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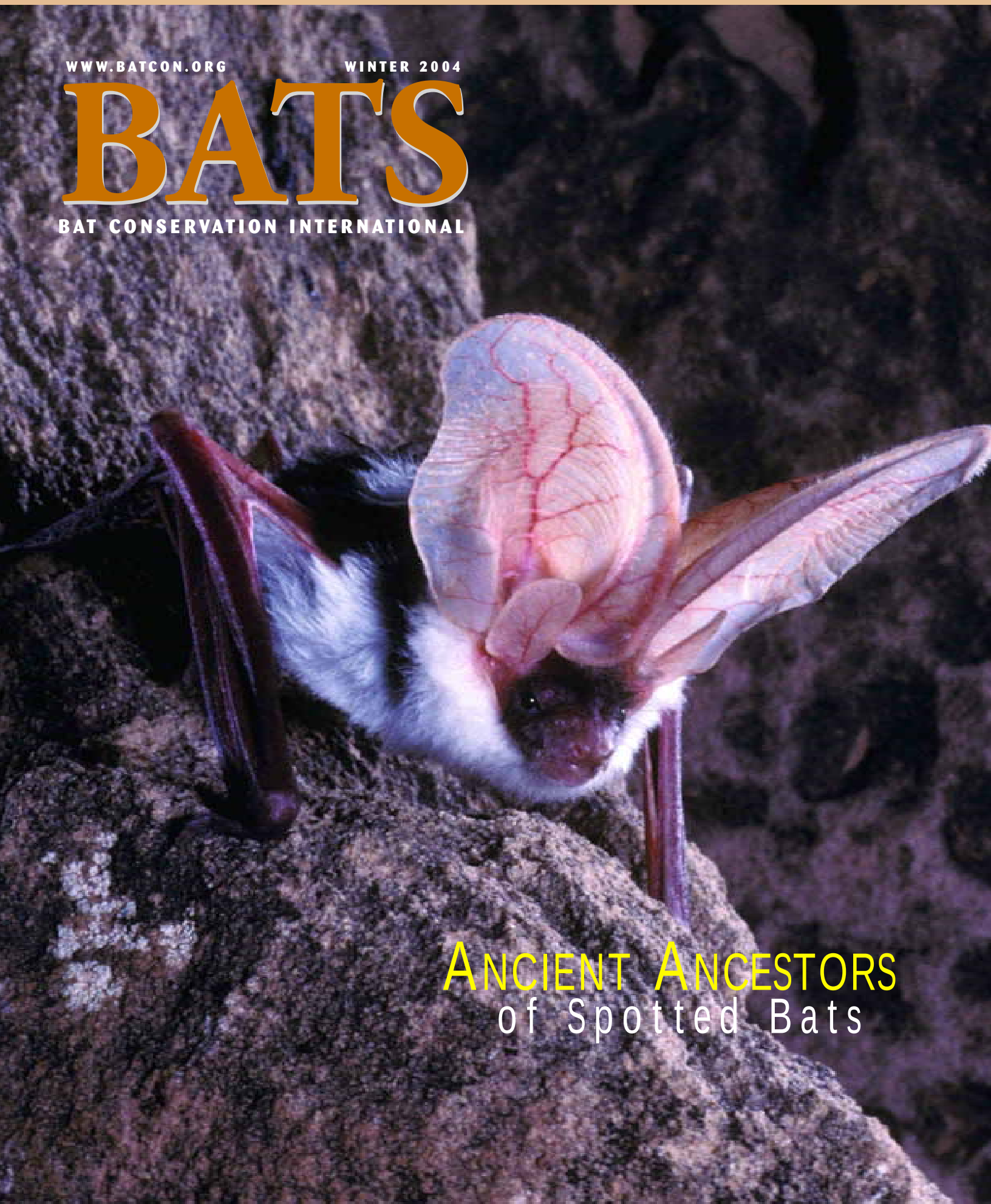

Ancient Ancestors of Spotted Bats

BATS

Volume 22, No. 4, Winter 2004

FEATURES

DEPARTMENTS

COVER PHOTO: Researchers in Arizona are studying mummies as old as 10,000 years – ancestors of today's spotted bats, like the one on the cover. Remains of the bats were mummified by the dry conditions inside the cave where they died, and where spotted bats may have been roosting continuously for millennia.

PHOTO COURTESY OF DAVID MIKESIC (SEE PAGE 8)

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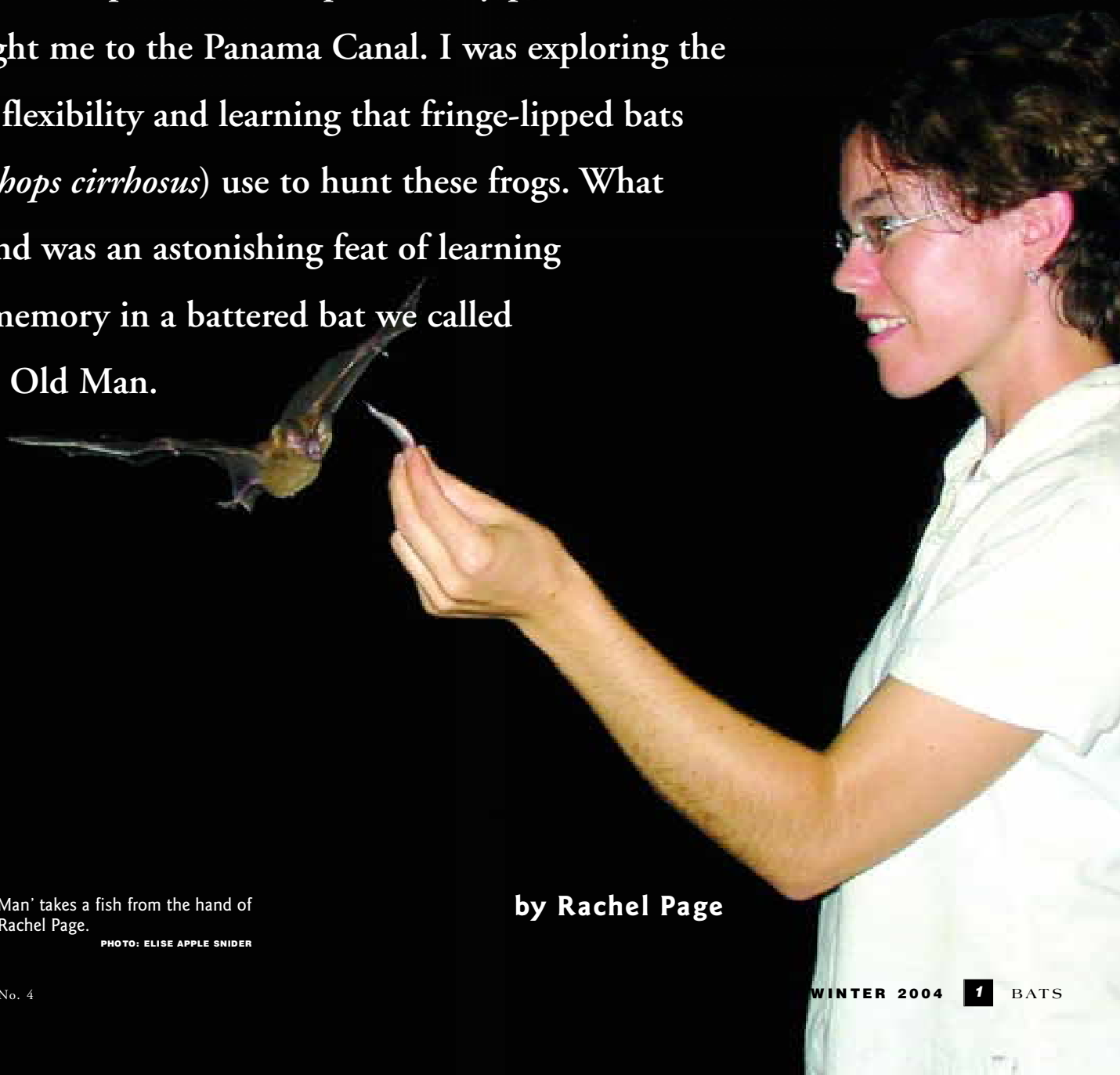
Little Old Man

A tale of frogs, fish and amazing memories

THE TROPICAL NIGHT WAS FILLED WITH A CACOPHONY OF CHORUSING FROGS. Gathered by the hundreds in forest puddles and ponds, these males endlessly shout their desire for mates. Naturally, a bat has evolved to tap this cornucopia of noisy protein. And that brought me to the Panama Canal. I was exploring the cues, flexibility and learning that fringe-lipped bats (*Trachops cirrhosus*) use to hunt these frogs. What I found was an astonishing feat of learning and memory in a battered bat we called Little Old Man.



'Little Old Man' takes a fish from the hand of researcher Rachel Page.
PHOTO: ELISE APPLE SNIDER

by Rachel Page

This fringe-lipped bat is about to snatch a frog from its perch. The bats rely heavily on sound to locate their prey and even use the frogs' mating calls to distinguish between poisonous and edible species. Fringe-lipped bats range from southern Mexico to Brazil.

BCI Founder Merlin Tuttle and Michael J. Ryan (now a Professor of Zoology at the University of Texas at Austin) found that the fringe-lipped bat of Central and South America feeds on frogs and uses their mating calls to find its prey. As a graduate student at UT-Austin, I went to Barro Colorado Island in Lake Gatun, in the Panama Canal, to study the behavior of this frog-eating bat.

I hiked through the wet, tropical forests of Barro Colorado to small streams and ponds and set mist nets each evening. Each time I caught a frog-eating bat, I would take it to an outdoor flight cage to conduct behavioral tests, measuring the bat's responses to different frog calls and other acoustic stimuli. After several days of testing, I marked each bat with a small PIT tag (a passive microchip inserted under the skin, similar to those used to identify pet dogs and cats). Then I released the bat in the same spot where I caught it.

Previous experience with these bats led me to suspect that they are extremely quick learners and very flexible in their foraging behavior. But I was unprepared for the feats of Little Old Man.

The tale goes like this: I was nearly finished with my fieldwork for the season, when my field assistants – Danielle Temple, Katy Klymus and Tida Beng – caught three *Trachops*. We marked all three with PIT tags and I began testing the first bat in the flight cage. We put the other bats in a flight tent on the other side of the field station. One of these bats was notable – by far the oldest *Trachops* I had ever seen. His teeth were yellowed and broken off, his wing and tail membranes

Working in a flight cage on an island in the Panama Canal, University of Texas graduate student Rachel Page trains the bats she studies to come and take food – a minnow – from her hand. Although fringe-lipped bats normally prefer frogs as their primary food, they learn to accept the fish, which helps researchers provide for their needs in captivity. Teaching a bat to eat from a human's hand can take several hours.

were scarred and dry, he had a tear in his right ear, and his fur was a coarse, yellowish color. We named him Little Old Man.

While the bats were awaiting their tests, we took turns feeding them. There are several ways to feed a *Trachops* in captivity: You can catch it and feed it by hand; you can catch a small army of katydids and release them into the flight tent in hopes that the bat will catch them on its own; or you can throw prey such as katydids against dried leaves to make a rustling sound the bat will key in on and attack. (Allowing the bats to feed on captured frogs is not an option because frogs are protected at the Barro Colorado Island field station run by the Smithsonian Tropical Research Institute.)

The easiest approach is to teach the bat to come on call to snatch minnows from your hand. This can take hours, but once a bat learns the new taste and gets over its fear, the result is well worth the effort. This allows me to precisely monitor the bat's food intake and the bat is more likely to exhibit normal behavior. Plus, you don't have to run all over the island catching katydids all night long!

We buy small bait fish that I freeze, thaw and feed to the bats. Once trained, the bats readily accept the fish.

So that night in late June, we set to work training the bats to come to our hands on call. You walk very slowly and quietly up to the bat, with a thawed minnow in your hand. Usually, the bat flies away, so you approach again. And again. And again. But eventually, if you are lucky, the bat may take a small nibble of food before flying away. Then you're set. You need only to add a small noise, like making a clicking sound with your tongue, and soon the bat will learn to fly to your outstretched hand and delicately take the fish.

As I worked through my tests with the first bat, the other bats waited their turn in the flight tent. Danielle, Katy and Tida divided the night into feeding sessions, each taking a few hours so the bats would receive enough food. Soon all the bats would come quickly to our hands, including Little Old Man.

Our flight tent had been used previously to house Jamaican fruit-eating bats, *Artibeus jamaicensis*, which prefer figs. Like *Trachops* taking fish in lieu of frogs, this bat will readily eat bananas when figs aren't available, and some bananas had been left in the tent. Unfortunately, another rain-forest denizen is also extremely fond of bananas – the coati (*Nasua narica*).

Much like the northern raccoon, this scavenger made quick work of the flight tent, ripping large holes and extracting the fruit. The bats were unharmed and, amazingly, were still in the flight tent the next morning, despite the coati-sized holes. We spent many hours mending the holes with needle and thread – but apparently not well enough.

Fringe-lipped bat (*Trachops cirrhosus*)

The feeding bat on this series (*except at far right*) is Little Old Man, a battered but remarkable fringe-lipped bat that, after his return to the wild, was recaptured and, without coaching, remembered the lessons he'd learned a year earlier about how to collect food from Rachel Page's hand.

A few days later, we were very frustrated to find that Little Old Man had disappeared from the tent. Not only had we missed our chance to test him (and we were very interested in the foraging ability of such an old bat), but he would have to fly clear across the island to get back to his home. It's a small island, but it still took us a good hour to hike from

the field station to his roost. Would he find his way home?

The rest of the testing went well, all the bats were returned, well-fed, to their homes, and I returned to Texas to analyze data and write up my results. A year passed. The following spring, I returned to Panama to continue my research. I had new nets, new questions and a new set of experiments. The weeks passed in their usual sleep-deprived blur.

One night toward the end of the season, my field assistant, Clark Jones, came rushing into the flight cage. He had caught a bat that he thought was a *Trachops*, but was unsure of his identification. I lifted the bat from the carrying bag and found that it was, indeed, a *Trachops* – and a most peculiar-looking one at that. Its fur was bleached, its membranes looked dry and scarred, its teeth were in terrible shape. And it had a little tear on one ear. I scanned it with the PIT tag reader and, sure enough, it was Little Old Man.

Now this was exciting in itself. Clark had set his nets and caught this bat in the exact spot we had caught him the year before. After escaping so ingeniously the previous spring, Little Old Man had found his way right back to where he belonged.

Knowing his tricks, we made doubly certain that all screens were secure, then released him into the flight cage. I first tested him on frog calls, playing a call and waiting to see if he would approach the speaker in search of a frog. There was no response. That's not unusual. Bats are often frightened during their first night; they have just been caught in a net, carried through the forest in a bag and released into a strange place. I try to treat them gently throughout the experiments, but I am especially careful the first night. If I can't get them to eat in captivity, I must take them back to where they were caught and let them go.

Little Old Man was hanging from a perch in the corner of the flight cage. I tried the frog call again. No response. I sighed, anticipating a night of catching katydids for his dinner. Just as I was leaving I had an idea. This bat had, after all, learned to approach our outstretched hands for food the year before. Would this bat remember his feeding experiences over the course of five nights in a flight tent a year ago?

Roosting fringe-lipped bats

I took a minnow and held it between thumb and forefinger. I did not approach the bat at all. Instead, I stood in the center of the flight cage and held out my hand. He watched me from his corner. Feeling a little foolish, and nearly certain I was wasting my time, I made the clicking noises. To my astonishment, Little Old Man took off from his perch, flew directly toward me and deftly plucked the minnow from my fingers.

He took no notice as I laughed, delighted. He flew back to his perch and promptly ate the fish. As soon as he finished, I got another minnow and tried again. Again he took it. And again. I ran to the field station and got my assistants. We watched in amazement as this wild bat, caught that very evening, flew to our hands without fear. What had been learned 12 months before, over the course of just a few days, and with no subsequent reinforcement, had been stored and remembered.

This has impressive implications for the role of learning and memory in foraging bats. Some researchers have speculated that *Trachops* must relearn the correct responses to frog calls each wet season, when the frogs become available, because they forget them over the dry season. A single incident in a single bat does not definitively prove anything about the foraging behavior of a species. Yet it is now clear that *Trachops* are far more capable of long-term memory than researchers had anticipated.

Taking Little Old Man back to his roost several days later, I released him with wonder. Would I catch this old bat again? And what would he remember of me in the meantime? As I study the foraging behavior of this species, it is clear to me that learning is going in both directions: I learn from the bats just as they learn from me.

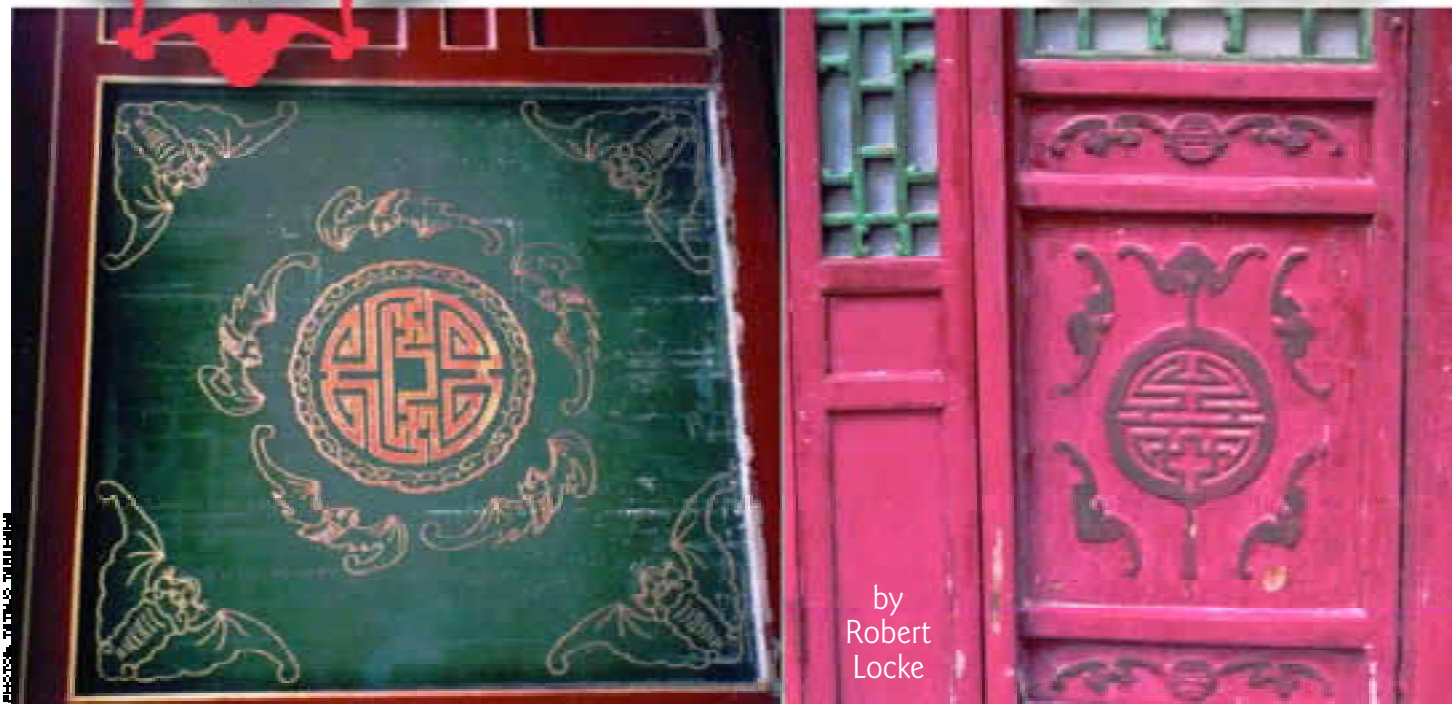
RACHEL PAGE is a Ph.D. candidate in Ecology, Evolution and Behavior at the University of Texas at Austin. Her first experience with bats came while helping Barbara French of BCI and George Pollak of the University of Texas investigate social communication calls of Mexican free-tailed bats. She is in her third year of doctoral studies and is returning to Panama this spring for another field season working with fringe-lipped bats.

THE AUTHOR THANKS the fantastic field assistants who helped on this project: D. Bethel, M. K. Clark, N. Cooper, K. Gillies, C. Jones, K. Klymus, E. A. Snider, D. Marks, D. Temple and K. Sheldon. I am grateful to my funding sources: Smithsonian Tropical Research Institute, the National Science Foundation, the Theodore Roosevelt Memorial Fund of the American Museum of Natural History and the University of Texas at Austin; and to my advisors on this project: M. J. Ryan, M. D. Tuttle, E. K. V. Kalko and A. S. Rand.

I am always looking for volunteers to help me in the field. If you are interested, please contact me at
rachelpage@mail.utexas.edu

Celebrating Bats

Bats bring happiness in Chinese art

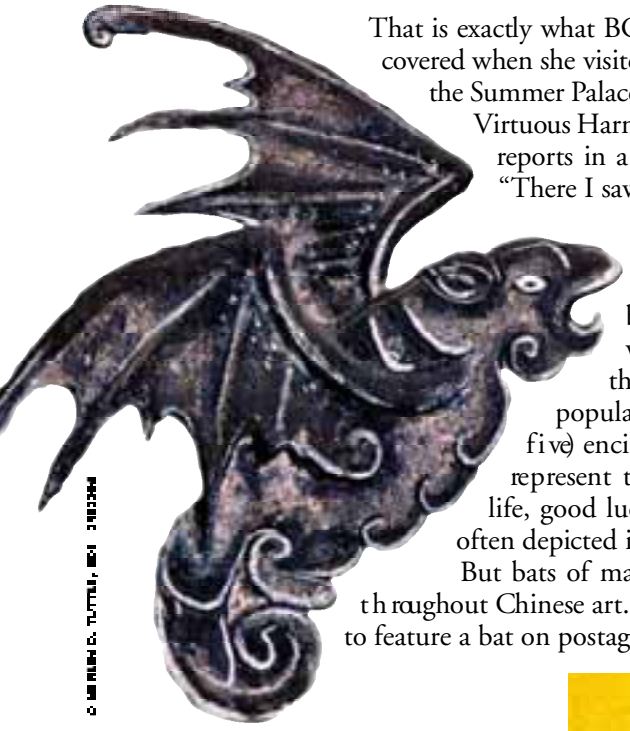


by Robert Locke

Bats in history and legend were feared as sinister denizens of the night throughout much of the world. But not in China. There, bats have long been celebrated as symbols of good luck and happiness. Their images abound in fine fabrics, jewelry, furniture and tapestries. Stylized bats are carved of jade and ivory. They embellish the palaces, thrones and robes of emperors.

Top photos: BCI's traditional logo (top left) is the Chinese "wu-fu" a symbol of happiness that features five stylized bats. The wu-fu is common in Chinese art, as seen in these images taken by BCI member Tatsuo Takehana of Japan at the Summer Palace in Beijing.

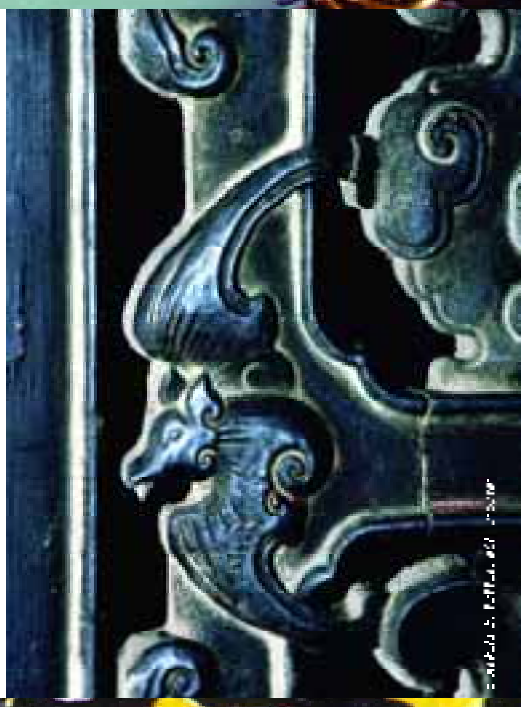
Left: This exquisitely embroidered bat is one of many displayed beneath cushions in an imperial resting chamber. Like the other photos for this story (except those at the top of this page), it is from a rare exhibit, *Imperial Life in the Qing Dynasty* (1644-1911), from the People's Republic of China. It that was presented in Singapore.



That is exactly what BCI member Tatsuo Takehana of Japan discovered when she visited Beijing recently. "I visited a place called the Summer Palace, a huge, beautiful garden – the Garden of Virtuous Harmony – made by the Empress of Qing," she reports in a letter to Bat Conservation International. "There I saw many figures and ornaments of bats."

She shared a number of photos (some of them shown here), including many versions of the "wu-fu" symbol that became BCI's original logo. The Chinese word for bat is "fu," which is pronounced the same as the word for happiness. The popular wu-fu features five bats ("wu" means five) encircling the symbol for prosperity. The bats represent the five happinesses: health, wealth, long life, good luck and tranquility. This ancient design is often depicted in red, the color of joy.

But bats of many designs and colors have a rich legacy throughout Chinese art. China, in fact, was the first nation known to feature a bat on postage stamps– more than 100 years before the



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Top: The ceiling of the emperor's main sitting room is well-adorned with highly stylized bats. Bats were also featured on the wall above the emperor's throne.

Above: Bats like this one were carved onto the face of stone building blocks used to construct a Qing Dynasty palace.

Above right: A wooden panel presenting the "Seven Buddhas" and Buddhist doctrines is also decorated with delicately carved bats.

Right: This intriguing depiction of a bat was stitched into each of many cushions around the emperor's sitting room. As symbols of happiness and good fortune, bats were very common motifs in imperial chambers and clothing.

Pink bats surround a dragon in this elaborate embroidery on an emperor's robe (*top*) from about two centuries ago.

United States got around to it in 2002.

Two bats on the wrapping of a gift convey best wishes and good fortune. The bat pair often appears with two butterflies, a symbol of marital bliss, on gifts for newlyweds.

Bats also appear in Chinese art with peaches, which symbolize fertility. Peaches, in fact, were first cultivated in China nearly 5,000 years ago, and before humans took control of the fruit, wild peaches depended on bats to disperse their seeds.

Although other cultures of Asia share some of China's delight in bats, no Western nation comes close. If more of us accepted the Chinese view of these invaluable flying mammals, Bat Conservation International would have far less work to do.

A green bat shares a stone column (*right*) with Chinese characters, and the carved jade jewelry (*above*) depicts a bat resting on a peach, the ubiquitous symbol of fertility.

Return of the Bat Mummy

A desert cave preserves a 10,000-year-old spotted bat

PHOTO BY MERLIN TUTTLE

A very long time ago, a spotted bat poked his head into a crack in the limestone wall of northern Arizona's deepest known cave. The male bat, apparently looking for a day roost, found himself hopelessly stuck. He died there, trying to extricate his head. The crack became his eternal roost, and there he stayed for more than 10,000 years. The cave's still, dry air mummified the small body.

by David G. Mikesic & Carol Chambers

In 1994, two cavers came upon the bat's dried remains, still stuck in the crack. The mummy itself was easily identified by its unique coloration. Spotted bats (*Euderma maculatum*) are among the most easily recognized bats, with their large pink ears and striking black-and-white fur.

But modern spotted bats are not known to roost in caves, choosing instead cracks and crevices in vertical rock faces. Only two documented sightings of spotted bats in caves had been reported before 1994: a single bat day-roosting at the entrance to a small California cave in 1948, and four bats hibernating in a Utah cave in 1930.

The remarkable discovery of the Arizona mummy is – directly and indirectly – changing that and other assumptions about spotted-bat behavior. And more surprises are likely.

The cavers who found the bat mummy remained at the site for several days. Each night they heard echolocation calls emerging from the depths of the cave – calls that, unlike those of most bats, were audible to the human ear. This is one of few North American bat species with such low-frequency echolocation calls. Could spotted bats be living in the cave even today?

Scientists from the Arizona Game and Fish Department, Northern Arizona University and the Navajo Nation Department of Fish and Wildlife accompanied the two cavers back into the cave to search for any other mummified bats and to determine the age of at least one of them. We also hoped to confirm whether spotted bats were day-roosting in the cave.

The mummified remains of seven spotted bats were found in the cave, along with a few individuals of other local species. All were on the cave floor and in various stages of decomposition.

Along the way, we confirmed the surprising early hints that spotted bats do indeed use caves. We set mist nets at the cave several times from 1995 to 1997 and documented the presence of six to nine spotted bats. They were roosting in the fissured and fragmented limestone ceiling, 100 feet (30 meters) above the cave floor. From May to October, these bats came out of the cave just after sundown, emerging individually or in pairs, up to 10 minutes apart. They returned just before dawn.

Our original mummified bat was radiocarbon-dated, thanks to geology Professor Jim Mead of Northern Arizona

The distinctive coloring of spotted bats makes them easy to identify, even in mummified animals like this one, which died in an Arizona cave about 300 years ago. The same dry cave yielded the naturally mummified remains of seven spotted bats, including the remarkable specimen on the opposite page, which has been dated to roughly 10,400 years ago.

Spotted bats like this one are still using the cave in northern Arizona as a day roost.

Zoologist David Mikesic of the Navajo Nation Department of Fish and Wildlife attaches a tiny radio-tracking transmitter to a captured spotted bat. The researchers used the transmitters to learn more about the foraging habits of the species.

University, to approximately 10,400 calendar years ago.

(Radiocarbon dating is calculated from the decay of radioactive carbon isotopes that are present in all living things. This very well-established dating technique determines the time of a plant or animal's death in what are called radiocarbon years, which differ from the regular calendar years we are used to. A radiocarbon date can, however, be converted to approximate calendar years. Our 10,400-year-old bat mummy had produced an age of 9,180 radiocarbon years, ±50 years.)

The doomed spotted bat went searching for a roost at a time when Earth was undergoing dramatic shifts in climate. Vast glaciers were receding and sea levels rose more than 100 feet (30 meters). Many large mammals – mammoths, mastodons, saber-toothed cats and giant sloths – were disappearing. And the American Southwest was becoming habitable for the first time in many millennia. This likely was the first time the spotted bat, and many other animals, could survive here.

Our research resumed in 2003, after a hiatus of several years, with a grant from Northern Arizona University, and the research team expanded with the addition of U.S. Bureau of Land Management and U.S. Forest Service biologists. We planned to calculate the age of the other six mummified bats in hopes of determining whether all died together, perhaps in a catastrophic event of some kind, or whether the remaining bats might help to show continuous occupation of the cave for thousands of years.

At the same time, we hoped to learn more about foraging habits of the cave's current occupants by attaching tiny radio transmitters to several spotted bats and tracking their movements. We had theorized that these bats' behavior might be similar to that of spotted bats studied in the Grand Canyon by Melissa Siders (formerly with the U.S. Forest Service), Mikele Painter (U.S. Forest Service), Elaine Leslie (formerly with Grand Canyon National Park) and Mike Rabe and Tim Snow (Arizona Game and Fish Department). Bats in maternity roosts of the Grand Canyon and Kanab Creek area travel nearly 35 miles (56 kilometers) nightly from the depths of the Grand Canyon at an elevation of approximately 2,400 feet (730 meters), over the Grand Canyon rim (at 6,100 feet [1,859 meters]) and out to the North Kaibab Plateau (at 8,200 feet [2,499 meters]) to feed on moths at the high-elevation meadows.

We collected the six remaining spotted-bat mummies from the cave under sterile conditions to avoid contaminating the samples. Small patches of skin were removed from each bat and sent for radiocarbon dating. None of these bats was nearly as old as the original mummy. The two oldest were dated around 2,100 and 1,450 years old, while the remaining four samples were less than 300 years old.

Carol Chambers of Northern Arizona University and Jason Corbett (*holding the antenna*) track radio-tagged bats. They found that the spotted bats were foraging over the desert scrublands on the floor of Marble Canyon.

The range of ages among all seven mummies strongly suggests a remarkable conclusion: This cave probably has been used by spotted bats, more or less continuously, for 10,000 years.

Moving from the distant past to the present, we netted four male spotted bats as they emerged from the cave in June 2003. Each of the bats was quickly tagged with a tiny transmitter weighing 0.67 gram (just over one-fourth the weight of a penny) and sent on its way. The transmitters' batteries last about 14 days, so we, along with several very dedicated volunteers, tracked the four bats from dusk to dawn every night for two weeks.

Our results are still being analyzed, but one intriguing discovery already has emerged from the data: Spotted bats from the cave routinely used alternate roosts in the vertical cliffs along the Colorado River in Marble Canyon. This is a typical roosting habitat, long known to bat biologists, that is rich in cracks and crevices that provide protection from predators and the day's heat.

We also quickly discovered that the bats were not flying to the top of North Kaibab Plateau as we expected. They were foraging mostly over the desert scrub of the valley floor and the canyon tributaries of Marble Canyon. They flew to slightly higher elevations only to night roost in nearby piñon/juniper woodlands.

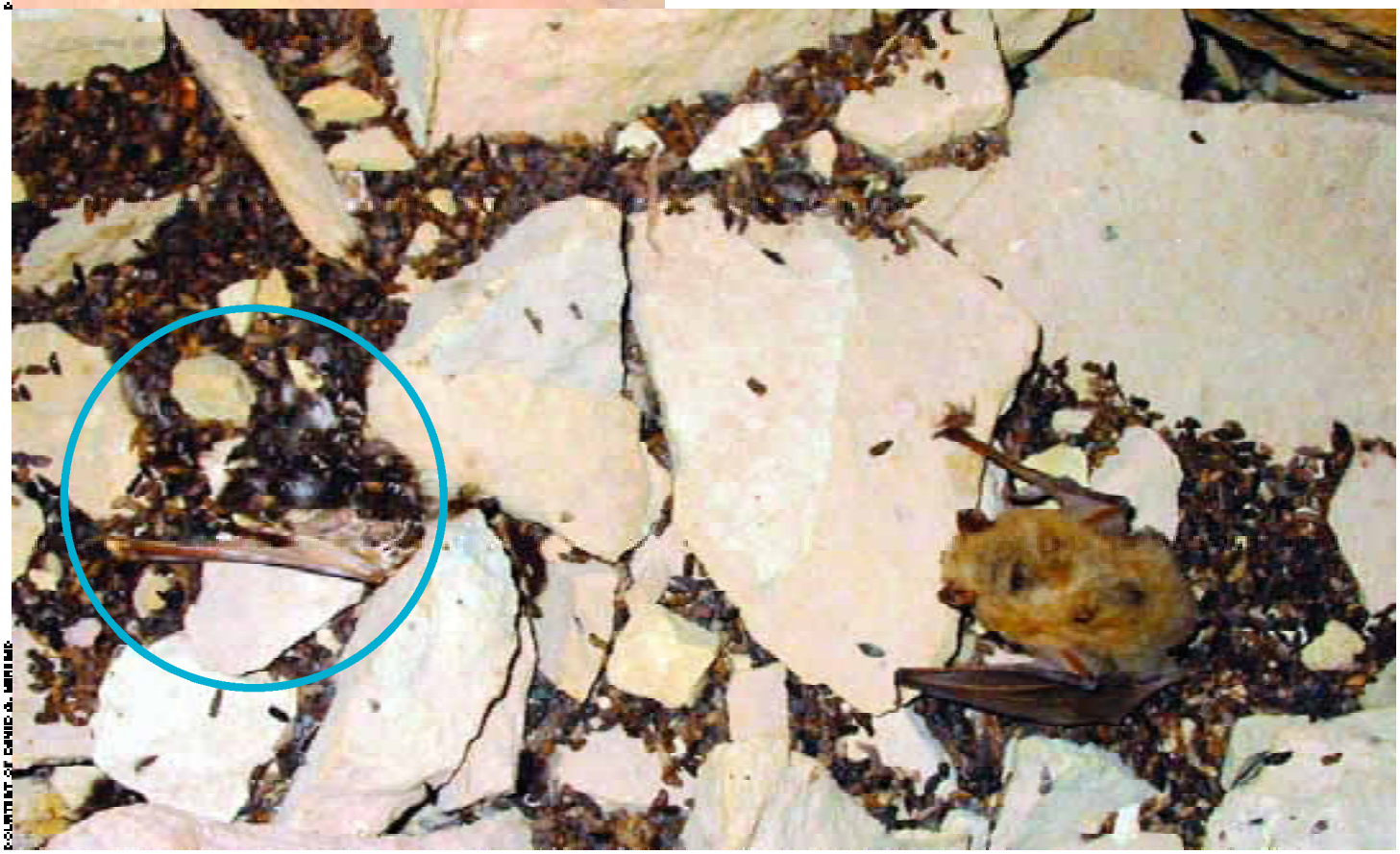
Yet these spotted bats were covering a similar distance – about 50 miles (80 kilometers) – as the Grand Canyon females that forage on the North Kaibab. Remember: This is a 15- to 22-gram (0.5- to 0.75-ounce) bat with a wingspan about the same as an American robin's. Traveling 50 miles each night, at times reaching 30 miles per hour (48 kph), in search of food and water is quite a feat!

We hope to conduct studies with hair and tissue samples collected from the four contemporary bats. Radioisotope analysis will reveal aspects of their diet, and genetic analysis may determine whether our modern-day spotted bats are related to their mummified predecessors in the cave.

These ancient bats opened a treasure chest of information and there almost certainly are more surprises yet to come.

DAVID G. MIKESIC is a zoologist with the Navajo Nation Department of Fish and Wildlife's Natural Heritage Program in Window Rock, Arizona.
CAROL CHAMBERS is Associate Professor of Wildlife Ecology at the Northern Arizona University School of Forestry in Flagstaff.

COURTESY OF DAVID G. MIKESIC

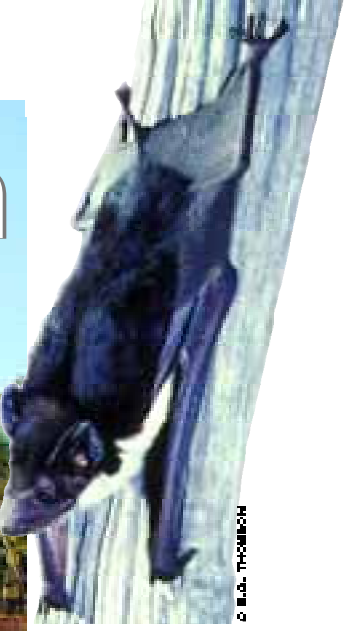


COURTESY OF DAVID G. MIKESIC

The still, dry air of the cave often preserves the remains of bats that die there. The spotted bat mummy in the left photo is only about 50 years old, while the bat at center-left below (shown with a myotis mummy found with it) is about 2,100 years old.

Protecting Cotton

Bats attack pests over Australian cotton farms



Research in New South Wales, Australia, demonstrated that bats, such as the yellow-bellied sheath-tail bat (*above*), play a very active role in controlling insects that damage cotton crops and that bat numbers and diversity are highest when cotton fields are planted like this one near irrigation ponds and old-growth eucalyptus.

by Rachael Long

The battle commenced above the cotton field one hot February night. Cotton bollworm moths, whose larvae ravage cotton bolls, cut erratic paths across the dark sky. Bats of up to half a dozen species raced in hot pursuit, their echolocation calls beeping wildly on our bat detectors. And that aerial combat is exactly what I had come to Narrabri, in the cotton country of southeast Australia, to study.

Narrabri, at the edge of the outback in New South Wales, reminded me of home in California's Sacramento Valley. Both areas are studded with vast cotton fields interspersed with rolling hills of golden grass and trees.

A single river, the Namoi, flows through Narrabri, providing water for farmers and others. Most of the cotton in the Namoi River Valley is produced on family farms. Irrigation water is pumped from the river after rainstorms and stored in lakes scattered around the fields. These lakes, which generally cover 3 to 5 acres (1.2 to 2 hectares), are full of old-growth eucalyptus trees that had been left standing when the land was cleared for farming. The areas around the lakes were teeming with birds – and, we soon discovered, with bats.

Soon after arriving, I joined colleagues Greg Richards, an Australian bat biologist; Monika Rhodes, a Ph.D. student from Australia's Griffith University; John Westbrook, Research Leader at the U.S. Department of Agriculture's Area-wide Pest Management Research Unit in College Station, Texas; and our host, Martin Dillon of the Australian Cotton Research Institute in Narrabri. Our project, with obvious implications for bat conservation, was to study the role of bats in controlling cotton pests. We were funded in part by Bat Conservation International.

The major pest of cotton in Australia is the cotton bollworm. The eggs of this night-flying moth hatch into larvae that feed on developing cotton bolls, severely reducing yield and fiber quality. Growers now use various methods to control these pests, including insecticide sprays that are costly to the farmer and the environment. Our goal was to document the impact of bats in helping to control this very expensive pest.

The Australian villain is the Old World bollworm (*Helicoverpa armigera*). It is very similar in size, appearance and agricultural devastation to its western hemisphere relative, the New World bollworm (*Helicoverpa zea*). Both moths lay their eggs – from about 500 to as many as 3,000 per female – on plants. The caterpillars (larvae) that emerge grow to an inch (25 millimeters) or more long and eat just about anything that grows, including each other. Besides cotton, corn and tomatoes, they feed on food crops from beans to watermelons and a variety of ornamental plants. Their commercial damage in the United States alone exceeds $1 billion a year.

In North America, insectivorous bats – especially Mexican free-tailed bats (*Tadarida brasiliensis*) – are prodigious predators of cotton bollworm moths. Their presence in the cotton fields can reduce the need for pesticides. We hoped to document a similar value of bats against the Old World bollworm in Australia.

Armed with Anabat echolocation detectors, night-vision goggles and infrared video cameras, we headed for

the fields and spent many a night scouring the sky for the sight and sound of bats on the hunt. The nights were warm and humid, for February is midsummer in Australia, and we were overdressed in hats, gloves and long-sleeved shirts to deter mosquitoes, some of which carried the Ross River virus, a local disease that causes severe flu-like symptoms.

I also always wore boots for fear of snakes. I had spotted a couple in the area, including highly poisonous red- and blue-bellied black snakes – which my host insisted I was "lucky" to see. During our midnight breaks for tea and biscuits, I was extremely careful where I rested.

We quickly found that night skies above the fields were aswarm with flying bats and insects. In cotton fields adjacent to irrigation ponds with old-growth trees, we recorded six species of insectivorous bats. These included the white-striped freetail bat (*Tadarida australis*), southern freetail bat (*Mormoptens planiceps*), little broadnosed bat (*Scotorepens greyii*), little forest bat (*Vespadelus vulturnus*) and the less common chocolate wattled bat (*Chalinolobus morio*) and yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).

All six are known to roost in old tree hollows and are listed as vulnerable to the clearing of land for agriculture. These bats were continuously active over the cotton fields from dusk until we left the fields well after midnight.

In cotton fields that had been completely cleared of native vegetation for miles around, we spotted only two species of insectivorous bats foraging over the cotton: the white-striped freetail and the southern freetail bat. In these large-scale, monoculture cotton fields, both species generally showed up after dark and activity was sporadic. Since these bats are fast flying and capable of long-distance flight, we surmised that they roosted in remnant old eucalyptus trees in the foothills of the local mountains and along streambeds and roads.

After many nights of observations in different fields, we clearly documented the importance of local roosting sites in old-growth eucalyptus trees for enhancing the diversity and abundance of bats that prey on cotton pests.

There is no doubt that the bats were hunting the insects in the cotton fields. When foraging bats appeared over a field, insects promptly took evasive action or fled. We observed moths spiraling into the cotton or suddenly increasing their flight speed.

We believe bats have an impact on these moth pests by reducing numbers and disrupting their mating and egg-laying activity. Bollworms are among insects that are biologically equipped to hear bats' ultrasonic echolocation calls, and when they do, they obviously take evasive action, attempting to avoid areas where bats are most active.

The cotton bollworm moth is one of the world's most damaging agricultural pests. In addition to cotton, its larvae feed on corn, tomatoes and many other food crops. Bats eat huge quantities of these moths, greatly reducing farmers' needs for chemical pesticides.

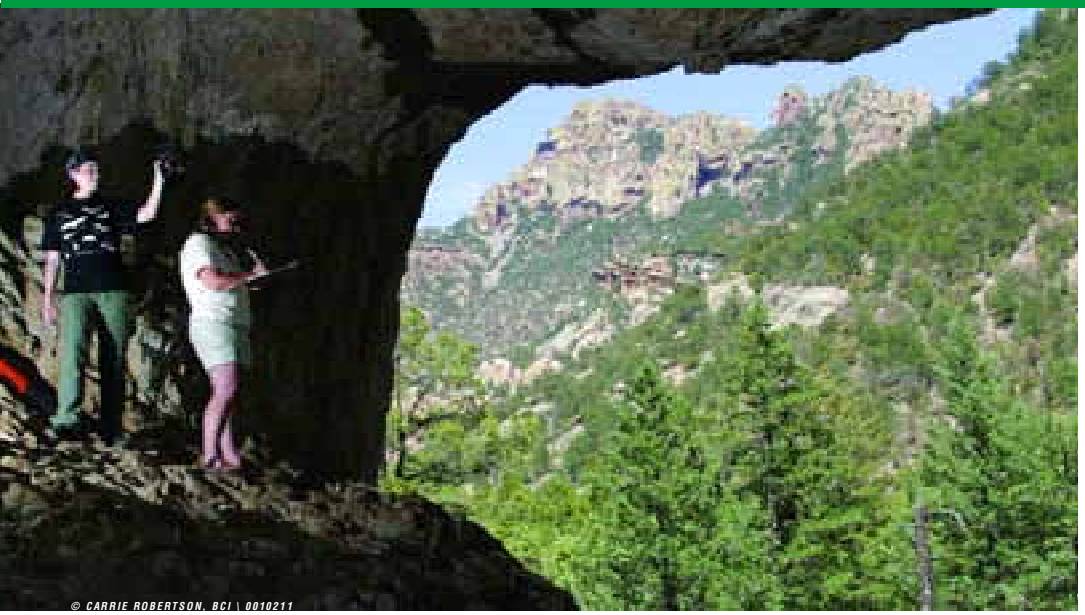
Armed with bat detectors, night-vision goggles and infrared video cameras California researcher Rachael Long prepares for a night of monitoring bat-foraging activity over a cotton field in Australia. The research team also included Australian bat biologists. The southern freetail bat (*top left*) is among bats that feed on cotton-damaging moths.

After many hours of monitoring bat activity and counting bollworm eggs on cotton plants, however, we were unable to document clear differences in the number of eggs as a result of bat activity. A severe drought in the region kept bollworm pressure too low to measure significant differences during our visit. Further investigation is needed.

We were, however, able to demonstrate the great importance of old-growth eucalyptus trees in maintaining the diversity and abundance of bats on cotton farms. This information is being disseminated to cotton growers at local and regional meetings, and farmers are beginning to realize the economic value of conserving trees on their farms to enhance bat activity for natural pest control.

RACHAEL LONG is a Farm Advisor with the University of California Cooperative Extension Service in Yolo County, California.

The author thanks Bat Conservation International for partially funding this study and Martin Dillon of the Commonwealth Scientific and Industrial Research Organization's Australian Cotton Research Institute in Narrabri for hosting our team.



Workshop participants monitor rock temperatures in a cave at Cave Creek Canyon in Arizona.

The Ultimate Bat Experience

Sign up now for BCI's 2005 field workshops

Extraordinary successes have been achieved in bat conservation, research and education by graduates of BCI's field workshops. Nearly 1,100 biologists, land managers, educators, animal-control personnel and bat enthusiasts have attended these workshops. For many, the experience changed the course of their careers.

And while the workshops are invaluable for wildlife professionals, they are also exciting, informative experiences for anyone who's serious about bat conservation and research. Learn about bats and their needs, field-research techniques and species identification. Personally capture, examine and release a variety of bats. And see an array of wildlife and spectacular scenery. BCI field workshops are an unforgettable experience. But space is extremely limited, so sign up early. (Fees include materials, meals, lodging and transportation from the departure city.)

Bat Conservation and Management Workshop – Arizona

Our field location at the renowned Southwestern Research Station in the Chiricahua Mountains features a range of habitats from lowland deserts to coniferous forests. The six-day sessions emphasize bat identification and habitat assessment. You'll catch and release up to 18 bat species in a single evening, then watch endangered long-nosed bats visit hummingbird feeders just outside your lodging.

Workshop leader Janet Tyburec, along with Katy Hinman and Arizona Game and Fish biologists, share a wealth of knowledge on species identification (including echolocation calls), bat conservation, management, education, public health and nuisance issues, artificial habitats and much more. Each workshop features radio-tracking a forest bat back to its roost, watching an emergence of Mexican free-tailed bats from a local cave and learning bat-capture techniques.

Length: *six days, five nights. Limited to 15 people per session.*
Three sessions: *beginning May 23, May 28 and June 2, 2005.*
Departure city: *Tucson, Arizona.*
Cost: *$1,295.*

Bat Conservation and Management Workshop – Pennsylvania

The rolling hills and mixed agricultural fields of central Pennsylvania provide a perfect place to see how easily bats and humans can coexist. Many thousands of little brown myotis live and raise their young in buildings, barns, attics and other structures. Nearby mines and caves offer ideal hibernation sites for at least six bat species.

Janet Tyburec and Cal Butchkoski of the Pennsylvania Game Commission provide in-depth information on eastern bat species, public education, public health, nuisance issues and related topics. We'll net, trap and release bats over trout streams and beaver ponds, see endangered Indiana myotis swarming at a mine entrance and watch 20,000 little brown myotis in a spectacular dawn return to their restored roost in a church attic. We'll visit both summer and winter sites as colonies are beginning to disperse, and we can expect to catch, study and release such striking, migratory species as red, hoary and silver-haired bats.

Length: *six days, five nights. Limited to 15 people.*
One session: *beginning August 14, 2005.*
Departure city: *Harrisburg, Pennsylvania.*
Cost: *$1,195.*

A limited number of full and partial scholarships for BCI Bat Conservation and Management Workshops in Arizona or Pennsylvania are available for state and federal biologists, land managers and other professionals with special needs.

Acoustic Monitoring Workshop – Pennsylvania

This year, BCI is offering an Acoustic Monitoring Workshop in conjunction with our Bat Conservation and Management session in Pennsylvania. This special workshop will cover bat-detector hardware and software (including Anabat, Pettersson and SonoBat), call identification, and strategies for developing a monitoring program. Joining BCI's Janet Tyburec will be acoustic experts Sybill Amelon, Joe Szewczak and Ted Weller. The session combines research discussions with hands-on demonstrations and fieldwork. Each night, we will be capturing bats and developing call libraries so participants can return to their home study areas and begin their own projects.

BCI will have equipment on hand, but participants are encouraged to bring their own systems. The Acoustic Monitoring Workshop is an advanced session designed for graduates of previous BCI workshops and/or experienced bat researchers.

Length: *six days, five nights. Limited to 15 people.*
One session: *beginning August 8, 2005.*
Departure city: *Harrisburg, Pennsylvania.*
Cost: *$1,195.*

For workshop details and online applications, visit
www.batcon.org/trips/toptrips.html
or contact Kari Gaukler, Bat Conservation International, PO Box 162603, Austin, TX 78716; (512) 327-9721; *kgaukler@batcon.org*

Boy Scout Corwin Ames (*right*) and Andrew McCalla of Austin's Meridian Energy Systems celebrate completion of a solar-light system (*above right*) at Bracken Cave. The solar panel is mounted on the roof of the old shed.

PHOTOS COURTESY OF CORWIN AMES

Lighting the Way

Experiencing the awesome emergence of the world's largest bat colony just got a bit more congenial for BCI members, thanks to hard work by a San Antonio, Texas, Boy Scout and his friends. Subtle, solar-powered lights now guide visitors back from the mouth of Bracken Cave.

Corwin Ames says he was overwhelmed the first time he saw the Bracken bats fly out of their cave a few years ago. So, in search of a project for Eagle Scout honors, he decided on an environmentally friendly way to improve the site. Since the bats spiral out of the cave around twilight and guests often walk back to the parking area after dark, Ames wanted to light their way.

With his plan approved by the Eagle board at Scout Troop 809, he worked with BCI's Andy Moore on the details. Andrew McCalla of Austin's Meridian Energy Systems volunteered his expertise on electrical wiring and mounting a solar panel and battery.

Ames, several Scout friends and McCalla spent a day mounting the solar panel on the roof of a historic old shed, installing a battery, burying electric cables and placing the lights.

If you visit the cave on one of this year's Members' Nights, enjoy the walk – and thank Corwin Ames and his friends.

New Members' Nights at Bracken Cave

Many BCI members requested a little more flexibility in our schedule of Members' Nights to see the incredible evening emergences of 20 million Mexican free-tailed bats from Bracken Cave. So we've added some springtime and late-summer dates for 2005.

Now you can join Bat Conservation International staff and fellow members on March 12, April 2 and April 9 (all Saturdays), in addition to our summer schedule. The earlier dates promise equally impressive flights by the world's largest bat colony, plus a chance to see the Texas Hill Country awash in springtime wildflowers.

Summer dates (also all Saturdays) are June 25, July 2 and 9, August 6 and September 24. Whether spring or summer, mark your calendar for this popular member benefit at BCI's Bracken Bat Cave and Nature Reserve near San Antonio.

Registration for all Members' Nights begins February 1 (and will not be accepted earlier). Space is limited, so please don't delay. Send BCI your name, address, phone number, the number in your party and your first and second choices of dates.

On or after February 1, email the information to *bracken@batcon.org* or fax it to (512) 327-9724, Attn: Members' Night Coordinator. You may also call (512) 327-9721.

We'll send you a map and additional information with your confirmation.

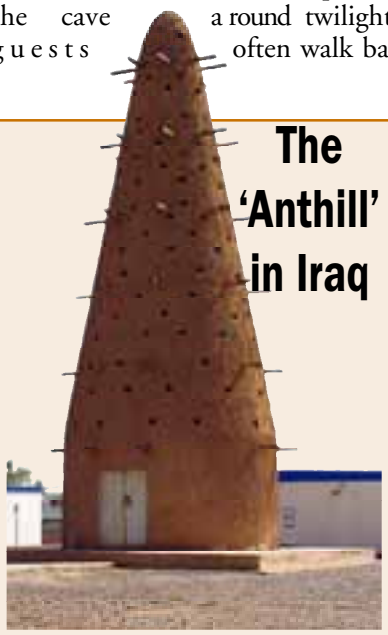


PHOTO COURTESY OF RON EBERT

The 'Anthill' in Iraq

In the last issue of *BATS*, we carried a picture (*left*) of a peculiar clay, anthill-like structure at the U.S. Army's Victory Base outside Baghdad. Contractor Ron Ebert said it was home to a number of bats and asked BCI's help in identifying the bats and the "anthill." We offered some possibilities on the bats, but were no help at all on the structure. BCI members, however, offered some ideas.

Member Sue Payne of Council Bluffs, Iowa, who's a member of the U.S. Army Corps of Engineers, wrote of "a friend who just got back from Camp Victory. He says Saddam originally built it as a bat house. The area around it had more trees then. Since most of the trees have now been cut down, a lot of pigeons are living in the 'anthill' now, but there are still a huge number of bats living in it."

Homer Hansen of Willcox, Arizona, says his brother-in-law, Jeff Ferro, is stationed in Iraq and had this explanation: "This place used to be a safari refuge/nature preserve/vacation home, so that termite mound-looking 'thingie' was a bird-house for exotic birds."

John Bishop of Nashua, New Hampshire, suggests, "I believe the large cone-shaped structure might be a dovecote (a pigeon roost). These were common throughout pre-modern Europe and elsewhere," as early as the 13th century. The pigeons were a major source of meat and provided copious supplies of fertilizer. These were typically round, tower-like structures, but sometimes were built as squares or other shapes. Many are today being carefully preserved.

The suggestions make sense. You be the judge …

Honors for a Friend of Bats

Sally Walker, an American who has devoted her life to wildlife conservation in India, and whose work has been supported by Bat Conservation International, recently received high honors from the World Association of Zoos and Aquariums. She was chosen for the Heini Hediger Award of 2004 for "excellent and unstinting service to the zoological park and aquarium community."

Walker first visited India in the early 1970s as a Sanskrit scholar and eventually became devoted to wildlife conservation and to zoos throughout Asia. She was named to India's national Zoo Advisory Board and founded the Zoo Outreach Organization (ZOO) to work for conservation issues at zoos and in the field. The organization is active throughout South Asia and its impact has spread far beyond the region through monthly publications that Walker founded and edited.

BCI's Global Grassroots Conservation Fund has provided several grants to Walker and her organization for specific projects. Probably the most important was BCI's support for an unprecedented conference that was vital in winning federal protection for two critically endangered bat species – the first bats ever formally protected in India.

The Bat Conservation International Global Grassroots Conservation Fund provides small grants to support innovative bat-conservation projects by local organizations and individuals around the world. To help support Global Grassroots, contact BCI's Emily Young: *eyoung@batcon.org* or (512) 327-9721.

Bat gate at Mammon Mine in Arizona

Bats & Mines in Reno

Bat Conservation International is co-sponsoring a wide-ranging conference on managing abandoned mines and the bats that use them. The session will be May 3-5, 2005, in Reno, Nevada. Topics range from the history of mining in the American West to detailed reports on the most up-to-date options for securing old mines without evicting bats.

The symposium is aimed at wildlife and resource managers, students, researchers, mining personnel and archaeologists. Experts in the field will discuss the bat species that use abandoned mines and how they use them; the latest strategies for surveying bats' use of mines; how to accurately gauge the success of bat-friendly mine closures; and procedures for managing biological resources in old mines. Case studies will also be presented.

The conference – *Past, Present & Future: Management of Abandoned Mines and the Bats that Depend on Them* – is sponsored by BCI, Christopher Newport University and the University of New Mexico.

For details as they develop, check BCI's website: *www.batcon.org*.

Another 'Call of the Wild'

The Houston Zoo announced its cell-phone recycling program for Bat Conservation International a year ago (*BATS*, Winter 2003), with plans to continue it through September 2004. But the response from BCI members has been so impressive that the program is being extended for another year – through September 2005.

The zoo accepts old cell phones, chargers and batteries for delivery to The Wireless Foundation, which pays the zoo. The equipment is refurbished and sold or safely recycled. BCI is the sole recipient of all proceeds from the program, dubbed: "Answer the Call of the Wild – Be a Bat Crusader."

So keep those worn-out cell phones coming.

A phone-recycling bin is located at the zoo's gift shop or cell phones may be mailed to: Houston Zoo Inc. • Cell Phone Recycle • 1513 North MacGregor • Houston, TX 77030

Bat Facts for Brownsville

Donna Berry (*right*), a tireless conservationist and bat booster in Brownsville, Texas, was a big hit at her community's Halloween festival at the University of Texas at Brownsville. She set up her popular "bat cave" and a video that clarifies overblown fears about bats and rabies (*above*) and handed out more than 200 copies of BCI's pocket-sized *Bat Facts* cards. "The kids loved the video," she reports, "and the parents liked having a place to sit down and eat their pizza. The coolest visitors to the booth were four teenage boys who kept asking us questions about the bats on the video. They very carefully placed their *Bat Facts* in their wallets so they wouldn't lose them. Very cool!"

BCI Member Snapshots

LAURA KAHANEK, a BCI member in Pearland, Texas, sewed this delightful "tracing pad" of bats and BCI's logo. An animal lover all her life, Laura says she was inspired by a visit to Austin, where she watched the dramatic emergence of the bats that live under the Congress Avenue Bridge. She works at the public library in Pasadena, Texas.

Share a snapshot of your bat activities with your fellow members: Send it to Robert Locke, Bat Conservation International, PO Box 162603, Austin, TX, 78716.

The Wish List

Your help with any of these special needs will directly improve BCI's ability to protect bats and bat habitats. To contribute or for more information, please contact Emily Young at (512) 327-9721 or eyoung@batcon.org.

Help the bats of Nepal

The spectacularly beautiful Pokhara Valley of Nepal is home to many bats of 50 or more species – but almost nothing is known about their current status or needs. Conservation efforts, as a consequence, are virtually nonexistent. A Nepalese student seeks a modest grant from BCI's Global Grassroots Conservation Fund to begin a scientific survey of bats in the valley. Sujas Prasd Phuyal plans to interview residents and examine sparse records to initially identify bat habitats, then follow that with on-site surveys to identify species, estimate numbers and assess existing threats. After analyzing the data, the student will issue a final report and conservation recommendations. This groundbreaking study can be financed for just $839.

All-terrain wheels for Bracken Cave

BCI is restoring 700 acres of Texas Hill Country to its natural, pre-civilization state as a critical part of creating the Bracken Bat Cave and Nature Reserve. But much of the land is rugged and broken in good weather and almost impassable when it rains. Inspecting and repairing the four miles of fence that protect the cave and its 20 million bats is now done on foot. Staffers' vehicles used for land stewardship are simply not up to the task. An All-terrain Vehicle would dramatically improve our ability to restore and care for this important property. A Honda FourTrax Rancher 4x4 with two helmets costs $4,950.

Finding key bat caves in Mexico

Working with Mexican scientists, Bat Conservation International is discovering key bat caves in northern Mexico as the first major step in conserving countless migratory bats along the U.S.-Mexico border. To study these caves, the Borderlands Project urgently needs $415 for caver's gear: Petzl Duo head lamp ($110); 50 meters of climber's rope ($105); and a complete GGG Frog Harness System ($200).

Nurturing a New Generation of Scientists

A BCI scholarship allowed Nathan Muchhala (*right, with a field assistant*) demonstrate the economic value of bats as pollinators in the rain forests of Ecuador.

In the past 14 years, 184 graduate students have relied on Bat Conservation International scholarships to conduct bat conservation-related research in 44 countries. In addition to their direct contributions to conservation, these young people acquired the knowledge and advanced degrees needed to become leaders on behalf of bats worldwide.

A panel of leading bat scientists reviews scholarship applications and guides the selection process. The scholarships provide seed money to attract matching funds from other sources. Historically, BCI scholarship awards have been matched at a ratio of 11 to 1, producing millions of dollars in vital research. Here's a sampling of the research being undertaken with 2004 BCI scholarships:

- Mapping the diversity of bats in the Mpumalanga Province of South Africa to help establish conservation priorities and population monitoring and to guide future studies of bat behavior and needs in these habitats.
- Examining the responses of forest bats to varied timber-harvesting strategies along streams, clearings and roadways in North Carolina to improve bat-friendly timber management.
- Identifying factors that affect bats' choice of cave roosts in Madagascar to help limit the impact of cave tourism.
- Documenting the seasonal movements of Townsend's big-eared bats between hibernation sites and summer roosts in Washington to identify poorly understood patterns that play important roles in conservation.

This year's 12 scholarship students are adding to our understanding of bats and bat habitats in five countries. But we could do so much more. Limited resources force us to reject many excellent applicants with important projects. You can help Bat Conservation International support these students and make a real difference far into the future.

To support the BCI Student Scholarship Fund, contact Emily Young: eyoung@batcon.org *or (512) 327-9721.*

2004 Oracle Bat Research Scholars

Oracle Corporation of Redwood Shores, California, provided a generous grant to BCI's scholarship program, allowing us to support key research by eight graduate students. Here are the 2004 Oracle Scholars (with their university and research country):

Scott Cardiff, Columbia University (Madagascar)
Gloriana Chaverri, Boston University (Costa Rica)
Kathryn Durkee, Longwood University (Virginia)
Marcia Maslonek, West Virginia University (Pennsylvania)
Eleni Papadatou, Leeds University (Greece)
Daniel Riskin, Cornell University (Madagascar)
Patricia Ruback, Northern Illinois University (South Africa)
Stu Tuttle, Northern Arizona University (Arizona)

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