

2021 ROOST MONITORING REPORT

By Heather Kaarakka

Join the community of caretakers – support the conservation of bats in Wisconsin.

Become a volunteer - visit <https://wiatri.net/inventory/bats/volunteer/roosts/>
Make a tax-deductible donation - visit wiatri.net/inventory/bats/donate.cfm

Wisconsin Bat Program
Bureau of Natural Heritage Conservation
Wisconsin Department of Natural Resources
Image courtesy of Heather Kaarakka

WISCONSIN
BAT PROGRAM



Table of Contents

To our Wisconsin Bat Program volunteers,

In 2021 we were able to get mostly back to normal in terms of bat roost monitoring. Volunteers and monitors continue to be an exceptionally dedicated group of scientists—this year you conducted nearly 600 emergence surveys and counted over 15,000 bats! We continue to receive more data than we can incorporate into the yearly report for which we are extremely grateful, but we've included some highlights and information here that we hope you'll find interesting. Enjoy learning about everyone's hard work surveying bats in 2021!

With thanks,

The Wisconsin Bat Program team



Little brown bat tucked into a decorative bird house. Photo: S. Richardson.

pg 1.
Background on bats

pg 2.
Wisconsin's bats

pg 3.
2021 roost monitoring effort

pg 4.
Results by roost type

pg 5.
Map of bat roosts by size

pg 6.
Map of bat roosts by type

pg 7.
Seventh annual Great Wisconsin Bat Count

pg 8.
Mixed-species roosts

pg 9.
Daily monitoring

pg 10.
Daily monitoring

pg 11.
WNS and Persisting colonies

pg 12-13.
How WPB uses information from volunteers

pg 14.
Continuing the bat roost monitoring project

pg 15.
References

pg 16.
Bat roost monitoring infographic



Little brown bats happily using the bat houses at the I-90 bridge site. Photo: H. Kaarakka, WDNR

A Background On Bats

Bats are found on every continent except Antarctica. They have diverse diets including bats that eat fruit, insects, pollen, scorpions, fish and even blood.

Bats are cryptic and commonly misunderstood animals, but they are important to almost every ecosystem on the planet. Bats provide many ecosystem services, including pollination, seed dispersal and **pest-insect control**. Bats save farmers in North America an estimated \$22 billion in pest control services every year, and bats' services are worth \$1 billion each year to the corn industry alone^{1,2}.

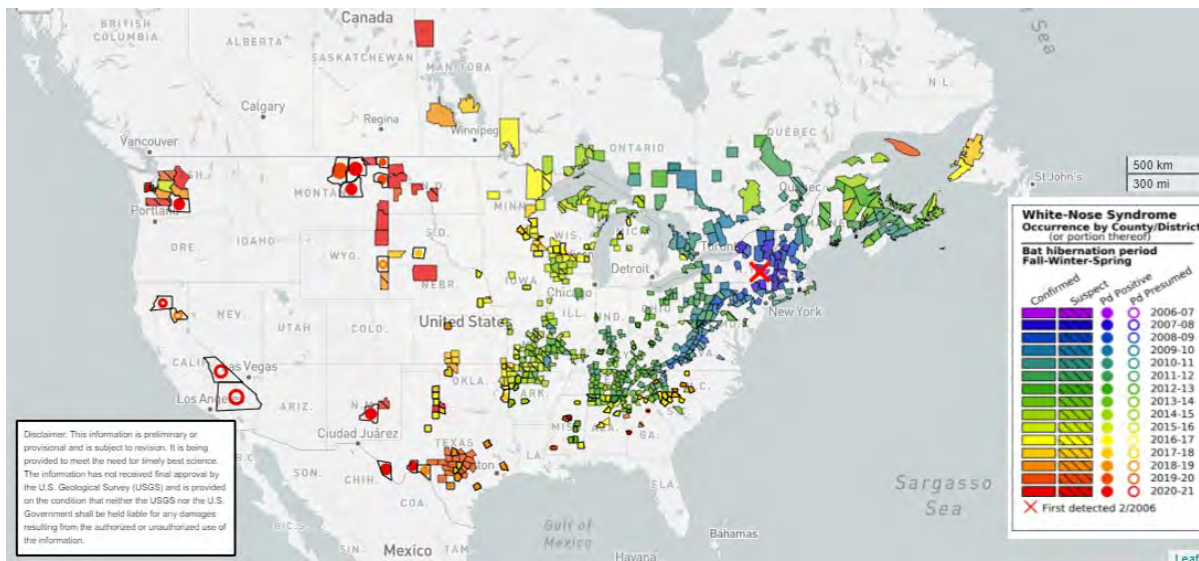
Bats are important to Wisconsin's agricultural industry, but some species are under threat of extinction from a deadly fungal disease called white-nose syndrome (WNS). In 2006, a fungus, later named

Pseudogymnoascus destructans, was documented growing on the muzzles and wings of hibernating bats in a New York cave. The disease causes mass mortality in hibernating bats, and population die-offs of 90-100% are not uncommon. WNS and the fungus have spread to 37 states and seven Canadian provinces, and millions of bats have died from WNS since 2007. Unfortunately, WNS was confirmed in Wisconsin in March of 2014 with Sites in 25 counties infected as of fall 2021.

With the threat of WNS looming, the Wisconsin Bat Program (WBP) began efforts in 2010 to locate both summer and winter colonies of bats. Landowners and volunteers have helped WBP locate and monitor over 200 summer **bat roosts** in the state since 2010. These monitoring efforts by citizen-scientists helped WBP establish base-

A roost is where bats congregate to rest during the day. Bats need these safe places to sleep and raise their young. Summer roosts can be trees, bat houses, attics, barns and other buildings, bridges and other secret places.

A single little brown bat can consume up to 1,000 mosquito-sized insects in one hour!



Currently, Wisconsin has 25 counties where sites are infected with WNS or have the fungus causing the disease. Map courtesy of whitenosesyndrome.org

line information about where bats are, what type of roosts bats use and how many bats inhabit each roost over the summer before declines from WNS were seen in the state. Now that the disease is here, these efforts continue to help WBP learn about impacts from WNS on the summer landscape and monitor stabilization of colonies.

Wisconsin's Bats

Wisconsin has eight species of bat, but only two are most likely to use bat houses or man-made structures: the little brown bat and the big brown bat. Little brown bats tend to use hot places in south-facing bat houses and barns, while big brown bats prefer cooler conditions. The warm temperatures help female bats gestate quickly and the newborn bats (called pups) mature quickly. These two species often form large colonies in summer and individual may bats return to the same roost yearly.

The other six species in the state are solitary or form much smaller colonies, use mostly trees in summer, and do not often return to the same roost sites making them much harder to find and monitor. As a result, WBP volunteers primarily monitor little brown bat and big brown bat roosts. But since

2015, several colonies of **eastern pipistrelles**, or tricolored bats, have been reported and monitored in St. Croix, Richland, Trempealeau and Dane counties.

Eastern pipistrelles are the state's smallest bat and are also called the tricolored bat.

Bats in Wisconsin return to summer roosts from winter habitat in April and May and by late May and June, most of the colony is present at the site. Bat pups are born in early June and are flightless for four to six weeks. In mid-July, bat roost monitors often observe an increase in bats because the juveniles begin flying. In August, the adults begin to leave their summer roost to go to winter habitat, where they will forage and mate at the entrances of caves and mines. Females delay fertilization until they emerge or return to summer habitat in the spring.



Roost Monitoring In 2021

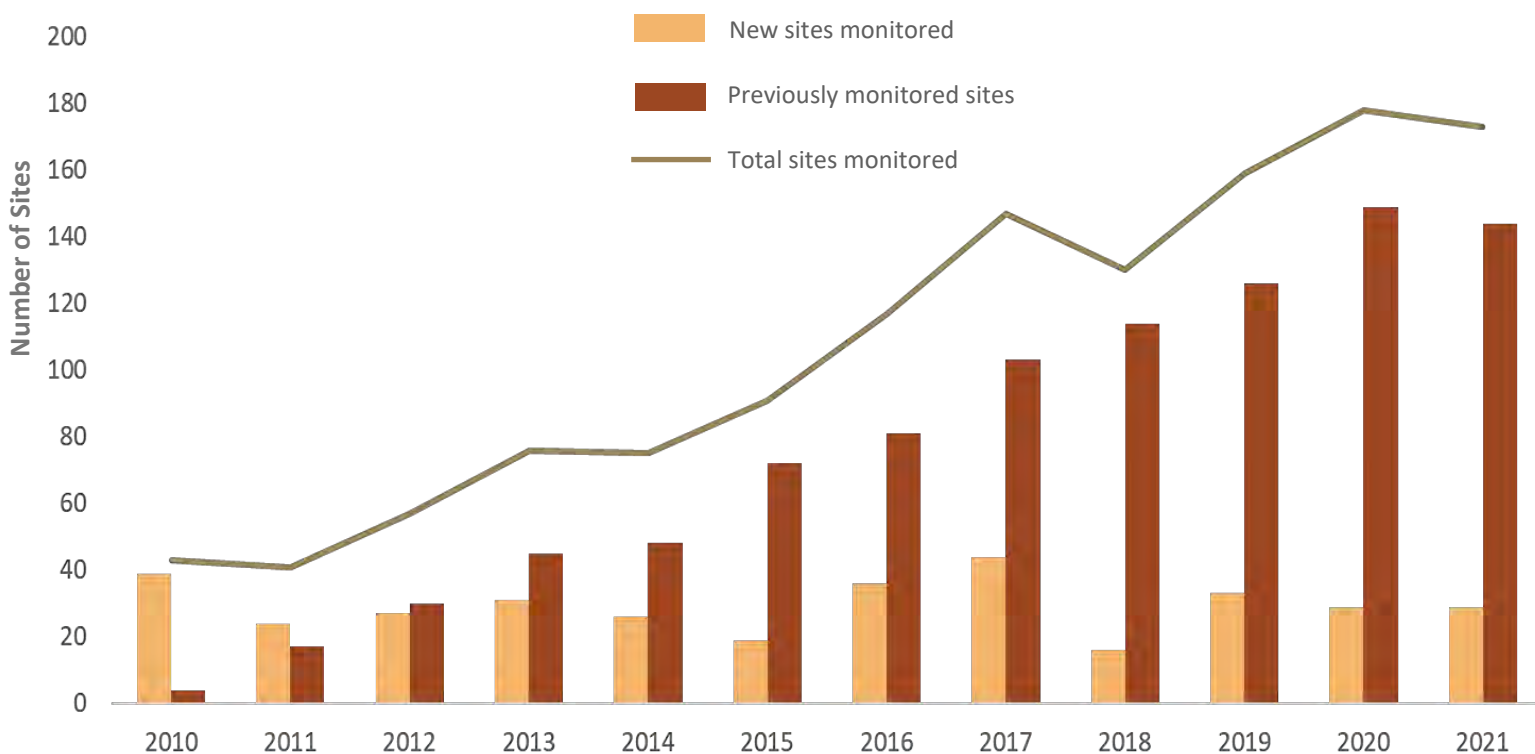
In 2021, 228 volunteers conducted nearly 600 emergence surveys in 63 counties from March to October. Volunteers monitored 173 roosts in summer 2021 including 29 newly reported roost sites!

In 2021, a total of 10,337 little brown bats were counted, down again from the 2016 total count but up from 2017-2020 counts. A total of 4,712 big brown bats were counted, up yet again since 2017-2019 and closer to 2020 numbers. Total numbers counted are estimated from the highest counts at each site. Four eastern pipistrelles were counted at only one site in summer 2021; however, one individual was observed in spring at a bridge roost. Little brown bat were counted at 42% of monitored sites in 2021, big brown bats were counted in 49% of the sites, and the remaining sites housed eastern pipistrelles, both little brown and big brown, or it is unknown which species is housed. See page 15 for more details in the

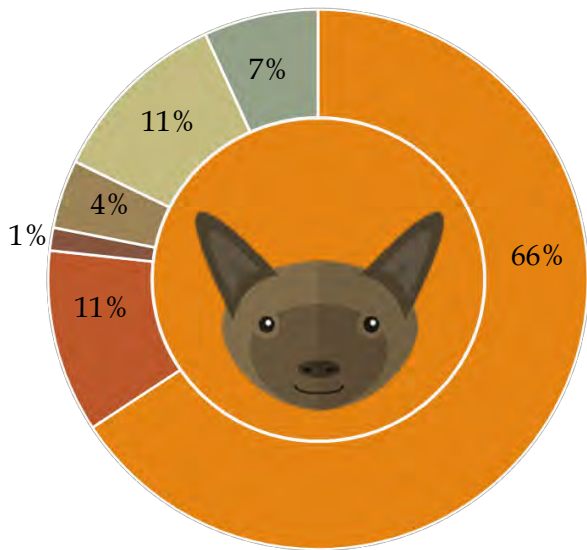


Above: Big brown bats hang out in a Dane County bat house in 2021. The smaller bats are pups alongside the adults! Photo: T. Voeck.

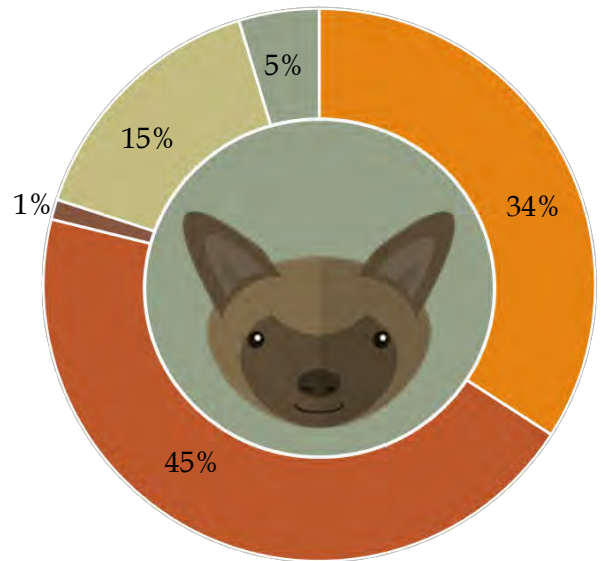
2021 Monitored Bat Roost Sites



Bat Species By Roost Type



Little Brown
73 roosts

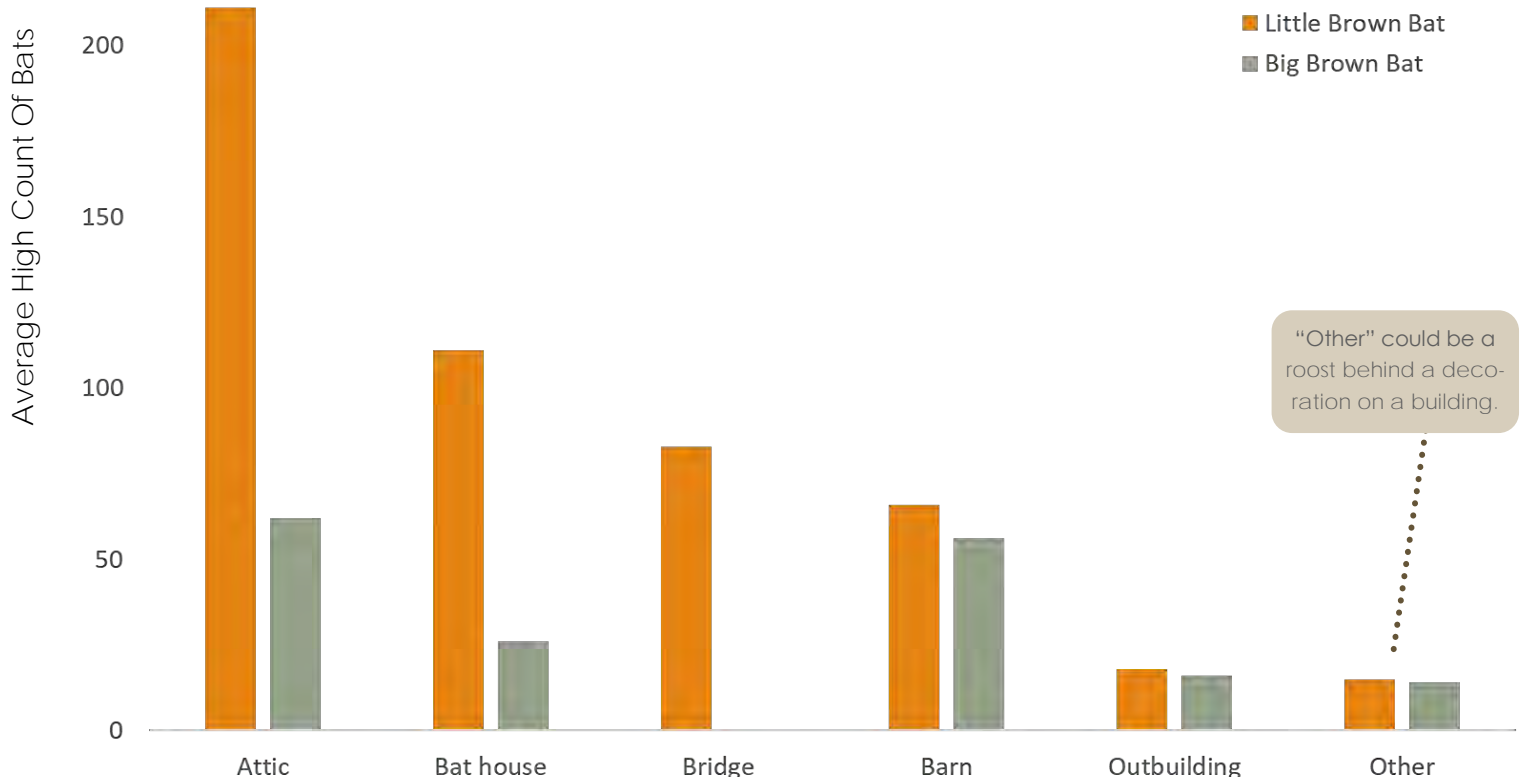


Big Brown
85 roosts

Little brown bats were found most often in bat houses, and big brown bats preferred barns.

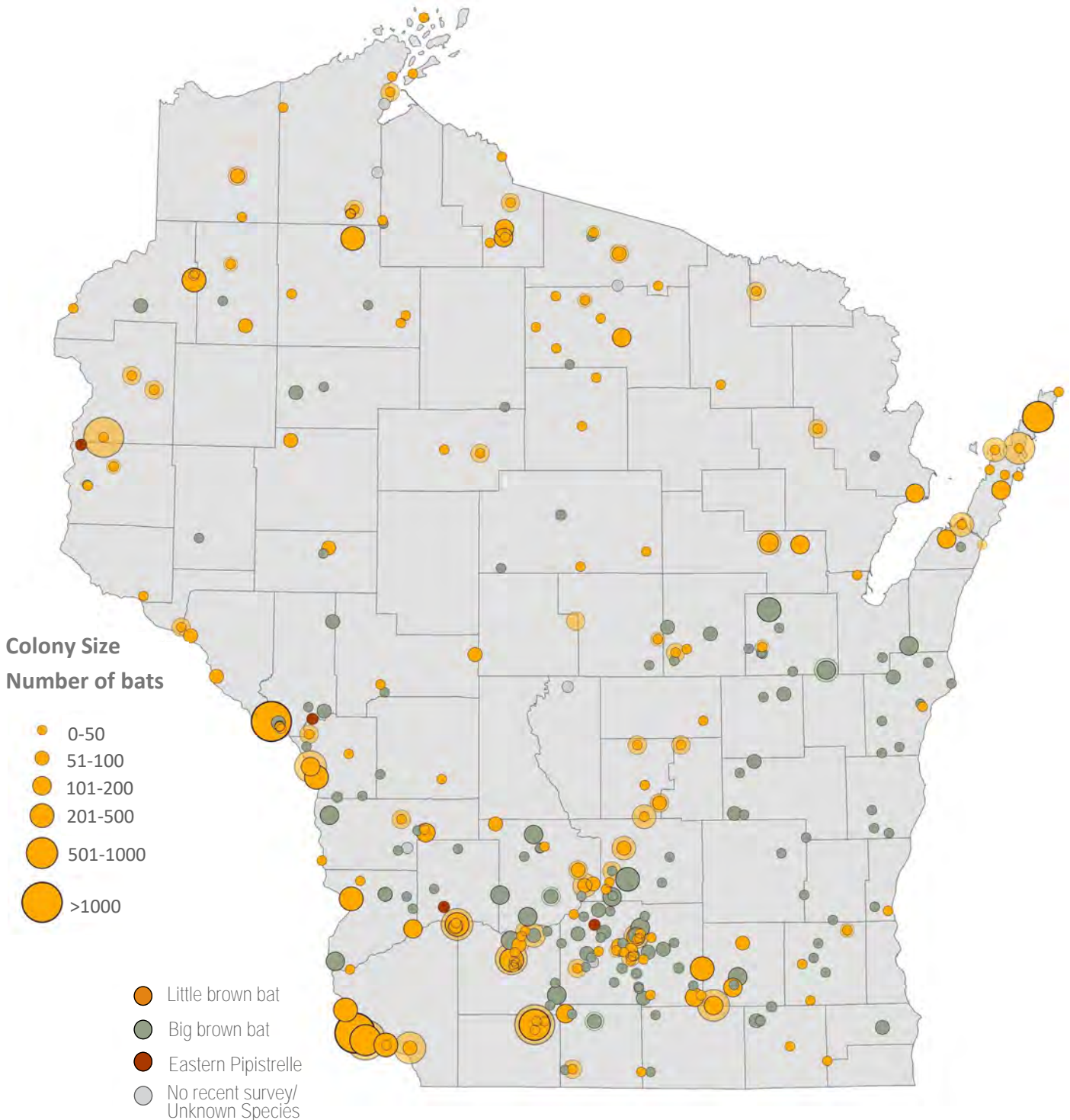
Results from 2016, before white-nose syndrome started to affect bat populations, showed several average little brown bat roost colony sizes by type between 300 and 600 bats. In 2021, the largest little brown bat average colony size was 211 bats, down from pre-WNS colony sizes but up from the past couple of years!

Bat Colony Sizes By Roost Type



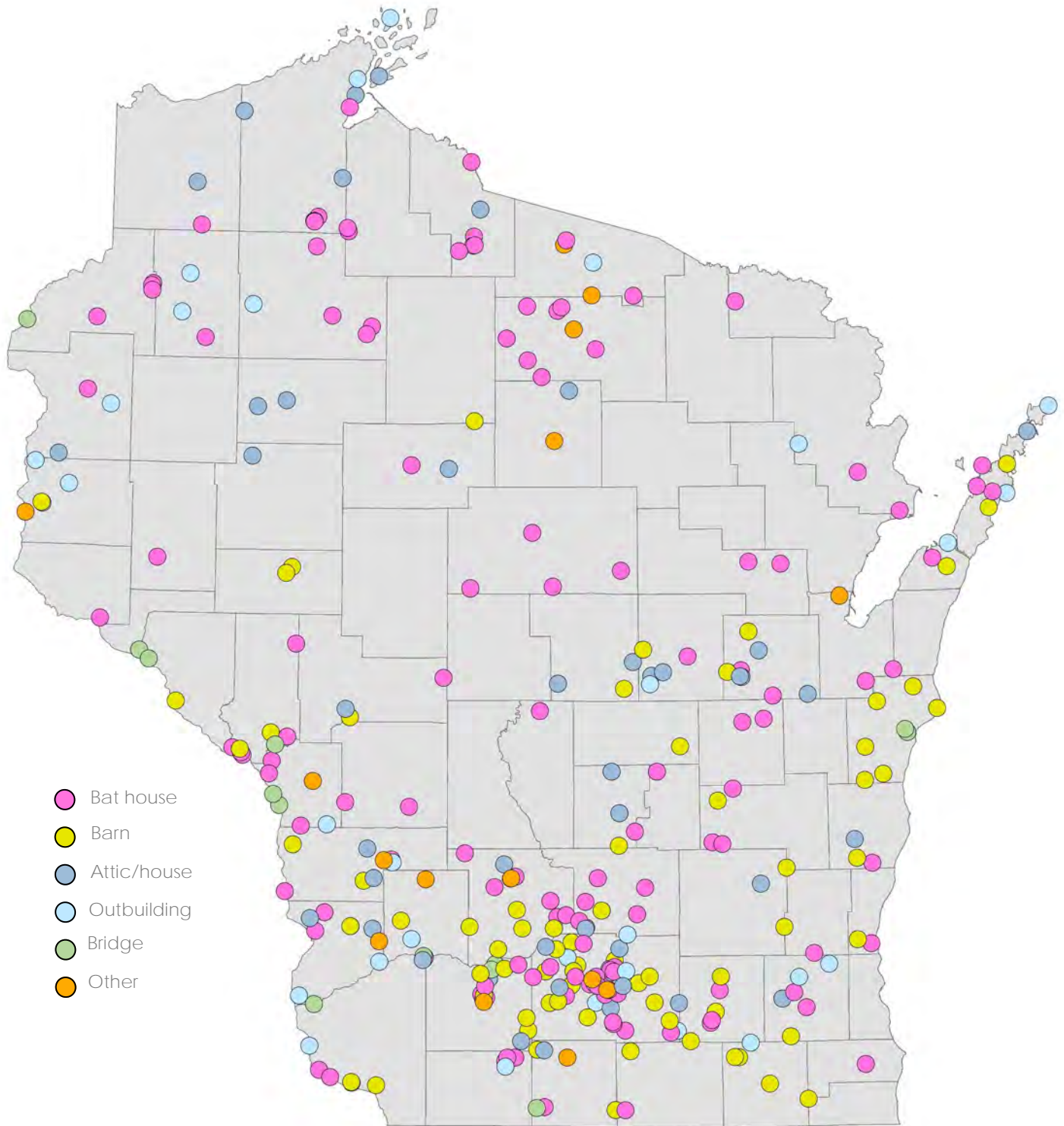
Bat Roosts By Size

This map depicts the distribution and size of monitored bat colonies in Wisconsin. Green indicates big brown bat colonies, orange indicates little brown bat colonies and dark red indicates eastern pipistrelle colonies. The size of the dot indicates the average size of the population at the roost, and the shaded circles behind the roost locations are previous population estimates from emergence surveys.



Bat Roosts By Type

This map depicts the distribution of monitored bat colonies by type of roost. The color of the dot indicates the type of roost.



Seventh Annual Great Wisconsin Bat Count

WBP created a statewide bat count, similar to the Christmas Bird Count.

The Great Wisconsin Bat Count started in 2015 with the goal of counting as many roost sites as possible in a single weekend. Two statewide counts are completed yearly, the first weekend in June during the pre-volancy period (before pups are able to fly) and a weekend in mid-July during the post-volancy period (after juveniles can fly) to help investigate reproductive success of the monitored colonies. All these counts have been great successes. This year monitors counted 5,504 bats in June and 12,729 bats in July!

Great Wisconsin Bat Count Results 2015-2021



Volunteers in 2015 wait for bats to emerge at Yellowstone Lake State Park during the post-volancy Great Wisconsin Bat Count. Photo: H. Kaarakka, WDNR

Mixed Species Roosts

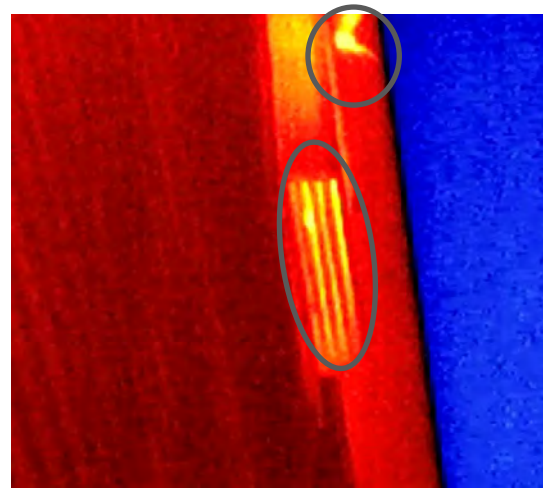
Thanks to the work done by volunteers and landowners in the roost monitoring project, the Wisconsin Bat Program continues to learn about bat roosting behavior and ecology. For example, mixed-species roosts were considered relatively rare in Wisconsin until the past couple of years. The two commonly encountered bats (little brown and big brown bats) seem to prefer different conditions in summer, where little brown bats like warmer temperatures than big brown bats. This led biologists to assume that most little brown roost sites would be too hot for big brown bats, and big brown bat roost sites too cool for little browns.

Mixed-species roosts do occur in other bat species, especially in the west, where many species may seek similar conditions for their roosts, or roost sites may be limited³. Anecdotal reports of mixed-species bat roosts in trees exist, however this behavior is not well documented.

Due to differences in roost preferences, if little brown and big brown bats use the same roost, they are likely to choose different spaces within the same structure. This is often seen in barns, where big brown bats hang on the open beams at the top of the hay loft, and little brown bats select tight crevices found lower in the hay mow or even in the lower level in the milking area. We've confirmed little brown bats and big brown bats in the same barn on two occasions in the past three years. In one barn in Jefferson County, 30-50 little brown bats roost in cracks along the northeast side of the barn, and 10-15 big brown bats roost among the beams. In Rock County, a large barn houses 60-80 little brown bats in cracks between support beams, and 20-30 big brown bats again hang on the rafters at the top of the barn.

Mixed-species roosts occur in more than just barns. In 2016, during a banding effort of little brown bats in a bat house, imagine our surprise when a big brown bat landed in the trap! Since then, through thermal camera footage and additional trapping efforts, biologists documented 3-5 big brown bats roosting in the same bat house as 70+ little brown bats. This year while trapping at large bat condo at Trempealeau National Wildlife Refuge, biologists again caught a single big brown bat flying out of the condo which houses over 1,000 little brown bats. Big browns, little browns and tricolored

bats are also found together in the same bridges.



A big brown bat flies from the top of the bat house, presumably roosting behind the box (top circle), while the little browns sit content inside the box (bottom circle).

One important note is that in these mixed-species roosts, the big brown bats appear to emerge earlier than the little brown bats. At both the bat house and condo, the big brown bat was one of the first bats to fly into the trap. From thermal camera footage, the big brown bats at the bat house were the first bats to emerge and they often came from behind the box rather than from inside. During a recent count at the Rock County barn, all the big brown bats had emerged before the little brown bats began to fly.

While it may not be common, it appears big brown bats and little brown bats do roost in the same structure, especially if it is large and hosts a variety of conditions. In most cases it is a small number of big brown bats with a larger number of little brown bats. The lack of evenly mixed roosts and the selection of different spaces within the roost may yet be because of differences in roost preferences. Why the big browns emerge before the little brown bats remains unknown.

One final mixed-species roost of note is a church in Dane County that hosts big brown bats and the occasional flying squirrel family!



A big brown bat roosting in the same bridge as a small colony of eastern pipistrelles, but never in the same space.

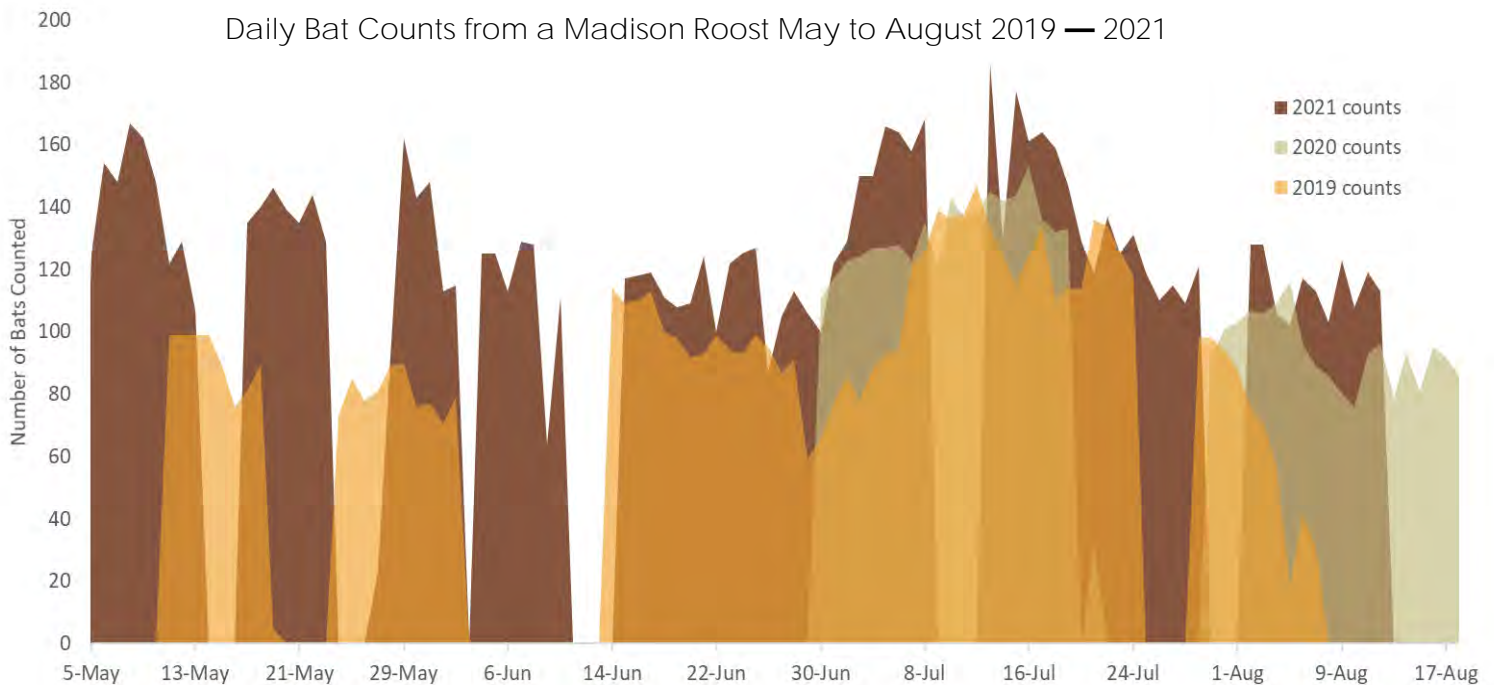
Photo: H. Kaarakka, WDNR

Continued Daily Emergence Counts

Study of daily emergence continues with thermal cameras at several little brown bat roosts.

At a site in Madison where we recorded emergence summers of 2019-2021, the daily counts in 2020 were slightly higher than in 2019 (see below) and yet higher in 2021! As with the big brown bat colony daily counts (page 10), the data start to get confusing after three years of counts. However, several things are becoming clear from these counts:

1. The number of bats emerging daily can be drastically different, likely due to changes in behavior depending on the time of year (e.g., pups in roost) and weather (e.g., cold snap in late May).
2. Juvenile bats in southern Wisconsin start to fly in the first couple of weeks of July and may vary depending on spring weather.
3. There appears to be more bats each year these sites are surveyed. Whether these increases in population are driven by reproduction, survival or immigration remains a mystery.



Note: gaps in counts were because the battery ran out or the camera was pointed away from the bat house. In 2020, the camera was not installed until July.

These daily counts show that we will never get an exact number of bats using a roost in summer since the number is so fluid. This doesn't mean that two counts or even one count doesn't provide us any information. The Wisconsin Bat Program is beginning to think about roosts in terms of classes and even with one or two counts per year, long-term trends begin to appear, such as the effects of white-nose syndrome on little brown bat summer colonies.

The Wisconsin Bat Program is cautiously optimistic about seeing increases in little brown bat numbers!



A little brown bat (in circle) emerges from the Madison bat house in 2020. The colors in the footage are altered to more easily see the bats.

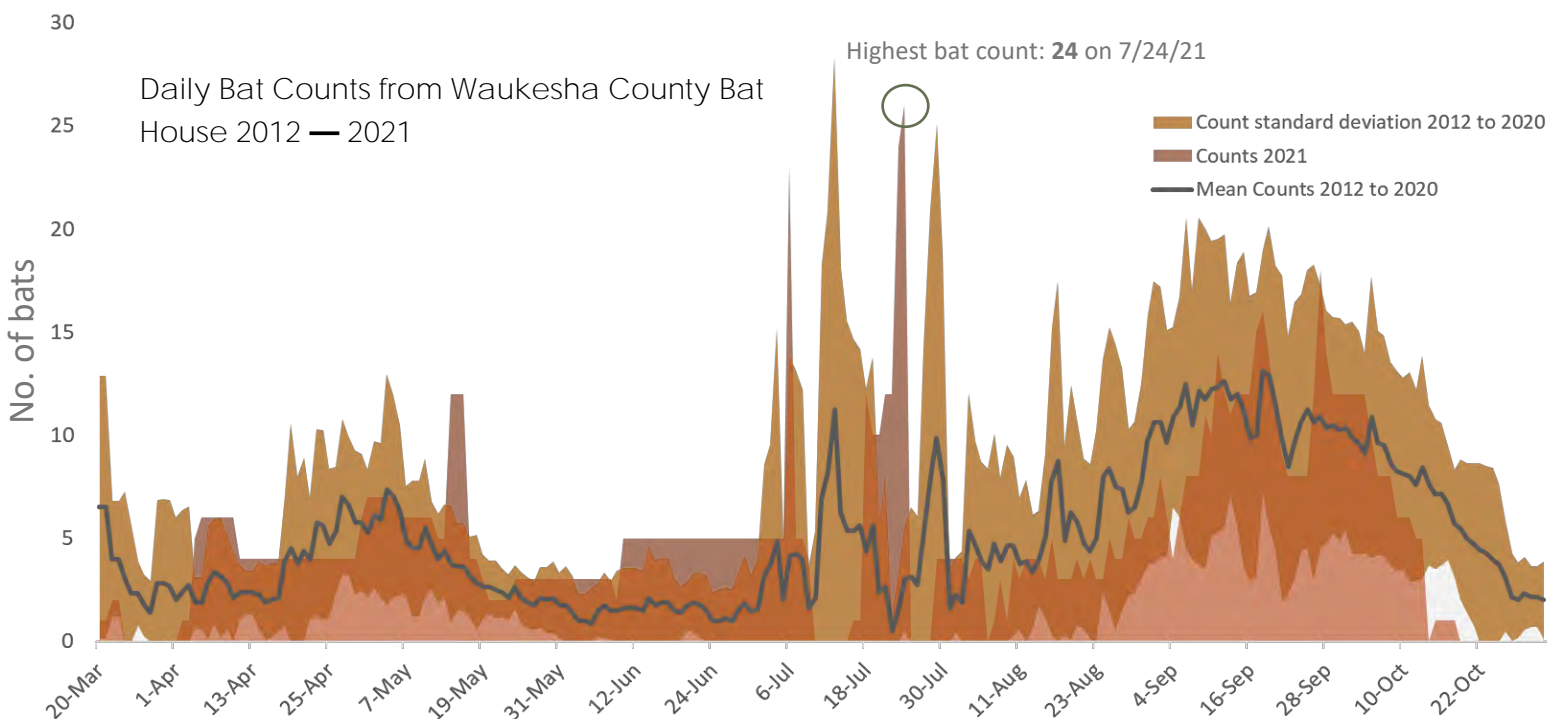
Big Brown Bat Roost Daily Counts

Daily count surveys also continued at the big brown bat house in Waukesha County. In 2021, the most bats counted this year was 24 in late July. The highest number of bats counted each surveyed year has been between 17 in 2018 and 49 in 2013. When in the summer the most bats were counted has also varied over the years. The most bats ever counted at this roost (49) was observed in mid-July, likely due to volant (flying) juveniles exploring, whereas the high count from 2020 was observed on September 1 possibly from bats moving from summer to winter habitat.

Numbers again spiked in mid-July most likely because of volant juveniles either exploring on



their own or being shown roosts by their mothers. Like other years, more bats were observed in August and September than in early summer in 2021. Though the exact timing of arrival and number of bats varies, it is interesting to see how much bats can be creatures of habit!



This site has been surveyed daily every year since 2012! In this graph, the brown indicates counts from 2021, the black line indicates the average daily number of bats at the roost over the past seven years, and gold indicates how much variation in bat numbers there was on that day over the past eight years.

Have you observed bats flying out of bat roosts on hot days?

Researchers in the western and southern North America have observed bats flying out of bat houses during the day seeking shade because bat houses reach temperatures that are too hot for them. If you have observed instances of this we would be very interested to learn about them since it can help complete the picture of critical temperatures for bats. DNRbats@wisconsin.gov

Impacts Of White-Nose Syndrome

There is no doubt that white-nose syndrome has impacted summer bat colonies; however, impacts are varied and may not be as dire for some species as expected. Like biologists watching populations in the east, the Wisconsin Bat Program has started to observe stabilization of little brown bat colonies and even some roosts that still have significant numbers of little brown bats. What causes some summer colonies to collapse and others to persist is unclear, but potential causes could be hibernation locations and conditions. Some summer roost sites might be ideal habitat encompassing good roost locations and close proximity to foraging habitat to reduce commuting costs. The questions about surviving bats and their habitats are what make summer monitoring and projects like mark-

ing important. Big brown and little brown bat populations can continue to be tracked long-term with citizen-based monitoring at summer bat counts. Marking efforts can track individuals over time and potentially make connections between summer and winter habitats. This link between seasons is one of the remaining mysteries for bats surviving white-nose syndrome in Wisconsin and is one of the keys to understanding what the future of bats looks like in the region.



A northern long-eared bat infected with white-nose syndrome in Crawford County. Photo: H. Kaarakka, WDNR

Persisting, and Potentially Growing, Colonies

Thanks to the monitoring efforts of landowners and volunteers, the WBP has been able to identify several key roost sites around the state where little brown bat colonies appear to be persisting in large numbers despite impacts from WNS. Several roost sites along the Mississippi and Wisconsin rivers again had post-volancy counts of over 70% of historical numbers. These sites used to be home to more than 1,500 bats meaning these roosts continue to house significant colonies in the age of WNS. The Wisconsin Bat Program will continue examine whether there are differences between roost sites that are persisting and sites where the bats have declined sharply. Differences could include how old the roost site is, how many bat houses are present and proximity to large water bodies.



Little brown bats persisting in an attic in Marquette County. This roost has declined by about 82% in response to WNS. However, like other roosts monitored by volunteers, this one saw a slight increase in bat numbers in 2021 since steep drops in 2017 and 2018. Photo: J.P. White, WDNR



Through banding and now passive integrated transponder (PIT) tagging bats at many summer roost sites has made it clear that many colonies have bats that are surviving white-nose syndrome infection. Female bats banded in 2016 and 2017 were recaptured in 2021 during coordinated summer roost work with United States Geological Survey –National Wildlife Health Center. Bats PIT tagged in 2011 were recaptured in 2021 too! These recaptures suggest that some bats are indeed surviving white-nose syndrome and stabilizing colonies is not simply bats redistributing among

Banding efforts like this one in 2015 are the way biologists have been able to recapture marked individuals years later and assess survival.

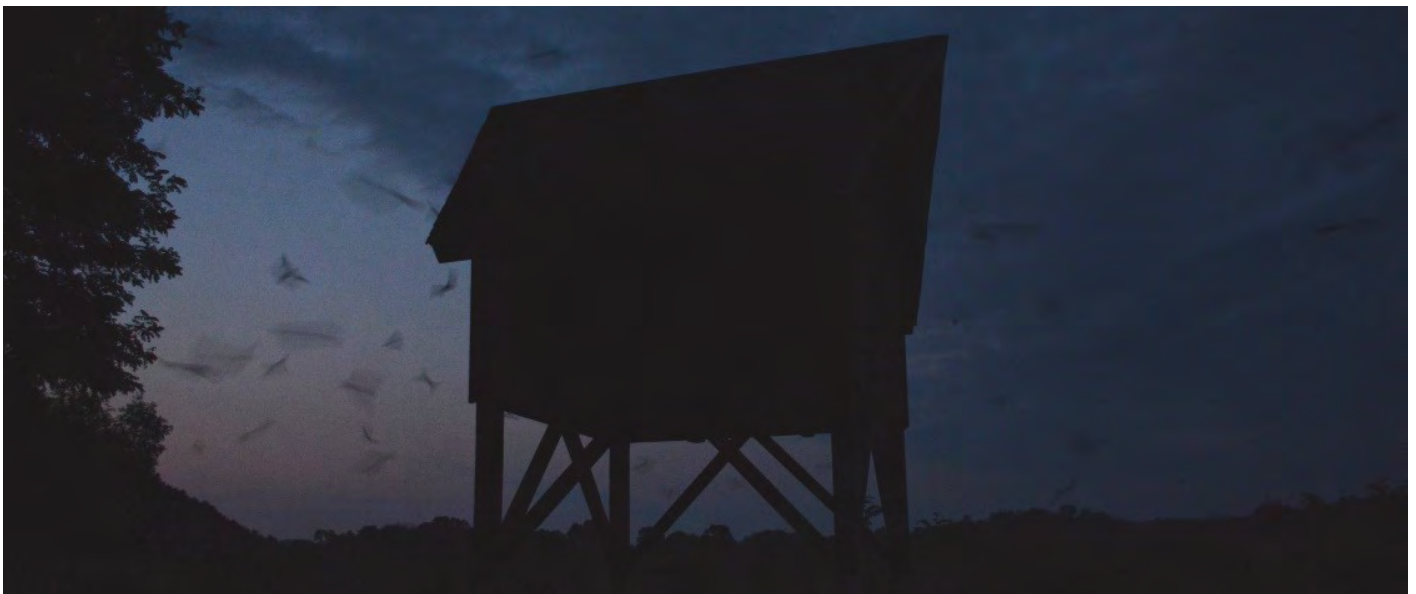
How Wisconsin Bat Program Uses Information From Volunteers

Reported and monitored bat roosts are important for furthering research and understanding of bats and white-nose syndrome in Wisconsin. Thanks to the efforts of volunteers and landowners, Wisconsin is unique and fortunate to have an established database of summer roost sites throughout the state which acts as a springboard for other important projects investigating bats and WNS in the state. The assistance of volunteers allowed the Wisconsin Bat Project to coordinate and complete several projects at reported summer roost sites in summer 2021.

Projects Conducted at Reported Roosts

- **Differences in declines at summer roosts.** Some declines observed at summer roosts due to WNS-impacts in the state have been significantly more severe than at others. What would cause some roost sites to hold on while others see few or no bats? There are likely many factors impacting survival of bats in both summer and winter. Using count data collected pre- and post-WNS arrival at little brown bat roosts across the state, the Wisconsin Bat Program is investigating what might play roles in the differences in observed declines. Does distance to water or how long the roost has existed impact

how much a site declined? Learning these details can help determine management of summer roosts moving forward. Preliminary results from this study suggest that large colonies (>500 bats) had less severe declines from WNS-impacts than smaller colonies. This may suggest that there is a survival advantage to roosting with many other bats. Perhaps roosting with many other bats helps increase the temperature of the roost, particularly in spring when night temperatures can still drop.



Little brown bats swarm in early morning at one study site used to investigate variation in declines from WNS.
Photo: H. Kaarakka, WDNR

How Wisconsin Bat Program Uses Information From Volunteers

Recoveries of Passive Integrated Transponder Tagged Bats at a Southwestern Wisconsin Roost



Each green dot represents a date and time when a bat was recorded. Bats are rarely recovered everyday suggesting they may move roosts frequently over the summer.

Projects Conducted at Reported Roosts

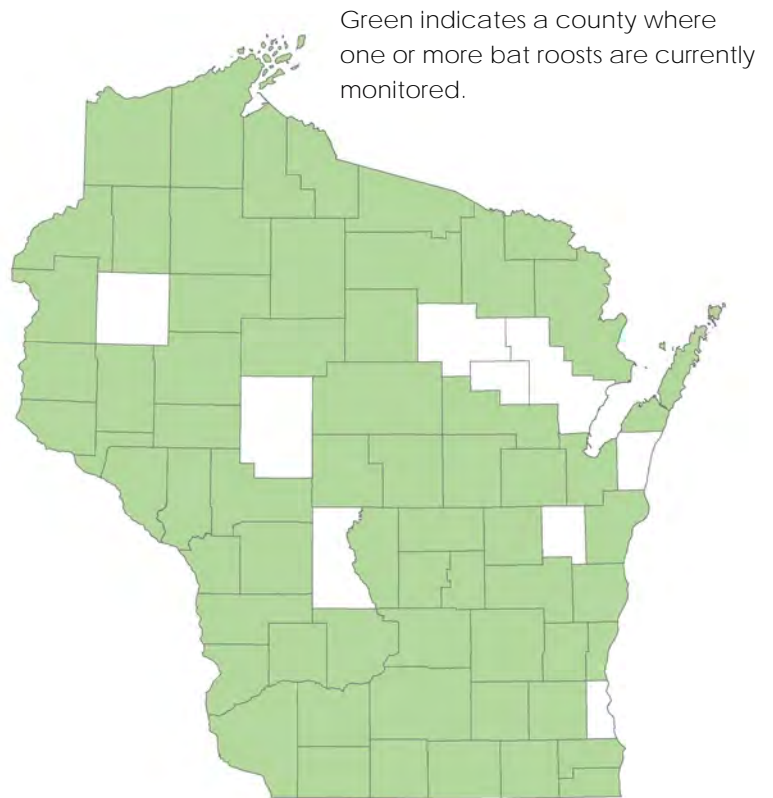
- **Tagging bats with passive integrated transponders and installing readers.** Tagging bats with passive integrated transponder tags offers the opportunity to collect much-needed information without recapturing and handling bats to read the band number. Tagged bats can be scanned using special readers to record the exact date and time of their activity of each tagged bat. Tagging also allows biologists to watch movements of bats between roosts and even between summer and winter habitat. While working with United States Geological Survey - National Wildlife Health Center to investigate efficacy of a WNS vaccine, the Wis-

consin Bat Program installed several readers on multiple bat houses and discovered that bats moved readily between the bat houses. Working with partners at Virginia Tech University, the Wisconsin Bat Program tagged bats and installed stationary readers at the entrances to major hibernation sites. This allowed biologists to make some of the first seasonal connections between summer roosts and winter hibernacula when two juvenile females from different roosts flew 30 and 50 miles to a site in Pierce County! Having a network of tagged bats and readers at both winter and summer sites will help to make more connections and investigate aspects such as seasonal timing and survival.

Continuing The Bat Roost Monitoring Project

Over the past 11 years, volunteers and citizen-scientists have helped create an important and valuable database of bats roosts around the state. Each roost reported and emergence count completed helps create a better picture of summer bat roosting ecology in Wisconsin. The amazing efforts by land-owners and volunteers are extremely valuable and current (and future!) roost monitoring will continue in the coming summers. WBP also continues the aim to grow the summer bat roost database. Every year, the number of monitored roosts grows and gives the WBP important information. The map at right shows each county where bat roosts are monitored in Wisconsin. The public is encouraged to report bat roosts in counties with and without monitored roosts.

Based on surveys conducted by Wisconsin Bat Program volunteers, bat colonies in Wisconsin appear to be stabilizing following impacts from WNS. As



Wisconsin Bat Project scientists determine what potentially recovering populations look like, the roost data collected by volunteers shows that not all colonies are affected equally. Some habitats may be more suitable than others now that fewer bats are on the landscape. The data also help with understanding reproduction and whether bats in the region might fully recover or if what is observed now is the “new normal” for little brown bats.

The bat roost monitored project is able to thrive because of the incredible work of volunteers and land-owners. **The Wisconsin Bat Program cannot thank everyone involved enough for their dedication and effort.**

I am constantly amazed by and thankful for the effort put forth by everyone who volunteers for the bat program, whether it be counting a roost or conducting an acoustic survey. It is magical to witness the excitement people have about bats and science, and I count myself very lucky to be a part of it. There is a long, hard road ahead with WNS finally in the state, but thanks to your efforts, we have made great strides in assessing WNS impacts on Wisconsin's bats. It may seem excessive, but thank you. We cannot continue the program without your help and support.



Heather Kaarakka
Bat Roost Project Coordinator



Heather Kaarakka removes a bat from a mist-net in western Wisconsin. Photo: Michael Kienitz

References

1. Boyles, J. G., P. M. Cryan, G. F. McCracken and T. H. Kunz. 2011. Economic importance of bats in agriculture. *Science* 332: 41-42.
2. Maine, J. J. and J. G. Boyles. 2015. Bats initiate vital agroecological interactions in corn. *PNAS* 112: 12438-12444.
3. Licht, P., and P. Leitner. 1967. Behavioral responses to high temperatures in three species of California bats. *Journal of Mammalogy* 48:52-61.

Have questions about bats or roost monitoring?
Feel free to contact Heather:
heather.kaarakka@wisconsin.gov

The Wisconsin Bat Program is part of the Bureau of Natural Heritage Conservation in Wisconsin Department of Natural Resources. The majority of Wisconsin Bat Program funding comes from grants and donations and much of our data are collected by volunteers. Thank you for your support.

585 surveys
were completed in 2021, counting
15,106 bats



Wisconsin Bat Program | Wisconsin Department of Natural Resources

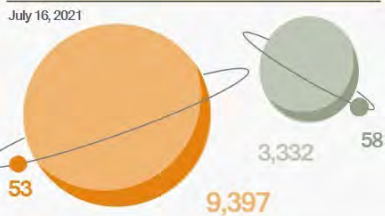


2021 Roost Monitoring Report

Great Wisconsin Bat Count

The goal was to count as many roosts as possible in a single weekend, now in its 7th year.

- Little brown bats counted
- Little brown bat surveys
- Big brown bats counted
- Big brown bat surveys



Bat houses, outbuildings draw bat crowds

In 2021, outbuildings and bat houses housed the largest numbers of little brown bats.



Meet a couple of our bat species

Two bats that use artificial roosts in Wisconsin are the little brown bat and tricolored bat



Little brown bat
Myotis lucifugus

This formerly common bat roosts in bat houses and buildings in summer. In winter they hibernate in caves and mines and are heavily impacted by white-nose syndrome



Tricolored bat
Perimyotis subflavus

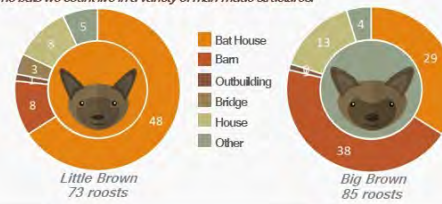
This little bat likes to eat caddisflies and beetles, and roosts in leaf clusters or open areas of buildings. In winter, tricolored bats hibernate in caves and mines

Where do bats live?

The bats we count live in a variety of man-made structures.



227 volunteers reached for their clicker-counters to help count bats this summer



05

May: the roost colony population steadily grows as bats return to their summer roost from overwintering habitat.

06

June: most of the colony is present at the roost, and female bats give birth to flightless young, called pups.

07

July: bat pups born in June begin to fly in late July and the number of bats emerging from the roost increases.

08

August: adults begin migration back to winter habitat where they will mate throughout the fall.

Number of roosts counted in 2021

Little Brown Bat



73 85



Big Brown Bat

Help survey bats!

Know a place where bats roost? Want to help count bats?

Contact Heather at heather.kaarakka@wisconsin.gov or visit wiatri.net/inventory/bats