ECHOLOCATOR

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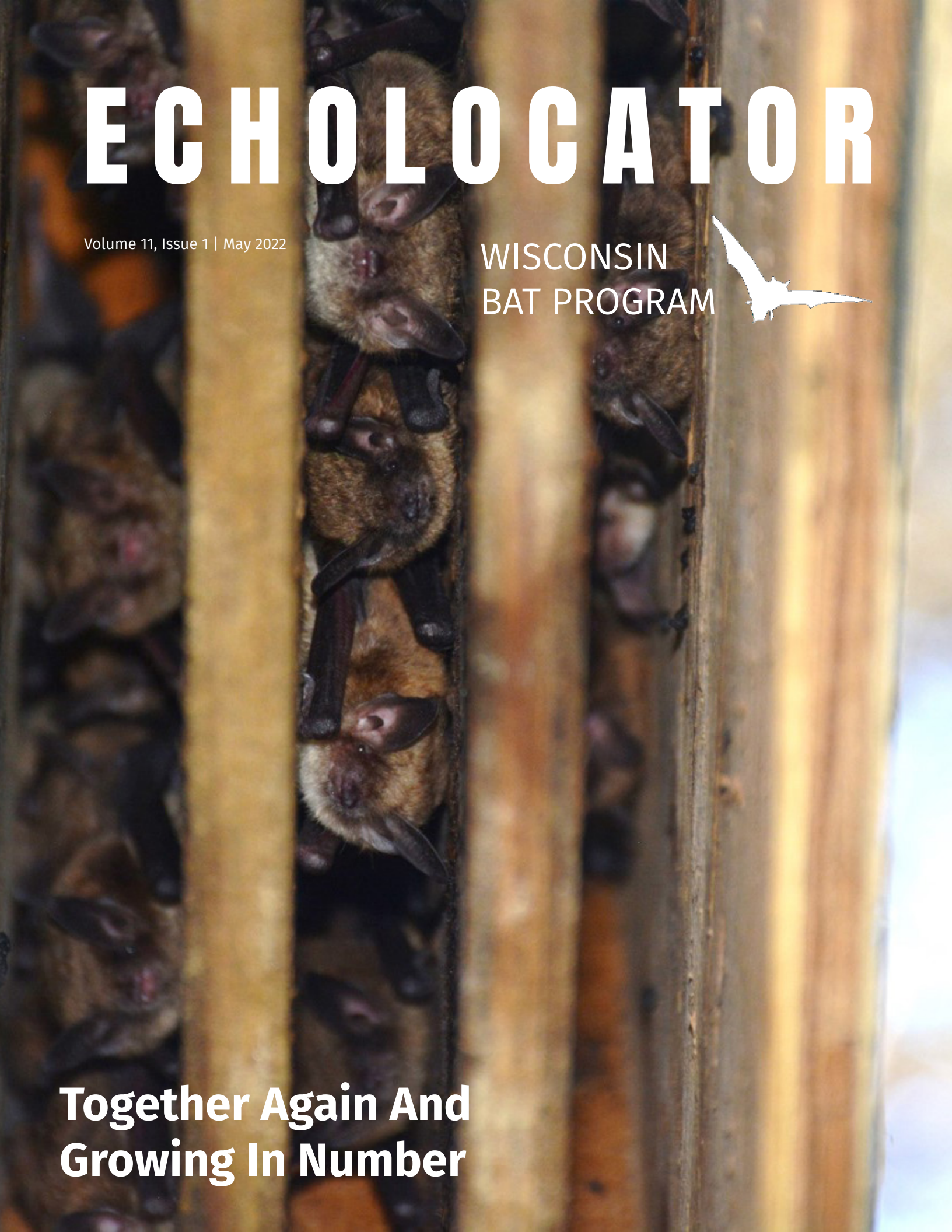
BAT PROGRAM



Together Again And Growing In Number

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Cover Photo: Little brown bats roosting in a bat house in summer.
Photo: Heather Kaarakka

Echolocator is an annual publication of the Wisconsin Bat Program, part of the Wisconsin Department of Natural Resources 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.

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Bats & Volunteers Hang On At Summer Roosts

Some Populations Appear To Have Stabilized

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

Tricolored bats (also known as Eastern Pipistrelles) rarely hibernate while touching another bat. Photo: J. Paul White

In 2021 it felt like we were everywhere—and all at the same time!

The Wisconsin Bat Program (WBP) was mostly back to normal operations in 2021. The sense of being everywhere at once is in part thanks to our dedicated volunteers, working the summer night shift alongside us and a wide network of remote monitoring technologies, employed at a variety of habitats across the state. The support of these resources combined made it possible for us to collect more data in 2021.

We listened in on bats as never before, staging acoustic recorders at the entrances of key hibernacula, recording over a million bat voices in the process! Dedicated volunteers continued to drive, paddle and walk acoustic survey routes while stationary bat detectors recorded bat activity on properties not previously surveyed, as part of the North American Bat Project.

Hundreds of people helped count bats emerging from roosts, giving us the ability to assess reproduction at summer colonies. New antenna systems that detect tagged bats at some of the largest sites kept tabs on the largest little brown bat colonies remaining in the Midwest. This data provided clearer insight on the individual behavior of bats during fall and winter. These systems, along with several now installed at surviving summer roosts, are already paying off as they reveal concrete connections between the summer and winter habitat of individual little brown bats.

The summer of 2021 gave our spirits a much-needed lift. It was a great summer for some river's edge little brown roosts, giving us hope for the future. This good news is reflected in few, but not many, winter hibernation counts as we see early signs of population stabilization and even population growth at a few of our underground sites. Although COVID-19 precautions curtailed our winter white-nose syndrome (WNS) surveillance season in 2021, we were still able to conduct 40 site visits working with our partners at Virginia Tech University.

Another morale booster was the increased turnout of landowners and groups invested in protecting and improving life for the bats on their properties. In this issue, you'll find updates about resources and improvements for bats at Mississippi Valley Conservancy's Kickapoo Caverns, Door County Parks' Horseshoe Bay Cave and Frank Lloyd Wright's Taliesin Preservation.

Thanks to improvements for bats and the massive dataset collected by volunteers, Wisconsin is uniquely poised to understand WNS-impacts at small colonies which have been largely neglected in the eastern United States. Together with our partners and volunteers, we will continue to monitor small sites and investigate the differences in recovery compared to sites with large colonies. This streamlined newsletter details much of the work we and our partners accomplished to help bats in 2021.

The Challenges Of Research In A COVID-Altered World

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

White-nose syndrome (WNS) is now considered endemic in Wisconsin. Since the disease was first detected in 2014, at least 64 sites in 25 counties have been confirmed as WNS positive or WNS suspect.

Conducting WNS research in a COVID-constrained era has a labyrinthine quality to it. From November 2020 through March 2021, we made 40 visits to 26 hibernation sites for WNS surveillance and research during a somewhat-restricted winter hibernacula survey season. Biosecurity precautions and personal protection equipment shortages associated with the pandemic curtailed many of our regular activities. Only sites of high importance were visited and in association with other critical WNS research. Following guidance from U.S. Fish and Wildlife Service, staff and partners wore fit-tested N95 masks when working underground to guard against the risk of reverse zoonosis – humans infecting bats – of SARS-CoV-2.

If there is to be a glimmer of optimism on the WNS front, we've found evidence that rapid declines at some of the larger sites have slowed down. A small number of hibernation sites appear to have stable population sizes from the previous year, albeit greatly reduced from their pre-WNS maximum.

Our partnership with Virginia Tech University continues to yield valuable scientific insights. Together we've collected swab samples from 20 sites, once in fall 2020 and again in spring 2021, which helped describe fungal loads and infection rate of *Pseudogymnoascus destructans* (Pd) on bats and within the environment. All samples (bat and environmental swabs) from this group were collected from four hibernating species. Little brown bats (*Myotis lucifugus*), northern long-eared bats (*M. septentrionalis*), eastern pipistrelles (*Perimyotis subflavus*) and big brown bats (*Eptesicus fuscus*) in Wisconsin were sent to Dr. Jeffrey Foster's Lab at University of Northern Arizona for testing.

An eastern pipistrelle hibernates above a psychrometer recording temperature and humidity. Photo: J. Paul White

With Virginia Tech University, we are also working on a study to understand how bat movements among different microclimates inside hibernation sites affect the growth of the fungus that causes WNS. Virginia Tech University researchers deployed 40 loggers in Wisconsin with additional loggers in neighboring states during November 2021 and we are excited to see the results from March 2022.

We continue to prioritize site visits. Post-WNS Wisconsin sites were prioritized by population size, species richness, sites with historic data (for

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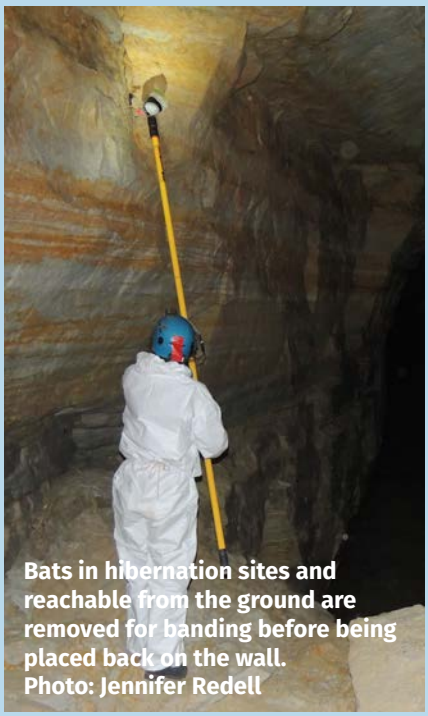
Individuals Lost

The winter of 2020-2021 was Wisconsin's eighth year with WNS affecting overwintering bats. All known and monitored bat hibernation sites in the state have experienced steep declines since the 2014 arrival of WNS.

The bat population at Wisconsin's first WNS site has experienced a 99.2% population decline in year eight of infection when compared to baseline data. Over these eight years, across 45 closely monitored hibernacula, individual losses for each highly impacted species are staggering. The data show losses of 167,358 little brown bats, 1,721 tricolored bats and 476 northern long-eared bats. Data from the only eighth year site reported four tricolored bats and for the second consecutive year since monitoring began in 1994, zero little brown bats.



Bats in hibernation sites and reachable from the ground are removed for banding before being placed back on the wall. Photo: Jennifer Redell

baseline comparison) and sites with a high probability for encountering marked individuals through research and related projects that were conducted at the site or within 10 miles of the vicinity. This work is made possible by U.S. Fish and Wildlife Service WNS grants.

Notable Observations In 2019-2020 Hibernation Season

- WNS has now affected cave bat populations in Wisconsin for eight hibernation seasons and the WNS fungus is considered present in hibernation sites in all 72 counties.
- Two of Wisconsin's largest surveyed sites are down 83% and 76% from their pre-WNS mean. Both sites originally held tens of thousands of little brown bats as well as hundreds of individuals of three other species. Both sites are now in their sixth year of infection.
- The DNR has focused on understanding survivorship, immigration/emigration and site fidelity. To this end, the DNR and our Virginia Tech University partners banded and Passive Integrated Transponder-tagged over 1,800 bats between fall 2020 and spring 2021.

What's Next?

WNS is now considered endemic in Wisconsin. Since the disease was first detected in 2014, at least 64 sites in 25 counties have been confirmed as WNS positive or WNS suspect.

Now that bat numbers are greatly reduced at most underground sites and non-existent at many, site visits are being put on a rotating two-, five- or ten-year schedule of visits, depending on their original population size, level of disturbance and species diversity. Hibernacula survey datasets will continue to comprise the Wisconsin Cave & Mine Catalogue and are added to the Natural Heritage Inventory database. We will use this data to continue searching for trends in population stabilization and (hopefully) growth over the coming years.

CAVE & MINE CATALOGUE UPDATE

Trespassers Caught; More Than A Million Bat Calls Collected!

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

Together with our partners at Virginia Tech University (Virginia Tech University), we were able to conduct 40 site visits during the 2020-2021 hibernation season. With their help, we managed to gather data from all our regular high-prioritization sites. Hibernating bat populations are no longer in steep decline, as we saw from 2015-2018. Most sites' little brown bat populations are down by 90% or more from their pre-White-Nose Syndrome (WNS) means.

We continue to gather annual counts to determine if and when we see population stabilization, or hopefully, growth. Unfortunately, eastern pipistrelles (i.e., tricolored bat) and northern long-eared bats continue to disappear from sites where they were once regularly observed. Many of the eastern pipistrelles we encounter in hibernation are male and appear to be young of the year, meaning they have not yet faced one or two winters of WNS. We continue to band most bats we encounter (when they are accessible), and re-sighting banded individuals provides valuable clues to survivorship.

"Connecting bats to both their summer (roost) and winter (underground) habitat is critical to our understanding of ways to support their survival."

Connecting bats to both their summer (roost) and winter (underground) habitat is critical to our understanding of ways to support their survival. Now, in addition to bands, Passive Integrated Transponder (PIT) tags are helping us learn about Wisconsin's thriving survivors.

Logistical Support Of WNS-Related Research Projects At Wisconsin Hibernation Sites

United States Geological Survey-National Wildlife Health Center - Field Evaluation of Vaccine Candidates Against WNS In Bats.

As part of this study, in the fall of 2020, 256 free-flying little brown bats were captured, vaccinated and distributed among treatment groups at one hibernaculum. During a spring census trip to the study site in March

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2021, we opportunistically re-sighted and processed (scanned, band read, swabbed, wing checked) project bats.

In addition to providing onsite support during research trips, DNR staff performed necessary maintenance (changing batteries) on the PIT tag systems to allow for continuous reading of treatment animals to assess seasonal activity levels and survival. These systems were placed at the primary bat entrances of two study sites in Pierce County in 2019 to monitor activity by bats marked with a PIT tag and continued to operate throughout 2021.

Our summer work to support the vaccine project included capturing 83 little brown bats that were vaccinated and distributed among treatment groups between two maternity colonies in southwest Wisconsin. This work is being used to assess survival (proxy for vaccine efficacy). Four PIT tag systems, distributed among six maternity boxes, were installed in spring of 2021 at the same summer maternity colonies where tagging took place. To ensure consistent surveillance of PIT-tagged bats, electrical work was conducted at both sites to provide power to the four systems. Overall, survival rates were higher than expected, particularly among juveniles.

The same two maternity colonies were targeted in the summer of 2021. In July, 127 little brown bats were captured, vaccinated and distributed among treatment groups between two maternity colonies in southwest Wisconsin. Routine maintenance and data collection were conducted throughout the survey season.

Most exciting this year were the August recoveries at our largest hibernaculum of two juvenile female bats from summer colonies! One bat traveled about 30 miles and the other bat approximately 50 miles. The summer roosts and the winter hibernaculum are along the Mississippi River, providing further evidence that bats use the river as a migratory corridor.

Virginia Tech University- Factors That Influence Pathogen Transmission & Population Impacts

This ongoing work is helping us understand how variation among individuals - in susceptibility, infectiousness and mortality - contributes to WNS impacts. In fall 2020 and spring 2021, 20 hibernacula were visited (one to two times). The DNR provided landowner access and field support when necessary. Since 2012, this project has investigated movement and transmission of *Pseudogymnoascus destructans* (Pd)/ WNS across the Midwest, providing a unique look at sites before WNS arrival, during the invasion and after the arrival of WNS. Samples from hibernacula environment as well as all four cave bat species were collected from fall 2020 and through spring 2021.

Department employees also helped install and maintain eight PIT tag systems, two trail cameras and four acoustic recording devices at high priority hibernacula in Dodge and Pierce counties. Acoustic recording devices were installed and maintained at one hibernaculum in Pierce County (four detectors), one site in Sauk County (one detector)

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Left: Vaccine is carefully orally administered to a little brown bat, just a few drops from a pipette.

Right: A PIT tag reading antenna surrounds the bat-friendly openings on a mine gate, ready to capture the date and time of each tagged bat as it enters or leaves the hibernation site

Photos: Jennifer Redell

Cause For Concern

Numerous break-ins, site vandalism and other disturbances were reported or observed during the past year. The unintended consequence of people trespassing on hibernation sites can be disturbance or repeated disturbance to hibernating bats or bats swarming at site entrances during late summer and early fall. Just one bat roused by humans using light and making noise can lead to a cascade effect of arousals in the neighboring individuals and throughout a cave or mine. Smoke from campfires and fumes from spray paint may also lead to disturbance or even death of hibernating bats. In 2021, trespassing, vandalism and theft disrupted ongoing WNS research projects at five study sites.

Thankfully, catching trespassers has become more common and may be due to the increased vigilance and surveillance at sites across the state. Thanks to the help of remote cameras and other monitoring technology, more trespassers are being caught in the act of either entering, exiting or disturbing and law enforcement follow-up has been swift. Landowners and managers are encouraged to remain vigilant for possible vandalism targeting caves and mines important to Wisconsin's hibernating bats. People observing vandalism or trespassing at hibernation sites should report the incidents directly to local law enforcement to protect the integrity of the caves, bats and ongoing research.

and one detector in Monroe County. Throughout operation, 1,170,549 call recordings were collected. These recordings will be used to investigate hibernacula use and timing.

Bat Conservation International – A Continental-Scale Study Of Acoustic Phenology To Improve Population Monitoring & Inform Management Of Hibernating Bats

DNR employees installed three acoustic detectors in fall 2020 at the entrances to one priority one bat hibernaculum in Pierce County. Staff maintained the detection systems and data were collected from fall 2020 through fall 2021. A total of 286,546 calls were collected from three acoustic detectors during site visits and sent to Bat Conservation International (BCI) as part of the Acoustic Phenology project. Three sites were monitored between August 2020 and November 2021 (Table 1). Data was attributed with metadata and scrubbed of noise using SonoBat Data Wizard and then run through SonoBatch within SonoBat 4.4.5 set to the Great Lakes Midwest classifier. While no manual vetting has been done, the automated species identification results are presented (Figure 1).

State	Site	Total Files	# Files After Scrubbing	# Noise Files	% Noise	Notes
Wisconsin	1	54,785	29,431	25,354	46.28%	Not all files have been scrubbed of noise yet
Wisconsin	2	88,750	64,668	24,082	27.13%	Not all files have been scrubbed of noise yet
Wisconsin	3	66,412	61,556	4,856	7.31%	Not all files have been scrubbed of noise yet

Table 1. Overview of the number of files received from bat acoustic monitoring at the three sites surveyed at hibernaculum in Pierce County, Wisconsin between August 2020 and November 2021 as part of the Acoustic Phenology project. Files were attributed with metadata and scrubbed of non-bat noise using SonoBat Data Wizard.

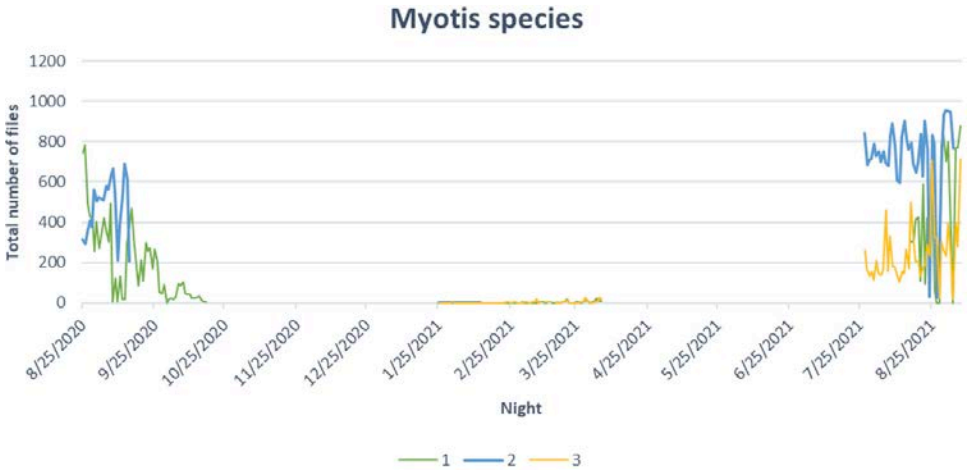

Figure 1. Number of files SonoBat identified as a Myotis species at each of the three sites monitored in Wisconsin 2020 – 2021.

Volunteers Take To The Water, Detect Mixed Results For Bats

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

The sounds of silence have never been documented as thoroughly as they were in 2021. I can't think of a year where the Wisconsin Bat Program (WBP) had more going on, acoustically speaking, than we did last year. After a shortened monitoring season in 2020, bat detectors were dusted off, batteries charged, set to record and didn't stop until bats went dormant for the season. Some detectors even continued to record when bats were slumbering away underground during the winter months. As always, given limited time and resources, the WBP couldn't monitor the state's population without the dedicated assistance of partners, colleagues and citizen scientists. The results shared in this article represent countless hours spent by our valued friends planning, coordinating and implementing acoustic bat monitoring projects. A sincere thank you to all those involved in the acoustic bat monitoring project.

Photo: J. Paul White

"While it's not the huge rebound we were hoping for, the halt in continuing declines gives us hope for better days ahead."

Citizen-Based Acoustic Monitoring

From the onset of this project in 2007, the goals have been and remain to define local and regional bat monitoring activity (species ranges and relative abundance) through grassroots training and outreach. Most notably of this effort are bat walks, where a leader, well-versed in natural resources, exposes interested parties to acoustic bat monitoring while traversing alongside rivers, through wooded trails and along prairie edges. A bat detector that converts the inaudible to the audible is shown and passed around as an audience listens to a bats' searching "clicks" and feeding "buzzes." For many, this unique sensory experience ignites an interest in bat conservation and regular involvement in bat monitoring.

We are fortunate to have remarkable leaders and coordinators scattered throughout the state, all of which contributed data this year, from the Urban Ecology Center, Woodland Dunes, North Lakeland Discovery Center, Kickapoo Valley Reserve, River Bend Nature Center, Camp Y-Koda, Beaver Creek Reserve, Schlitz Audubon Nature Center, Heckrodt Wetland Reserve, Wehr Nature Center, Mosquito Hill Nature Center and groups based in Racine and Vilas Counties. In total, 29 of these bat walks were conducted in 2021, enlightening over 100 onlookers to acoustic bat monitoring.

Over 350 acoustic bat monitoring surveys were completed this year by 270 surveyors in 59 of the possible 72 Wisconsin counties. Most of the surveys were driven (a total of 160), although 142 surveys were set over water and 55 surveys were walked. While much of this data is still being analyzed, we were able to examine one of our more active regions in the state. Vilas County is rich in water resources, with over 1,300 lakes and is home to the headwaters of four major riverine systems including the Wisconsin and the Chippewa Rivers. This landscape has one of the highest concentrations of naturally-formed lakes in the world (Vilas County Land and Water Conservation Department) and true to form, 76 of the 80 bat surveys from Vilas County were conducted over water. Those rich water resources make the county prime bat habitat and because many Wisconsin bat species frequently drink on the wing while feeding on soft-bodied aquatic insects, there's no better location to assess the bat population.

Data collected by our volunteers is used to assess bat activity. One way we use the data is to compare relative bat abundance across multiple years while accounting for variations in data collection, such as survey speed and distance. To compare surveys over time, we use bat encounters/survey distance/survey length metric (bats/km/hr). In this example, we looked at little brown bat (*Myotis lucifugus*) detections from surveys completed in Vilas County from 2015-2021. What's evident is that in 2015, prior to bats in the region being affected by white-nose syndrome (WNS), little brown

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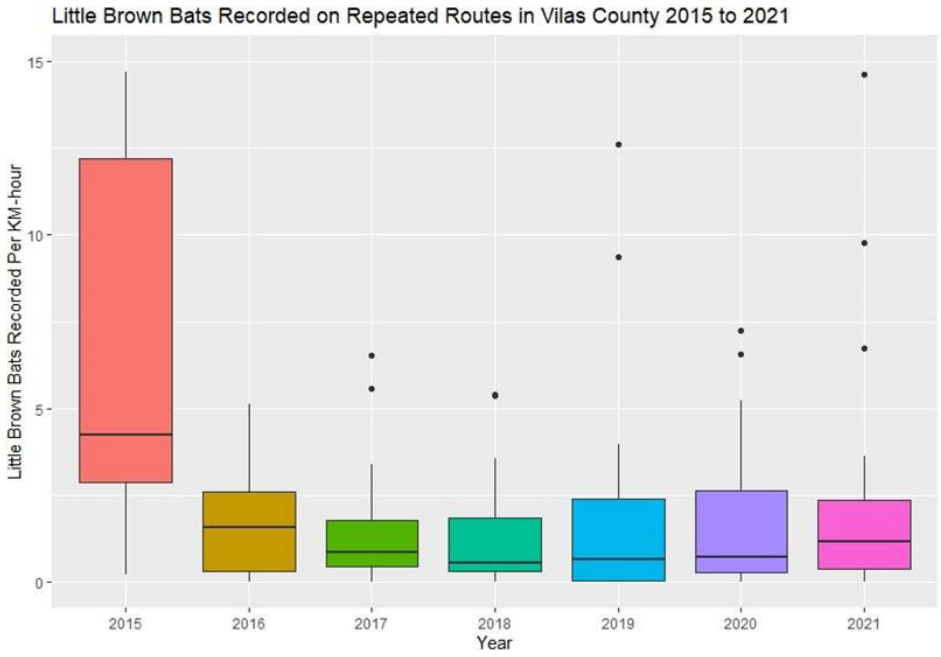

Figure 2. By assessing bat passes per survey each year on the same survey routes, we can investigate relative abundance of bats over time. Here, little brown bat activity was high in 2015 prior to arrival of WNS and declined significantly in response to the disease. Graph: Heather Kaarakka

bats/km/hr activity was significantly higher than during the following years when WNS decimated populations.

Whether we look at hibernacula counts, summer roost counts or acoustic records, 2016 and 2017 were bad years to be a cave bat in Wisconsin. Figure 2 shows that statistically, the 2015 little brown bat activity is significantly different from all the other years but 2021 is not significantly different from 2016-2020. While it's not the huge rebound we were hoping for, the halt in continuing declines gives us hope for better days ahead.

Hibernacula Acoustic Monitoring

There are many ways to use acoustic technology beyond the traditional summer monitoring when bats are most active on the landscape. Since 2020, the DNR has partnered on two separate projects, one with Bat Conservation International and the other with Virginia Tech University to learn more about bat activity at major bat overwintering sites (i.e., hibernacula). Stationary acoustic detectors were deployed at five hibernacula to help the WBP understand the phenology of fall swarming, hibernation and spring emergence. Whether it's protecting areas around hibernacula during high bat-use periods or understanding survival and population trends, using acoustic detectors to passively monitor bat activity is a less invasive, low-cost alternative than traditional monitoring methods that can help make informed management decisions. From 12 detectors, we've collected over 1.6 million bat calls since the monitoring first began in fall 2020.

Combining acoustic bat encounters from five important hibernacula in Wisconsin, we can identify when bats start to leave hibernacula, which is extremely helpful when managing activities around these sensitive locations (Figure 3). Also included in the graph is the average daily temperature in Madison, Wisconsin (National Weather Service NOAA). The month of April is an active period for bats as they'll emerge from hibernacula and head to summer roosts, especially during warm-up events that bring the nighttime temperature consistently above 50 degrees Fahrenheit. The temperature of 50 degrees Fahrenheit is the bat activity benchmark: above this temperature, bats are more active, and below this temperature, bat activity drops dramatically, as shown in the graph. Based on the recorded bat calls, the 2021 spring exodus had two distinct periods, early April and late April. The lull in activity could be attributed to a stretch of freezing temperatures in mid-April.

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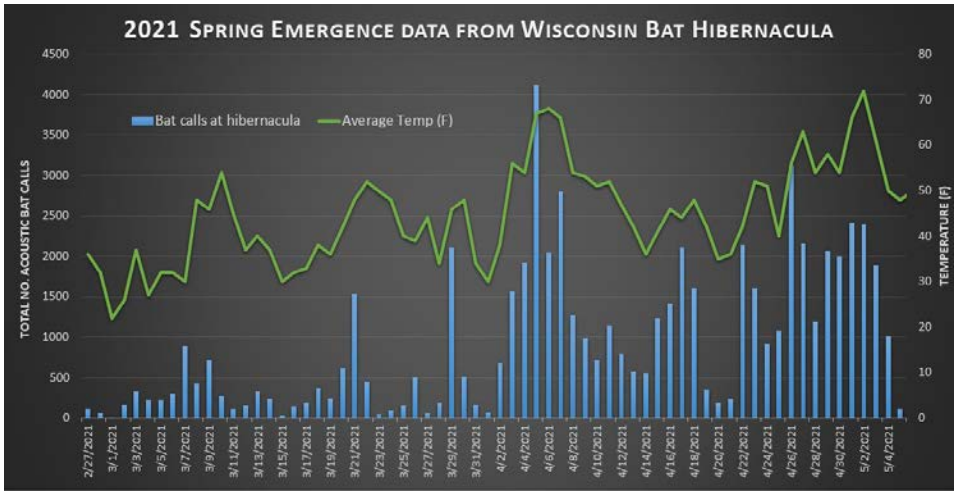


Figure 3. Acoustic bat activity from 13 detectors at 5 hibernacula in relation to the average daily temperature in Madison, WI. Data were processed using an AutoID program by Wildlife Acoustics, Kaleidoscope Pro v 5.4.2.

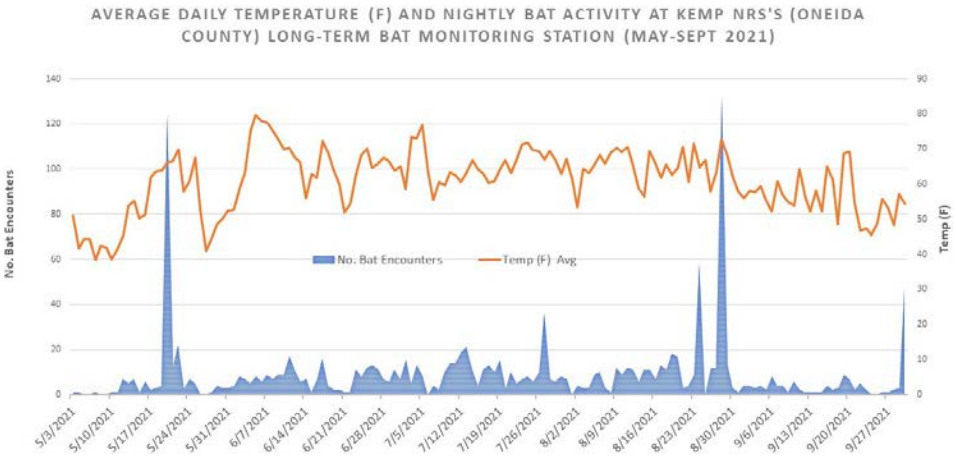


Figure 4. This graph is just a snippet of what can be done with data collected from the long-term stations. Summer acoustic data from Kemp Natural Resources Station in Lake Tomahawk is plotted against average daily temperature, which can help us understand when bats are most active. Of interest are the few spikes on either end of the summer, which are likely migrants moving through the area in the spring and in late summer.

Long-Term Bat Monitoring Stations

In 2007, the WBP installed long-term bat monitoring stations at a few locations in the state. Some locations have since stopped monitoring, while others, through the watchful eye of the local station manager, continue to operate to this day. Housed in a weather-proof case, an acoustic recording device captures bats' echolocation calls as they navigate and hunt for food. The detectors automatically turn on every night, 365 days a year at sunset and record to sunrise through a fixed microphone that captures all local bat echolocation activity. As with our other bat monitoring systems, the acoustic signals record the date and time of each bat pass. Through these recordings, land managers can determine aspects of bat biology like where and when bats are flying, relative activity levels and timing of migration. Currently we have long-term bat monitoring stations at Kemp Natural Resources Station (Oneida County), University of Wisconsin - Stevens Point Schmeeckle Reserve (Portage County), Urban Ecology Center at Riverside Park (Milwaukee County) and Upper Mississippi River National Wildlife Refuge (La Crosse County). We hope to have another station at Lawrence University (Outagamie County) up and running in spring 2022.


Photo: J. Paul White


Photo: J. Paul White

NABat

The North American Bat Monitoring Program or NABat is a program that was established in 2015 to help States standardize the monitoring of bat species to provide clear but adaptable guidance for monitoring efforts in the U.S., Canada and Mexico. One of the tenets of the program uses a master sampling approach that divides North America into a series of 10 x 10 km (100 km) grid cell frameworks. Grid cells are numbered and randomized, so priority cells can be identified.

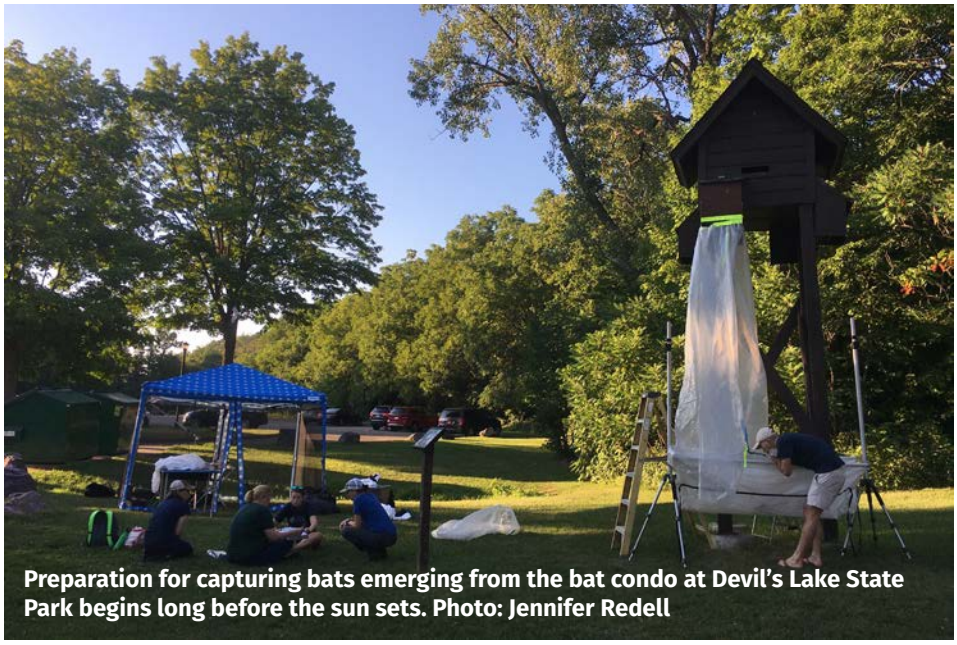
NABat Monitoring

In the summer of 2021, the WBP followed the lead of The North American Bat Monitoring Program (NABat) to assist in collecting state acoustic records consistent with national protocols. During this sampling, bat detectors were strategically deployed in various habitats throughout Wisconsin to help the WBP document species presence and relative abundance of local bat communities in prioritized sampling grids. While deployed, detectors were set to record from sunset to sunrise. In summer 2021, the Wisconsin Bat Program sampled 13 grids at 50 unique locations, which include public lands (federal, state, county, city), conservation group easements and private lands. The total sampling effort from the stationary detectors equated to 191 detector-nights which recorded 67,752 acoustic files. Data is still being summarized from this effort.


Photo: J. Paul White

Little Brown Bats Bounce Back

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



Preparation for capturing bats emerging from the bat condo at Devil's Lake State Park begins long before the sun sets. Photo: Jennifer Redell

As 2021 crept into fall and summer roost monitors watched their bats disperse for overwintering sites, I began the exciting task of reviewing counts conducted during summer roost season by our amazing team of roost monitors. It looked as though little brown bats, hit hard by white-nose syndrome (WNS) in 2016-2018, had a Bounceback Plan of their own!

Many of the little brown bat colonies that have been monitored over the past 5-10 years appear to be stabilizing since seeing severe declines due to WNS. Some colonies have even seen modest increases in colony numbers in years post-WNS. Big brown bats were booming as well, though their characteristic roost switching during warm temperatures muddied the count-waters later in summer. The mystery remains – why do some little brown roosts recover quicker than others? This is a trend we continue to investigate.

"Daily counts reveal some little brown bat colonies have stabilized or are increasing."

The largest colonies continue to trend along the Mississippi River and the Lake Michigan shoreline, suggesting these large water bodies may be important for several reasons. They may act as migratory corridors, allowing bats to find roosts easily as they transition from winter to summer habitat. Being close to water may reduce commuting costs when bats leave to forage each night. Early in the summer when bat food may be scarce during chilly nights, aquatic insects might be some of the only flying prey available to eat. Proximity to large water bodies, coupled with other unknown factors, seems to be important for little brown bats surviving WNS infection.

Unfortunately, northern long-eared bats and eastern pipistrelles (aka tricolored bats) have not fared as well. We haven't seen a northern long-eared bat in a known or monitored summer roost in many years and all but one of the tricolored bat roosts are empty. These disappearances are reflective of what we see underground in winter.

In addition to the fantastic work that roost monitors do surveying bats every summer, we continue to investigate roosting behavior at other project sites. In 2021, we completed a third year of daily monitoring at little brown bat sites using thermal cameras. Cameras turned on each evening shortly after sunset, recording bats and racking up numbers to be counted in the doldrums of winter. These daily counts suggest that some little brown bat colonies have stabilized or are increasing.

PIT Tags

We partnered with USGS National Wildlife Health Center to mark bats at summer roosts with passive integrated transponder (PIT) tags, similar to how one would microchip a dog or cat. We installed stationary tag readers at the entrances to bat houses, automatically recording when a tagged bat flew through the antennas. These records provided a fascinating look at the movement and timing of bats entering and exiting bat houses over the summer. Some individuals frequented different bat houses while others were faithful to one box and were recorded entering and leaving almost every day.

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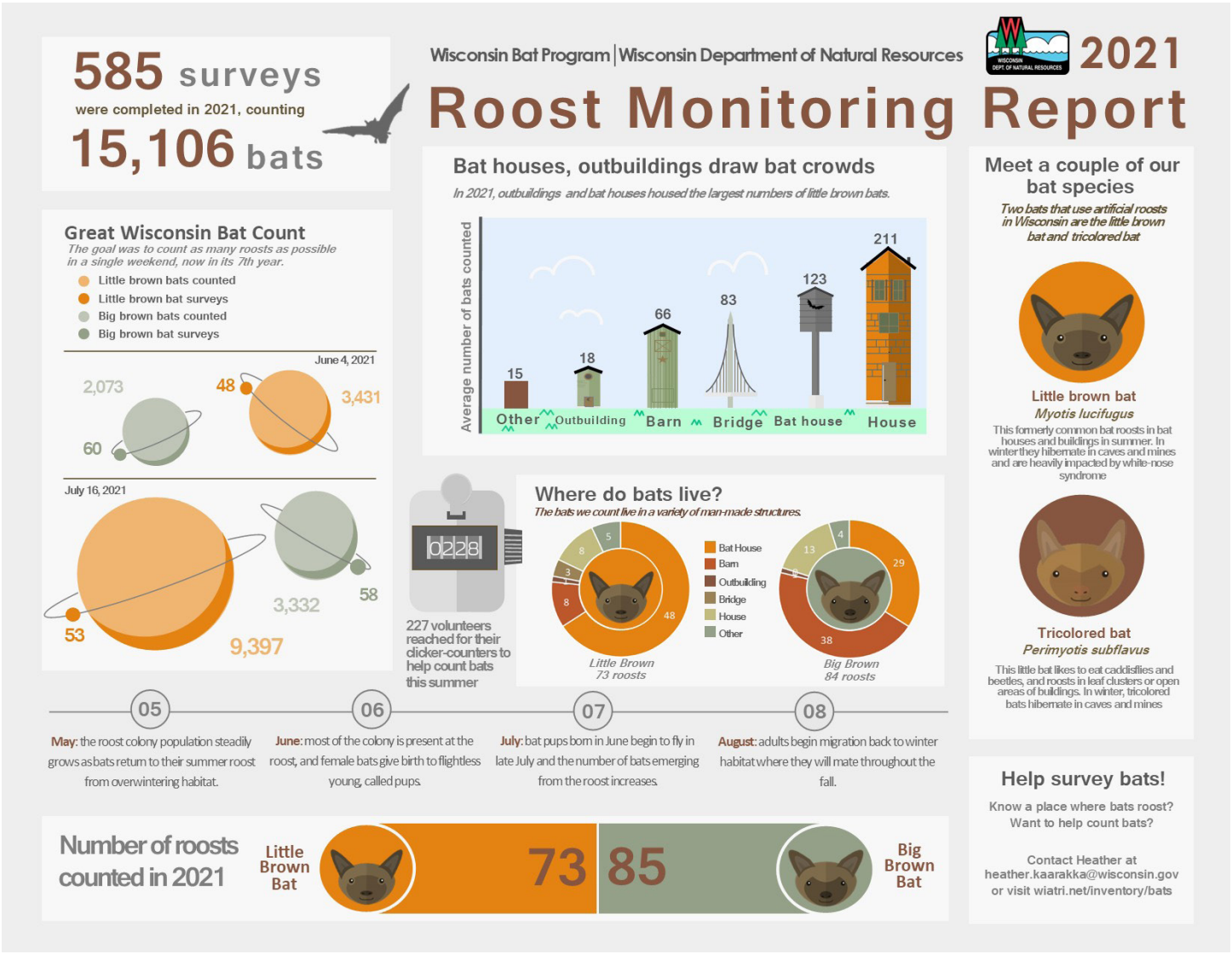

Along with the addition of several new roost sites, interest and engagement in the monitoring project continue to be high. Most sites surveyed this summer have been monitored for many years and the data collected have proven invaluable. Roost monitoring has been integral to understanding how bats are faring in the face of WNS, including the added factors of extreme weather events such as heat waves and cold snaps. As one of the longest-running summer bat monitoring efforts in the country (both roosts and acoustics), we are in one of the best positions to accurately report how our bats are doing. This achievement would not be possible without the dedicated volunteers who serve as our eyes and ears throughout the state. Thank you for your support and help protecting Wisconsin's bats!

The Latest Bat Research

Studies with research partners using data collected in Wisconsin, combined with DNR staff support, culminated in several new publications in 2021. These results advance our understanding the impacts of disease in bats and are informing how we might support bat populations moving forward.

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Report: Environmental Transmission of Pseudogymnoascus Destructans to Hibernating Little Brown Bats

Pathogens with persistent environmental stages can have devastating effects on wildlife communities. In 2009, during the early stages of the white-nose syndrome (WNS) investigation and before molecular techniques had been developed to readily detect *Pseudogymnoascus destructans* (P.d.), in environmental samples, we initiated this study to assess whether P.d. can persist in the hibernaculum environment in the absence of its conclusive bat host and cause infections in naive bats. We transferred little brown bats (*Myotis lucifugus*) from an unaffected winter colony in Wisconsin to two P. d. contaminated hibernacula in Vermont where native bats had been excluded. Infection with P.d. was apparent on some bats within 8 weeks following the introduction of unexposed bats to these environments and mortality from WNS was confirmed by histopathology at both sites 14 weeks following introduction. These results indicate that environmental exposure to P.d. is sufficient to cause the infection and mortality associated with WNS in naive bats, which increases the probability of winter colony extirpation and complicates conservation efforts.

Report: The Scope & Severity Of White-Nose Syndrome On Hibernating Bats In North America

Assessing the scope and severity of threats is necessary for evaluating impacts on populations to inform conservation planning. Quantitative threat assessment often requires monitoring programs that provide reliable data over relevant spatial and temporal scales, yet such programs can be difficult to justify until there is an apparent stressor. Leveraging efforts of wildlife management agencies to record winter counts of hibernating bats, we collated data for five species from over 200 sites across 27 U.S. states and two Canadian provinces from 1995 to 2018 to determine the impact of WNS. We estimated declines of winter counts of bat colonies at sites where the invasive fungus that causes WNS (P.d.) had been detected to assess the threat impact of WNS. Three species undergoing species status assessment by the U.S. Fish and Wildlife Service (*Myotis septentrionalis, Myotis lucifugus,* and *Perimyotis subflavus*) declined by more than 90%, which warrants classifying the severity of the WNS threat as, "extreme," based on criteria used by NatureServe. The scope of the WNS threat as defined by NatureServe criteria was large (36% of *Myotis lucifugus* range) to pervasive (79% of *Myotis septentrionalis* range) for these species. Declines for two other species (*Myotis sodalis* and *Eptesicus fuscus*) were less severe but still qualified as moderate to serious based on NatureServe criteria. Data-sharing across jurisdictions provided a comprehensive evaluation of scope and severity of the threat of WNS and indicated regional differences that can inform response efforts at international, national and state or provincial jurisdictions. We assessed the threat impact of an emerging infectious disease by uniting monitoring efforts across jurisdictional boundaries and demonstrated the importance of coordinated monitoring programs, such as the North American Bat Monitoring Program (NABat), for data-driven conservation assessments and planning.

Report: Exceptional Longevity In Little Brown Bats Still Occurs, Despite Presence Of White-Nose Syndrome

WNS has reduced the size of hibernating populations of little brown bats Myotis lucifugus by 90% across much of eastern North America since 2007. Herein, we report the recapture of eight banded little brown bats, all males, with minimum ages of 18.6–25.6 years. The recaptures occurred during winter 2019–2020, at a hibernaculum in Michigan where white-nose syndrome likely has been present since 2013–2014, indicating that these old and apparently healthy males are in their seventh season of exposure to the disease. Hence, our data suggest that a long life in little brown bats and existence of white-nose syndrome are not necessarily incompatible.

Report: Experimental Challenge Of A North American Bat Species, Big Brown Bat (*Eptesicus fuscus*), With SARS-CoV-2

The recently emerged novel coronavirus, SARS-CoV-2, is phylogenetically related to bat coronaviruses (CoVs), specifically SARS-related CoVs from the Eurasian bat family Rhinolophidae. As this human pandemic virus has spread across the world, the potential impacts of SARS-CoV-2 on native North American bat populations are unknown, as is the ability of North American bats to serve as reservoirs or intermediate hosts able to transmit the virus to humans or to other animal species. To help determine the impacts of the pandemic virus on North American bat populations, we experimentally challenged big brown bats (*Eptesicus fuscus*) with SARS-CoV-2 under BSL-3 conditions. We inoculated the bats both oropharyngeally and nasally. Over the ensuing three weeks, we measured infectivity, pathology, virus concentrations in tissues, oral and rectal virus excretion, virus transmission and clinical signs of disease. We found no evidence of SARS-CoV-2 infection in any examined bat, including no viral excretion, no transmission, no detectable virus in tissues and no signs of disease or pathology. Based on our findings, it appears that big brown bats are resistant to infection with the SARS-CoV-2. The potential susceptibility of other North American bat species to SARS-CoV-2 remains to be investigated.

DOOR COUNTY'S HORSESHOE BAY CAVE

Bats Are In Residence & Volunteer Trustees Are Needed

Participants get ready to enter Horseshoe Bay Cave on a public tour day. Photo: Heidi Thomas

By Burke Pinney,
Door County Parks Manager

The past several years, with a brief pandemic-related break, have been busy ones at Horseshoe Bay Cave. Bats continue to arrive at the cave at the end of each summer, white-nose syndrome (WNS) research has continued during the winter months, and spring sees high water levels in the cave before visitors arrive in summer for cave tour days.

Part of the overall importance of the Door Peninsula's bat resources, which include significant foraging and roosting habitat, Horseshoe Bay Cave continues to be an important site for bat and WNS research. Providing winter protection to all four of Wisconsin's cave bat species, it is one of approximately 15 hibernation sites researchers from Virginia Tech University and the DNR visit each November and December to collect swab samples from bats and cave walls. Their research on WNS is primarily focused on investigating factors that influence transmission, impacts and bat community persistence. The cave is an integral part of the long-term studies being conducted by Virginia Tech University following WNS.

Flooding – Where Does The Water Come From?

Caves and similar karst features in Door County provide rich habitat for four of Wisconsin's threatened hibernating bat species. They are also part of the overall hydrological system, channeling groundwater rapidly beneath the surface and occasionally sending it back to the surface. Such is the case at Horseshoe Bay Cave, where groundwater emerging at high velocity from the mouth of the cave occurs after significant rain events. Flooding in the cave when bats are in residence may be posing a threat to the surviving low population.

Understanding where the cave's flood waters come from may be critical to evaluating how local land-use decisions might impact the cave and its bat population, and to future efforts at groundwater and spring protection. The County's Soil & Water Conservation Department is currently working with the Wisconsin Geologic and Natural History Survey to determine a Zone of Contribution (ZOC) for Horseshoe Bay Cave. A ZOC is the land area that contributes water to the cave, which also becomes a resurgence point (or spring) for groundwater after heavy rain events.

Getting Involved

Caring for the cave and the resources contained within it is a necessary task, as is sharing the cave with the public in a safe and sustainable way. Door County Parks is in the process of developing the Cave Trustee Program and needs volunteers who are interested in various aspects of the cave, from education to art to geology and biology. People interested in training to serve as a future cave Trustee should contact Burke Pinney, Door County Parks Manager.

The study will attempt to delineate surface areas contributing groundwater to HSBC. Delineations use a combination of soil water-balance modeling and simple groundwater flow modeling to determine contributing areas. Contributing areas to any given cave can range in size from less than a mile to many square miles. Shallow groundwater around the cave flows through a fractured dolomite aquifer and the amount of time rainwater spends underground can be quite short. Geochemical and isotopic data will be collected at the cave and surrounding wells to help determine this. As part of the study, county and DNR staff entered the cave in 2021 to place a series of water level, conductivity and barometric pressure loggers throughout the main cave passage.

Thrilled & Muddy – Visitors Participate In Public Tours

Organized public tours of the cave continue to be conducted on tour weekends each summer barring the

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pandemic-related cancellation of the 2020 trips. As concerns eased after COVID-19 vaccine availability, limited public tours were provided by Door County Parks in summer 2021. As usual, volunteers from the Friends of Door County Parks provided excellent help in organizing and cleaning caving gear and welcoming both registered cave tour visitors and the curious public who stopped by on tour days. William Schuster, former county conservationist; Grant Thomas, Door County Corporation Counsel; and Jennifer Redell, DNR Cave and Mine specialist, served as guides and teachers.

In 2020, the Door County Parks Department was able to purchase a 7 x 14-foot enclosed trailer to store and transport the dedicated gear used for both research and public cave visits. In groups of ten, the public suit up in caving gear (helmet with light, boots, gloves, coveralls) and crawl through the first 300 feet of the cave. The one-hour tour includes information about the cave's history, geology, hydrology and ecology. Many visitors even get fully immersed in the "Duck Under" section—braving the chilly 48-degree water without the benefit of a wetsuit to crawl to a place where they see the transition of the lower cave level and its sand and clay base to the upper level of the cave, with its polished limestone floor. Limited public tour days are scheduled each summer. Public tours of Horseshoe Bay Cave in 2022 will be held Friday, July 22. For tour times, reservations and other information, contact Door County Parks.

Join Us And Show Your Support! Sign Up For A Bat Field Trip!

There are still a few spaces available on the bat-focused trip below. You must be a member of the Natural Resources Foundation of Wisconsin to sign up.

Horseshoe Bay Cave Crawl
Prepare to get wet and muddy venturing inside the state's longest wild cave with cave and bat biologists from the DNR Bat Program. Crawl to areas of the cave normally inaccessible to the public and experience the Niagara Escarpment from the inside out. In winter, this cave serves as an important hibernaculum for bats and home to a number of other animals and invertebrates. Participants must be able to crawl on their hands and knees at least 50 yards. Fundraiser for bat conservation & Friends of Door County Parks. Ages 8+

- 11:30 a.m.- 1:30 p.m.
- Saturday, July 23
- Murphy County Park, Egg Harbor, Door County
- Leaders: Jennifer Redell, Heather Kaarakka, Paul White
- Limit: 10 per session
- Cost: $50 adult, $30 child (8+), per person
- Physical level: 5 (from a scale of 1-5)

MISSISSIPPI VALLEY CONSERVANCY'S KICKAPOO CAVERNS

Home & Health Improvements For Bats

By Sarah Bratnober, Mississippi Valley Conservancy

Many projects are underway to make for better bat habitat and better visitor experiences at Mississippi Valley Conservancy's Kickapoo Caverns nature preserve in Crawford County. The global pandemic has temporarily prevented the Conservancy from offering guided walks through the property's massive cave, but the place has been buzzing with activity in preparation for reopening in 2023.

In 2020, Conservancy staff developed a plan to convert the cave entrance building (formerly a gift shop) into an interpretive exhibit and sought funding to support that plan. Thanks to a grant from the Wisconsin Natural Resources Foundation, staff and volunteers were able to implement phase one, which included clearing out items unrelated to the cave's natural history and making the space ready to serve as an interpretive experience.

Several volunteers who supported the Conservancy's acquisition of Kickapoo Caverns in 2017 stepped up to help liquidate the gift shop merchandise and raised nearly $5,000 selling the items. One hundred percent of the proceeds went to upgrades and maintenance of the property and its buildings at a time when this work was most needed.

In 2021, plans were slowed by a windstorm that felled a large tree on the roof of the cave entrance building. The conservancy's land management crew, summer intern crew, several dedicated volunteers and a Boy Scout troop took on the tasks involved in

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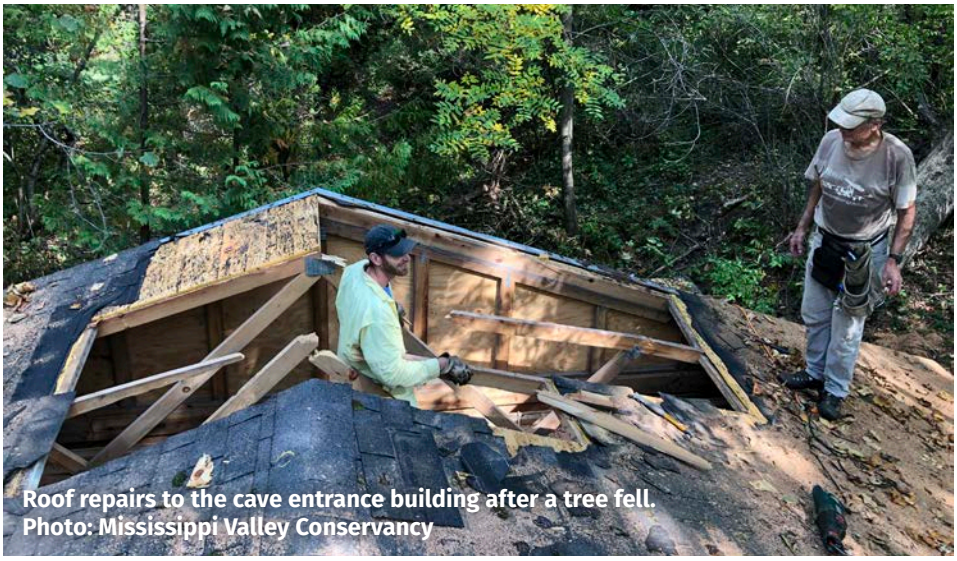
repairing and improving all structures on the property.

While replacing the roof, the crew also improved cave access for bats by redesigning and replacing portions of the eaves along the cave side of the entrance building. The cave entrance building was constructed in 1947 with no consideration given to bats but in subsequent decades the building deteriorated and bats managed to find ways to crawl into the building and enter the cave. Unfortunately, bats seeking cave habitat in this way are vulnerable to predation so creating a clear flight path is an important step in protecting the cave's bat residents.

The stairwell into the cave now features two 5 3/4-inch tall bat access doors, encased in steel framing. Small openings were created rather than completely removing the walls to minimize any change in temperature and airflow at the cave. This was done with input from bat specialists at the DNR and U.S. Fish and Wildlife Service. The bathroom building at the nature preserve was also reroofed and repainted by volunteers.

In 2022, the Conservancy will proceed with developing interpretive displays for the cave entrance building with funding from the Community Foundation for Crawford County and some of the proceeds from the gift shop merchandise sale. At the same time, electrical wiring inside the cave will be updated to ensure safe and reliable lighting during cave tours. This work will be implemented during the short window of time when bats are roosting outside of the cave during summer months. The Conservancy plans to offer guided hikes of the property again in 2023.



Roof repairs to the cave entrance building after a tree fell. Photo: Mississippi Valley Conservancy

Visit Virtually

Kickapoo Caverns has continued to serve as a virtual underground classroom despite restrictions of the pandemic. Plans for the 2020 summer tours were cancelled due to COVID-19 but a two-part virtual video tour series was created in their place and can be viewed on the Conservancy's YouTube page. Although the cave will remain closed to visitors in 2022, the property is a great place to walk, picnic, and observe wildflowers, birds, and other wildlife at any time of year. Learn more at https://www.mississippivalleyconservancy.org/protected-land

Kickapoo Caverns, Natural Laboratory For The WNS Vaccine Trial

In more exciting news, Kickapoo Caverns recently became the first location where the WNS vaccine was tested on bats held in a natural cave environment. Studies over the last few years have demonstrated vaccination against white-nose syndrome to be safe and effective in reducing disease in a highly susceptible bat species, little brown bats. Captive experiments are an important step in vaccine development, but to determine if any treatment is effective in wild bats, it was important to test the vaccine under natural conditions. Beginning in 2018, the DNR and USGS National Wildlife Health Center asked the Conservancy to partner on a research trial for a vaccination for WNS. The Conservancy agreed, seeing the opportunity to contribute to bat conservation on a local and global scale. As with all the properties the Conservancy protects, science-based research and education opportunities are crucial to guiding conservation practices. Thus, initial testing of WNS vaccine candidates was conducted with bats housed in the cave during the 2018-2019 and 2019-2020 hibernation seasons.

A new steel framed bat access doors provide a free flight path into the cave.

Learning Continues At The Cave Preserve

Bat biologists from the DNR continue to conduct annual winter hibernation counts at the cave, albeit post-WNS numbers remain very low. Bats found using the cave are banded with a small aluminum forearm band in the hope of being resighted in the cave in subsequent winters, or even at their summer roost site. Since the Conservancy acquired the cave property, DNR acoustic sampling of summer bat populations determined that four different bat species also use the property during summer months, the hoary bat, big brown bat, little brown bat and eastern red bat, meaning a total of six different bat species use the property overall.

Bats At The Home Of Frank Lloyd Wright

By Mike Degen,
Natural Landscapes Coordinator for the Frank Lloyd Wright Foundation

Dug out cold storage caves and a root cellar at Taliesin continue to be a sanctuary for healthy big brown bats (*Eptesicus fuscus*). The DNR Bat Program has been monitoring these bats since 2015.

Taliesin was the home and studio of architect Frank Lloyd Wright (1867-1959). Located in the Driftless Area of southwestern Wisconsin near Spring Green, Taliesin is the name of Wright's 37,000-square-foot home as well as the 800-acre estate that includes buildings from nearly every decade of Wright's career, from the 1890s to the 1950s. In 1976, Taliesin was designated a National Historic Landmark and in 2019 was named a UNESCO World Heritage Site.

The root cellar located at the main house was completed in 1916 and had been used for cold storage. Currently it is used for overwintering of plant bulbs and seasonal storage.

The other two cellars are hand-dug out of the soft sandstone. One was used for cold storage at Hillside Home School while the other was a cheese cellar for Hillside Creamery and Cheese Factory that operated from 1885 to 1908.

The surrounding landscape of this beautiful estate has seen significant ecological restoration over the last decade. The work was supported by DNR through the Landowner Incentive Program, the U.S. Fish and Wildlife Service and generous donors. The landscape is diverse, including four dry bluff-side prairies, ridgetops, rolling hills and floodplain forest. Numerous endangered and threatened species, as well as species of special concern, make their home here. The cropland is organically farmed.

The site's location adjacent to the Wisconsin River is ideal for bat hibernation, as the river may serve as a guide for migrating bats. The cellars at Taliesin are colder and drier than many natural caves, offering big brown bats ideal hibernating conditions for their species, while also leaving them less vulnerable to White-nose syndrome. A significant number of bats banded inside the sites are returning each season. Visible signs of WNS are not present on the hibernating bats due to the cold, dry conditions.

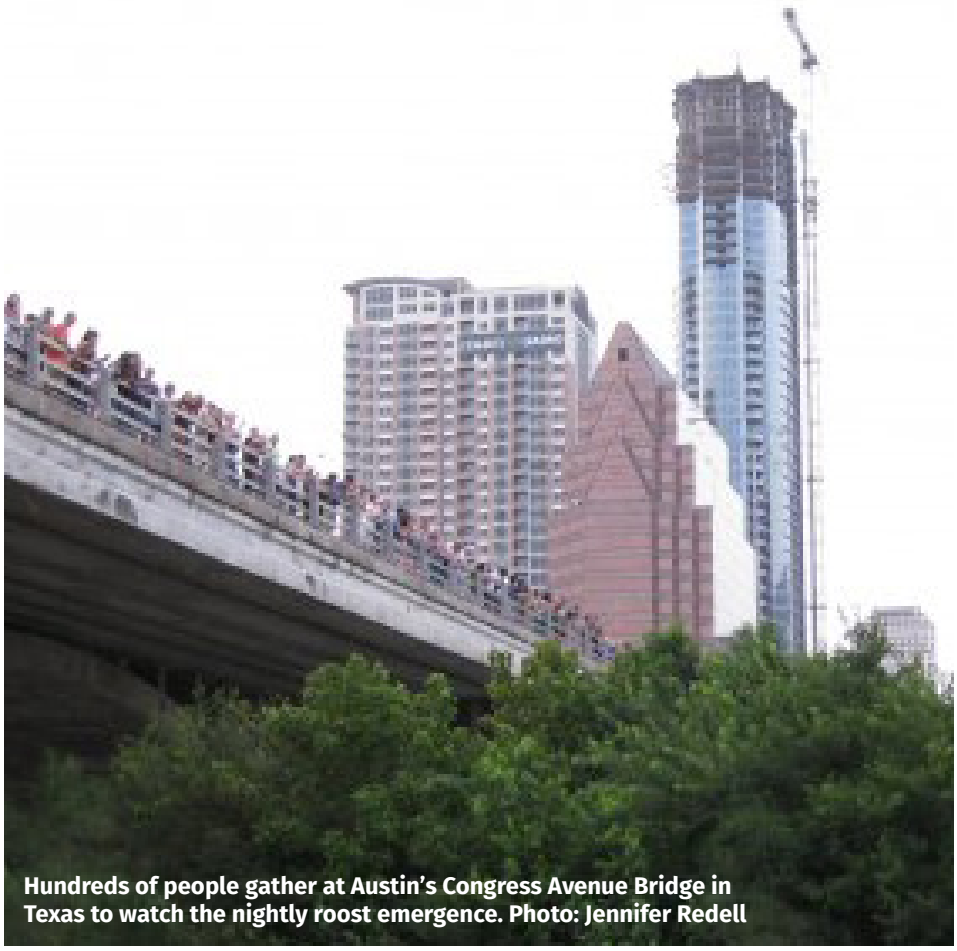
Band numbers can often be read without removing a bat from the cluster (2021). Photo: Jennifer Redell

Bats hibernate in clusters such as this in Taliesin's caves and cellars (2017). Photo: Jennifer Redell

Bat-Friendly Communities, Rise Up & Be Recognized!

By Jennifer Summers,
Wisconsin Center for Wildlife,
Program Development Specialist

Scott Hygnstrom,
Wisconsin Center for Wildlife Director



Hundreds of people gather at Austin's Congress Avenue Bridge in Texas to watch the nightly roost emergence. Photo: Jennifer Redell

Only one city is known as "Bat City USA." Any warm summer evening in Austin, Texas offers an opportunity to witness thousands of bats as they awaken and emerge from under the Congress Avenue bridge. This bridge is a popular tourist attraction, but the bats were not always welcome. Many residents did not know much about bats aside from some old myths and were fearful of the bats. Bat Conservationist Merlin Tuttle worked to educate the community and change their perceptions about bats. Because of his efforts, Austin's bats now are beloved members of the community, so much so, that the city has been dubbed "Bat City USA." Very few cities are fortunate enough to have a large, visible bat population like Austin; however, many communities are still interested in helping their resident bats!

Following Austin's example, we at the Wisconsin Center for Wildlife (WCW) at UW-Stevens Point are working to develop a far-reaching program that would recognize all communities across the nation that put in effort to conserve bats. We are building a Bat City program to recognize bat-friendly communities. It is modeled after the successful Bird City Wisconsin program and the Bat-Friendly Communities program facilitated by Community Bat Programs of BC in British Columbia. These programs promote wildlife protection, citizen pride, community engagement, and education.

Primary objectives of the Bat City program are to reduce threats to bats, increase bat habitat and increase public knowledge about bats and regulations protecting bats through a community engagement and recognition program. Bat-viewing is not needed to be designated a Bat City, because many bat colonies are secretive and sensitive to disturbance. Instead, cities will need to meet a rigorous yet flexible set of criteria that promote bat conservation. These criteria include three main components: bat habitat protection/creation, reducing threats to bats and educating the community about bats. Example activities include building bat houses or growing bat-friendly gardens in public spaces, avoiding disturbing bat roosts by scheduling construction projects when bats are not present and encouraging schools to use bat-related curriculum. We still are developing this program and discussing how to determine eligibility to be a Bat City.

Planning for the Bat City program is in its infancy. We have presented a model for the idea at three different conferences in an effort to attract partners and supporters. We are actively seeking partners to assist with developing, planning and implementing the program. We welcome anyone interested in participating! Please contact us with your questions or comments at WCW@UWSP.edu!

Special thanks for the beginning phase of Bat City goes to Monae Taylor, former project assistant at Wisconsin Center for Wildlife.

Conservation works better together.

Donate to the Endangered Resources Fund. Your gift will be matched, doubling your impact for Wisconsin's rare species.





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