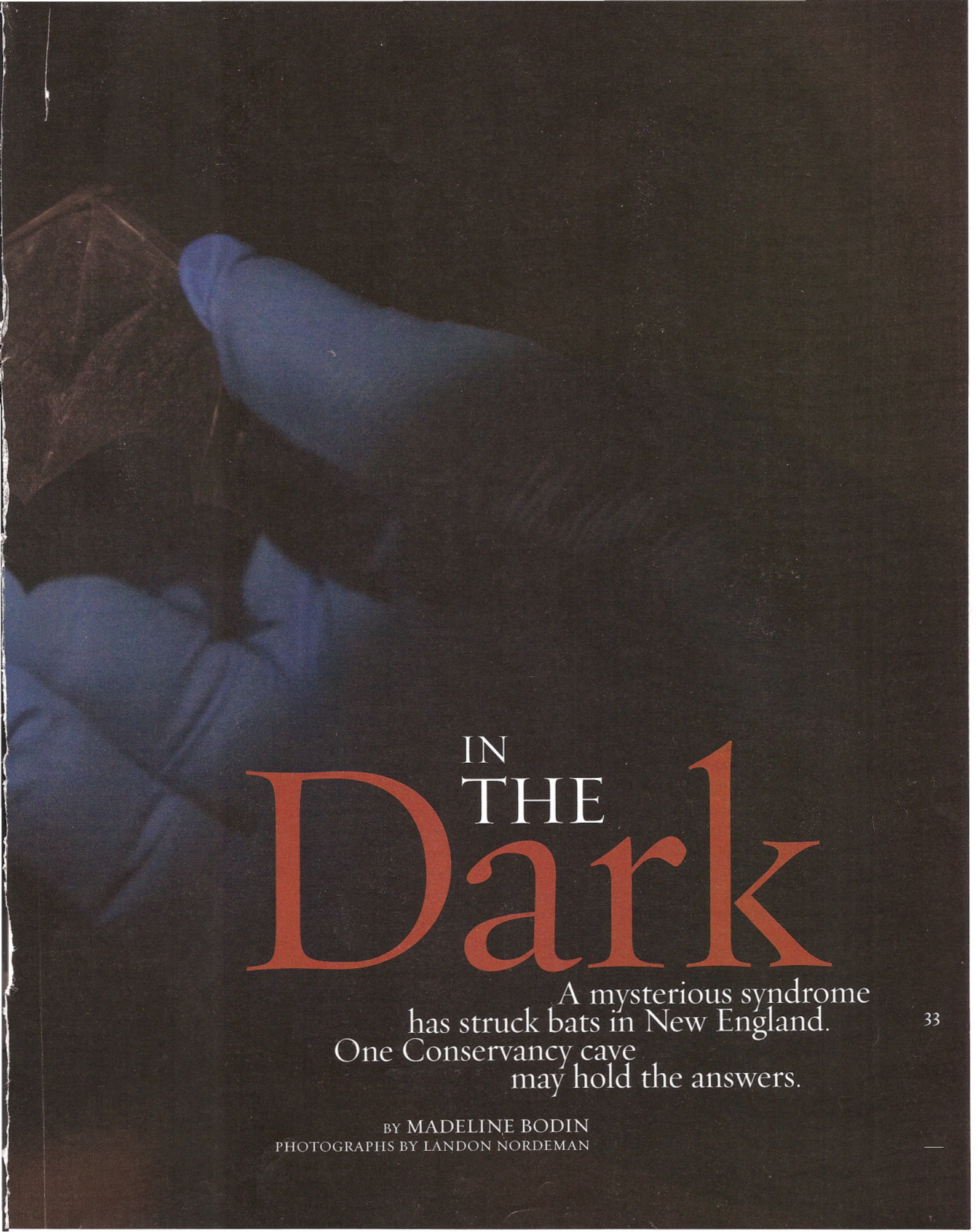


IN THE Dark

A mysterious syndrome has struck bats in New England. One Conservancy cave may hold the answers.

BY MADELINE BODIN
PHOTOGRAPHS BY LANDON NORDEMAN

TURNING HIS TRUCK OFF THE HIGHWAY, Scott Darling sees the signs everywhere. In broad daylight, bats skim a recently thawed pond, and they flutter about in the roadway to the trailhead. They should still be hibernating—it is early spring, and there are no flying insects around for the bats to eat. Something is wrong.

The bats at The Nature Conservancy's Mount Aeolus cave in Dorset, Vermont, are dying, and no one knows why. As the Vermont Fish and Wildlife Department's bat biologist, Darling was the one who discovered a few months earlier that white nose syndrome, a mysterious ailment of bats, had struck here at New England's largest bat hibernation site.

White nose syndrome gets its name from the white fungus that grows around the muzzle of many affected bats, making them appear as though they have rooted around in confectioner's sugar. But not all bats have fungus on their muzzles. Some have it on their ears, forearms or wings. Others show no fungus at all.

Darling's plan for this April day is to hike to the cave to trap and weigh 200 bats. Laboratory tests show that bats afflicted with white nose syndrome have little or no body fat. For whatever reason, they are starving to death. Darling hopes to see how well the bats survived the ravages of the syndrome over the winter.

Every time he visited the cave over the preceding months, the situation looked increasingly dire. Each trek revealed dozens more dead bats and even greater numbers that were dying. With the onset of spring, Darling is not sure what he'll find. "All we need is one healthy bat," he says to his three technicians as he hoists his backpack for the mile-long trek up the snow-covered trail to the cave.

Six species of bats are known to hibernate in the Mount Aeolus (ē-OH-lis) cave, including the endangered Indiana bat. By far the most prevalent are little brown bats, tiny creatures weighing about 7 grams (as much as three pennies) that can live 20 to 30 years and produce just one pup each year. While many people think of bats as flying mice, they are more closely related to primates.

The mouth of the cave is set in a wall of weathered limestone. Ferns and small trees growing on the cliff ledges give the place the look of a garden grotto. This spring it is a macabre garden, however.

Two hawks wheel above the cave entrance, ready to scoop up addled bats that swoop in and out of the cave. Ravens clack and grawk just out of sight, likely scared away from scavenging bat carcasses by the arrival of Darling and his team.

A little brown bat weighs about 7 grams, or as much as three pennies, and lives as long as 20 to 30 years.

What look like clumps of brown moss in the crevices around the cave mouth are actually clusters of bats. Scientists believe that as the bats starve, they move closer to cave entrances, where, during the winter months, it is colder than in the deep recesses of the cave, where they usually hibernate and where the temperature is steady. It is perhaps an attempt to save energy by lowering their body temperatures further than is the norm for their winter torpor.

Some, like these at the Aeolus cave, take their chances outside, where temperatures are colder. Whether they move near the cave mouth or outside, it's a gamble that most bats lose. They continue to starve, if they don't freeze to death first.

As the team sets up the harp trap that will capture the bats with nylon filaments that their radarlike echolocation can't detect, a bat flies out of the cave and crashes into the snow nearby. Shivering, it crawls stiffly across the snow on feet and thumbs, like an ape. As it inches across the snow, Darling scoops it up and hangs it by its toes on the cliff wall at the mouth of the cave.

Bats collected at Aeolus and the information Darling and his team gather are providing insight for scientists investigating the cause of the syndrome. About 25 laboratories and government agencies are in on the research. Several are investigating infectious agents such as fungus,

COLD COMFORT: Vermont biologist Scott Darling is fascinated by bats' ability to store enough fat to hibernate for 40 percent of the year. Bats that are killed by white nose syndrome (left) usually die of starvation—their fat stores exhausted before winter has ended.

bacteria and viruses. Others are examining the bats' food supply, weight and fat composition. Some labs are studying environmental contaminants like mercury and pesticides. Still others are looking into whether the bats are rousing too often during hibernation.

Aeolus has provided clues for nearly every aspect of the ongoing research on white nose syndrome. And right now, clues are about all researchers have to go on.

AEOLUS HAS BEEN THE SITE OF bat research since the 1930s, when Donald Griffin, the Harvard University scientist best known for discovering that bats echolocate (meaning they sense the world by bouncing sound waves off their surroundings), collected information on the bats hibernating here.

Throughout the 1960s, Middlebury College professor Harold Hitchcock counted and banded the bats hibernating in the cave. Those bats were later found throughout New England, as far away as Cape Cod and Rhode Island. That research established Aeolus as the largest, and perhaps most important, hibernation site for bats in New England. In the 1970s, Thomas Kunz of Boston University, one of today's leading bat researchers, came to Aeolus to measure how much fat bats stockpile before they hibernate.

"Aeolus is the most famous bat research site in the Northeast, clearly," says Al Hicks, the bat biologist for the New York State Department of Environmental Conservation.

The Conservancy was aware of the conservation value of the Mount Aeolus bat cave more than 40 years ago. When the land that holds the cave came up for sale in 1967, the Conservancy tried to purchase it, but the owners sold it to a mining company. The Conservancy was undeterred. "A core value of The Nature Conservancy is continuity of purpose," says Rose Paul, the Conservancy's director of science and stewardship in Vermont. "It may take years to get the land we think is needed to meet the conservation goal."

In this case, it took decades. Persistence paid off in 1983, when the mining company donated 150 acres on Mount Aeolus to the Conservancy. The male bats that hibernate in the cave often summer nearby, so preserving the surrounding forest is important, too. A recent donation by the

SURVIVOR: Biologist Scott Darling wore a white Tyvek suit to protect himself when he began studying bats afflicted with white nose syndrome. After years of research, however, he does not believe the syndrome affects humans. His evidence: "Because I'm still here."

Kranichfeld and Perina families means that the Conservancy now owns 249 acres on Aeolus. "We think it's an adequate amount of land to protect the bat cave," Paul says, "but we are always learning more."

Mount Aeolus is one of three bat caves the Conservancy owns in Vermont and just one of many caves the Conservancy protects nationwide. "We are working on all levels to protect these ecosystems," says Mike Slay, program director for the Conservancy's Ozark karst program in Arkansas. (Karst is a landscape of porous limestone characterized by caves, sinkholes and springs.) "Our approach is global," Slay says, noting that he and Cory Holliday, the Conservancy's karst program director in Tennessee, work with officials in a handful of countries to share cave-conservation techniques.

Jim Kennedy, the cave resources specialist for Bat Conservation International in Austin, Texas, examined the Mount Aeolus bat cave at the request of the Conservancy in 2002. He's visited thousands of caves in the past 35 years, but the Aeolus cave stands out. "It's a beautiful marble cave," he says, "one of the most stable caves, temperature wise, and one of the coldest caves that I've seen." This makes it an ideal place for bats to hibernate, particularly for the federally endangered Indiana bat, which is finicky about its hibernation sites, Kennedy says.

NEAR THE MOUTH OF THE CAVE, even though the sun is still bright, bats are flying and falling into the harp trap's vinyl collection trough with a patter like the sound of raindrops.

After a winter that saw thousands of bats die, Darling is surprised by how many bats fly out of the cave. There are clearly more bats hibernating here than even Darling ever suspected—and he coordinated the last count himself. That survey, conducted in 2003 by technicians scrambling through all reachable areas of the more-than-3,000-foot-long cave, tallied 23,000 bats.

No scientist in decades has been here to watch the bats emerge from the cave in spring. Now, as Darling watches bat after bat fly out of the cave and into the trap or into the surrounding forest, he reconsiders the numbers. There could be 100,000 bats hibernating in Aeolus.

The technicians call out the bats' weights in grams to Darling, who leans against a rock at the cave mouth and writes them in a three-ring binder. "6.1." "5.5." "6.7." The weights range from 5.4 grams to 7.1 grams. "These numbers don't sound that bad," says a technician.

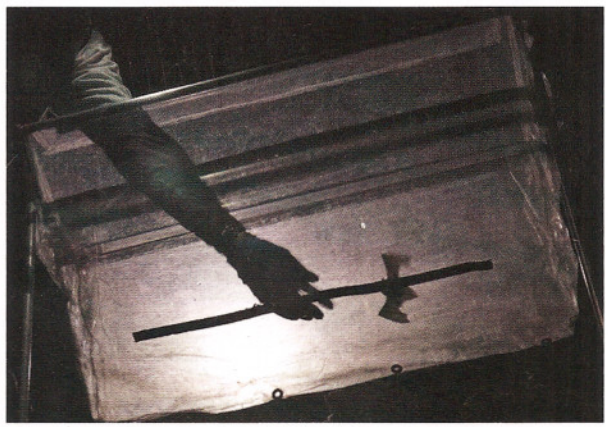
"Six grams is thought to be the point of no return for little brown bats," says Darling. He doesn't expect any of the bats that weigh less than 6 grams to live long enough to breed next fall. Still, he expected worse.

By 9 o'clock, the group has caught and collected data on about 150 bats. The results have been mixed. Many of the bats have been marked with white fungus on their ears, wings or forearms. Just one had fungus on its nose. Many are critically underweight, but their numbers are robust. Darling can only hope that this is enough for some of the bats to make it through the summer and return to the cave in the fall to mate and then hibernate.

"The lesson here is not about bats. It's about how we take care of the ecological potholes."

All but one on the group's tally sheet has been a little brown bat. "I don't think you guys are getting enough experience with little brown bats," Darling teases. A technician reaches into the trap's vinyl trough and removes a bat. She peers at it. "Another luci," she groans, using the scientific nickname for *Myotis lucifugus*, or little brown bat.

"Just remember how many bats you are seeing this year," says Darling. "You may not see them next year."



TRAPPED: Researchers use a harp trap—which stretches out fine filaments that bats cannot detect with their radar-like echolocation—to capture the animals. In one evening the scientists will weigh and measure more than 200 bats, working to assess their health.

WHEN DARLING WAS NAMED the Vermont Fish and Wildlife Department's bat biologist in 2001, he told his supervisor, "But I don't know anything about bats." His supervisor assured him that he would nonetheless quickly become the state's expert—because nobody else knew much about the status of bats in Vermont, either. There hadn't been a dedicated bat researcher in the state in a generation.

His boss was right. Today, Darling's opinion is sought out by his peers in state fish and wildlife departments and by officials in the federal government.

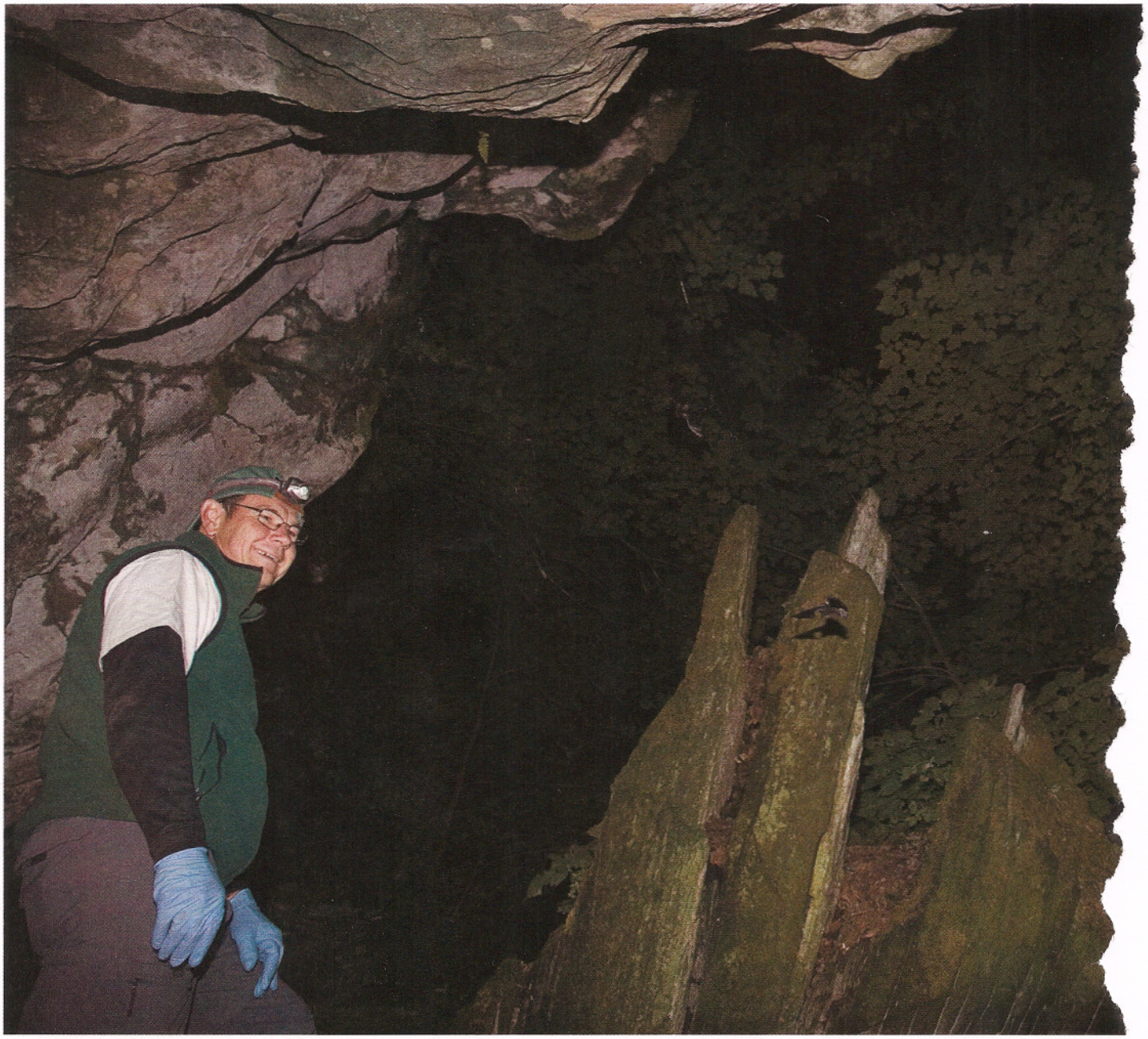
Studying bats in Vermont, Darling came to value their knack for survival in spite of the state's cold climate. They live such streamlined lives that they can hibernate for 40 percent of the year. "They are probably the greatest experts in energy efficiency," Darling says.

More than anything, Darling appreciates Vermonters' affection for these night-flying, bug-eating creatures. He remembers many a flannel-shirted farmer, framed in a bright farmhouse doorway on a summer night, telling him, "Bats are good."

"I've knocked on the doors of old Vermont farmers who don't know me at all, but they tell me about the bats in their barns and say I can survey their property for the federally endangered Indiana bats." In seven years of asking Vermonters for permission to survey private property, Darling has never been turned down.

Darling had been wrapping up his seven-year study of Vermont's bats when he first got wind of white nose syndrome. In March 2007, he received an e-mail from Al Hicks, his New York counterpart. Attached was a photo of eight bats, seven of which had white noses. His colleagues had found thousands of dead bats in a routine survey of a hibernation cave near Albany, Hicks explained. A number of the bats that were still alive and hibernating in the cave had white noses like the bats in the picture.

Darling had never seen anything like it. And neither had the other experts who received the e-mail. Before the snow disappeared from the landscape of eastern New York that winter, four more caves had been found where bats were killed by the mysterious malady that was already being called white nose syndrome.

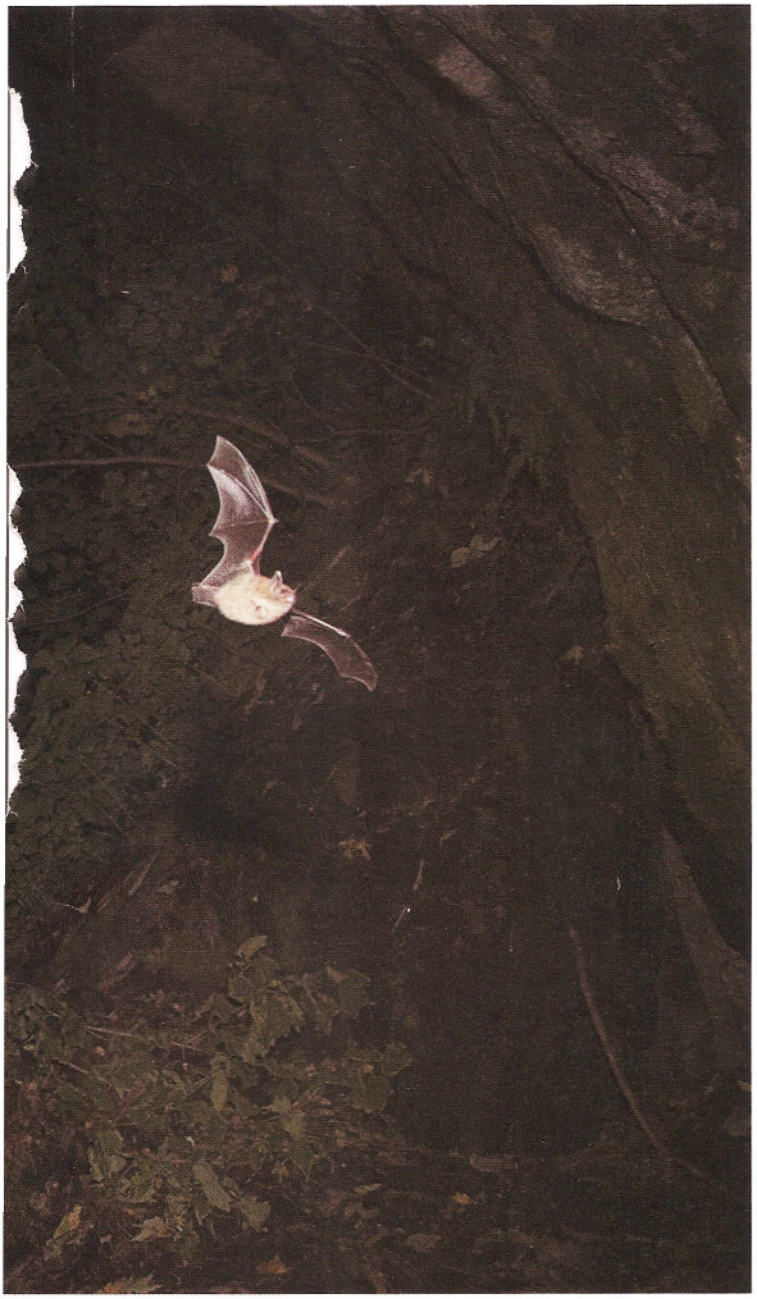


IN THE AIR: While many people think of bats as flying mice, the noctural fliers are more closely related to primates. In fact, with 1,116 distinct species, bats account for nearly one-quarter of all the known mammal species in the world.

Nearly a year later, in January 2008, Hicks called Darling at home when a caver reported white nose syndrome at Morris Cave in Vermont, less than 10 miles from the Aeolus cave. "This is the phone call you didn't want to get," Hicks said.

On Valentine's Day, 2008, Darling and several colleagues, including Peter Youngbaer, president of the Vermont Cavers Association, visited the Mount Aeolus bat cave. They found what they had feared: bats flying in the daylight, clusters of bats on the cliff outside the cave and the broken bodies of bats in the snow. White nose syndrome had arrived at New England's biggest bat hibernation site.

Shortly thereafter the syndrome was found in Connecticut and Massachusetts. Back in New York, where white nose was first spotted nearly two years earlier, some of the affected caves had lost 80 to 90 percent of their bats. Scientists still don't know how far white nose syndrome will travel or how seriously individual caves will be affected. The syn-



Bat Benefits

Without bats, there would be no margaritas.

Making up one-quarter of all mammal species, the 1,116 species of bats worldwide provide a lot of services: They pollinate flowers, gobble insects and fertilize plants. Even blood-sucking vampire bats benefit humans at least some of the time.

Around the world, bats pollinate or disburse the seeds of more than 300 important species, including wild bananas, wild avocados and durian, a fruit coveted in southeast Asia. In Mexico bats pollinate saguaro cactus and agave plants, from which tequila is distilled. Bats are an important pollinator of agave and have helped make commercial tequila production possible (although the agave seedlings used for tequila production are increasingly being grown in labs). Still, no bats, no tequila. And no tequila, no margaritas.

These bats follow cactus and agave blooms north out of Mexico and into the southwestern United States, says Barbara French, science officer for Bat Conservation International in Austin, Texas.

But of the 47 species of bats in the United States, French says, most are insect eaters.

In fact, a single little brown bat can eat up to 1,200 insects an hour. And one study showed that 150 big brown bats eat enough adult cucumber beetles in one summer to prevent them from laying the eggs that would produce 33 million crop-damaging larvae the following year.

Even bat guano, or excrement, has important benefits to humans. Guano recently renewed its popularity as a plant fertilizer because it is all natural and totally organic. Two hundred years ago it was also used to make gunpowder. Today, enzymes first discovered in bacteria that grow in bat guano are used in laundry detergents.

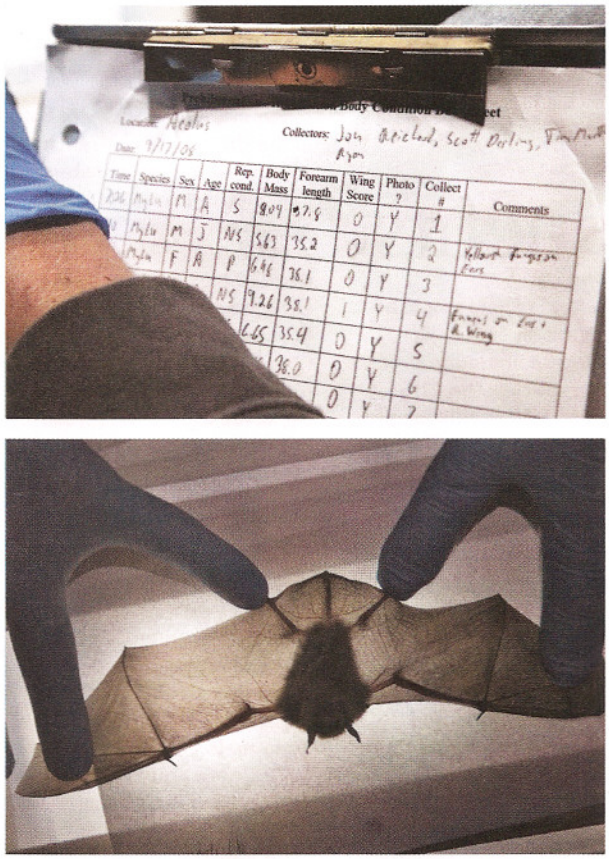
There are probably no bats more reviled than vampire bats, which are found only in Latin America. Their blood-sucking strategies, however, are more akin to those of mosquitoes than Count Dracula's. They bite, but don't kill. Even these bats benefit humans. The substance in vampire bat saliva that stops blood from clotting has been used in medical research to develop drugs that researchers hope will help treat stroke victims.

drome has already slashed the number of bats in the northeastern United States by an estimated tens of thousands, and it has the potential to spread beyond the region.

Scientists also don't know what the death of so many bats will do to the surrounding ecosystem. One possibility is a surge in agricultural and forest pests. The caterpillars and larvae that munch and snip the leaves and stems of crops are often kept at bay by bats, which feast on their moth and beetle parents.

With the discovery of white nose syndrome in Vermont, Darling put aside the management plan he had drafted for Vermont's bats. After seven years of work, the syndrome made it nearly irrelevant. He plunged back into basic research, this time with more urgency.

IN MAY, AFTER WRAPPING UP several weeks of work on Mount Aeolus, Darling begins a barnstorming tour of Vermont. He brings his PowerPoint presentation on white



BILL OF HEALTH: The researchers working at Mount Aeolus check for signs of white nose syndrome and assess the health of the bats they snare, including checking the animals' wings for scars—a possible sign of previous fungal infection.

nose syndrome to libraries and bank conference rooms. After a presentation at the Equinox Hotel in Manchester, near Mount Aeolus, a man in the audience raises his hand to ask if white nose syndrome affects people. "The evidence is overwhelming that it's not so," Darling says, "because I'm still here." The crowd chuckles. He adds that there has been no case of a human or a pet exposed to the syndrome getting sick.

Someone else wants to know if the bat syndrome has anything to do with colony collapse disorder, which struck honeybees around the country the previous year. Not directly, Darling tells them. Bats don't eat bees, but a new class of insecticides is a suspect in both ailments. He doesn't mention that the bee research has received consideration for funding from Congress, while the bat research has not.

He compares the disorders of bees and bats to ecological potholes: We don't worry about one pothole destroying a highway, but when the potholes start to collect, the highway is no longer safe. "The lesson here is not about bats," he says. "It's about how we take care of the ecological potholes."

Darling spends the summer studying Indiana bats in the clayplain forests of northwestern Vermont, where the Conservancy has conserved land important to bats raising their young. In late August, he returns to Mount Aeolus. This time, though, no hawks circle the cave mouth. There are no bats clustered on the cliff wall outside.

For this round of research, Darling has teamed up with Jon Reichard, a Ph.D. candidate and researcher from Boston University who happens to be one of Darling's former summer interns. Reichard's thesis adviser is the same Thomas Kunz who conducted research at Aeolus in the 1970s. Reichard plans, in part, to repeat that study. He will collect data every two weeks from the time the bats start gathering for their fall mating swarm in front of the cave until October, and will visit the cave twice more before they emerge from hibernation in the spring. The results will highlight any differences in how much the bats have fattened up for winter before and after the syndrome was discovered here.

"Wherever white nose syndrome takes us, Aeolus is going to be a critical factor in the bats' recovery. White nose makes it even more important to conserve the places that the bats have left."

Another addition to the team is 12-year-old Tim Clancy of Rehoboth, Massachusetts, who is so concerned about white nose syndrome that he built 20 bat houses with his grandfather and sold them to his neighbors for $30 each. He donated the money to white nose syndrome research. Moved by Clancy's enthusiasm, Reichard agreed to bring him to Aeolus to show him how bat research is done.

At this time of year, bats typically congregate and fly just outside the mouth of the cave. It is part of their mating ritual. There are enough of them soaring and swooping in and out of the cave mouth so that collecting them is easy, but it is a little early in the year for the swarm to be a true frenzy.

Young Clancy seems honored when he is handed a clipboard and pencil and asked to record the data tallied by the examination of each bat. He even reminds Reichard to take a forearm measurement before the researcher moves on to another bat.

The boy tells a story as the work progresses, his voice emanating from deep inside the orange hooded sweatshirt he wears against the chill of the late summer night. He describes backyard bats chasing his buzzing toy light sabers, and then he complains about being called "Bat

CATCH AND RELEASE: Jon Reichard, a Ph.D. candidate at Boston University, releases a bat that he has weighed and measured. "Just remember how many bats you are seeing this year," says biologist Scott Darling. "You may not see them next year."

Boy." Darling and Reichard sympathize. Neither one can shake the name "Batman."

Reichard collects a biopsy from a captured bat that shows signs of what might be a fungus. He also records the type of scarring on the bats' wings, which can be a sign of a previous fungal infection. He rates the wings from zero, no significant damage, through three, severe damage. "I haven't seen a three since June," he says.

TWO WEEKS LATER, Darling and a technician return to Mount Aeolus to collect the early September samples. After nightfall, Darling leans his forearm on the rock wall at the cave mouth. Bats swerve in and out of his headlamp beam. All around him, bat wings flap, like flags snapping in a stiff breeze. They dodge and swirl, coming so close to Darling's face that he can feel puffs of air on his cheeks as they pass. It is a true frenzy. There are as many bats here as he has ever seen during a fall swarm.

Later, in a thoughtful mood, he will say, "Wherever white nose syndrome takes us, Aeolus is going to be a critical factor in the bats' recovery. White nose makes it even more important to conserve the places that the bats have left." But at this moment, he has dozens of bats pattering into the harp trap and data to collect on them.

He and his technician check the bats' wings for scarring from white nose syndrome, identify their species and sex, weigh them, and measure their forearms with calipers. They also collect samples of little brown bats for future laboratory work. They work deep into the night. Finally, the last bat squeaks and flaps in Darling's blue-gloved hands. "Don't worry," he says. "You are going to make it."

She is chubby by little brown bat standards, weighing 9.9 grams. Likely she's bulked up on the bugs that are almost as numerous on this September evening as the bats are. Her wings are pristine, looking like bits of black silk in Darling's headlamp. He rates them a zero, no damage.

"Zero score, ready to let go," Darling says. He lifts his arm toward the cave entrance. The bat scrambles up his hand, then flies off, joining the throng of bats swirling outside the cave.■

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