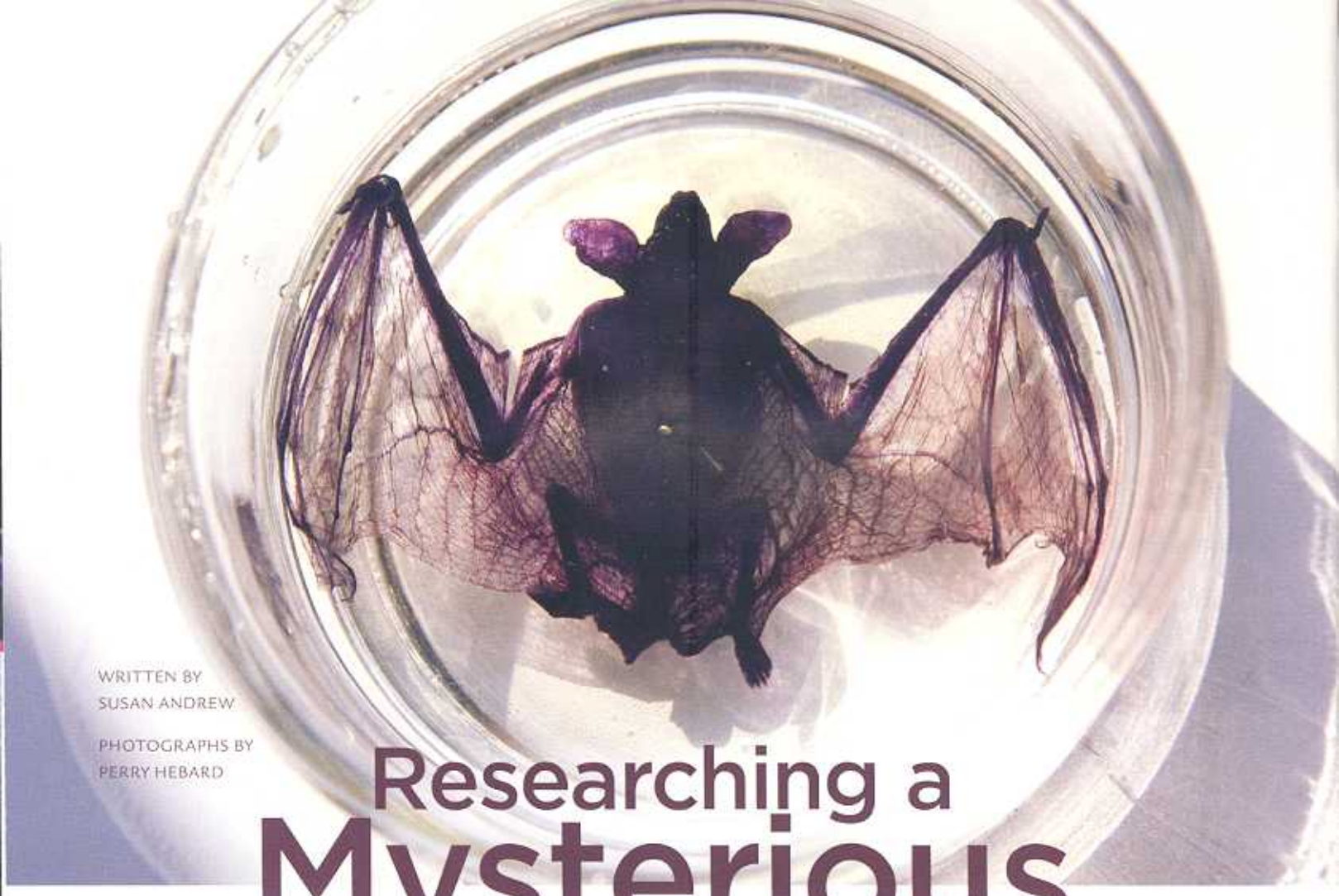

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Researching a Mysterious Malady

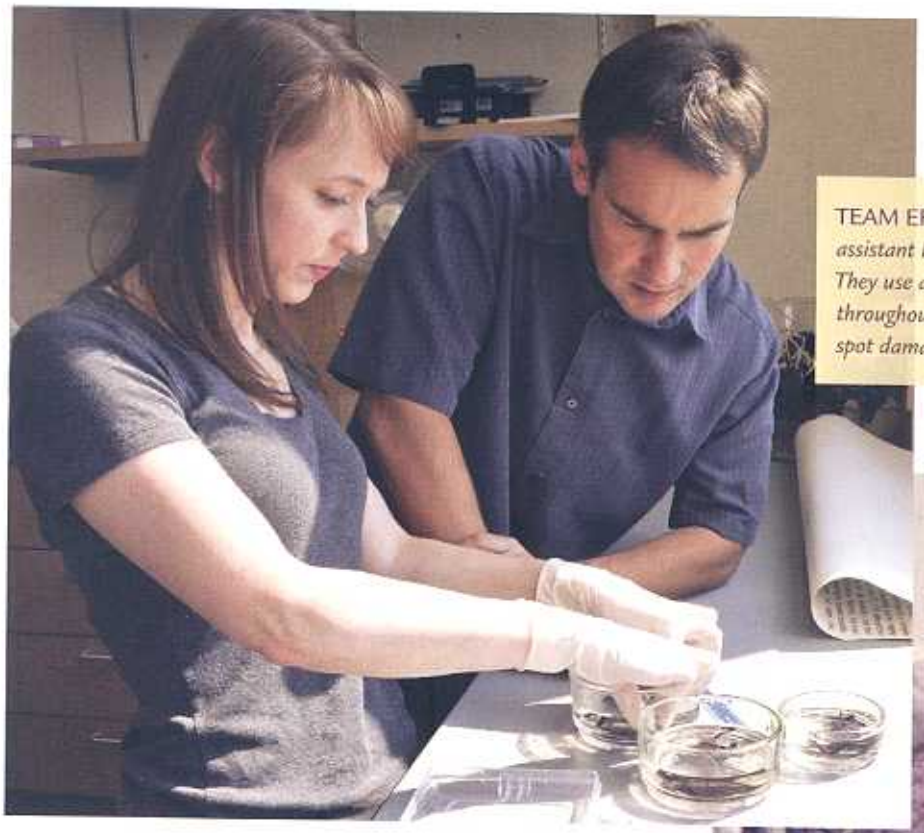
A professor and student race to understand the deadly **WHITE-NOSE SYNDROME** that is killing bats

Chris Nicolay was a kid who liked to play with dinosaurs. He developed a keen interest in what makes living things work and how various creatures solve the basic problems of existence—morphological wonders like wings, working muscle groups, and how our ancestors came to produce speech.

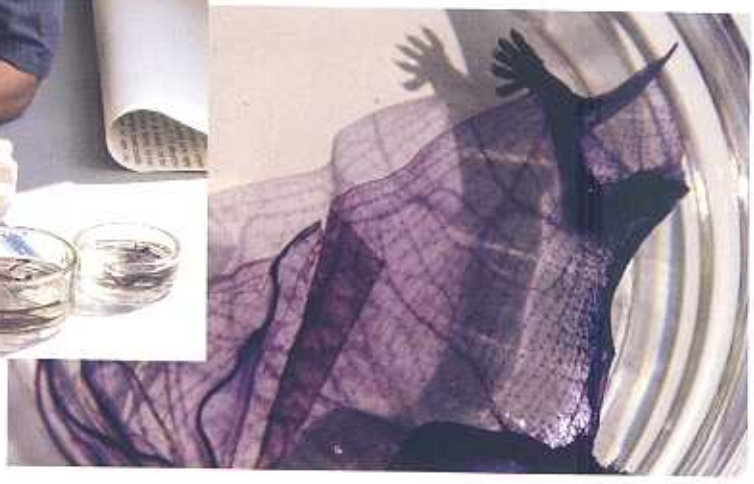
It's little surprise that Nicolay makes his living investigating some of those basic problems. As an associate professor in UNC Asheville's Department of Biology, specializing in functional morphology, he and his undergraduate students may help solve a major threat facing one of the least visible—but still very important—creatures in Western North Carolina's ecosystem.

Imagine yourself a small mammal that's totally dependent on the power of flight to find food in midair. You also must depend on your capacity to reduce your body temperature during hibernation—your wintertime adaptation to the cold and the lack of your insect prey. You're a bat, of course, but now, along with ordinary challenges like finding food on the wing in the dark, there's a new problem: *Geomyces destructans*.

That's the alarming name of a recently-described fungus associated with a mysterious disease in bats called White Nose Syndrome. The disease produces fuzzy white patches on the faces and wings of affected animals during their winter slumber.



TEAM EFFORT: *Chris Nicolay and undergraduate research assistant Rebecca Hoffman examine a specimen of a little brown bat. They use a purple stain to highlight the distribution of nerves throughout bats' wings, making it easier to for the researchers to spot damage caused by White Nose Syndrome.*



The fungus thrives in the cool, damp conditions of the caves where the animals hibernate. When a bat's body temperature drops to its minimum, and its metabolism has slowed to a crawl, the fungus gets its chance, blooming with the characteristic white growths that damage the bat's tissues.

Eventually the animal stirs, perhaps with the urge to scratch at the fungus. But when the bat awakens enough to do so, it's returned to a more active metabolic state, and herein lies its downfall. Burning energy drives the need to eat, but in winter, there are no insects to catch. A few attempts to forage, and the animal depletes its fat reserves and starves to death.

Millions of bats have succumbed to the syndrome since it first appeared in a single cave in New York in 2006. Mortality rates exceeding 90 percent have been reported in some caves, and the disease is spreading fast. Last spring, wildlife biologists in Western North Carolina confirmed the appearance of the disease in at least four counties, with Buncombe County the latest suspected case.

Researchers including Nicolay and his undergraduate student assistant Rebecca Hoffman are racing to gain a basic understanding of the disease and the fungus associated with it, to provide a remedy before species go extinct, with irreversible costs to the environment and our economy. Bats are invaluable to humans because they consume vast quantities of insect pests, and they play a valuable role as pollinators for food crops and other plants we use. Scientists estimate that with the loss of one million bats, between 660 and 1,320 metric tons of insects are no longer being consumed in affected regions, exposing plants and crops to widespread damage. The negative impacts on ecosystems from increased use of pesticides can be substantial, they point out.

Extinction is a real possibility, according to evidence presented at a recent UNC Asheville forum on the syndrome. One forecast assumed a continuing 45-percent mortality per year—the average death rate observed for White Nose Syndrome so far. If that trend continues unabated, the little brown bat, a common species in Western North Carolina, would be extinct in just 16 years.

"Current studies implicate damage by the fungus to the bats' wings as a primary cause of mortality," Nicolay points out. The fungus causes lesions on the fragile wing membranes, eventually puncturing them, interfering with flight. Severely affected wing membranes adhere to each other, tear easily and lose tone and

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BatFacts

Little Brown Bat, *Myotis lucifugus:*

- Is widespread and common throughout North America
- Can eat up to 1,200 mosquito-sized insects in an hour
- Is not blind, but has average eyesight
- Has an average body length of 3½ inches; wingspan, 8–10 inches wide
- Has an average lifespan of 7–10 years
- Hibernates in caves during the winter, which makes it susceptible to White Nose Syndrome

elasticity. Bats disabled in this way may starve to death even when food is available.

Nicolay's research seeks to assess the damage to the nerves in the wings of affected bats. He hopes to discover the degree of infection required to produce destruction of nerve tissue, and to determine if nerves regrow in damaged areas of wings that have shown healing.

"We are mapping the normal distribution of nerves in the wings"—something Nicolay says has never been done systematically—"and looking at how the nerves are damaged in White-Nose Syndrome, and how they heal."

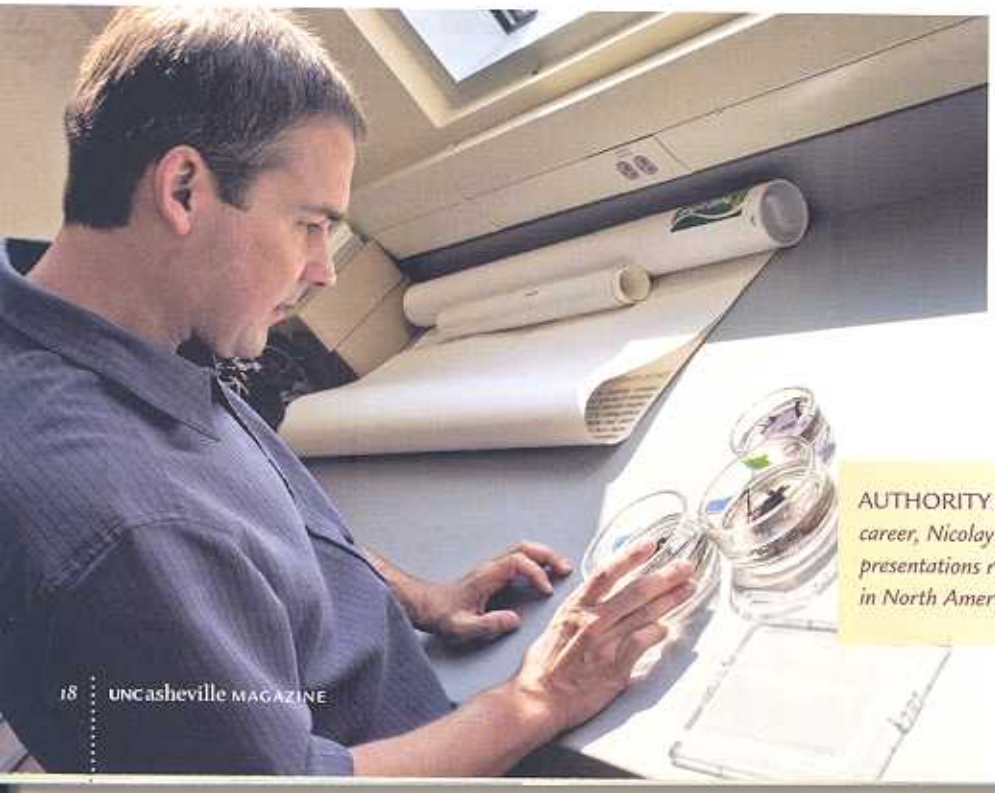
To do this, Nicolay and Hoffman have refined a staining technique to reveal the nerves. With this staining process, the wings become translucent and the nerves are left visible like a network of tiny highways. "You can see where the nerves are running in relation to infection," he says, "and determine whether the nerves are surviving, or if they are attacked quickly." The preliminary step is getting the nerves of healthy bats documented, he says, thus setting the standard for comparison with affected animals.

Nicolay says his research is aligned with national scientific goals, established by the Fish and Wildlife Service, for assessing the origins and epidemiology of the syndrome, especially regarding the interactions between the pathogen and its host—an area of scant scientific understanding at present. But in many ways it feels like a race against time. "In mammals, this looks like the worst natural disaster we've documented," Nicolay says. "This is such an urgent case, you feel called to engage."

There may be a ray of hope, however, in that European bats aren't affected, even though *G. destructans* is present there. "This suggests that European bats have developed an immunity to the disease syndrome," Nicolay says. Perhaps North American bats can do the same. "If bats with white-nose live through winter, some healing can occur. It's a question of how well can they heal."

Whatever happens with the disease in the near term, Nicolay says studying the disease has had benefits for his students. He says that meaningful undergraduate research projects such as the bat research are a tremendous opportunity for students and faculty alike, with tangible benefits for his teaching and for the career aspirations of his students.

"Personally, research helps me stay excited about the field. I have learned a great deal about histology and sensory physiology through this project, which I will bring into my anatomy and physiology classes." And when the student research collaboration works, he says, "we are able to increase our professional output while producing students who leave UNC Asheville with an exceptional background and useful set of skills."



AUTHORITY ON THE SUBJECT: *Over the span of his research career, Nicolay has been involved with numerous studies and presentations relating to a variety of bats. He has conducted research in North America, Europe, Costa Rica and Papua New Guinea.*

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