ECHOLOCATOR

Volume 8, Issue I
March 2019

WISCONSIN
BAT PROGRAM

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WISCONSIN BAT PROGRAM

PARTNER RESEARCH AND NEWS

Echolocator is an annual publication of the Wisconsin Bat Program, part of the Wisconsin DNR's Natural Heritage Conservation Program. DNR conservation biologists statewide monitor, research and inventory Wisconsin's eight bat species in collaboration with other state and federal agencies, universities, conservation groups, other non-governmental groups, and hundreds of volunteers. *Echolocator* presents bat conservation work and research relevant to Wisconsin and welcomes ideas for future articles and featured groups. Please contact Jennifer.Redell@Wisconsin.gov to share your suggestions.
Editors: Jennifer Redell and Lisa Gaumnitz
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Cover Photo: Joseph Hoyt
A little brown bat dusted with fluorescent powder glows under an ultraviolet light. Read page 14 to learn how this dust was used to trace bat interactions.

CONTRIBUTORS

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Elsa Cárdenas is a veterinarian from México working on her doctorate at Dr. Jorge Osorio's lab at the University of Wisconsin-Madison. Before joining UW-Madison and the USGS-National Wildlife Health Center, she worked in Colorado for the prairie dog and plague management research project.

Jeff Huebschman is a professor in the Department of Biology at the University of Wisconsin-Platteville, where he has taught since 2003. He loves teaching undergraduate students—Mammalogy and Ornithology are his favorite courses—and getting them excited about research. He and his wife, Erin, live in Lancaster, Wis., with their two yellow labs.

Levi Plath is the land manager for Mississippi Valley Conservancy and has been managing their 3,500 acres of nature preserves since 2015. Previously, he evaluated tallgrass prairies for the Minnesota DNR; sampled fish species on the Missouri River for the Iowa DNR, and surveyed herptile species for Iowa State University.

Christopher J. Yahnke is a professor of biology at the University of Wisconsin – Stevens Point. He first worked with bats as a Peace Corps volunteer in Paraguay at the Museo Nacional de Historia Natural and helped develop a national bat program for Earth Day 1990.

Bat Research Reveals Health, Economic and Climate Issues

***By Jennifer Redell**, editor*
DNR Conservation Biologist, Bat Program Cave and Mine Specialist

Echolocator was launched to share the bat conservation work of scientists, volunteers, and natural resource managers. Since white-nose syndrome was first detected in Wisconsin in 2014, this newsletter has become an archive of notable steps in the journey of bat conservation and wildlife disease in Wisconsin.

In 2018, Wisconsin witnessed the continued plunge in cave bat populations and the spread of the disease to yet more counties. Amidst all this bad news, there was some good news: gains in the laboratory, field, and classroom as partners, including at the University of Wisconsin (UW)-Stevens Point and Platteville, continued to engage and educate the next generation of scientists and citizens caring for bats.

Importantly, research in the field and the laboratory is yielding information that we hope can help protect bat populations in states that are still WNS-free and help guide future recovery efforts in Wisconsin. Research in Wisconsin caves and mines is also adding to the growing understanding of climate change. A sampling of some of the research papers growing from the research collaborations launched in the wake of white-nose syndrome is found in the listing on this page and in stories spread throughout *Echolocator*.

First, vaccine development for bats may be important for both preventing the ravaging effects of WNS and may help prevent the spread of rabies to cattle. As the climate warms, the common vampire bat (*Desmodus rotundus*) is expected to expand its range northward, reaching the United States for the first time. Due to public health concerns, plans are underway to prepare for the vampires' arrival – which you can read about here in

"Vaccinating Vampires" on page 17.

Secondly, our natural bat hibernacula are caves, formed over millennia deep inside the earth. Dripping water inside these natural time capsules preserves records of past climate data, including temperature, and provides a record of the presence of permafrost near glacial margins during the Ice Age. UW-Madison graduate student Cameron Batchelor has joined us underground to sample these records as she helps to refine our understanding of periods of glacial maximum in Wisconsin.

And finally, closer to home: a look at how Wisconsin's climate and landscape are linked to the distribution of eastern pipistrelles may help us understand where to best focus bat conservation efforts in the future. Check out *Some Like it Hot: Research Zeroes in on Bats' Preferred Summer Habitats* on page 10.

We hope you'll enjoy reading about these and many other bat projects and conservation efforts taking place statewide. And as always, we invite suggestions for future topics and stories.

Recently Published Articles

Field, K. A., B. J. Sewall, J. M. Prokkola, G. G. Turner, M. Gagnon, T. M. Lilley, J. P. White, J. S. Johnson, C. L. Hauer, and D. M. Reeder. 2018. Effect of torpor on host transcriptomic responses to a fungal pathogen in hibernating bats. *Molecular Ecology.*

Hoyt, J. R., K. E. Langwig, J. P. White, H. M. Kaarakka, J. A. Redell, A. Kurta, J. E. DePue, W. H. Scullon, K. L. Parise, J. T. Foster, W. F. Frick, and A. M. Kilpatrick. 2018. Cryptic connections illuminate pathogen transmission within community networks. *Nature 563:710-713.*

Kaarakka, Heather M.; White J. Paul; Redell, Jennifer A., Luukkonen, Katie L. 2018. Notes on Capture and Roost Characteristics of Three Female Evening Bats (Nycticeius humeralis) in Southern Wisconsin: An Expanding Species? *The American Midland Naturalist 180* (1), 168-172.

Kurta, Allen; Auteri, Giorgia; E. Hofmann, Joyce; M. Mengelkoch, Jean; J. Paul White, J & Whitaker, Jr, John & Cooley, Thomas & Melotti, Julie. (2018). Influence of a Large Lake on the Winter Range of a Small Mammal: Lake Michigan and the Silver-Haired Bat (Lasionycteris noctivagans). *Diversity. 10. 24. 10.3390/d10020024.*

Wray, Amy K.; Jusino, Michelle A.; Banik, Mark T.; Palmer, Jonathan M.; Kaarakka, Heather; White, J. Paul; Lindner, Daniel L.; Gratton, Claudio; Peery, M. Zachariah. 2018. Incidence and taxonomic richness of mosquitoes in the diets of little brown and big brown bats. *Journal of Mammalogy. 71: 8966-.*

White-Nose Syndrome Advances in Wisconsin and North America

By J. Paul White
DNR Mammal Ecologist,
Bat Program Lead

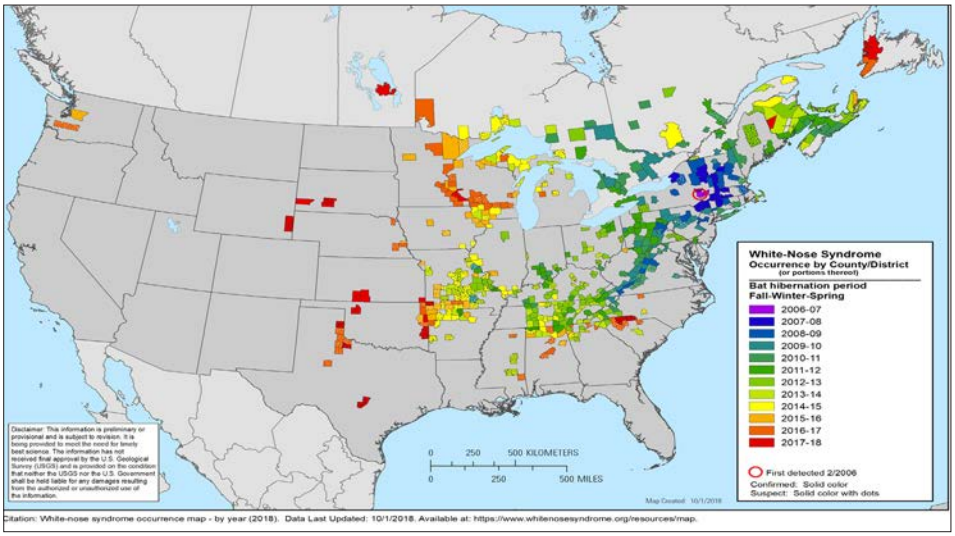
White-nose syndrome (WNS) and the fungus *Pseudogymnoascus destructans* (Pd) that causes the disease have continued to spread in Wisconsin and across North America. Altogether, bats with WNS have been confirmed in 33 states, seven Canadian provinces, and three more states – Mississippi, Texas and Wyoming – have detected Pd in bats.

Wisconsin Bat Program staff visited more than 60 hibernation sites between November 2017 and April 2018 and observed WNS and/or Pd at every site. We added one more county, Pepin, to the national map as infected.

Analyzing pre- and post-WNS infection data from 30 sites we've consistently monitored since white-nose syndrome was first detected in Wisconsin in 2014, we've seen our bat populations drop precipitously. Little brown bat numbers have dropped about 73 percent, eastern pipistrelles 90 percent, northern long-eared bats 97 percent and big brown bats 23 percent.

Unfortunately, it's too early to talk about population stabilization at this point in Wisconsin, but we will continue to monitor and report on our findings, including sharing good news where we find it.

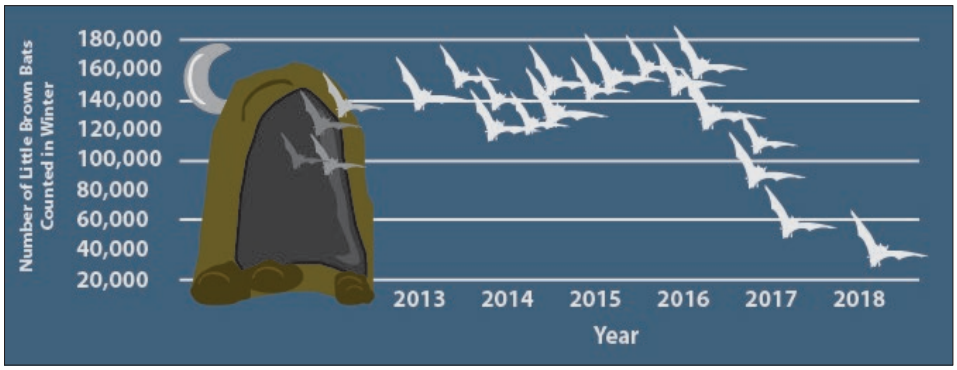
Research Continues into Treatment
Besides conducting our population census counts, we provided logistical support to four research projects, two of which continue to investigate possible treatments for bats with WNS.



Top: National map illustrating the spread of WNS in 2018. For up-to-date maps visit whitenosesyndrome.org.

Middle: On a frigid day in early February, DNR staff and partners prepare for one of the most extensive mine surveys in Wisconsin.

Bottom: Over the winter of 2017-2018 hibernating bat numbers continued their rapid decline.



Now, 10 years post-invasion, states such as Vermont and New York have found small flickers of hope. At a few test sites, biologists have found more than 50 percent of marked little brown bats from one year to the next, suggesting some survival or persistence despite the presence of WNS. Regrettably, these populations are only a fraction (less than 10 percent) of what their historic numbers were, but it is a sign of hope.

5,000 Acoustic Surveys and Countless Stories

By J. Paul White
DNR Mammal Ecologist,
Bat Program Lead

Four thousand, nine hundred and twenty-three.

That's how many bat survey uploads have been submitted to DNR's Wisconsin Bat Program since the acoustic bat monitoring project began in 2007. Now, realize not all the surveys were successful. But, with that number comes countless stories of epic and not-so-epic nights in search of our nocturnal winged companions. Nights shared with family and friends, encounters of rarely seen or heard wildlife, darkness (of course) and hopefully, bats. To that end, I read something recently that reminded me of the acoustic bat monitoring project; it stated, "no one person can do it all, but everybody can do something." For me, that quote is the epitome of the project and I can't thank everyone enough for their participation.

This year we had at least 478 people take part in an acoustic bat survey. The most productive month was June with 145 surveys completed. In total, people spent 564.8 hours (23.5 days) surveying for bats in Wisconsin. Distance traveled while surveying was an astonishing 4,617.8 miles, which is about 80 miles short of traveling the entire length of the Mississippi River from northern Wisconsin to the Gulf of Mexico and back!

On June 27, 2018, we had 11 surveys completed simultaneously in nine different counties. Vilas County volunteers continue to hit the lakes and rivers in full force, with 78 surveys completed by many water-savvy individuals, coordinated by the remarkable effort of Licia Johnson of North Lakeland Discovery Center and Quita Sheehan of the Vilas County Land and Water Conservation Department. Ben Johnston of the Kickapoo Valley Reserve wins the most time spent surveying award (if there was such an award), for amassing more than 1,600 minutes afield while conducting 17 surveys.

Last year's acoustic surveys detected few bats in summer, regardless of whether the surveyor was paddling, walking or driving their route.

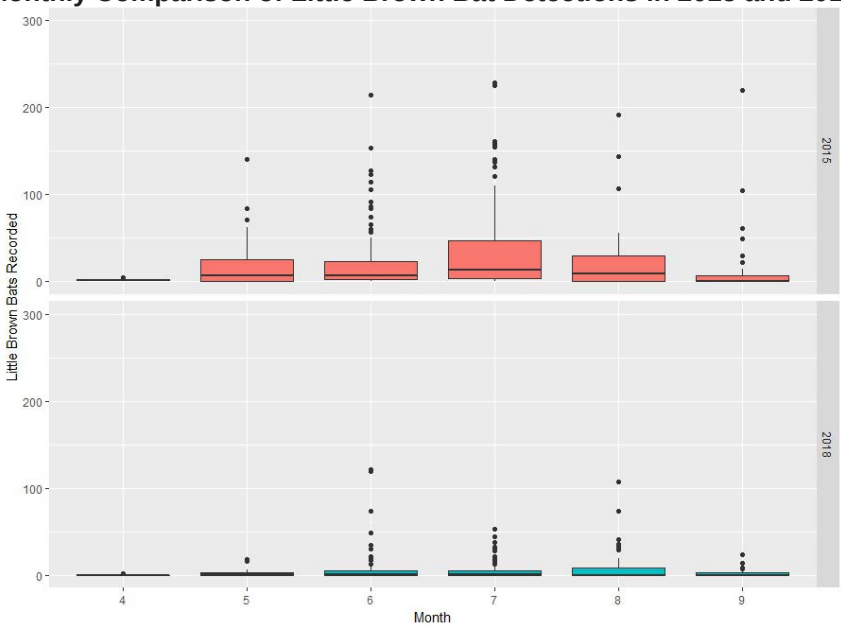
Eastern pipistrelles were detected in 2 percent, or 8 of 405 surveys. Northern long-eared bats were detected in 0.2 percent, or only 1 survey

Little brown bats were detected in 55.1 percent, or 223 of 405 surveys, yet were overwhelmingly down from 2015, when little browns were detected on 78.2 percent of completed surveys.

Moving forward, DNR's Wisconsin Bat Program staff will be evaluating our current monitoring effort and strategy to assure it accomplishes goals that meet the North American Bat Monitoring Program's protocols and objectives. Stay tuned for more updates and direction as the spring acoustic monitoring season draws closer.

Photo credit: J. Paul White
Preparing for an acoustic survey by kayak involves paddling to the survey starting point as the sun sets.

Monthly Comparison of Little Brown Bat Detections in 2015 and 2018



A monthly comparison of little brown bat acoustic detections by route for 2015 and 2018. Little brown bat detections are significantly lower in 2018 due to effects and the regional spread of white-nose syndrome.

Roost Counts Drop Sharply

By Heather Kaarakka
DNR Conservation Biologist, Bat Program Roost Monitoring Coordinator

Volunteers and surveyors continue to help the Wisconsin Bat Program make strides in understanding roost ecology for little brown bats and big brown bats. Without their efforts, we would not have the incredible amount of data we do, let alone one of the most robust bat roost databases in North America. We will always be incredibly thankful to those who donate their time and interest to bat roost monitoring.

In 2018, we continued to have more than 180 surveyors participate in roost monitoring, and 130 roosts were counted from April through October. Big brown bats were surveyed at 45 sites, 67 sites housed little brown bats, three sites were home to eastern pipistrelles, and the remaining sites housed both species or it was unknown which species used the roost. Over the summer, more than 8,000 little brown bats were counted, which is unfortunately down by more than 60 percent from 2016. Surveyors also counted 3,419 big brown bats, which is up from previous years.

The annual Great Wisconsin Bat Count continues to be a successful way to coordinate survey efforts. This statewide count is conducted twice in summer: in early June before pups are able to fly, in what is known as the pre-volancy period, and in late July, after pups are flying on their own. This year, numbers of little brown bats more than doubled from early June to mid-July, which is an indication of

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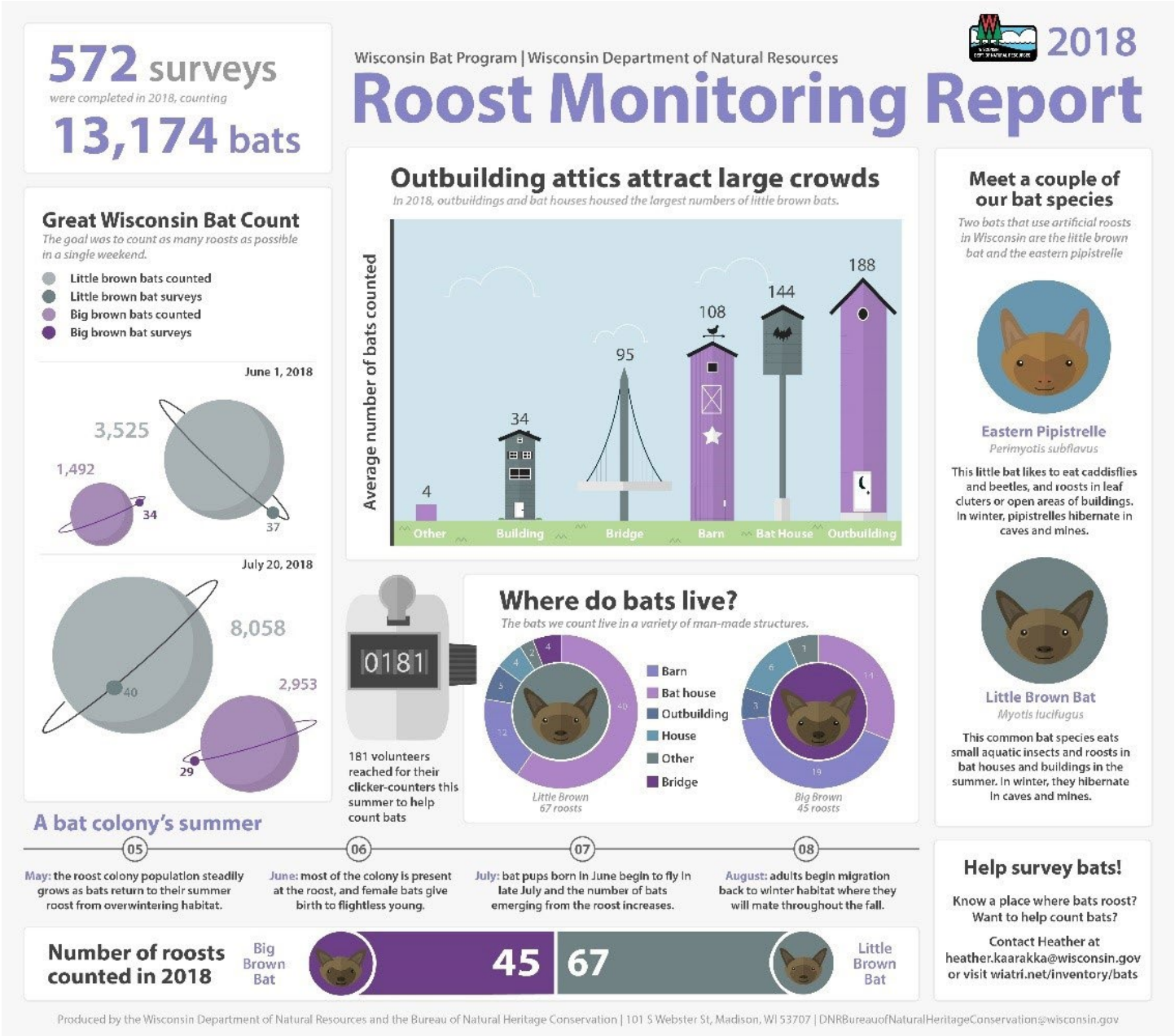

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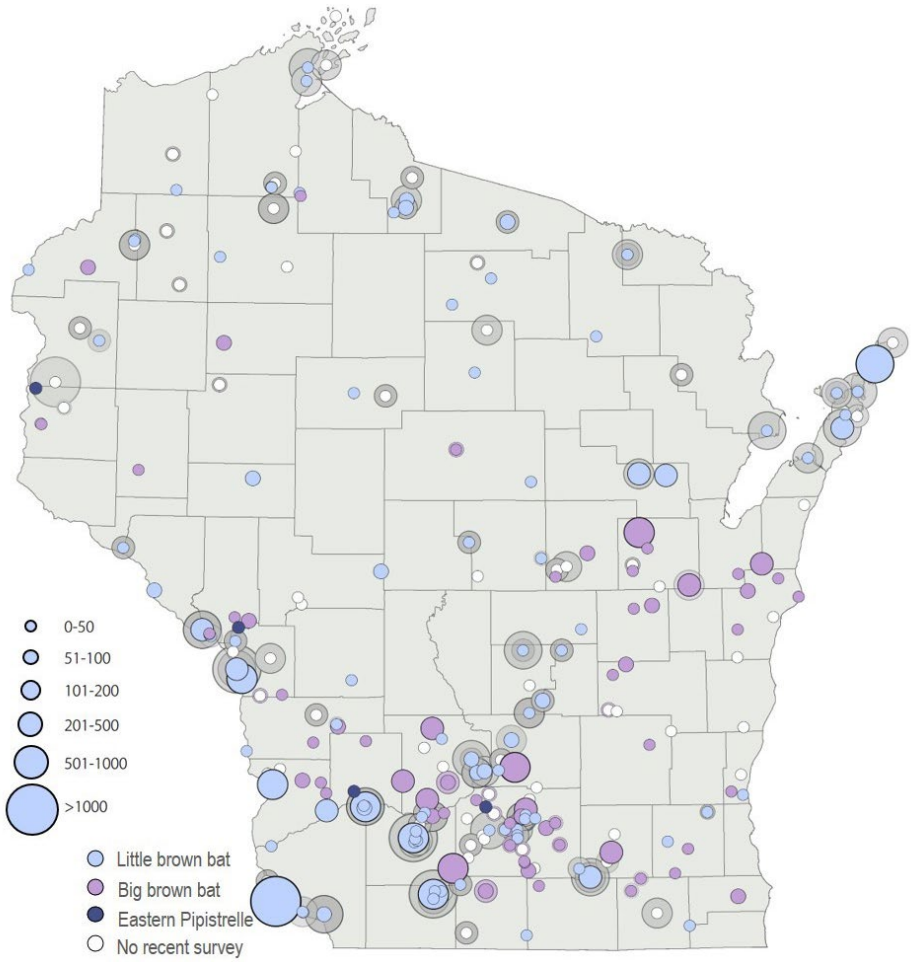
successful reproduction. However, many surveyors noted a conspicuous absence of bats in June, which could mislead conclusions about the number of bats giving birth. It is unclear what caused so few bats during the pre-volancy count.

There is still much to be understood about how bats are responding to impacts from white-nose syndrome and it is possible bats were present at unsurveyed sites early in the season, and then moved to roosts where volunteers were monitoring. With volunteers seeing significant declines in colony size at many roost sites, it is difficult to remain positive, but we look for bright spots and take wins where we can no matter how small. Two of the three eastern pipistrelle roosts had only two or three bats early in the season this year and no bats after mid-June, but a small colony remains at the last site and even had marked individuals return including a bat studied in 2017.

We are also finding bright spots in persisting colonies of little brown bats. Two sites along the Mississippi River still housed more than 1,000 bats, and a newly discovered roost in Door County had more than 800 in August. These colonies will be important to watch and learn about over the coming summers because they are likely surviving bats.

Learn more results from the 2018 bat roost monitoring season in the annual report available on the Bat Program website. If you have questions or are interested in participating in the summer bat roost monitoring project in any capacity, please feel free to contact me: heather.kaarakka@wisconsin.gov



Map illustrating known and monitored roost types by size and species across Wisconsin

A giant thank you to all the surveyors and volunteers who reported and monitoring roosts in 2018!

Visit our website to find publications on bat houses, excluding bats from your home, annual acoustic and roost monitoring reports, species guidance documents and more.

WIATRI.NET/INVENTORY/BATS/

Cave and Mine Catalogue Yields Surprises

***By Jennifer Redell**, editor*
DNR Conservation Biologist, Bat Program Cave and Mine Specialist

Our extensive efforts over the past decade to document and map the caves and mines where bats hibernate has helped us focus survey efforts for bats and made possible other cave-related research, including studies described on page 14. With much of that work behind us, cave and mine catalogue work in 2018 still turned up a few surprises and continued to advance knowledge of, and protect, these important hibernacula.

Silver-Haired Mystery
Last survey season (winter 2018) we were surprised to find five silver-haired bats (*Lasionycteris noctivagans*) using a mix of shallow caves and mines across Wisconsin. This is the first time this typically migratory species has been documented in traditional hibernacula during the winter hibernation season in Wisconsin.

Two of the bats tested positive for the presence of WNS fungus, confirming what is already known, that that silver-haired bats may be able to transmit the fungus across the landscape while remaining unaffected by the disease. Across their range, hibernating silver-haired bats have been found in basements of buildings, in silica mines, in shallow caves in sandstone cliffs, in limestone caves, and under loose bark of giant cedars. There are no reliable reports of large winter aggregations.

We continue to encourage the public to search for bats tucked into bluff faces, overhangs, and rocky crevices (while remaining out of caves) during the hibernation period from Oct. 1 through May 15. Please quietly photograph both closeups of bats and their associated habitat and submit reports (photos, date, and location) to DNRBATS@wisconsin.gov.

“This is the first time this typically migratory species has been documented in traditional hibernacula during the winter hibernation season in Wisconsin.”

Horseshoe Bay Cave-Mapping Survey Completed
Knowing precisely where caves lie beneath the surface helps prevent harm to the cave during property development and other routine human activity, so the completion of a multi-year effort to re-survey and map Horseshoe Bay Cave in Door County in August 2018 was a significant milestone indeed.

The cave re-survey was completed by a team led by Johanna Kovarik, who serves as the U.S. Forest Service National Cave and Karst Program Lead and maps caves in her spare time. The team surveyed the Mississippi River Section, which was about 1,400 feet from the cave entrance and consisting of about 500 feet nearly water-filled passageway with low air space.

Team members used a measuring tape or disto (digital measuring device) and clinometer (compass and inclinometer) to measure distances between survey stations, compass direction and vertical angle of the shots to create a basic line plot. Two members of a survey team take measurements while the third records measurements and sketches a scaled drawing of the passage in a survey book. The re-survey for Horseshoe Bay Cave will be reassembled into a cave map to relate the cave’s passages to the surface.

Photo credit: A.M. Kilpatrick
One of five silver-haired bats observed using caves during the 2017-2018 hibernation season.

Vandalism Hits Important Bat Site
Landowners and managers are encouraged to remain vigilant for possible vandalism targeting caves and mines important to Wisconsin’s hibernating bats. Two sites were vandalized in 2018, including an important bat site in southwestern Wisconsin where vandals cut the bat-friendly cave gate and left both litter and an interior map of the site they had drafted. A second site in north-western Wisconsin also had its cave-gate breached by trespassers. The vandalism disrupted an on-going WNS research project at the study site. Landowners, managers and others observing vandalism or trespassing should report the incidents directly to local law enforcement to protect the integrity of the caves, the bats and ongoing research.

Review Draft Chapters of Bat Habitat Conservation Plan

By Sarah Herrick
DNR Conservation Biologist

Key portions of a draft multi-state habitat conservation plan for three bat species threatened by white-nose syndrome are now available for public review, with more chapters to come. Wisconsin, Michigan, and Minnesota are collaborating on developing the Lake States Forest Management Bat Habitat Conservation Plan (HCP), known as the Lake States HCP, to protect federally listed bat species and provide incidental take coverage for forest management activities across all three states. Find the draft chapters on DNR's website and sign up for email updates.

The draft plan is being developed by the states in anticipation of the likely listing of cave-hibernating bats as federally endangered species. When it's completed, the HCP and resulting incidental take permit will provide coverage for the incidental take of northern long-eared bat (*Myotis septentrionalis*), little brown bat (*Myotis lucifugus*), and eastern pipistrelle, also known as the tri-colored bat (*Perimyotis subflavus*), during forest management and related activities, such as road and trail maintenance and prescribed fire.

Wisconsin, Minnesota and Michigan have received federal grants to fund development of the habitat HCP from the U.S. Fish and Wildlife Service, and work will continue over the next one to two years. The HCP development effort is led by a steering team made up of one representative for endangered species and one for forestry from each of the three state DNRs as well as a representative from the Service.

For more information, visit the Bat Habitat Conservation Plan website. Or, contact Wisconsin steering committee representatives:

- Sarah Herrick
  Sarah.Herrick@Wisconsin.gov
  608-267-7689
- Mark Heyde
  Mark.Heyde@wisconsin.gov
  608-267-0565

> **"Wisconsin, Michigan, and Minnesota are collaborating… to protect federally listed bat species and provide incidental take coverage for forest management activities across all three states."**

Photo credit: Heather Kaarakka
NHC conservation biologist Katie Luukkonen tracks an eastern pipistrelle to a tree where it has its summer roost as part of research informing a multi-state bat habitat conservation plan.

Some Like it Hot

Research Zeroes in on Bats' Preferred Summer Habitats

By Heather Kaarakka
DNR Conservation Biologist, Bat Program Roost Monitoring Coordinator

As we observe severe declines in bat populations across the state from white-nose syndrome (WNS), it is difficult to imagine what recovery of bats in Wisconsin might look like. What types of habitats do bats need and what will they require in a post-WNS world? What sort of spatial scales are appropriate to look at how bats use a landscape? The goal of my project is to investigate what types of habitats two species of Wisconsin bats are using and if there are particular landscape features, like amount of forest cover, that these species are targeting at local and statewide scales. Bats are notoriously difficult to study because they are nocturnal, fast, roost in hidden places, and many echolocate above human hearing.

Because of this, most research on summer habitat for bats has focused on specific roost use. What types of trees or other roosts are bats using and what is their behavior at these roosts? However, understanding what types of trees bats use is only part (albeit an important part) of the puzzle that makes up bat habitat. Bats may forage in areas that are often some distance from their roosts and connected by commuting corridors.

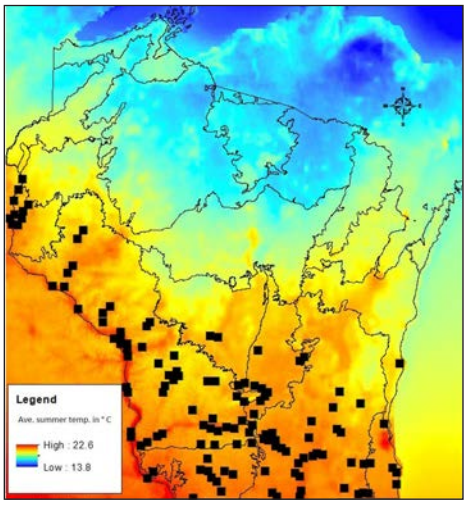
Stepping back even further, recovery of bats affected by white-nose syndrome requires some knowledge of each species' distribution in the region. Such knowledge will help focus conservation efforts in the future. For example, if we understand that bats likely move under 200 miles from their overwintering sites to summer habitat, are there areas where we are unlikely to find them? Would management of summer habitat in these far-flung locations make sense, or would efforts be better focused closer to hibernacula?

Ecolocation:
Insect-eating bats use echolocation to locate and capture prey. They emit ultrasonic clicks and buzzes above the range of human hearing which bounce off potential prey and back to the bats' sensitive ears.

> **"Bats are notoriously difficult to study because they are nocturnal, fast, roost in hidden places, and many echolocate above human hearing."**

To help answer some questions about distribution and range of eastern pipistrelles (*Perimyotis subflavus*) and northern long-eared bats (*Myotis septentrionalis*) in Wisconsin, I am using a program called MaxEnt, which compares climatic variables such as precipitation and temperature, percentage of deciduous trees in a specific area and others, with characteristics of sites where bats have been detected during acoustic surveys or mist-netting efforts. MaxEnt attempts to quantify which variables have the most input on where each species is likely found and also produces a "heat map" of where each species is likely to occur.

Preliminary work shows that the variables most affecting distribution

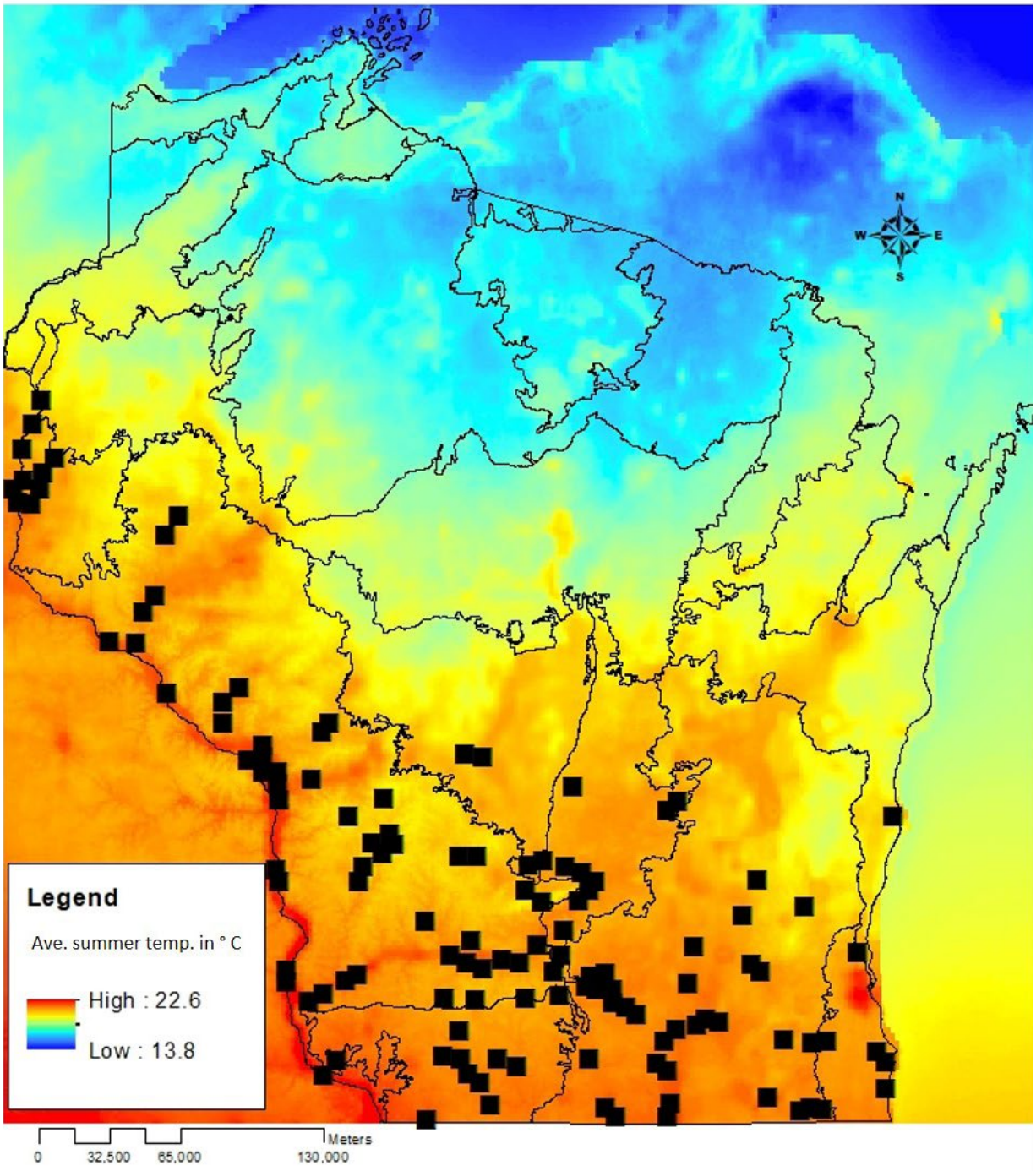


For the full size image, see page 11.

of eastern pipistrelles are average summer temperatures and distance to hibernation sites. Eastern pipistrelles like it warm and close to hibernacula. MaxEnt also predicts that this species would be unlikely to occur north of the tension zone in summer, and that the Mississippi and Wisconsin rivers are hot spots for eastern pipistrelles. Northern long-eared bat distribution appears to be most influenced by average summer precipitation, distance to hibernacula, and amount of deciduous forest. MaxEnt predicts that there are three hot spots for this species in north central, central and southwestern Wisconsin. Some investigation is still required to determine why each of these areas is standing out as suitable habitat for this species.

Digging into scales looking at characteristics of foraging and home range habitats is just getting started, but hopefully when combined with data about distribution of each species, we will have a better idea of the summer habitats used by eastern pipistrelles and northern long-eared bats in Wisconsin. Armed with this new knowledge, the Wisconsin Bat Program can focus efforts in looking for survivors, conserving areas of suitable habitat, and managing habitat for recovery now that WNS has moved through the region.

Average Summer Temperature and Eastern Pipistrelle Acoustic Encounters in Wisconsin



This map displays acoustic encounters of eastern pipistrelles from 2010-2016 (black squares) overlaid on a map of the average summer temperature in celsius where red is warmer and blue is cooler. This is an example of one of the variables we use to build a habitat suitability model to determine where this species is likely to occur. The model can also tell us which variables are playing the biggest roles in where this species is found. Climatic datasets such as this are obtained from WORLDCLIM dataset (Fick and Hijmans 2017).

Interest and Outreach Soars in 2018

Photo credit: U.S. Forest Service
Bat enthusiasts swarmed the Wisconsin Bat Festival in August 2018 in Ashland. Young fans enjoy a photo booth, left, and exploring a cave, right.

***By Jennifer Redell**, editor*
DNR Conservation Biologist, Bat Program Cave and Mine Specialist

Wisconsin Bat Program staff responded to growing requests for outreach about bats, providing more than 70 presentations and reaching more than 7,000 people in 18 counties. Talks ranged from smaller presentations at libraries and schools to events like the Wisconsin Bat Festival and Farm Technology Days where hundreds, and even thousands of people enjoyed learning about bats and their importance to Wisconsin's ecosystems and economy.

Bat Festival Migrates North
The 2018 Wisconsin Bat Festival migrated north in summer 2018 to the Northern Great Lakes Visitor Center in Ashland to raise awareness about the vital role Wisconsin bats play in our ecosystem and the threats posed by white-nose syndrome (WNS). Nearly 50 volunteers and partner staff members helped make this event, funded by a U.S. Forest Service grant, possible.

We were able to host 20 hands-on activities, six live bat talks, and 14 science talks throughout the day. Sixty people attended a misty-mist net demonstration on Bat Science Night, although the bats were a no-show likely due to the lateness of the season and dew-laden weather.

This year's festival was attended by just over 1,000 people, some from as far away as southern Wisconsin and other states, including Virginia! Just imagine if each of those people shared something they learned or took one action to benefit bats.

The educational impact was even greater as an additional 200 plus members of the public were exposed to our exhibits during set-up on Friday and more people were exposed to the festival through coverage in the local and Duluth media.

I want to extend a very special thank you to Brian Heeringa and Susan Nelson of the Forest Service and the wonderful staff of the Northern Great Lakes Visitor Center for coordinating details and helping host us at the beautiful facility. This year's partners included the U.S. Forest Service, U.S. Fish & Wildlife Service, USGS National Wildlife Health Center, UW-System Schools, Eastern Michigan University, Friends of the North Pikes Creek Wetlands, North Lakeland Discovery Center, and Wild Instincts.

Partner Efforts Fly High
The community of caretakers across Wisconsin that has formed to support bat conservation and bat research efforts continued their important work in 2018. New bat education efforts fledged under the inspiration of larger statewide Wisconsin Bat Program initiatives.

UW-Stevens Point Biology Professor Christopher Yahnke developed a Wisconsin Bat Curriculum, which you can read more about in this issue of *Echolocator* on page 19.

The Mississippi Valley Conservancy hosted their own Family Bat Fest at Kickapoo Caverns, sponsored by Mayo Health Systems and attended by more than 100 people. Before the event, volunteers received training and education from Wisconsin Bat Program staff about caves, bats, and white-nose syndrome. On the day of the event the public was able to hear

Continued on page 13

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talks by experts, activity booths, enjoy activity booths and tour an important bat hibernaculum at the conservancy's Kickapoo Caverns.

Door County Parks offered its fourth summer of public interpretive tours that detailed the history, geology, hydrology, and biology of Horseshoe Bay Cave. This year's guided tours took 160 people 200 feet into the cave. The county's future goal is to expand these tours to one weekend in June, July and August. The Door County Parks Department is looking for people willing and able to volunteer as cave trustees for this site. Cave trustees participate in a training program and then guide public interpretive tours. Contact Ben Nelson, superintendent of Door County Parks, if interested: bgnelson@co.door.wi.us or 920-746-7132.

Photo credit: Drake Hokanson

Volunteers Susan Knopf and Connie Arzigian help the Mississippi Valley Conservancy host public tours of their preserve, Kickapoo Caverns, during Family Bat Fest in the summer of 2018.

Live Bat Presentations and Wisconsin Bat Festival Hibernate in 2019

Wow - the public has really clamored for bat outreach in ever-increasing numbers. What a wonderful dilemma to face!

Our usual live bat presentations are hibernating in 2019 to give us a chance to reflect and revisit our Wisconsin Bat Program goals and priorities. Don't worry - there will be a few select opportunities to learn from us and meet our aging live bat ambassadors: at cave tours at Kickapoo Caverns, hosted with our partners at the Mississippi Valley Conservancy, and through the Natural Resources Foundation of Wisconsin's field trips program.

For those interested in educational resources, visit our Wisconsin Bat Program website and don't forget our Project Edubat Trunk Loaner program.

Researchers Discover How 'Cryptic' Connections Can Spread Disease

Researchers Kate Langwig, Joseph Hoyt, and Jennifer Redell search for bats dusted with a fluorescent powder to help them trace how white-nose syndrome has spread among bats.

By Kristin Rose and Tim Stephens
Excerpted from Virginia Tech Daily

By dusting bats in Wisconsin caves and mines with a fluorescent powder that glows under ultraviolet light, university and DNR researchers have traced the dynamics of disease transmission in bat species that have been devastated by white-nose syndrome (WNS), a deadly fungal disease that has killed 6.7 million bats in North America since 2006.

Their findings from these candy-colored bats were recently published in the journal *Nature*. And while WNS does not pose a threat to humans, the research has broad implications for understanding hidden or "cryptic" connections that can spread diseases between species and lead to large-scale outbreaks.

"These results uncovered and quantified connections, both within and among species, that we never knew about before," said first author Joseph Hoyt, who led the study as a University of California-Santa Cruz graduate student and completed the analyses as a research scientist at Virginia Tech's Department of Biological Sciences.

"We had been seeing explosive epidemics where an entire bat population would become infected with WNS within a month or two, and it was a mystery as to how that was happening. We are now able to more accurately explain and track the spread of WNS, and our study has strong implications for predicting other epidemics," Hoyt said.

Second author on the study, Kate Langwig, an assistant professor in the Department of Biological Sciences at Virginia Tech, said this study shows that infrequent and indirect connections, also called "cryptic" connections, among individuals play a far larger role in the transmission of disease than was previously understood.

The researchers conducted the study at eight hibernation sites, mostly abandoned mine tunnels, in the upper Midwest. Each site had as many as four species of bats using it. At the start of the study, the pathogen causing WNS had not yet reached these populations.

The researchers first surveyed the bats and characterized their social networks, measuring direct physical contacts among bats hibernating together in groups, as well as additional connections made by bats

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moving between groups. Then, they applied the fluorescent dust to several bats in early winter, using a different color for each individual bat. In late winter, the researchers returned to see where each color of fluorescent dust ended up.

"We amassed huge data sets for every single bat in each population. We characterized the bats' social groups, and also used the fluorescent dust to track their movements and contacts," said Langwig.

The researchers found that "the spread of the dust mirrors how the fungal pathogen spreads, so we can see if a bat deposits dust somewhere in the environment and another bat passes through and picks it up. It also reveals infrequent direct contacts that we would not normally observe," said Hoyt.

The fungal pathogen that causes WNS arrived in the area after the fluorescent dust studies were conducted, and the researchers also tracked its spread at each site.

"We were able to explain the actual invasion of the pathogen much better by including those cryptic connections, and they were even more important for explaining transmission between species than for transmission within species," Hoyt said.

One of the puzzling features of white-nose syndrome is its ability to spread through a community of bats during the winter, when the animals are hibernating 99.5 percent of the time. They rouse from hibernation only very briefly every two to three weeks. Yet the dust studies showed that they move around enough to have many more connections than can be observed in their hibernation groups.

Most striking were the cryptic connections revealed for one species, the northern long-eared bat, which roosts by itself, not in groups. Although classical theory would predict low infection rates for this solitary species, it has been hard hit by WNS.

Photo credit: Kate Langwig

An eastern pipistrelle bat covered in UVF dust.

"When we put fluorescent dust on the northern long-eared bat, it would show up on other species that we had never seen them interact with. We would never have predicted that the infection could spread by that route," Hoyt said.

The researchers discovered that a different solitary species, the tri-colored bat, has a lower infection rate and showed less evidence of cryptic connections with other bats, but did transfer dust to surfaces in the sites where it roosts.

Unfortunately for bats, the spores of the fungal pathogen that causes WNS stay in the environment and remain infectious for years. WNS is considered one of the worst wildlife diseases in modern times, having killed millions of bats across North America.

But WNS does not appear to pose a risk to human health. "Thousands of people have visited affected caves and mines since WNS was first observed, and there have been no reported human illnesses attributable to WNS," the U.S. Geological Survey said. "We are still learning about the disease, but we know of no risk to humans from contact with white nose-affected bats."

In addition to Hoyt, Langwig, and Kilpatrick, the coauthors of the paper include Paul White, Heather Kaarakka, and Jennifer Redell of the Wisconsin Department of Natural Resources; Allen Kurta at Eastern Michigan University; John DePue and William Scullon at the Michigan Department of Natural Resources; Katy Parise and Jeffrey Foster at the University of New Hampshire; and Winifred Frick at Bat Conservation International and UC Santa Cruz. This work was supported by the National Science Foundation, U.S. Fish and Wildlife Service, and Bat Conservation International.

Wisconsin Caves Hold Keys to Climate 250,000 Years Ago

By Cameron Batchelor
University of Wisconsin-Madison
Doctoral Student

Calcite cave deposits within the Midwestern United States, including in Wisconsin, may be the key to unlocking the geological record of the climate 250,000 years ago.

Researchers at the University of Wisconsin-Madison, including Ph.D. student Cameron Batchelor, research scientist Dr. Ian Orland, assistant professor Dr. Shaun Marcott, and Geology Museum Director Dr. Richard Slaughter, are currently working in caves located in the Midwest and using geochemistry methods to fill in the historical climate record. Wisconsin Bat Program staff helped the researchers locate sites and connected them with cave owners to aid the research.

Caves are a popular habitat for bats throughout the year due to their stable temperature, optimal humidity, and lack of disturbance. These same characteristics make caves an ideal study site for geologists to investigate past climate. This is because when water travels through the ground and drips into a cave, it releases carbon dioxide and leaves behind calcium carbonate, ultimately forming the calcite deposits we refer to as stalagmites and stalactites. These formations, while resembling ordinary mud piles on the outside, contain visually stunning calcite rings on the inside. These calcite rings are important because they contain the oxygen isotope composition of the drip water that formed them, and these oxygen isotopes provide information about the mean annual air temperature from above the cave. In addition, because stalagmites and stalactites form below ground, they remain undisturbed for thousands of years, protected from outside disturbances such as erosion that often compromise other geological records. This means they can provide nearly continuous climate records of the past that are typically rare for geologists to find.

Photo credit: Bryce Richter
Deep underground Cameron Batchelor reviews a plan for collecting speleothem samples with colleague Dr. Richard Slaughter.

The UW researchers hope their work can fill in the large gap in understanding of past climate in North America for the last quarter million years. They collect stalagmites, slice them open, and polish the open surface to reveal the pristine calcite rings preserved inside. These rings are then individually drilled for small amounts of calcite powder and put through geochemical analysis methods to obtain an age of growth and the oxygen isotope composition. The resulting data will ultimately be used to compile an extensive record of stalagmite growth and climate history.

And researchers are learning that overall, caves are unique ecosystems that not only provide peaceful habitats for bats, but also contain one-of-a-kind calcite deposits that inform us about past climate that would otherwise be undiscovered.

Vaccinating Vampires Prevents Rabies Spreading

Photo credit: Elsa Cárdenas

Weighing only two ounces, the common vampire bat has heat sensors in its nose that it uses to locate warm blood flowing just beneath the skin of its prey.

Dr. Elsa Cárdenas captures and collects vampire bats in Mexico for her research at the National Wildlife Health Center in Madison.

By Elsa Cárdenas
University of Wisconsin-Madison
Doctoral Student, USGS National Wildlife Health Center Researcher

Scientists at University of Wisconsin-Madison, in collaboration with the U.S. Geological Survey's National Wildlife Health Center, and other U.S. and Mexican government agencies are studying new approaches to prevent rabies in wild bats.

Rabies, a disease of zoonotic importance worldwide, is commonly associated with many species of bats. But in Latin America, the common vampire bat (*Desmodus rotundus*) is the main reservoir of the virus and often transmits the disease to cattle, causing mortality and severe economic losses. Vampire bats are not found in Wisconsin. For decades, populations of vampire bats have been decimated in attempts to control the disease. Culling is achieved when individuals from a colony are captured, coated with an anticoagulated paste on their bodies, and released back to their roost. Because vampire bats are highly social, the poison applied to their bodies (commonly referred to as "vampiricide") is transferred to the rest of the individuals through contact, thus resulting in multiple deaths. However, this strategy has not been effective and sometimes affects non-target species, such as fruit bats and other beneficial species. Thus, new alternatives to control the prevalence of rabies are being explored.

Recently, Dr. Jorge Osorio's research group at UW-Madison developed an oral rabies vaccine and tested it in big brown bats. The vaccine showed very promising results, protecting the bats from rabies after experimental challenge. Current research will test the same rabies vaccine, but this time in a group of common vampire bats that were captured last August in Mexico. The bats are part of a research project testing whether oral vaccination can protect them from rabies. Our goal is to have a vaccine that could be delivered following the same mechanism of application as the topical vampiricide. This way, colonies of vampire bats could be immunized with less effort and by capturing and applying the topical vaccine to only a portion of the colony. Thus, preventing transmission to other animals and humans.

In addition to the vaccine studies, we are interested in observing the behavior of vampire bats when infected with rabies. We hope to answer questions such as:

- Do sick bats change their social interactions?
- What signs do rabies cause in vampire bats?
- Are infected individuals aggressive toward group mates?

For this, we will use a surveillance camera system and record the behavior of the bats before and after rabies infection.

We expect to complete our experiment and assess the efficacy of the rabies vaccine by mid-2019. After that, we will step outside the lab and conduct fieldwork in Mexico. Our objectives will be to estimate the proportions of bats that must be captured and vaccinated in a colony in order to develop optimal vaccination strategies.

Conservancy Protects Wauzeka Cave by Installing Cupola Gate

Photo credit: Jennifer Redell

Pat Caffrey was instrumental in designing and installing the new bat-friendly cave gate at Wauzeka Cave, recently purchased by the Mississippi Valley Conservancy.

Photo credit: Levi Plath

Boards cover the sinkhole cave entrance to prevent soil from falling inside as the gate foundation is prepared.

Photo credit: Levi Plath

A cupola gate allows bats to fly freely in and out of the cave while protecting the site from vandalism and hibernating bats from human disturbance.

By Levi Plath
Conservancy Land Manager

The pristine Wauzeka Cave in Crawford County is now better protected for perpetuity while allowing easy access for bats as the result of a 2018 project completed by Mississippi Valley Conservancy staff, volunteers and partners.

Mississippi Valley Conservancy (Conservancy), a nonprofit land trust in the Driftless Area of southwestern Wisconsin, purchased and permanently protected the Kickapoo Caverns in Crawford County in 2017. The property included a former show cave that has been home to federally threatened northern long-eared bats and Wisconsin state threatened little brown, and eastern pipistrelle bats.

The show cave, complete with former gift shop and parking area, has been the main attraction of the property for the public, but there is also a much lesser known sinkhole that opens up into Wauzeka cave. Since the Conservancy acquired the property in 2017, staff and volunteers have done extensive work to protect and make the smaller, lesser-known sinkhole cave accessible for bats while limiting public access and disturbance.

“This was a priority for the Conservancy because this cave is in nearly pristine condition and with the property being open to the public, it is much more likely to be degraded and disturbed without some type of protection in place,” says Levi Plath, conservancy land manager.

As of Aug. 31, 2018, Conservancy staff and volunteers have installed a cupola gate meant to allow bats to come and go from the cave while limiting human access. The installation was no small feat, requiring the sinkhole to be enlarged to allow for the construction of a concrete collar that would hold the nearly 3,000-pound cupola. Volunteer Pat Caffrey, along with conservancy staff, dug out the edges of the sinkhole and poured concrete in forms that were custom made to fit the shape of the sinkhole. Once the concrete cured, the bar grating angle iron and cupola could be lifted, set into place, and welded together.

With guidance and hard work from the Wisconsin Department of Natural Resources, the U.S. Fish and Wildlife Service and volunteers, the conservancy was able to complete the project just in time for the fall swarm when bats select which cave they want to hibernate in during the winter months.

This cupola will be here at Kickapoo Caverns to protect the bat populations on this property for many decades to come while only allowing human access for research purposes to preserve the cave for bats and other wildlife. The Conservancy would like to thank Pat Caffrey, for putting in so much effort and taking on this monumental task as a volunteer.

Reflections from Surveying Bats with Students for 15 Years

By Jeff Huebschman
University of Wisconsin-Platteville
Biology Professor

Since 2004, my students and I at the University of Wisconsin-Platteville have caught and examined 1,441 individual bats representing seven species from mist-net surveys in Grant County, Wis. What originally began as an effort to introduce undergraduate students to field-based research and continue my own explorations into bat biology slowly turned into a long-term dataset effectively documenting changes to our local bat communities wrought by the presence of white-nose syndrome (WNS) in North America. For example, since beginning my survey efforts in 2004, the little brown bat (*Myotis lucifugus*) has been the most frequently captured bat (59.6 percent of all captures) across all years and sites. Last year, however, my students and I did not catch a single little brown bat, a result unfortunately consistent with the devastating impacts of WNS on this species.

Relatedly, in a manuscript soon to be published in *The Northeastern Naturalist*, I showed that at one of my long-term research sites there was a significant decline in the number of little brown bats captured per mist-net-meter-hour from 2007-2017, whereas for big brown bats (*Eptesicus fuscus*) and eastern red bats (*Lasiurus borealis*) there were no significant changes in the rate of bats captured. These results are also consistent with what others have found showing that the impacts of WNS on big brown bats are not as deleterious as they are on little brown bats, and that eastern red bats—a species that doesn't typically hibernate in caves and mines—have shown no diagnostic signs of infection with WNS.

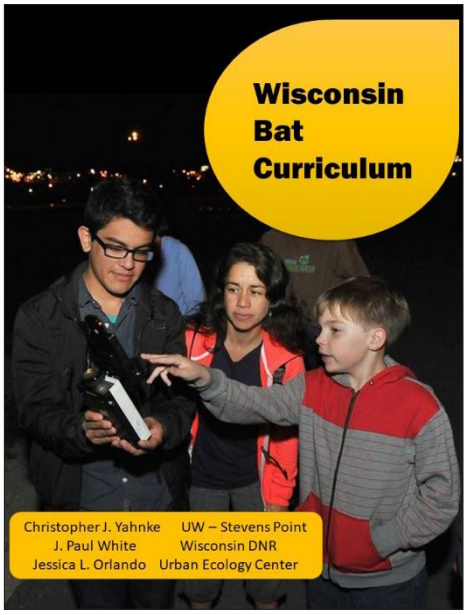
In addition to the scientific results of my research efforts, as a teacher I have been pleased to have several students go on to be involved in bat research efforts in others states, as well as pursue their own graduate research on bats. One recent student, who is now in veterinary school, co-authored a research note that will be published in the *Journal of Wildlife Diseases*, along with fellow collaborators from the Wisconsin DNR (among others). Needless to say, many of the students I have had the pleasure of teaching are introduced to my bat research in the classroom. Current real-world examples are often a useful way to engage students in the process of science.

Certainly one of the most enjoyable ancillary benefits of my involvement in bat research in Wisconsin has been the opportunity to engage with other bat researchers throughout the state and particularly within our own Wisconsin DNR. I can attest that the people involved in bat research and conservation efforts in Wisconsin are a passionate bunch who are all doing good work. The fun I have had in the field with students and colleagues, and the new and lasting friendships that have blossomed as a result of my involvement in the broader community of bat researchers in Wisconsin, has been one of the best outcomes of my research.

Photo credit for all: Andy McNeill

Bats and Big Data Build New Curriculum

By Christopher J. Yahnke
University of Wisconsin-Stevens Point Biology Professor, Birds and Mammals Curator at the UWSP Museum of Natural History



Christopher Yahnke, a UWSP biology professor, left, led development of the Wisconsin Bat Curriculum, right.

I started work on the Wisconsin Bat Curriculum in spring 2018 at the Urban Ecology Center in Milwaukee, working with their research and education staff on a Wisconsin bat curriculum. I met with high school biology teachers at Marquette University High School, Escuela Verde, Cristo Rey, and New Horizons at Shorewood High School to understand what would be useful for their students. Bohdan, Chad, and Tory suggested developing a module on WNS. This activity focuses on the two species of myotis bats recorded at three permanent acoustic monitoring stations: The Urban Ecology Center in Milwaukee, Schmeeckle Reserve in Stevens Point, and Kemp Natural Resources Station in Woodruff. These stations represent one of the ways the DNR has been monitoring bats since 2007. Engaging this dataset, students and teachers will discover the dramatic and rapid decline of these species, particularly in northern Wisconsin, following the arrival of WNS to the state in 2014.

A "Bataset" From "Listening" to 320,000 Acoustic Records of Bats

For today's science student, science literacy should include an appreciation of big data. That's a very broad term, but basically big data refers to extremely large data sets that can be analyzed to reveal patterns, trends, or associations. Imagine a dataset with 7 billion rows and 3 billion columns of data. That dataset would represent the human genome (3 billion nucleotide bases) of every person on the planet. This dataset has not been compiled yet, but it is part of a trend towards personalized medicine. Currently, hospitals are having a harder time finding qualified bioinformatics specialists to leverage big data than they are finding physicians, and graduate programs in bioinformatics are increasing in response.

Think about the Wisconsin Bat Curriculum as an introduction to big data, but instead of humans, the data reveals patterns, trends, and associations of Wisconsin's bats. In this bataset (see what I did there) the rows represent an individual bat flying by an ultrasonic microphone and the columns contain a variety of information like where the bat was recorded, when it was recorded (date, time of night), and quantitative data on the frequency, shape, and duration of the acoustic signal. Currently, the dataset contains 320,000 rows of data representing bats recorded at the three permanent acoustic monitoring stations.

The Wisconsin Bat Curriculum includes modules that utilize this dataset, but also modules that don't require it. For example, the Psychedelic Haiku Bat Hand Challenge involves drawing and poetry and was inspired by UW-Madison Art Professor Lynda Barry. How to Measure Sound engages the properties of an acoustic signal, demonstrates how to calculate a wavelength, and connects that property to the bat's ability to detect insects. These two activities are currently available on Canvas Commons for educators that use the Canvas platform.

Where to find the Wisconsin Bat Curriculum

My hope is that the curriculum will continue to evolve as new data is added from the detectors. I will be adding data we've collected from our bat monitoring station at the Wildwood Zoo in Marshfield, which had a healthy population of little brown bats until 2018. You can access the dataset and curriculum through my webpage https://www.uwsp.edu/biology/Pages/Faculty/Yahnke.aspx. Contact me at cyahnke@uwsp.edu with questions or suggestions for new modules.

Profile of Hoary Bat

By J. Paul White
DNR Mammal Ecologist,
Bat Program Lead

Photo credit: Heather Kaarakka

Identification
Easily distinguishable from all other Wisconsin bats by its large size—18-inch wing-span—and coloration, the hoary bat (also known as the Frosted bat, Great Hoary Bat and Twilight Bat) is quite likely Wisconsin's most colorfully attractive bat species, with its yellowish-brown hair around the face and white or cream underbelly. Many hairs are white-tipped and give the fur a frosted or "hoary" appearance. This unique pattern allows hoary bats to roost inconspicuously in large mature trees, in both conifer and hardwood stands.

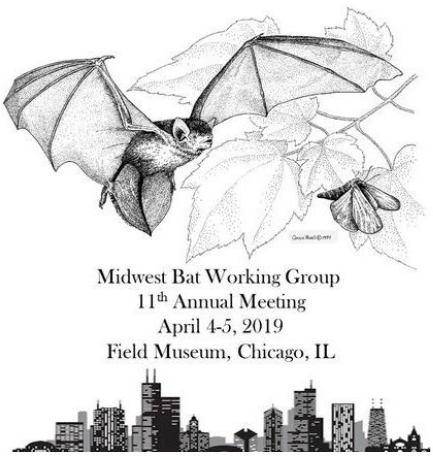
Life and Natural History
Females, which tend to be slightly larger than males, give birth from May to June, usually to twins, but sometimes up to four pups. Hoary bats are more active throughout the night than other bat species in Wisconsin and often can be found foraging in open areas, over open water or at higher elevations. Hoary bats have been known to travel as much as 24 miles while foraging. They are considered a migratory species and will not use caves or mines in the winter. Instead, they will travel from Wisconsin to warmer climates to take advantage of food availability in areas like Florida and Mexico. The hoary bat migrates some of the longest distance of any bat and a 2016 study by Weller et al. showed direct evidence that a male hoary bat completed a month-long journey of more than 600 miles through areas in northern California, Oregon and Nevada.

Diet
Hoary bats are considered a moth specialist, while also consuming beetles, flies, wasps, grasshoppers, dragonflies and of note, even smaller bats.

Distribution
Although hoary bats can be found in the summer months throughout Wisconsin, they are never very common, which can be said for their presence in North America. They are found in all 50 states including Hawaii, but in low numbers.

Threats
While we wouldn't expect hoary bats to be affected by white-nose syndrome, we know that wind energy facilities affect this species more than any other. The current estimate is 128,000 hoary bats are killed each year at wind facilities. A recent study by Frick et al. (2017) sounded the alarm by investigating whether fatalities at wind turbines could impact one of the most widespread bat species in North America. Their results suggested that wind energy development poses a significant threat to the existence of the hoary bat in North America, and their populations may drop 90 percent over the next 50 years if no action is taken to mitigate bat mortality.

So, next time you're out stargazing way past your bedtime and you see a large bat soaring above the treetops, you might consider that it's something different than the big brown or little brown bats you are used to in Wisconsin. It's quite likely a hoary bat, especially if you're out past midnight.



Wisconsin Students Go to Bat for Bats

The future of Wisconsin bats is in good hands with these members of "Generation Z" who received recognition in 2018 for their contributions to bats.

Ansel Brenneman of La Farge, 15, received the Outstanding Achievement in Youth Citizen-based Monitoring Award presented in late March at the Wisconsin Summit for Natural Resources Volunteers in Eau Claire.

A student at Laurel High School in Viroqua, Ansel champions bat monitoring by volunteering and giving public talks to get others involved. He started bat monitoring in 2016 as part of an 8th grade school project. Since then, he's volunteered to count bats at their roosts and to monitor them with acoustic detectors, and he helped DNR staff capture and band bats. He also builds and installs bat houses and gives bat presentations. Enjoy our Q & A with Ansel!

Why do you volunteer?
I volunteer because I believe that everyone needs to do what they can to help our planet, and to help the creatures that we share the planet with, to survive and prosper.

How did you get started?
I was very lucky to have an awesome citizen science mentor, Ben Johnston, who I met at the Wisconsin Citizen-based Monitoring Conference in the Spring of 2016. I first started volunteering with bat monitoring during that summer of 2016; when I chose the topic of bat conservation, for a school project that I would work on for most of my 8th grade year. The more I volunteered through the year, with my mentor's help, the more opportunities I had to do more types of citizen-based monitoring volunteering. I continue to volunteer with educating others about bat conservation and volunteering with acoustic monitoring, roost counts and bat house installation, now as a 10th grader.

Photo credit: Nicole Mondroski
After learning about bats from NHC's Jennifer Redell, students from Isthmus Montessori Academy in Madison raised $185 at a school dinner and gave dinner guests their own presentation on bats. This summer, the "mini bat crew" helped Redell count bats emerging from bat houses.

What is your favorite part of volunteering?
My favorite part of CBM volunteering would probably be knowing that I am making a positive change in the world, and that day, I did something good for the planet. For me, there is just no better feeling.

Do you have a favorite memory from volunteering?
All of my memories of volunteering have been so valuable and special to me, but I think one of my favorites would be doing my first walking acoustic bat survey with my mentor and other citizen scientists--walking through the woods, under a night sky of stars, and hearing the owls while we listened for bats.

Ansel Brenneman (far left) built and installed bat houses with guidance from WBP volunteer Ben Johnston (far right).

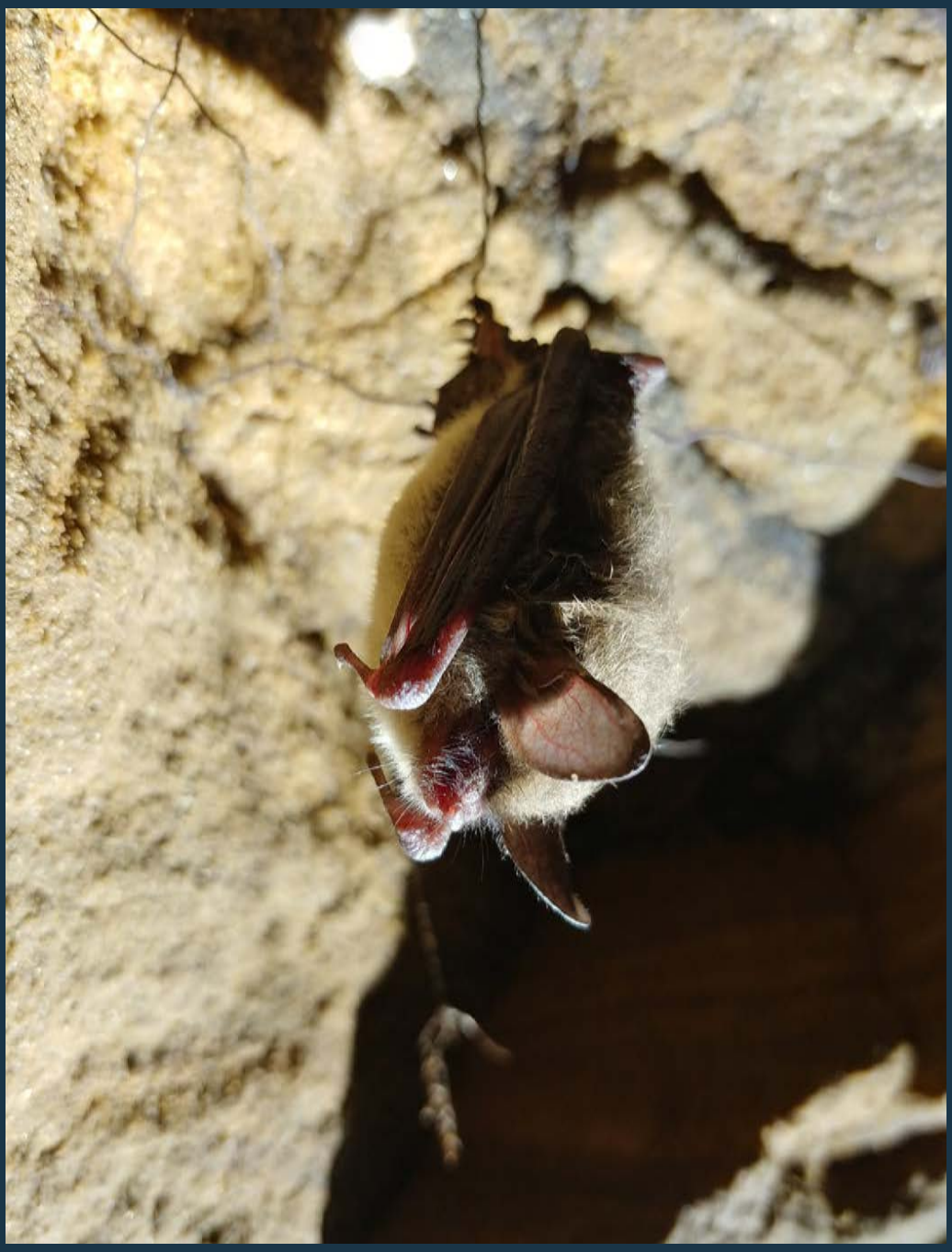


Photo credit: J. Paul White

Precariously positioned, this hibernating northern long-eared bat roosts comfortably along an exposed tree root using a tendon-locking mechanism in the digits of its feet. This feature allows bats to lock their toes in place in a flexed position until they disengage their feet. They can then hang for long periods of time without using their muscles or expending energy to cling to various surfaces.

WISCONSIN BAT PROGRAM

WISCONSIN DEPT. OF NATURAL RESOURCES