Hot Science Cool Talks

UT Environmental Science Institute

32

Seeing the World Through Their Ears: The Exotic World of Bats

Dr. George Pollack

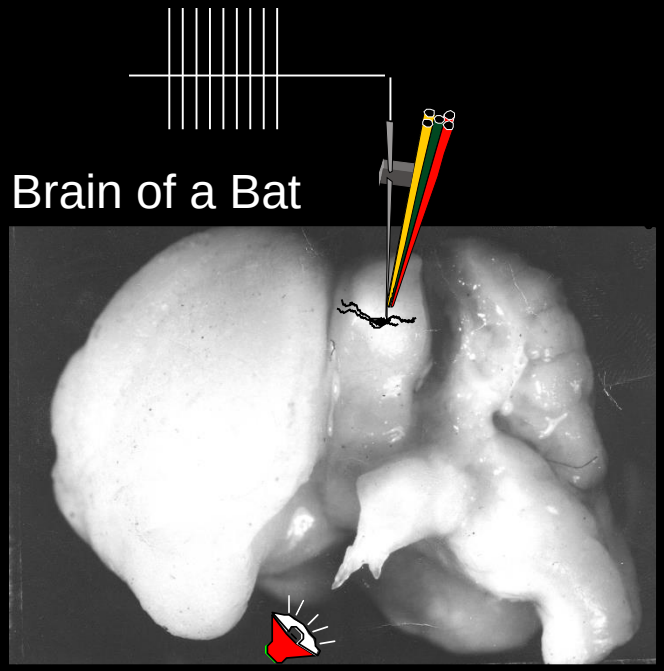
October 22, 2004

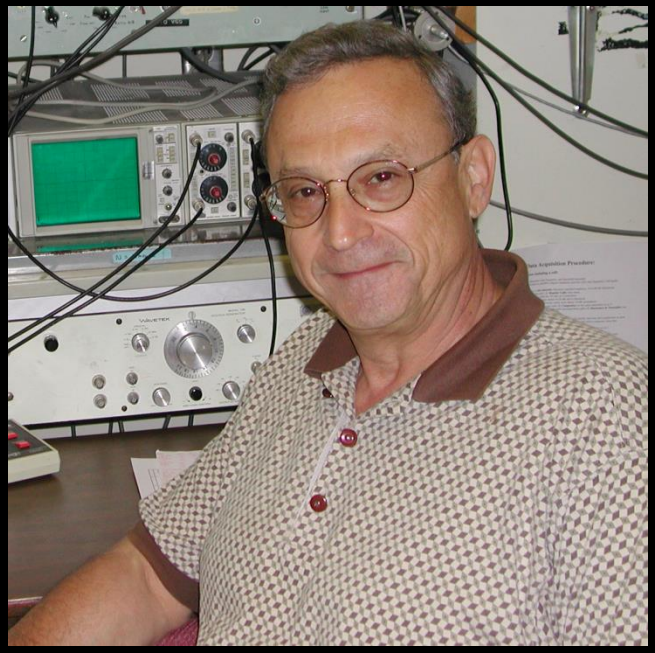
Seeing the World Through Their Ears: The Exotic World of Bats

George D. Pollak
Section of Neurobiology
School of Biological Sciences
The University of Texas at Austin

George Pollak in his lab

My field is neurophysiology, the mechanism by which the brain works. I study how sensory information is processed by the brain, and my focus is on how the auditory system processes and represents features of the external world.





Our sensory receptors and brain create the world we know

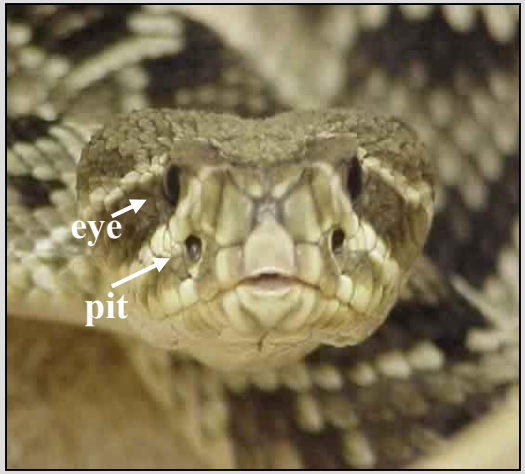
- **Example of neural construction: color vision.**
  We think of colors as an inherent attribute of objects: daffodils are yellow, your eyes are blue or brown or even green.

- **But, objects have no inherent color.**
  The brain creates color using input from the photoreceptors in your retina (red, green & blue cones). If you had different photoreceptors, you would see different colors or no color at all.

- If your brain could not create color, you would not see colors, even if your retina were normal!

Many animals are able to sense energies that we cannot

Rattlesnakes
(Pit Vipers)

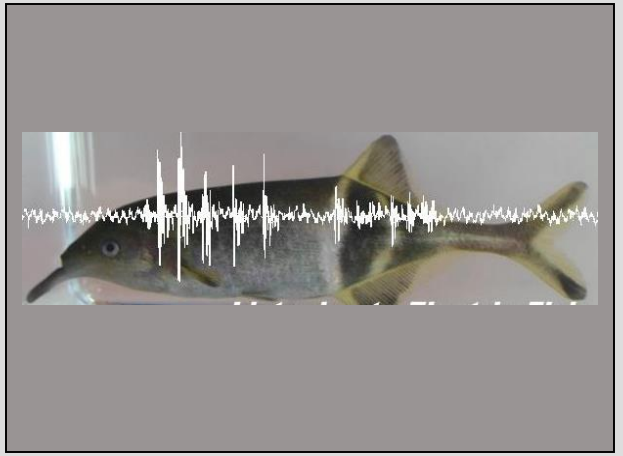


Rattlesnakes have two kinds of eyes: one just like ours, and one that sees heat (infrared wavelengths) They see body heat, even in the dark!

Bees

Bees can see ultraviolet wavelengths, which we cannot. We see flowers as having certain colors, but the same flowers look entirely different to bees!

Electric Fish



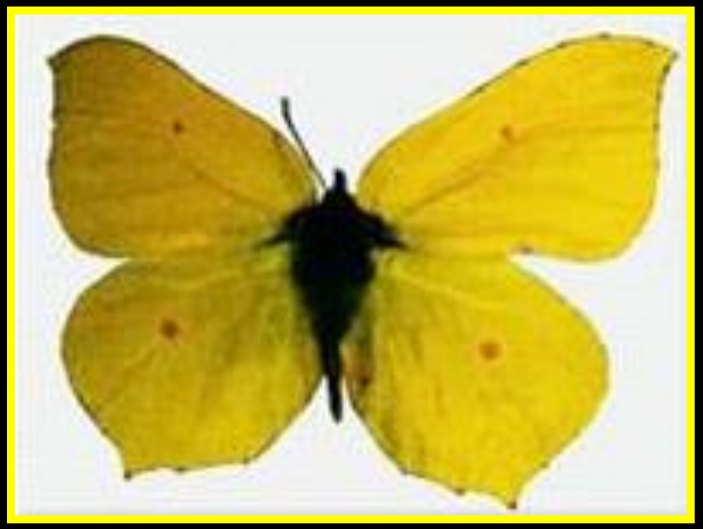
The electric fish of South America and Africa emit a weak electric field. They "see" their world through distortions in the field created by nearby objects.


This is how a dog appears to us or to a rattlesnake in daylight
Courtesy James Petersen


This is how a dog appears to us in the dark
Courtesy James Petersen

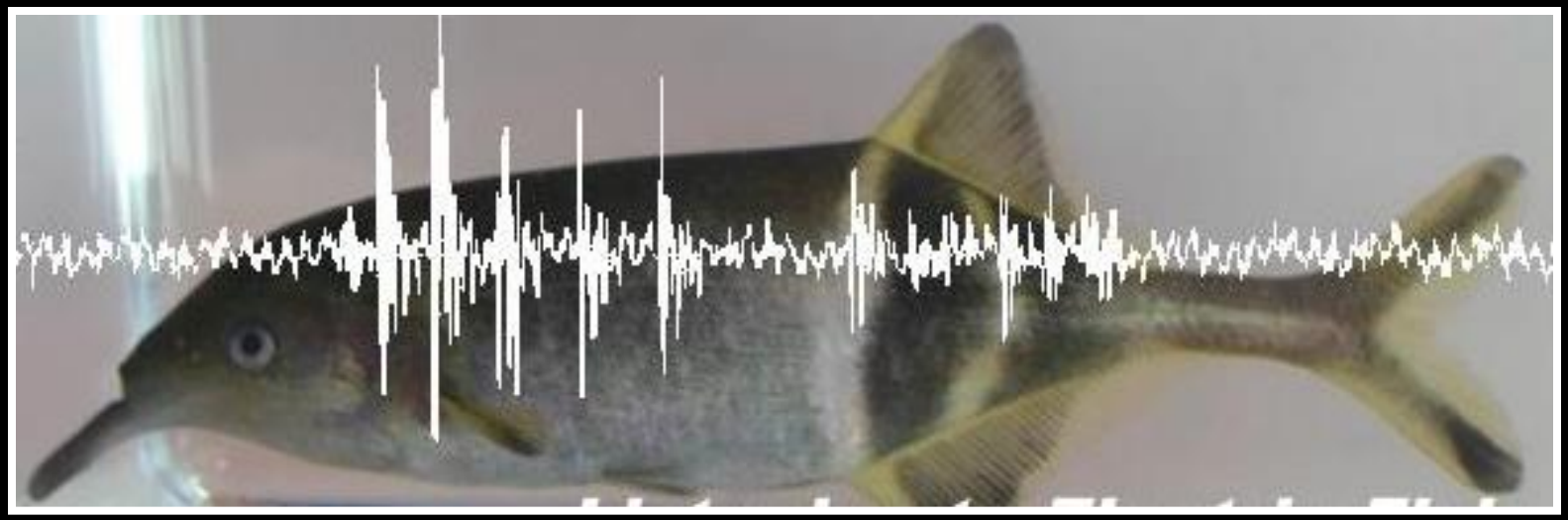

Somebody was
Sitting here!
This is how a dog appears
to a rattlesnake at night
Courtesy James Petersen

This is how we see a yellow butterfly

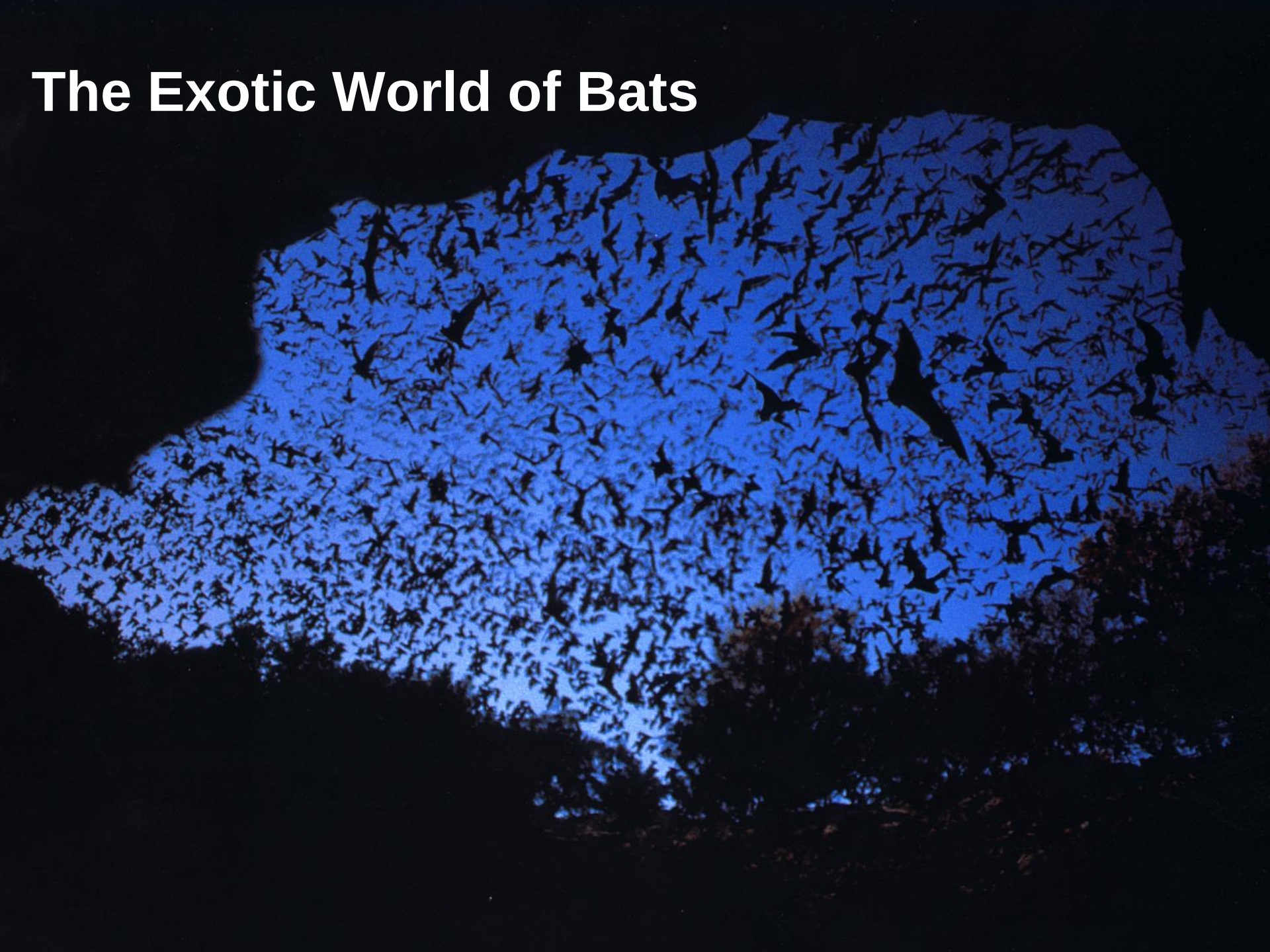


This is how a bee sees the same yellow butterfly

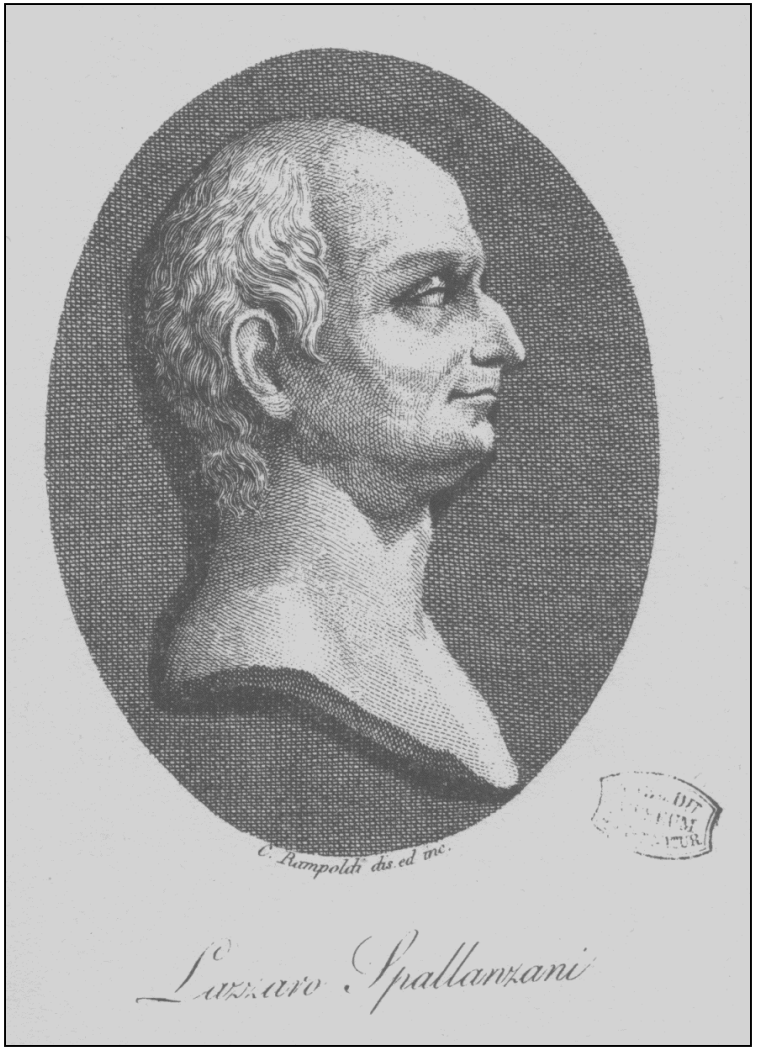
I have not the slightest inkling of how electric fish perceive their world



The Exotic World of Bats



In the late 1800s the great Italian natural scientist, Lazzaro Spallanzani, was the first to study how bats could fly and avoid objects in the dark, where vision was of no use.

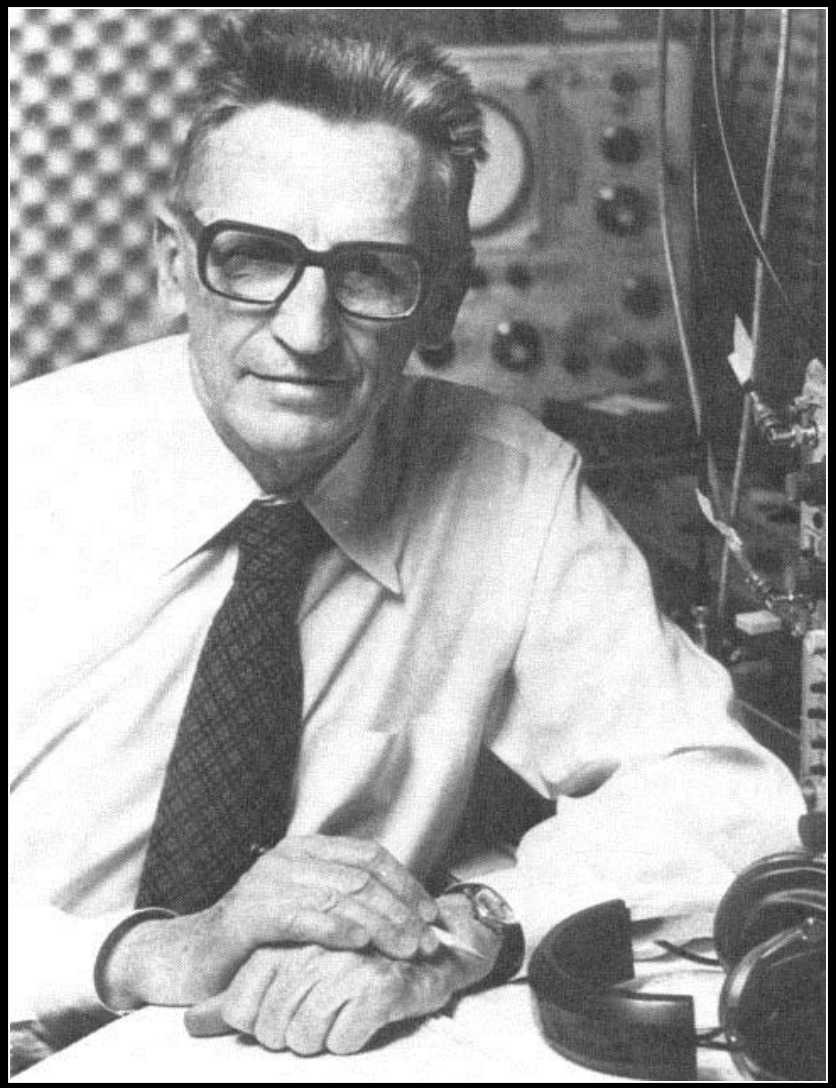


Rediscovery of Echolocation

In 1939 two young graduate students at Harvard, Donald Griffin and Robert Galambos, conducted a series of experiments which showed that bats navigate in the dark and avoid obstacles by emitting loud, ultra-sonic sounds and listening to the echoes that bounce off of nearby objects.

In 1942 Griffin coined the term, ***echolocation***, to describe this form of biological sonar.

Donald Griffin at his laboratory at Harvard



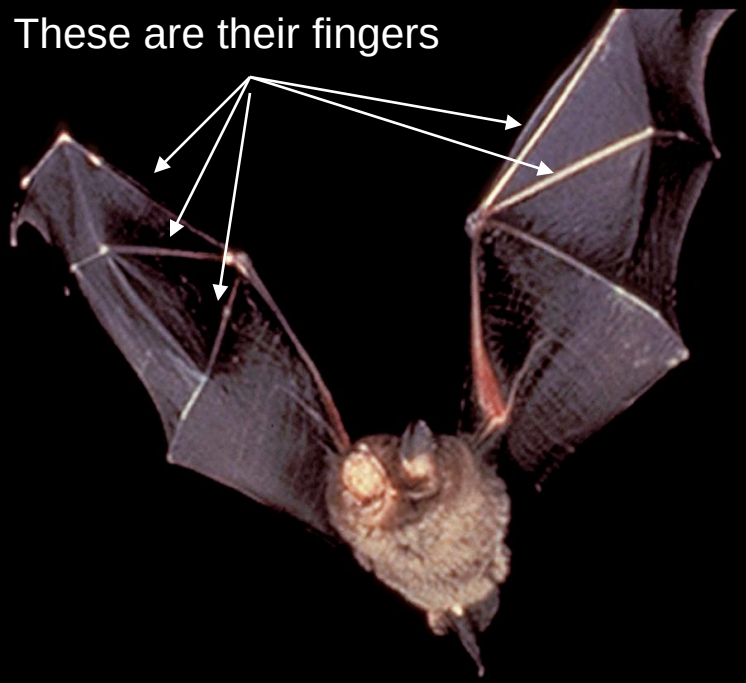
Bats use a form of biological sonar called echolocation to see their world

Watch Echolocation in Action

A mealworm is flipped in the air and a little brown bat tracks the mealworm with its echolocation calls and scoops it out of the air with its wing! This video segment was made at Harvard by Don Griffin and his colleagues more than 40 years ago. It is shown in slow motion.

MOVIE

It is not echolocation but rather the ability to fly that distinguishes bats from all other mammals. Bats fly with their hands!



Bats Populate the Entire Planet and Eat Everything Available

A horseshoe bat detects a moth and begins to home in on its target

The bat uses its wing to scoop the moth out of the air and then eats the moth while still in flight

Returning home with a large insect

The elegant fishing bat emits echolocation calls and detects a fish on the surface of the water

These claws are used to gaff fish on the surface


Bat Conservation International
Skimming the water
to gaff a fish

A fishing bat gaffs a fish!


Oh, what big ears you have.
All the better to hear you with!
This bat can actually hear the beetle’s footsteps!

The frog-eating bat specializes on tungara frogs.
This little tungara frog is in big trouble!

An unfortunate tungara frog provides this frog-eating bat with a late night snack

Bat Conservation International

Dining on the nectar offered by a night flowering plant

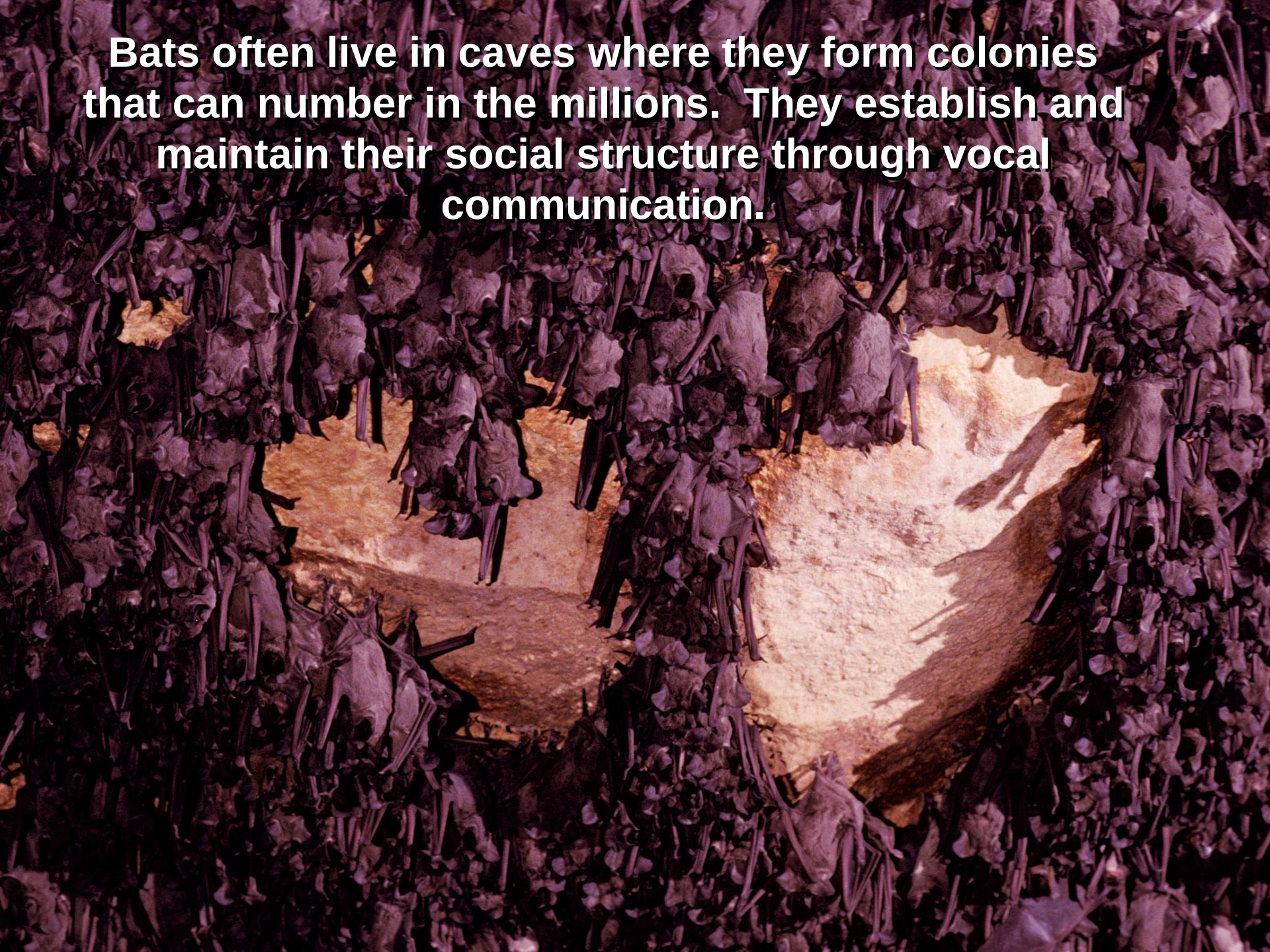
A sugar treat is offered by a night flowering plant

A bat returns to its cave with some ripe fruit

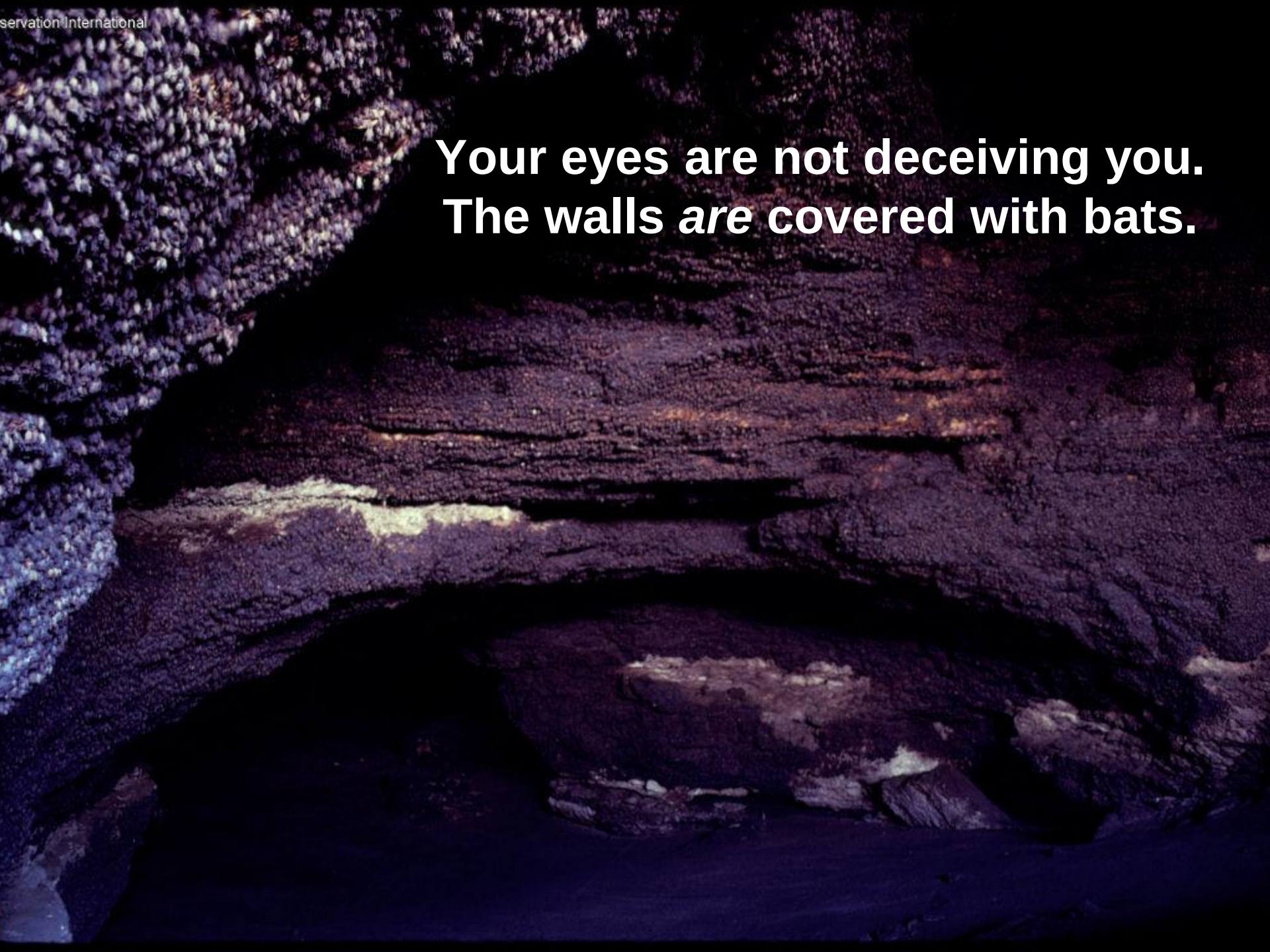

These are the infamous vampire bats

Although he looks goofy,
those incisors are razor sharp!

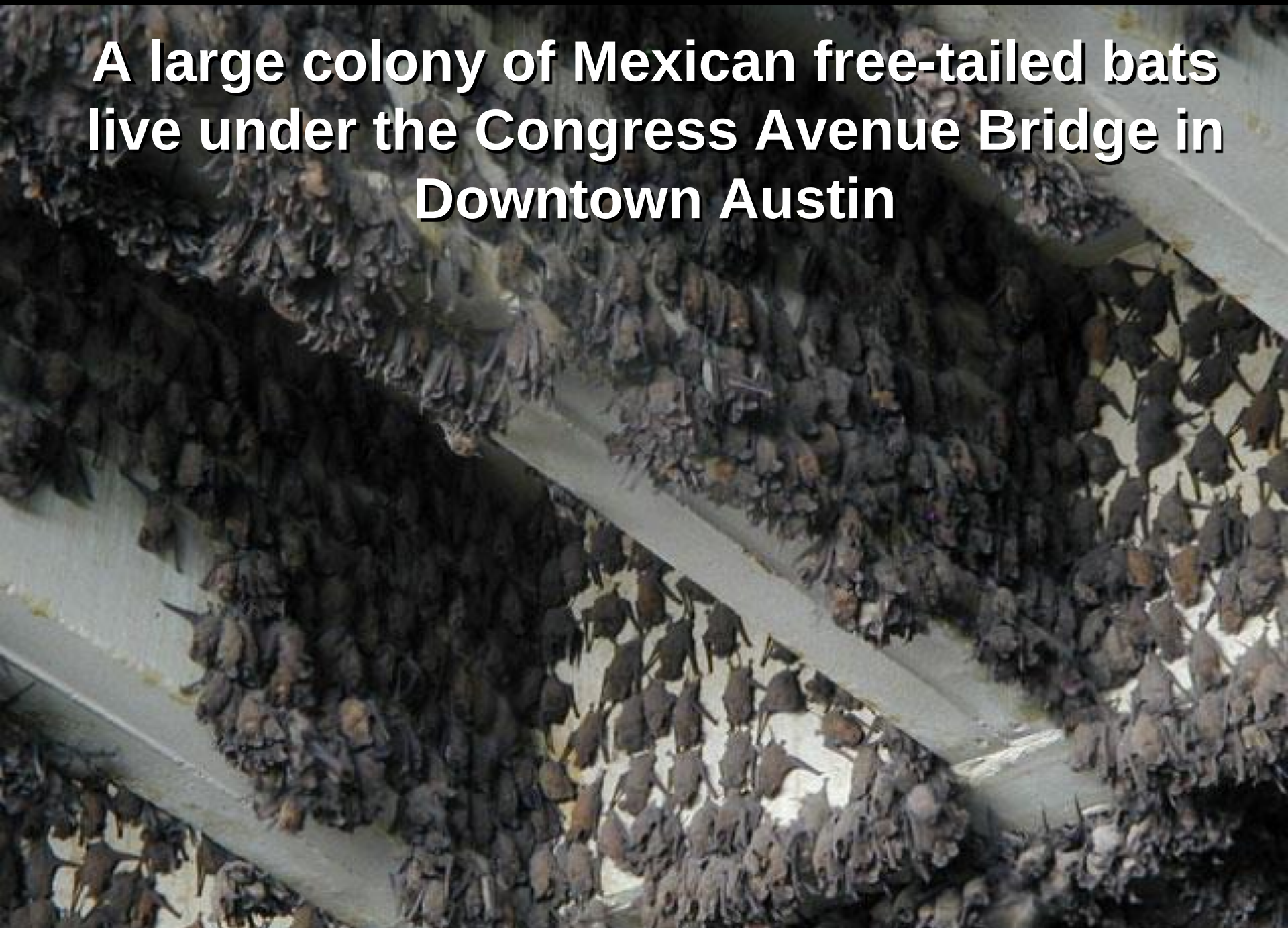
Specialized for lapping blood



Bats often live in caves where they form colonies that can number in the millions. They establish and maintain their social structure through vocal communication.


servation International
Your eyes are not deceiving you.
The walls *are* covered with bats.

The nightly exit of bats from Bracken Cave in central Texas


A large colony of Mexican free-tailed bats live under the Congress Avenue Bridge in Downtown Austin

We study the vocal communication calls of bats in the colony that Barbara French established and maintains in Austin

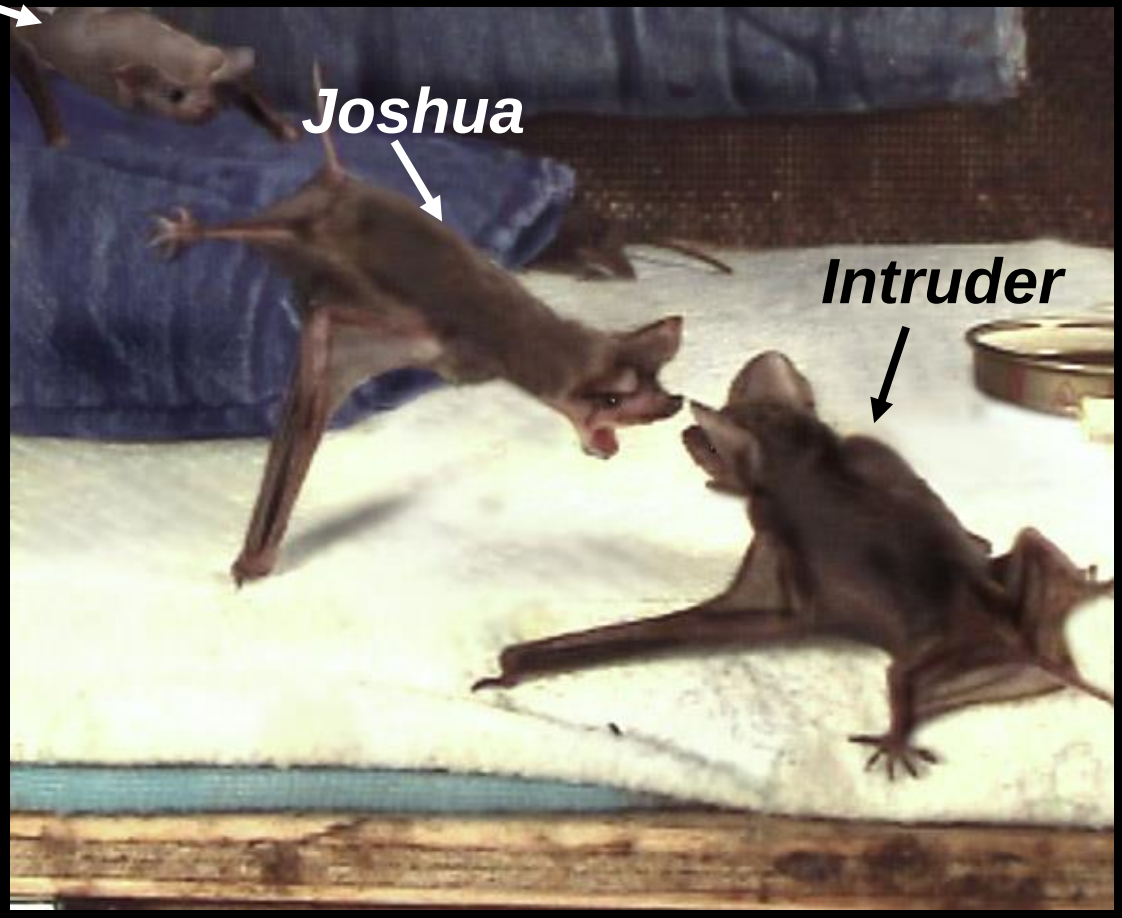
Barbara French at work

This is Sid, one of the dominant males in Barbara's colony

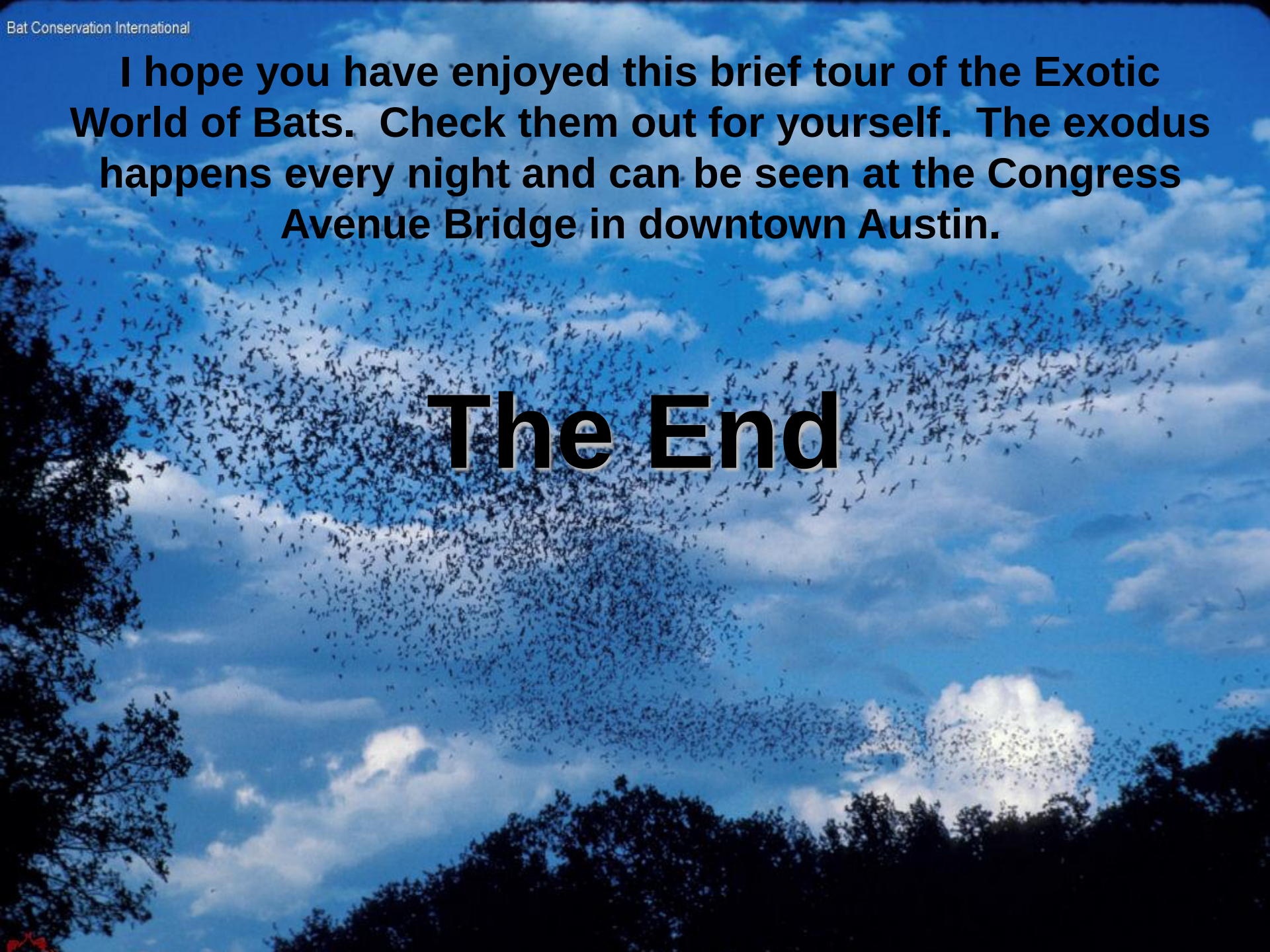
Sid woos the ladies with his courtship song

Joshua is another dominant male in Barbara's colony. Here Joshua is defending his territory and harem against an intruder.

A female in Joshua's harem



Joshua warns an intruder not to enter his territory by singing his territorial call



I hope you have enjoyed this brief tour of the Exotic World of Bats. Check them out for yourself. The exodus happens every night and can be seen at the Congress Avenue Bridge in downtown Austin.

The End

Dr. George Pollack

George Pollak received his Ph.D. in Physiology from the University of Maryland Medical School in1970. After completing his postdoctoral work in the Department of Biology at Yale University, he joined the faculty at the University of Texas in 1973. Dr. Pollak has had extensive collaborations with scientists both in the U.S. and in Europe. He was a Visiting Scholar at the University of Frankfurt, the University of Munich, the Neuroscience Institute of Salamanca University in Spain, and at the Virginia Merrill Bloedel Hearing Research Center at the University of Washington Medical School. His research has earned numerous awards, including a Research Career Development Award from the National Institutes of Health, a prestigious Alexander Von Humboldt Award, and a Claude Pepper Award from National Institute of Deafness and Other Communicative Disorders in recognition of his contributions to auditory neuroscience. Dr. Pollak also received a President's Associates Teaching Excellence Award from the University of Texas at Austin. He currently serves on the Executive Committee of the Institute for Neuroscience at the University of Texas and is Professor of Neurobiology there.