

# Cave Creatures

*Peering into the murky world  
of one of North America's most common bats*

By CAROL EZZELL

**A** thick fog of millions of bats swirls just inside the entrance of a cave. As dusk falls, the bats begin to stream outward, tentatively, as if testing a newfound freedom. After a few minutes they seem to gain confidence and the emerging bat cloud gently winds upward, making a circle over the cave. The mass spirals ever higher, disappearing into the gathering gloom.

"Nobody knows where they go," bat researcher Paul B. Robertson says wistfully of the winged inhabitants of Bracken Cave.

As with many bat species, the life cycle and behavior of the 20 million adult Mexican free-tailed bats (*Tadarida brasiliensis*) living in this cave outside San Antonio, Texas, have remained something of a mystery to scientists. But observations at Bracken Cave and recent, in-depth studies at other Texas caves have pierced the veil of secrecy surrounding *T. brasiliensis*, one of the most prevalent bat species in the southern and southeastern United States.

For hundreds of years, female Mexican free-tailed bats have come to the cave every March to bear and raise their

young, says Robertson, who has studied the ecology of the bats in collaboration with the Austin-based group Bat Conservation International (BCI), and who recently moved from Trinity University in San Antonio to the Center for Rainforest Studies in Yungaburra, Australia. After mating in Mexico in late winter, the females head toward the cave — accompanied by a scant 100,000 or so males — soaring to altitudes of 8,000 to 10,000 feet and averaging 40 miles per hour, he says.

Researchers have estimated the cave's mammoth summer population over successive years by monitoring the amount of time needed for all the bats to leave the cave to feed each evening. Bracken Cave, says Robertson, is the species' largest maternity colony, housing the world's largest concentration of mammals each summer, yet "nobody but the bats knows what's so special about it."

During the arduous late-winter migration, the females produce a vaginal secretion that keeps their mates' sperm in suspended animation until they reach their destination, Robertson says. Once settled into their summer retreat, the



Mexican free-tailed bats, such as the flying adult pictured, are named for the tail that protrudes beyond their posterior wing membranes.

Merlin D. Turtle/BCI

females become pregnant. Four months later, each gives birth to a single bat pup, swelling the cave's population to approximately 40 million.

The mothers keep their pups in a "crèche" in one chamber of the cave and nurse them at least twice a day for roughly 45 days, says Gary F. McCracken of the University of Tennessee in Knoxville. In 1984, McCracken reported the astonishing finding that each mother bat manages to sort through the crèche's throng of hungry millions and feed her own offspring more than 80 percent of the time. He and one of his students, Deborah L. Gelfand, went on to find that each mother accomplishes this remarkable feat by zeroing in on the distinct, high-pitched call of her pup.

Another of McCracken's students, Jonathan P. Balcombe, conducted a systematic study of the vocal-recognition strategy used by Mexican free-tailed bats. Mothers are significantly more attracted to a recording of their own pup's call than to the taped call of a strange pup, Balcombe reported in the May 1990 ANIMAL BEHAVIOUR. Conversely, he found that while pups are generally attracted to the sonar "echolocation" calls used by adult bats for in-flight navigation, they cannot discriminate their mother's echolocation call from that of an unrelated adult.

More recently, McCracken and University of Tennessee colleague Mary K. Gustin turned up evidence that mother bats also sniff out their young using a keen sense of smell, and that they recall with great accuracy the region of the crèche where they last left their pups. In a paper in press in ETHOLOGY, McCracken and Gustin describe their observations



A stream of millions of Mexican free-tailed bats emerges at dusk from Bracken Cave.

Mark J. Twery/U.S. Forest Service



Merlin D. Tuttle/BCI



A mother bat (upper left) must search through millions of baby bats to find and nurse her own pup. The hairless pups are grouped together in a specific region of the cave, known as a crèche.

of mother-pup behavior in two Texas caves over six nursing seasons.

By tagging nursing mother-pup pairs before the mothers left to forage, and then watching them return, the researchers found that mothers go back to the same area of the crèche each time. The mothers then call and sniff their way over and through the mass of pups until they find one that resembles their own. To confirm that she has located her young, a mother often sniffs and exchanges calls with a pup for a minute or more before either rejecting it or nudging it toward one of her teats, Gustin and McCracken

report. In their study, the entire searching process lasted between 12 seconds and about 6 minutes.

But even though researchers have clarified a few of the enigmas of *T. brasiliensis* biology, Robertson concedes "there's a lot we don't know about these bats." Exactly where do they go to feed once they leave their cave each evening? Why do they roost in certain caves but not others? And, more fundamentally, why do the females leave their Mexican homes and fly north to give birth?

Bat biologists have had a tough time answering such questions, because Mexican free-tailed bats are very difficult to study. Their droppings, called guano, contain so much ammonia that anyone entering a cave inhabited by these animals must wear respiratory gear to keep from suffocating. Moreover, researchers can make only a limited number of forays into the caves per year without scaring away its extremely shy inhabitants — an outcome that could have dire consequences for the species. "They are a very

sensitive group of animals," Robertson says.

BCI, which began managing Bracken Cave only a year ago, does not plan to allow many research expeditions into the cave, says Jacqueline J. Belwood, the group's former scientific director. BCI wants to shield Bracken Cave from the fate of Eagle Creek Cave, outside Phoenix, Ariz., whose summer population of roughly 30 million Mexican free-tailed bats plummeted to only 30,000 over a 10-year period, in part because of research forays and other human disturbances. "BCI won't do much research at Bracken Cave because its population is just too fragile," says Belwood.

**B**ut the bats of Bracken Cave have not always had such staunch protectors. During the Civil War, Confederate troops mined the cave's guano deposits in order to obtain potassium nitrate, a vital ingredient of gunpowder. And several years ago, the Air

## A fly-by-night adventure



"To get the best story, go directly to the source."

The words of my first editor came to mind last August when I was offered an opportunity to witness the early-evening emergence of 20 million Mexican free-tailed bats from Bracken Cave. The venture was part of a field trip organized to coincide with the annual meeting of the American Institute of Biological Sciences in San Antonio.

Our group, which consisted of two dozen ecologists and a couple of journalists, arrived at the cave after traversing bumpy, unpaved roads through cattle country. We gingerly sidestepped cowpies to reach the cave's entrance, nestled along one side of a wide pit. Seat-sized rocks left behind from early mining efforts littered the opposite side of the pit, forming a natural amphitheater within which we sat to await the upcoming spectacle.

While we waited, our guide, biologist Paul B. Robertson, debunked some popular bat myths. Although many people think of bats as sinister bloodsuckers, prone to rabies and fond of entangling themselves in bouffant hairdos, Robertson explained that most species are shy and harmless. Mouse-sized Mexican free-tailed bats have dull, flat teeth more adapted for mashing moths than for attacking people or animals. Although bats, like many other mammals, can carry rabies, only a handful of human rabies cases have ever been traced to a bat bite, he said. And he confidently advised us that any self-respecting bat would much prefer its own dark cave to anyone's hair, no matter how soft or alluring.

Just before dusk, we got an up-close-and-personal view of a dinner-bound bat. While most of us sat mesmerized by the flapping horde swooshing over our

seats, Robertson climbed down toward the entrance to the cave and literally plucked a bat from the air. With the nervous but otherwise unharmed bat clinging to his T-shirt, he clambered back to our perch to show off his guest.

The bat certainly didn't live up to any Halloween-inspired stereotype. In fact, with her tiny ears pricked up and her eyes scanning the crowd of people gathered around her, she was cuter than the pet hamster I owned as a child. She even submitted to having her graceful wings unfolded to satiate our curiosity about her wingspan, which measured roughly one foot.

After a few minutes of inspection, Robertson tossed the animal into the air, ending my first close encounter with a bat. I quickly lost track of her as she merged into the gray streaming multitude, on her way to who knows where.

— C. Ezzell

Force sought authority to bomb the cave closed because the bats' nightly emergence interfered with radar tracking at several nearby airfields, Robertson says.

Each female may fly as far as 60 miles from the cave to consume the huge quantity of insects — up to her body weight of half an ounce — that a lactating bat must eat every night, Robertson says. He estimates that the bat colony chows down 150 tons of bugs per night during peak lactation periods. "That certainly suggests that they have a major impact on the local insect population," he notes.

Mexican free-tailed bats capture, chew and digest their prey while on the wing, filling their stomachs three or four times per night, according to unpublished studies led by Thomas H. Kunz of Boston University. Kunz and his colleagues used tiny radio transmitters to monitor the nocturnal comings and goings of Mexican free-tailed bats from James River Cave, a smaller maternity cave in central Texas. An antenna placed inside the cave allowed the researchers to track the animals' comings and goings.

In the past, researchers had assumed that the bats stayed out all night, but Kunz's team found that females return to the cave after about five hours for a three-hour respite. During this time, they locate and nurse their young, defecate copiously and take a brief rest. Then they swoop back out again for another three-



hour session of moth-gobbling, returning *en masse* after dawn to spend another day dangling head-down from the cave's ceiling.

"People used to think Mexican free-tailed bats sought temporary roosts during the night under bridges or on buildings," says Kunz. "But we found that these bats don't roost anywhere else but their cave." He adds, however, that other populations of Mexican free-tailed bats may seek permanent roosts in the crevices of human-made structures. Ecologists estimate that the Congress Avenue Bridge in Austin, for example, hosts nearly 1 million such bats during breeding season.

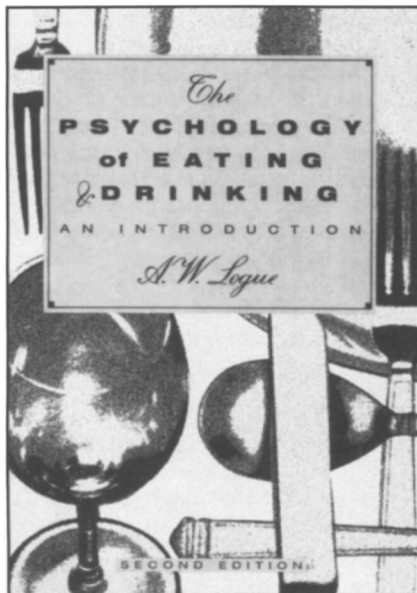
In two other studies recently submitted to scientific journals, Kunz's team monitored the metabolism of adult bats and pups. They discovered that about half the calories consumed by an adult bat are expended during flight — a statistic that shouldn't surprise anyone who has watched these creatures' high-speed acrobatics. The researchers also determined that lactating bats must consume enormous amounts of fat because, Kunz says, "they produce an extremely rich milk."

Moths, the bats' favorite food, contain only moderate levels of fat, according to Kunz. He and his colleagues found that Mexican free-tailed bats boost their fat intake during the nursing season by adding flying ants to their menus. These winged insects, called alates, are roaming juvenile forms of terrestrial ants; they eventually settle down, shed their wings and found new ant colonies.

Kunz says the rich milk of the mother bat helps fatten her pup for its first flight, which occurs at the age of six or seven weeks. Although a pudgy pup might have a harder time learning to maneuver, the extra fat keeps the youngster going until it learns to catch enough moths to adequately feed itself, he says.

Most baby bats rely on their fat stores for weeks after weaning, in part because some moths have adopted a unique strategy to avoid ending up in a bat stomach. In the 1980s, James H. Fullard at the University of Toronto and others reported that moths from at least six taxonomic families have primitive "ears" — consisting of one to four nerve cells — which they use to detect foraging bats. One family, the Arctiidae or tiger moths, has even evolved a bat-sonar-jamming mechanism, Fullard says.

But even the best moth's evasions work only a fraction of the time. And for now, the odds seem to favor Bracken Cave's mammoth bat population. □



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