, they have good eyesight. Bats sleep in caves, hollow trees, under large leaves, in termite nests, in large city buildings, and under the roofs of many houses. They can be found everywhere in the world, except in the coldest areas, such as the polar regions.

There are 1,200 species of bats in the world and scientists have studied only a tiny proportion of them. Bats can be gray, brown, or white, with yellow stripes, black masks, or marbled fur. They can be as small as a hummingbird or as large as a cat, like the fruit-eating flying fox of Asia. Bats feed on many things depending on the species. They can eat fruits, nectar, small animals, insects, fish, and even blood. But only 3 out of 1,200 existing bat species eat blood, and those can only be found in the wildest places of Central and South America.

BATS ARE OUR FRIENDS

Speaking of eating blood, some people believe that bats are dangerous or scary. Like any other mammal, bats can transmit diseases to humans, including the rabies virus. Also, a certain fungus can grow in bat feces, which can cause an illness known as histoplasmosis if it is breathed in. However, this does not mean bats are any more dangerous than any other wild animal. We should avoid touching all wild animals, including bats, without protective equipment like gloves and face masks. Instead of thinking of bats as scary creatures from horror movies, we should view them as our nocturnal allies! Just like bees, bats help pollinate thousands of flowers, help to keep insect populations down so that farmers can use fewer pesticides, and help to disperse seeds when they poop, eventually restoring forests.

THE AGAVE BAT, A.K.A MR. STINKY

We will now focus on just two bat species, the lesser long-nosed bat, and the Southern long-nosed bat. Their scientific names are *Leptonycteris yerbabuena* [pronounced lep-toh-nick-ter-is yerb-a-buen-ah] and *Leptonycteris curasoae* [pronounced lep-toh-nick-ter-is coo-rah-so-ah], respectively. These two species are known as agave bats because they pollinate agave plants. The lesser long-nosed bat is the smallest of the agave bats. As you can guess from its name, it has a long snout with an even longer tongue to reach the sweet nectar that hides at the bottom of flowers (Figure 1).

Agave bats travel hundreds of miles every year, from their birthplace to their feeding grounds and back, a behavior known as migration.

Figure 1

Agave bats have long snouts and tongues to feed on the nectar of flowers. Males have a bald patch on their backs called a dorsal patch. With the help of bacteria, the male bats use this patch to produce a stinky perfume that attracts females.

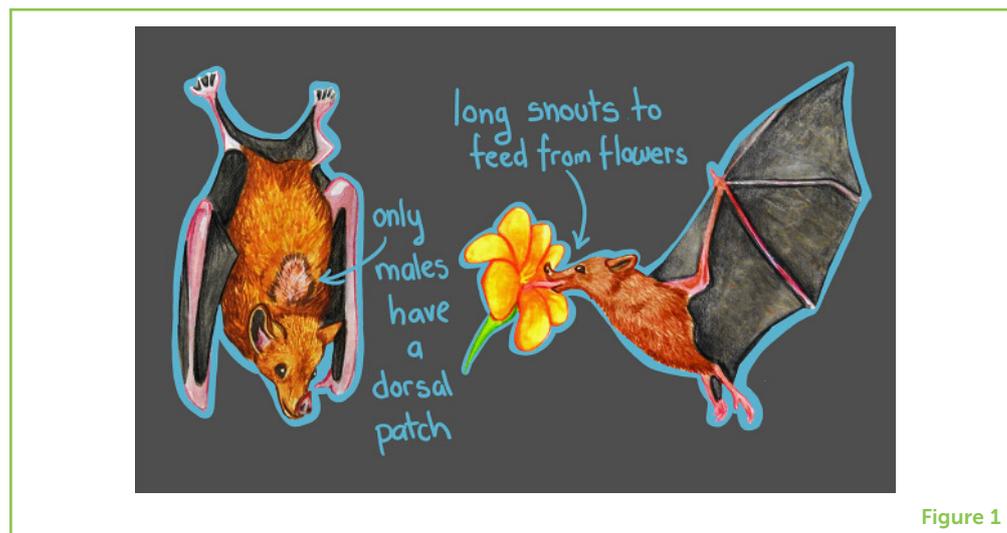


Figure 1

Females look for warm, humid caves in which to give birth to their offspring and feed them with milk. Because there are hundreds of mothers and babies in one place, scientists have named these special places maternity caves. Another amazing fact about bats is that mothers can fly with their cubs holding tightly to them, just like monkeys. Maternity caves are left empty when pups grow into adults.

Young adults start foraging for food on their own and begin migrating like their parents. When the time comes, males who are ready to find a mate congregate in roosts known as bachelor caves, where they meet females. A dark, busy cave full of potential mates flying around is a difficult place for females to choose a male. So, female agave bats resort to one of the most developed senses in mammals: smell. With their long snouts, females start sniffing for healthy, strong males, but a male's normal scent alone is not enough to attract females; the males need something stronger—a stinky perfume. Male agave bats attract females with a gross perfume that they create.

DORSAL PATCH

This is a gap of bare skin, the size of a fingerprint that develops between the shoulder blades on agave bat males during reproductive season. Dorsal means that something is situated near or on the back of animals.

FERMENTATIVE BACTERIA

These bacteria transform the molecules they find in their environment to create new ones. During this process, smelly gas is produced.

HOW DO MALE BATS GET SO STINKY?

In a quest to become the stinkiest male in the cave, male bats scratch at their backs, right between their shoulders, until they get rid of the fur in that spot, creating what is called a **dorsal patch**. Then they lick their feet and smear saliva and other body fluids on this bald patch, to create a gross soup [1, 2]. This nasty mess feeds the bacteria that live in the bald patch [3, 4]. In turn, some of these bacteria, called **fermentative bacteria**, produce a stinky fragrance that females find irresistible (Figure 2). Agave bats are not the only bats to use this smelly technique. Other bats, like the brown bat, also use scent cues to identify their kin and probably also use bacteria to help them produce these smells [5].

Figure 2

Bacteria help male agave bats to develop the dorsal patch. The dorsal patch releases a stinky perfume that attracts females. Thus, the bacteria in the dorsal patch help the male bats to find mates.

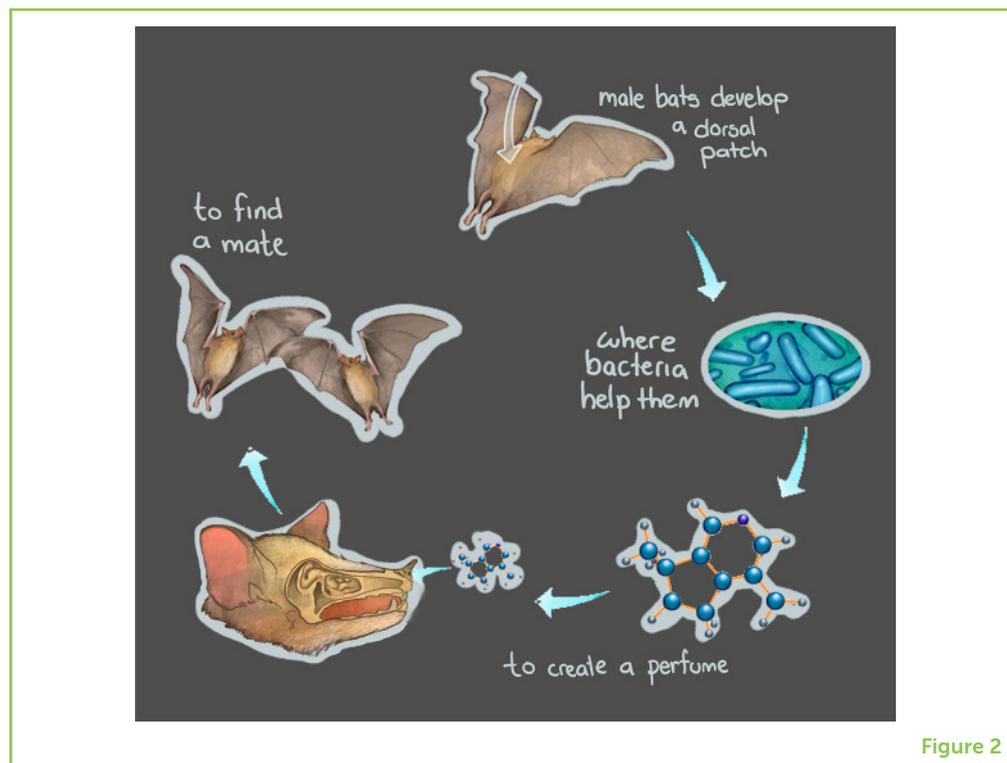


Figure 2

It is known that bats, just like all other animals including humans, are home for lots of microorganisms, such as bacteria and viruses. Some of these bacteria are good and help the animals to thrive, and these helpful microorganisms are known as the **microbiota**. We know from other studies that bacteria help produce odors, for example in human armpits. So, we wanted to test whether the skin microbiota of bats was responsible for the male's scent.

OUR STINKY BAT STUDY

Our group of bat experts headed out to capture a group of male agave bats during the reproductive season. We used sterile tools to sample the dorsal patches of 11 male bats and then safely released them back to the wild. Back in the lab, we used **molecular biology tools** to identify the bacteria growing in the bats' dorsal patches [4]. We were excited to find that all males shared 26 types of bacteria in their dorsal patches (Figure 3). Interestingly, 16 out of these 26 kinds of bacteria were fermentative, which means that they are bacteria that produce the chemicals responsible for scents [4].

Our results helped us demonstrate that Mr. Stinky uses bacteria to make the nasty cologne that attracts Mrs. Right! In summary, bats make their own perfumes with the help of bacteria. Much more work is needed to study these bats scents in more detail, but our research demonstrated that bacteria are in fact present in the dorsal patch and probably help males to attract females (Figure 3).

MICROBIOTA

It refers to all the living organisms that can only be seen through the lens of a microscope. All bacteria and viruses, and some fungus, are part of the microbiota.

MOLECULAR BIOLOGY TOOLS

Are the techniques and lab tools that biologists use to study molecules, like proteins and the DNA, within cells.

Figure 3

We sampled dorsal patches from 11 male bats and analyzed the bacteria present in the patches. All 11 bats shared many of the same types of bacteria (represented by the dots in the colored circles), most of them fermentative bacteria, which are those that produce odors. Each bat also had some bacteria that were unique to that individual bat (represented by the different colored circles).

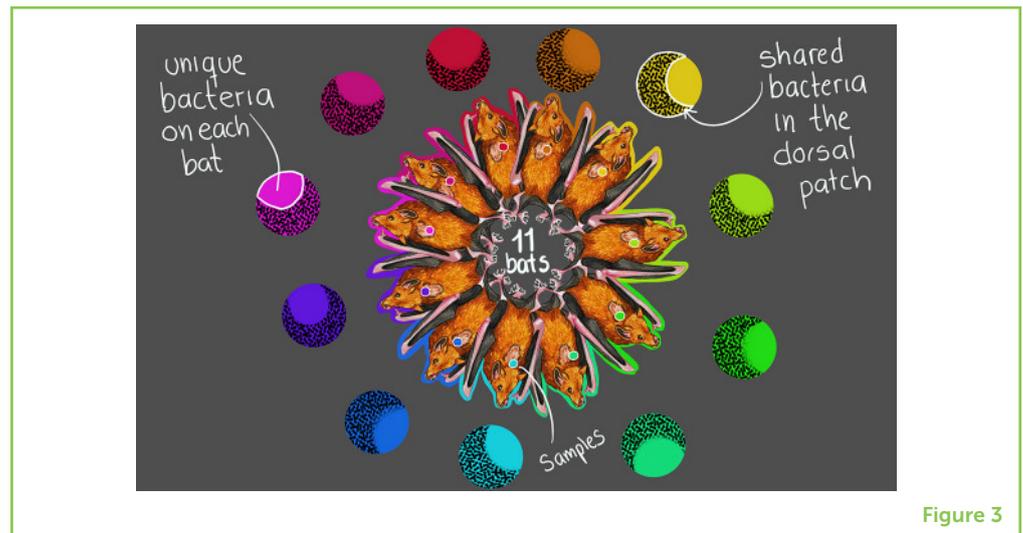


Figure 3

MR. STINKY AND MRS. RIGHT—THE SHORT STORY

Bats are fascinating mammals and very important for a healthy ecosystem. So, they are worthy of more scientific study. In our work, we found that male agave bats use fermentative bacteria to create a really strong perfume that attracts females. It seems that bacteria can help mammals in many ways—even in finding Mr. Stinky! The next time you use a perfume or deodorant, remember bats and how they use their bacteria to help them to be stinky in an attractive way!

ORIGINAL SOURCE ARTICLE

Gaona, O., Cerqueda-García, D., Falcón, L. I., Vázquez-Domínguez, G., Valdespino-Castillo, P. M., and Neri-Barrios, C. X. 2019. Microbiota composition of the dorsal patch of reproductive male *Leptonycteris yerbabuenae*. *PLoS ONE* 14:e0226239. doi: 10.1371/journal.pone.0226239

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YOUNG REVIEWERS

JACK, AGE: 10

I am the neighbor of Nadia. I like learning about electricity, and I like to practice America ninja karate and karate.



NADIA, AGE: 9

I am the neighbor of Jack. I like going to nature camp and camping with my family.



AUTHORS

OSIRIS GAONA

Osiris Gaona, Ph.D., is a biologist from the Faculty of Sciences at the National Autonomous University of Mexico. She has worked for over 20 years at the Ecology Institute in the Wildlife Conservation and Management Lab and in the Bacterial Ecology Lab, where she is currently working to understand the relationships between bacteria and their animal hosts. During her doctoral studies, she researched the role of bacteria in *Leptonycteris yerbabuenae* bats through their various life



stages. Osiris is also the founder and director of “Soluciones Ambientales Itzeni AC,” a non-governmental organization in Mexico focused on conservation and environmental education.



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Carla Ximena Neri has a bachelor’s degree in Earth Sciences from the National Autonomous University of Mexico and a specialization in environmental sciences. She is currently working in a non-governmental organization, Soluciones Ambientales Itzeni AC. Her work focuses on wildlife conservation and working to improve human relationships with nature. Ximena has participated in wildlife management projects in the Peruvian Amazon and the Indian Western Ghats, and she has also studied human relationships with wolves in Mexico. She is coauthor of several animal microbiome research publications led by Dr. Osiris Gaona. *carlaxneri@gmail.com