2019

ROOST MONITORING REPORT

By Heather Kaarakka

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Bureau of Natural Heritage Conservation
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Bat "condo" sketch by Heather Kaarakka

WISCONSIN BAT PROGRAM

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It was another successful year for monitoring summer bat roosts in Wisconsin! Thousands of bats were counted at over 150 sites in 2019. Similar to last year, with white-nose syndrome in the state, there were unfortunately still some downs, but a few ups this year too. Highlights include several persisting colonies and daily emergence counts. As usual bat roost monitors recorded more information than can fit in the report, but here are some results we hope you will be interested in. Enjoy learning about everyone's hard work surveying their bats in 2019!

Big brown bats roost in a newly reported bat house in Dane County. Photo: T. Voeck.

Little brown bats happily using the bat houses at the I-90 bridge site.

A background on bats

Bats are found on every continent except Antarctica, and 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** . In fact, it has been estimated that bats save farmers in North America upwards of $22 billion in pest control services every year, and bats' services are worth $1 billion each year to the corn industry alone[1,2] .

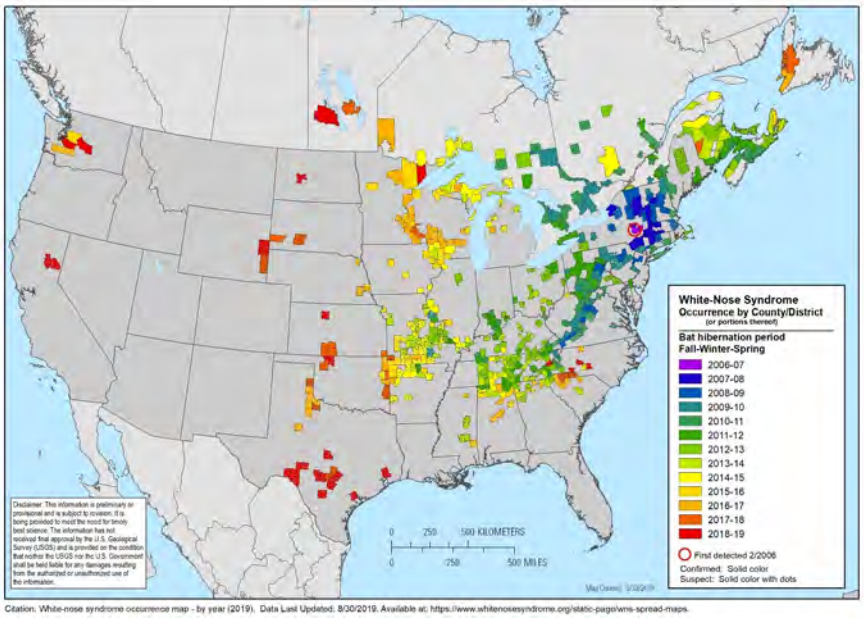
A single little brown bat can consume up to 1,000 mosquito-sized insects in one hour!

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 has spread to 36 states and seven Canadian provinces, and over 6 million bats have died from WNS since 2007. Unfortunately, WNS was confirmed in Wisconsin in March of 2014. Sites in twenty-five counties are infected in the state as of fall 2019.

A roost refers to the area 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.

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 baseline 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 are 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.



Currently, Wisconsin has twenty-five counties where sites are infected with WNS or have the fungus causing the disease. Map: Lindsey Heffernan PA Game Commission

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 females bats gestate quickly and the newborn bats (called pups) mature quickly. These two species will also form large colonies in summer and bats often 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. 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.

A little brown bat is spotted inside a decorative bird house on a porch in St. Croix County. S. Richardson

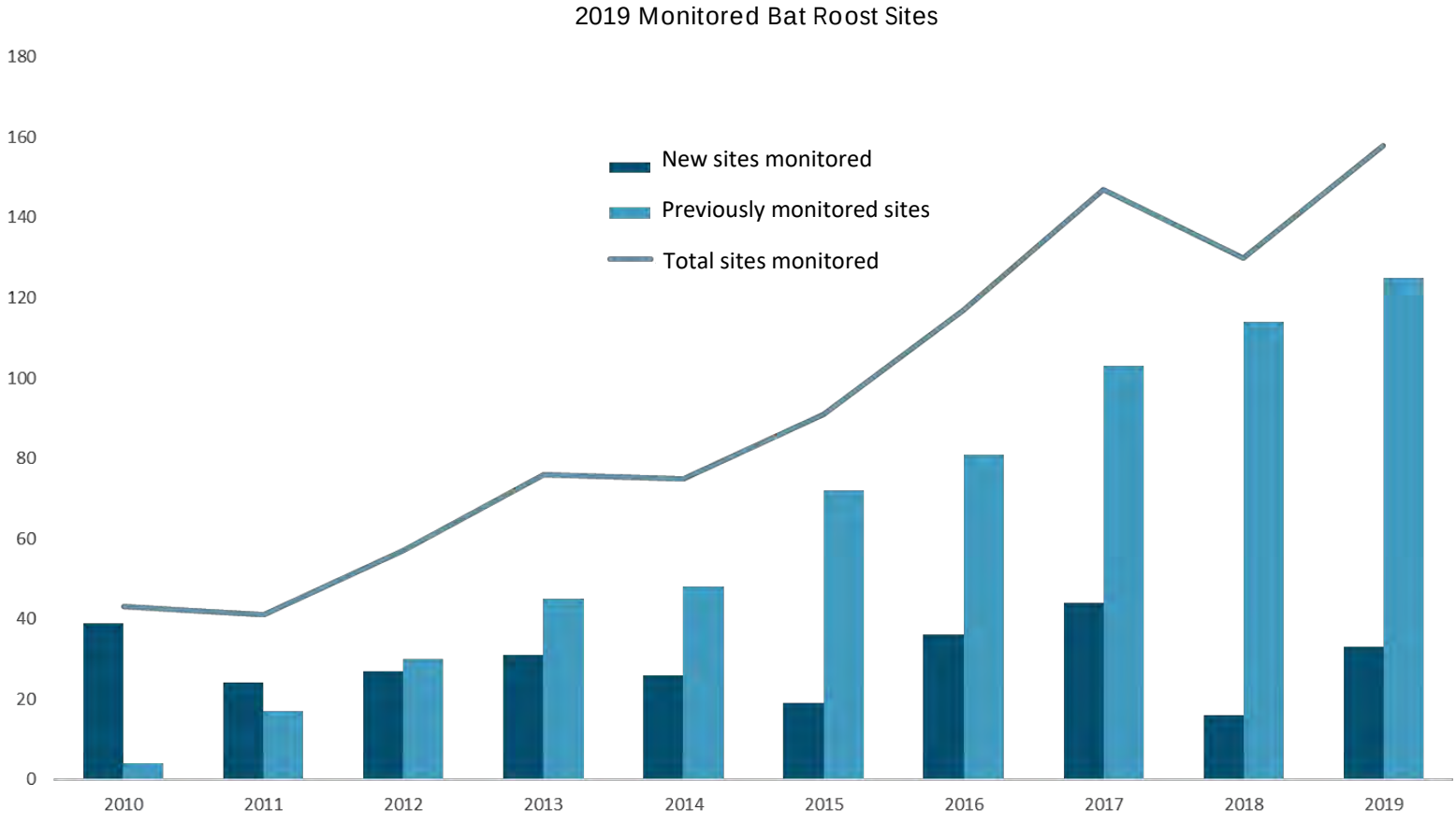
Roost monitoring in 2019

This year, 209 volunteers conducted over 700 emergence surveys in 52 counties from March to October. Volunteers monitored 159 roosts in summer of 2019 including 33 newly reported roost sites!

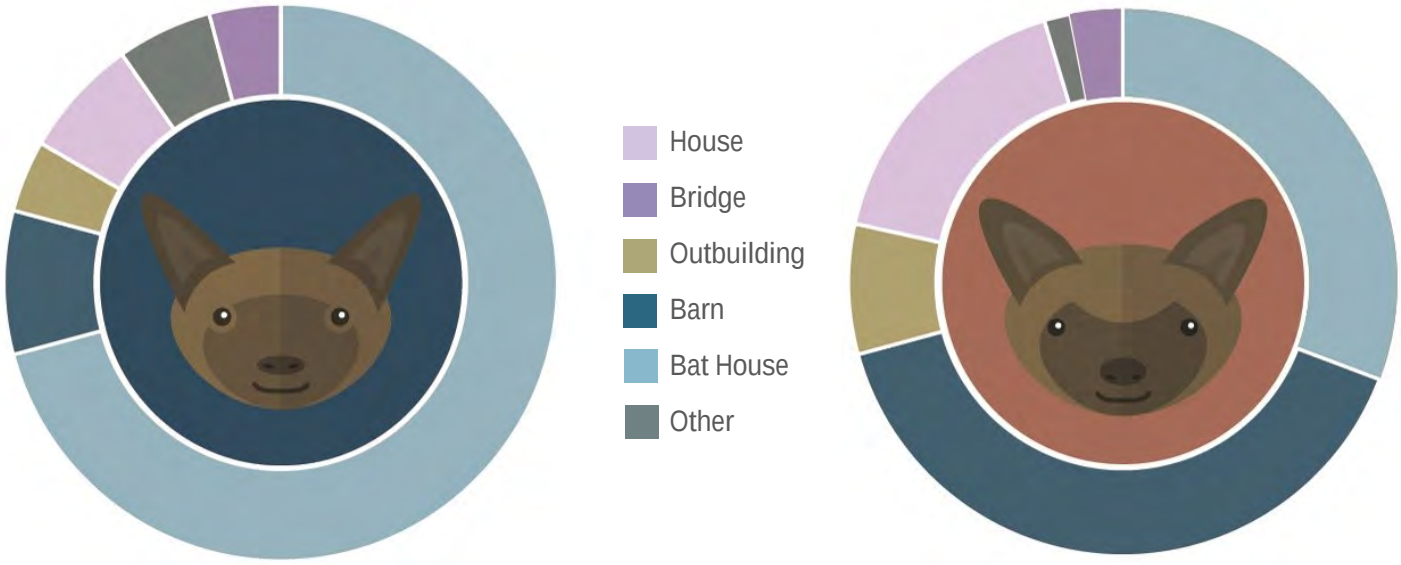
In 2019, the **total little brown bats** counted– **8,805**– was down by more than 60% from 2016 when 23,607 were counted, but similar to the total count in 2018. The **total number of big brown bats** counted – **4,080**– was up since 2017 and 2018. Total numbers counted are estimated from the highest counts at each site. Six eastern pipistrelles were counted at three sites in 2019. Little brown bat roosts comprised 46% of monitored sites in 2019. Big brown bats were counted in 43% of the sites and the remaining sites house eastern pipistrelles, both little brown and big brown, or it is unknown which species is housed. See page 15 for more details in the roost monitoring infographic.

Above: An eagle-eyed roost monitoring volunteer found this silver-haired bat at the Dane County farmer's market in May this year!

Below: a graph depicting the number of sites monitored every year through the roost monitoring project. The number of monitored roost sites in Wisconsin continues to grow!



Bat species by roost type

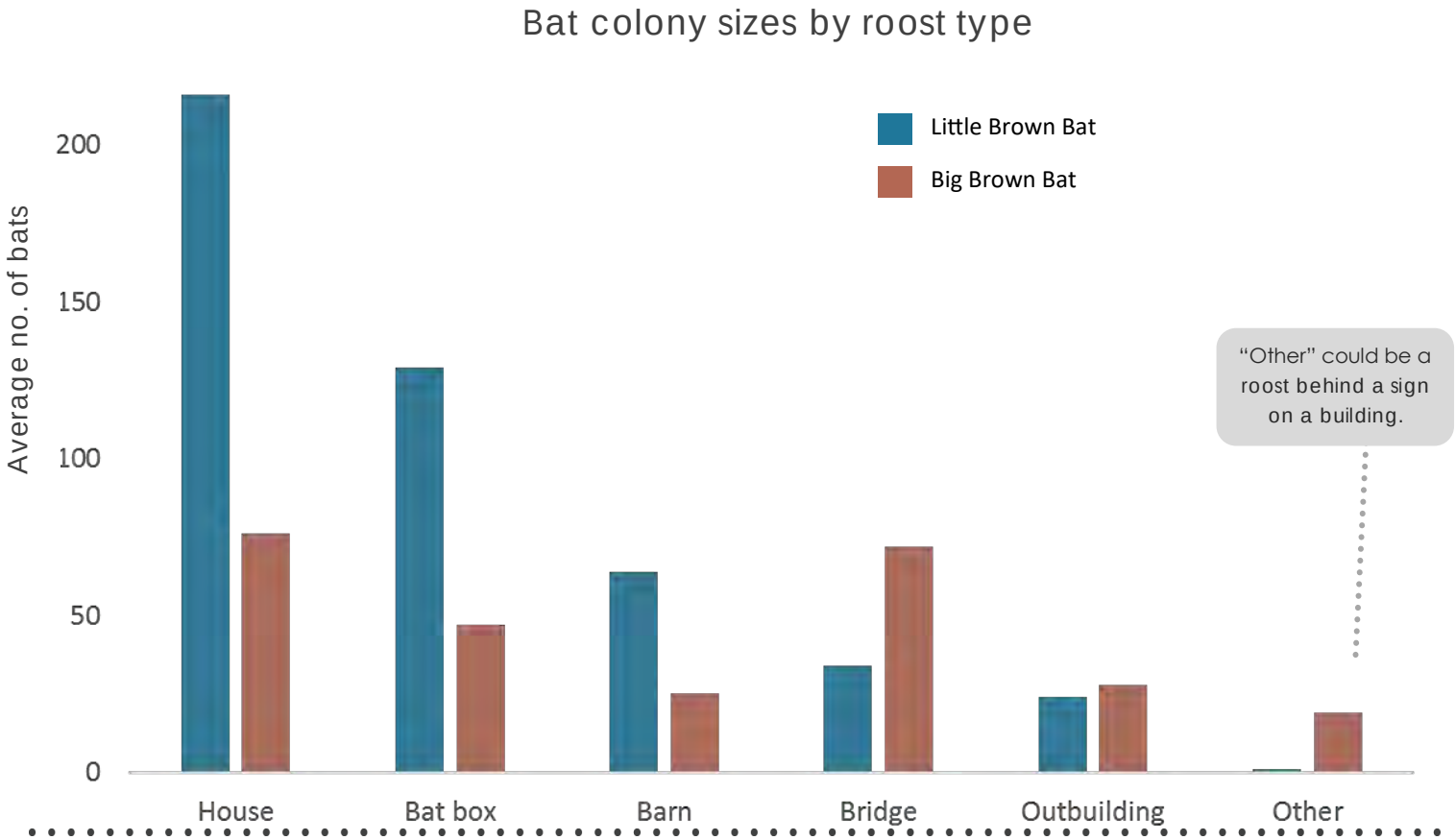


Little Brown
73 roosts

Big Brown
68 roosts

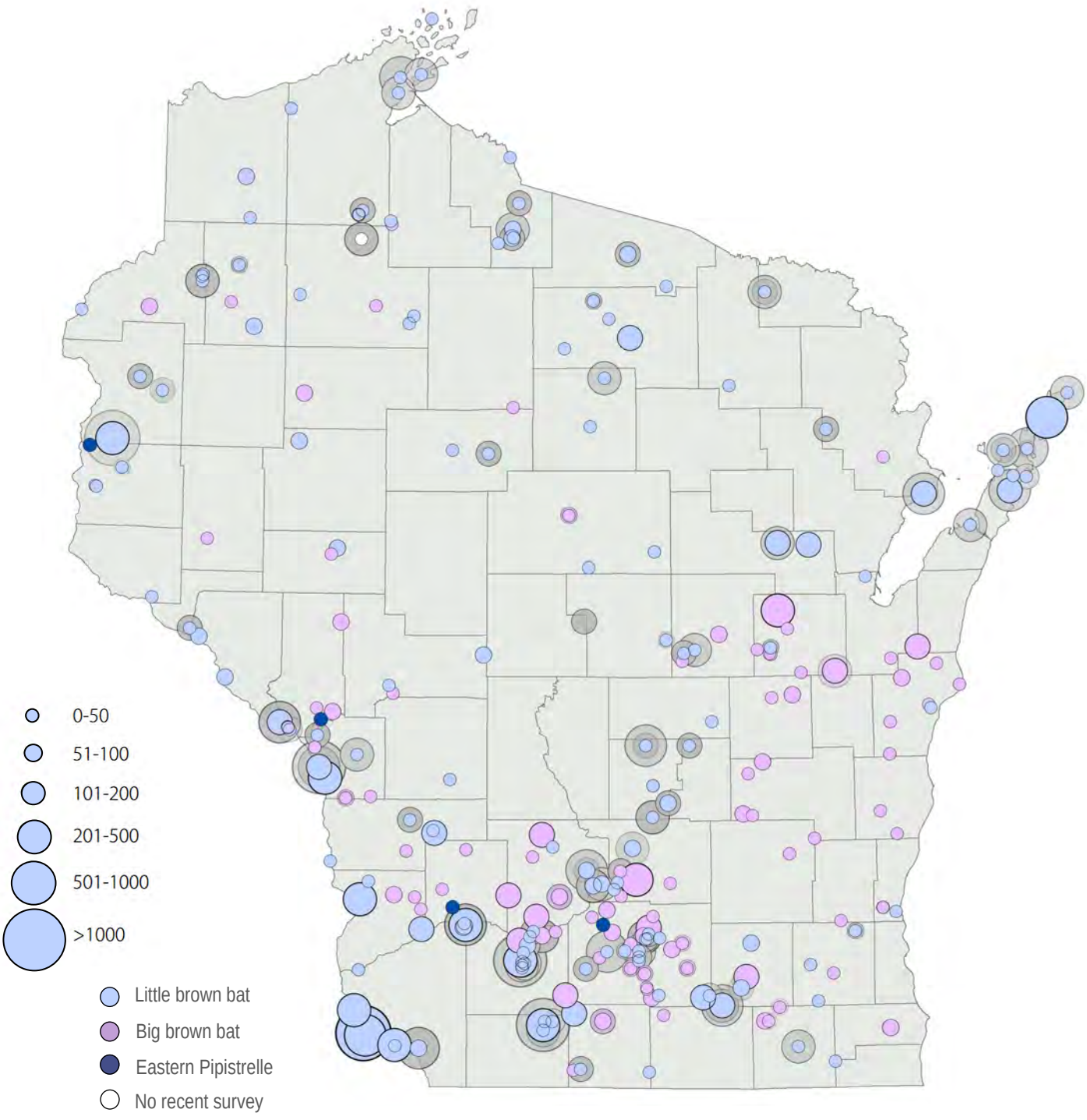
***Above**: sites of each species are split by type of roost. Little brown bats were found most often in bat houses, and big brown bats preferred barns.*

***Below:** Colony sizes for each species are sorted by the average of highest population size found in each roost type. Of note – results from 2016 (prior to effects of WNS) had several average little brown bat roost colony sizes by type between 300 and 600 bats. Below for 2019, the highest little brown bat average colony size barely reached 215 bats, but this is up slightly from average counts in 2018.*



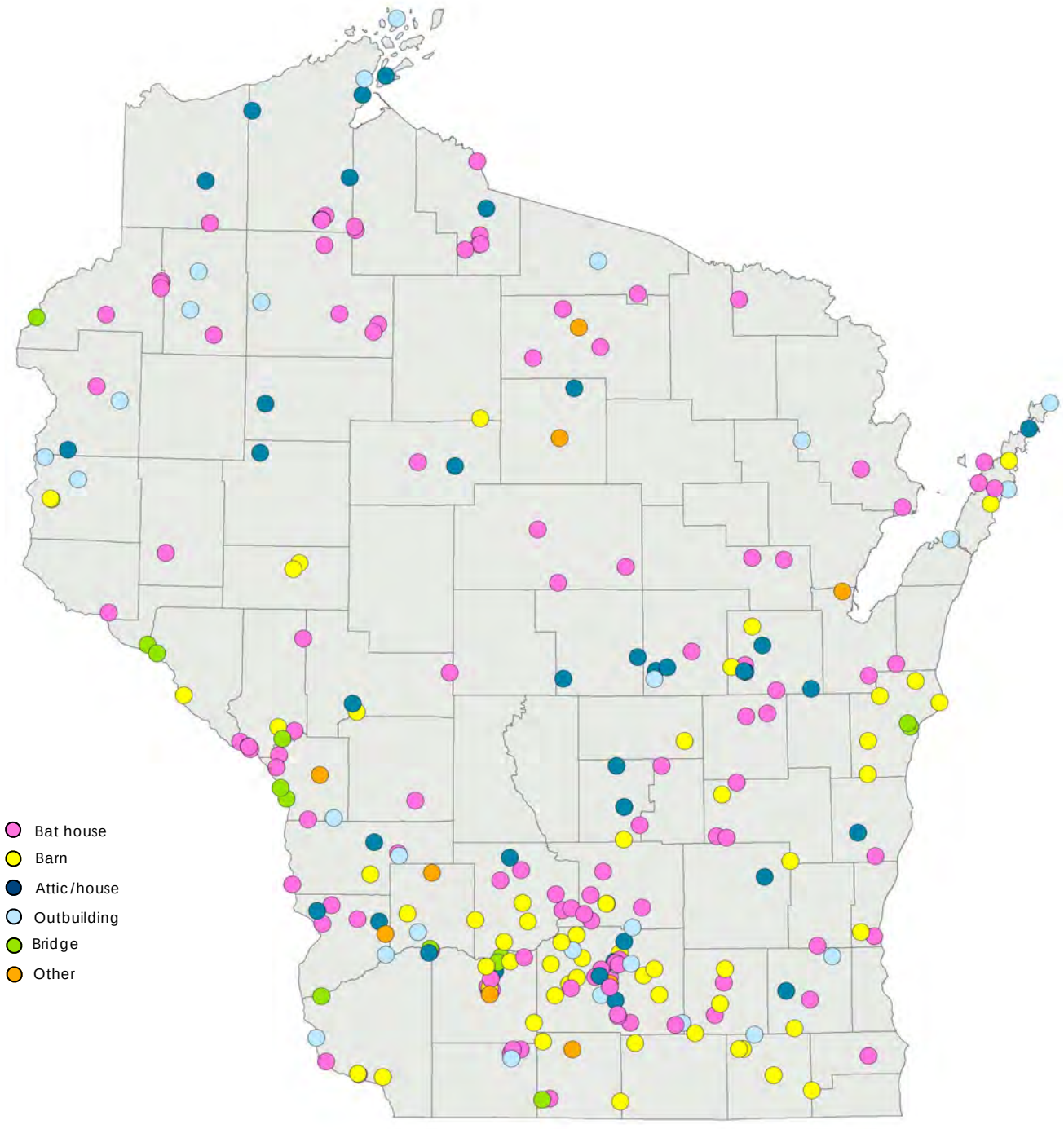
Bat roosts by size

The below map depicts the distribution of monitored bat colonies and their sizes in Wisconsin where purple indicates big brown bat colonies, light blue little brown bat colonies, and dark blue eastern pipistrelle colonies. Size of the dot indicates average size of the population at the roost. The shaded gray 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. Color of the dot indicates whether the bats roost in a bat house, attic, outbuilding, barn, bridge or other.

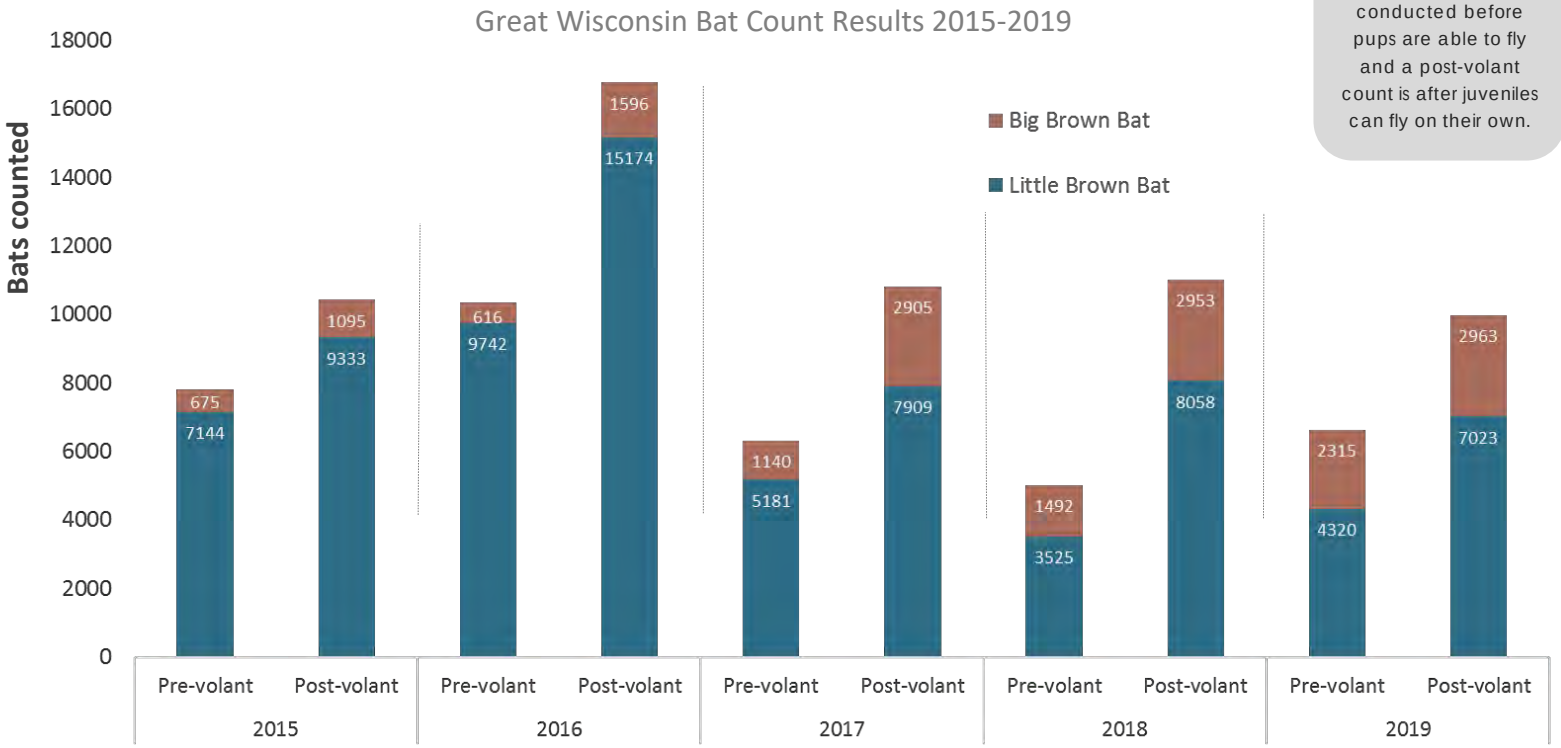


Fifth annual Great Wisconsin Bat Count

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

In 2015 we began the Great Wisconsin Bat Count, with the goal of counting as many roost sites as possible on a single weekend. Two statewide counts are completed yearly the first weekend in June during the pre-**volancy** period, and a weekend in mid– to late July during the post-volancy period to help investigate reproductive success of the monitored colonies. All statewide counts have been great successes. Including eastern pipistrelles, volunteers counted at 99 roosts in June, counting a total of 6,636 bats. In late July, volunteers surveyed 96 roosts and counted 9,988 total bats!

Volancy refers to flight. A pre-volant count is conducted before pups are able to fly and a post-volant count is after juveniles can fly on their own.

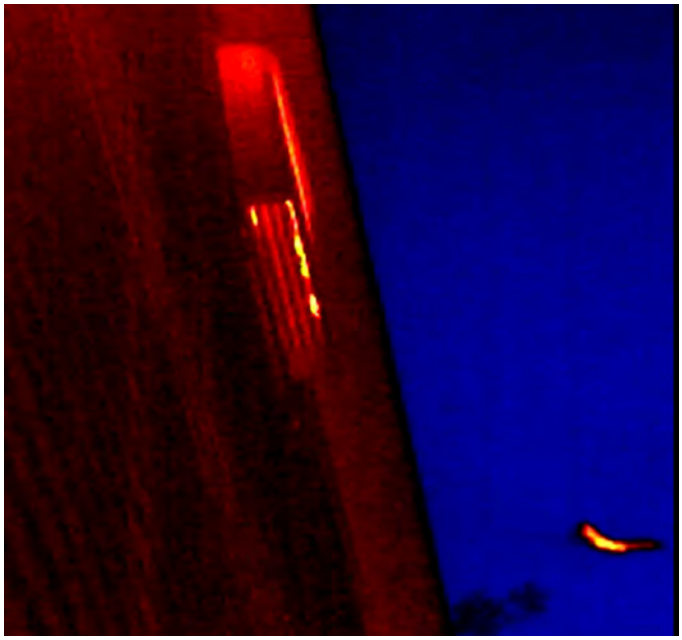


Volunteers wait for bats to emerge at Yellowstone Lake State Park during the post-volancy Great Wisconsin Bat Count

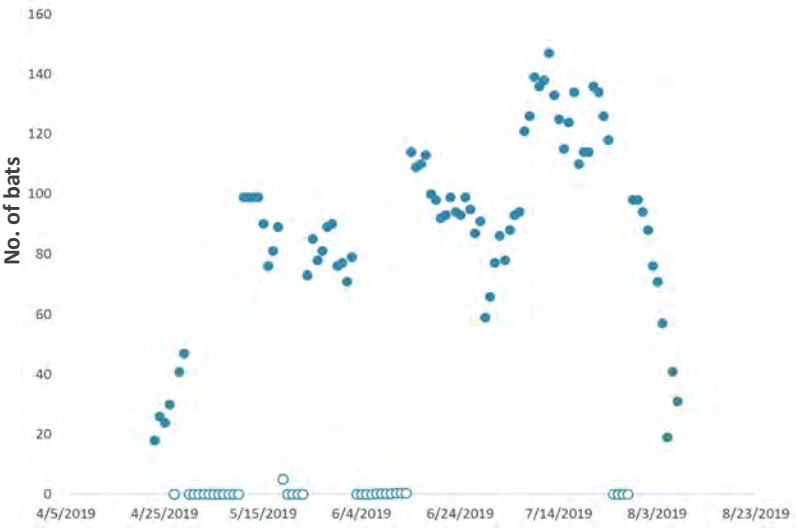
Daily Bat Emergence Counts

Some of the unknowns in bat roost ecology include how colonies change day-to-day and whether bat houses can potentially get too hot for bats. One of the National white-nose syndrome working groups is dedicated to looking at artificial roosts and honing in on specific requirements that bats have in roosting conditions in order to learn about building better bat houses. Matching temperatures to the number of bats using a roost can be difficult because bats move around, so daily counts are typically required to link up whether bats are vacating boxes on particularly hot days. To begin investigating this, we placed dataloggers inside bat houses in spring at several locations in southern Wisconsin which record the inside temperatures every hour. To gather daily counts, we deployed thermal imaging video cameras that turned on every evening to record emergence. The cameras recorded emergence every night, but we still need to analyze the footage by watching and counting the bats just like a regular emergence survey. We have preliminary results from one site and we begin to see some patterns.

Unfortunately there are several gaps in counts for this site when the camera did not turn on because the battery was drained or other reasons, but it did record emergence on 76 nights between 23 April and 7 August 2019 (see figure bottom left). Counts follow a pattern we usually associate with maternity colonies where the colony grows until late May when the number of bats levels off. In early July, the number of bats emerging jumps nearly 30 bats which could indicate pups that are learning to fly. Interestingly, there is a dip in numbers in late June and it is unclear why fewer bats would emerge from the box right before juvenile bats begin to fly. The number of bats emerging drops precipitously starting in early August which could be due to mother bats leaving the roost to head to hibernation sites where they mate. This time period is also potentially when mothers show young other roost sites and where to hibernate for the winter.



A little brown bat emerges from a bat house in Madison, WI. Red and orange is warm and blue is cool. Several bats can be seen as warm spots inside the box waiting to emerge.



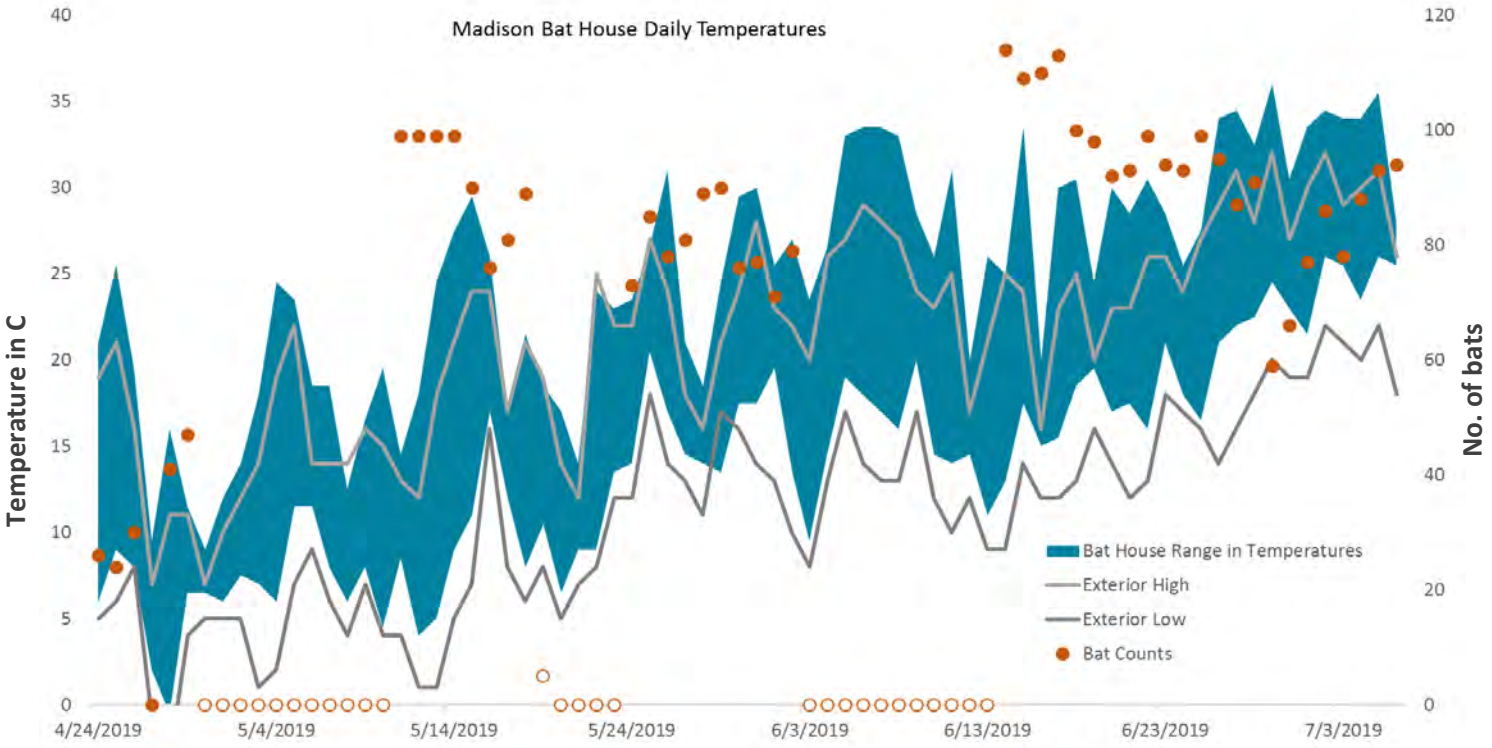
Daily counts from a Madison bat house. Solid circles are number of bats observed and open circles are days when camera was not recording. Highest bat count: 147 on 7/12/19

The dataloggers recorded temperature inside the bat houses from April to early July. We were targeting temperatures throughout the summer, but space limitations on the dataloggers meant that they filled up before the end of the summer and stopped recording on July 6. Regardless, we recorded important information about roosting conditions early in the summer season.

Cont. on next page

Daily emergence counts cont.

Temperatures above 42° C (108° F) are thought to be lethal for little brown bats and we can see below that during the period when temperature was recorded, it never got above 40° C. This is somewhat surprising because the bat house is mounted on the side of a building and faces directly south. One might expect this placement in full southern sun to heat up quickly and reach very high temperatures. It is possible the bat house reached above 40° later in the summer when the datalogger was not recording. With only one site analyzed, it is too early to tell whether bats are moving elsewhere on particularly hot days. We look forward to analyzing footage from five other little brown bat sites and continuing the project next year.



Above: Temperature ranges inside a Madison bat house in blue overlaid with exterior high and low temperatures in gray and nightly bat counts in brown circles.

Daily Big Brown Bat Counts

This year we were lucky enough to have not one but *two* dedicated landowners monitor their big brown bat colonies daily over the summer! Results from our usual daily bat-counting champ in Waukesha from the past seven years are displayed on the next page at the bottom. We were also fortunate enough to have a maternity colony of big brown bats observed daily by a landowner in Crawford County (middle graph next page)! The Crawford County roost also had a datalogger recording temperature from May until early July. Like preliminary results from temperatures at the little brown bat roost, there is no clear relationship between the number of bats and temperature, but big brown bats definitely move around between roosts a lot more than little brown bats as we can see from both big brown roosts. There are numerous periods at both sites where zero bats are present but large numbers show up within a day. Big brown bats could be less tolerant of high temperatures. Based on our captures of bats free-

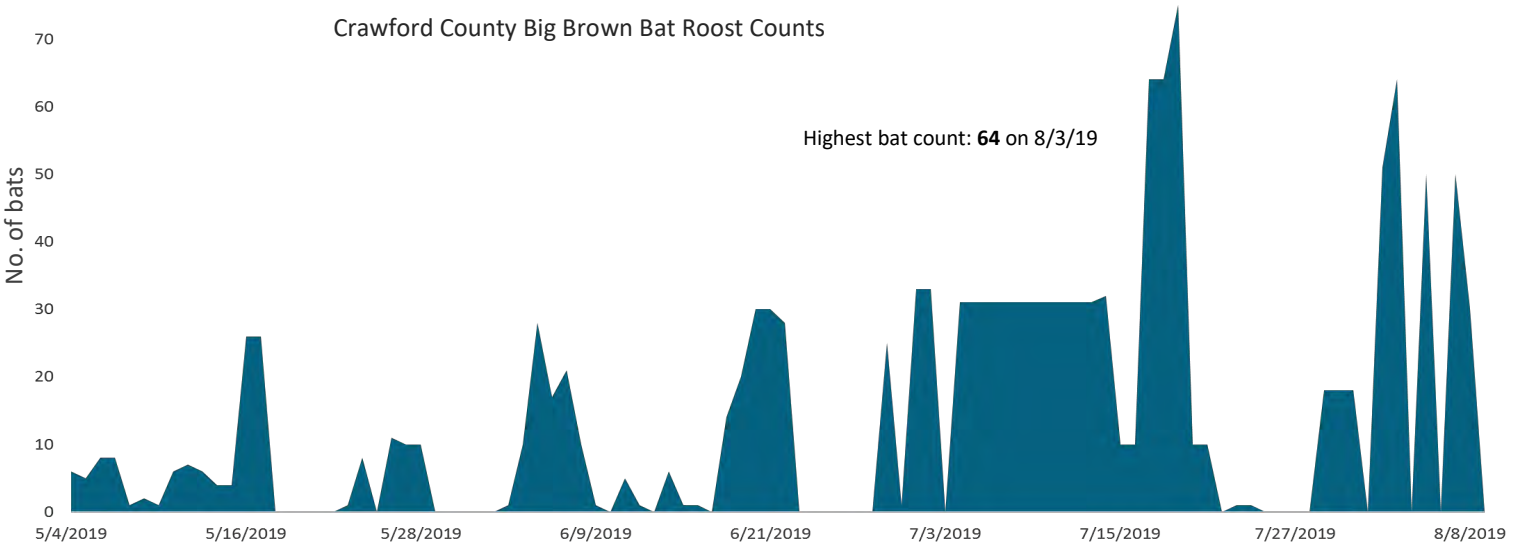
Cont. on next page

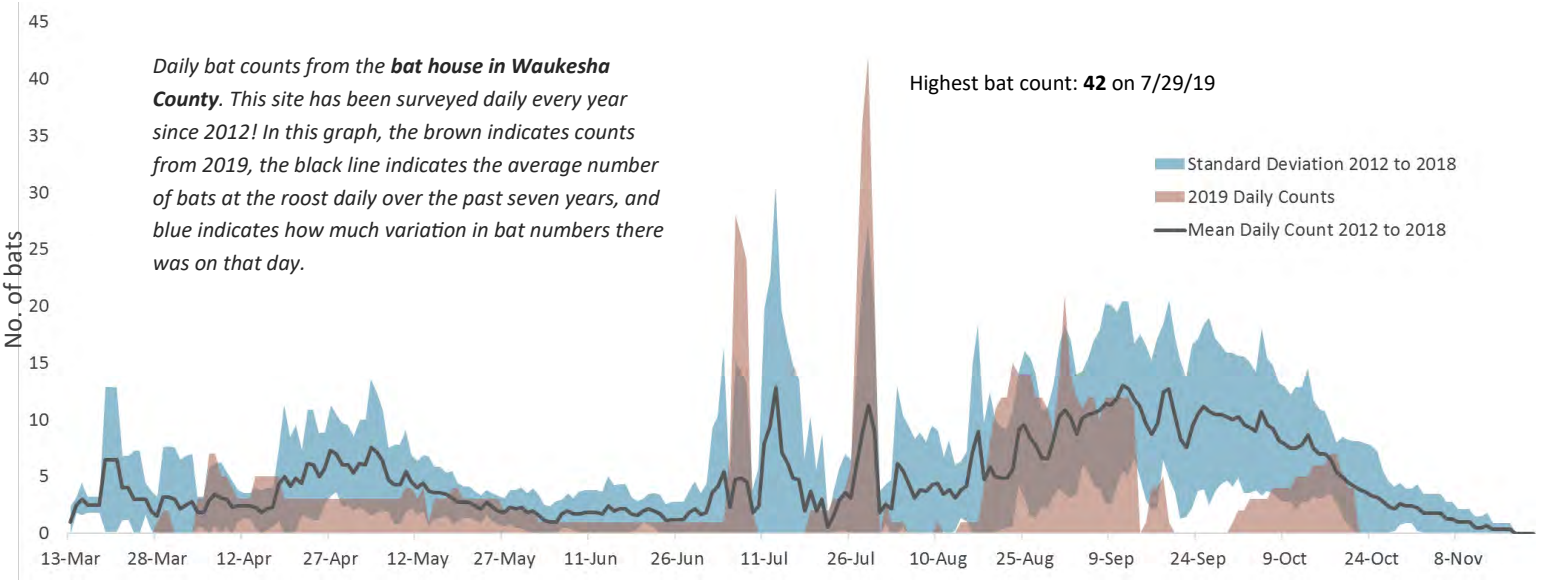
Daily emergence counts cont.

flying and at roost sites, big brown bats appear to have a higher parasite load which could be another cause of more frequent roost switching[3].

Despite the current unknowns, it is still fascinating to see these patterns, especially repeated in the case of the Waukesha roost!

A big brown bat emerges from the bat house in Waukesha County that is monitored daily. Photo: J. Edlhuber





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

Researchers in the West have described situations where bats fly 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.

Impacts of white-nose syndrome

There is no doubt that we have seen impacts on summer bat colonies from white-nose syndrome; however, impacts are varied and may not be as dire for some species as we expected. Like biologists watching populations in the east, we have observed 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. It could be where and what conditions bats are hibernating in. 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 banding important. We can track big brown and little brown bat populations long-term with CBM summer bat counts. With banding efforts we 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.

Persisting 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. Two roost sites along the Mississippi River in Grant County again had post-volancy counts of over 50% of historical numbers. These sites used to be home to more than 1,500 and 3,000 bats meaning both roosts continue to house significant colonies in the age of WNS. Another roost identified in 2017 in Door County along Lake Michigan housed over 600 little brown bats in 2019 however we don't have historic counts for this site and we don't know what declines from WNS the site experienced. During banding at this Door County site this summer, we recovered several individuals banded in 2018 indicating that these bats may be either immune to WNS or they hibernate in conditions where the fungus can't grow as well. Recoveries like these highlight the importance of marking individuals.

Banding is one method used to monitor individual bats over long periods of time, and provides the opportunity to recapture bats at locations other than where they were banded. ***Above left****: A little brown bat in Door County banded in 2018 and recovered in 2019.* ***Above right:*** *Little brown bats use the brick chimney as a thermal mass to stay warm. See if you can spot the banded bat on the chimney!*

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. This summer we were able to help coordinate and complete several projects at reported summer roost sites.

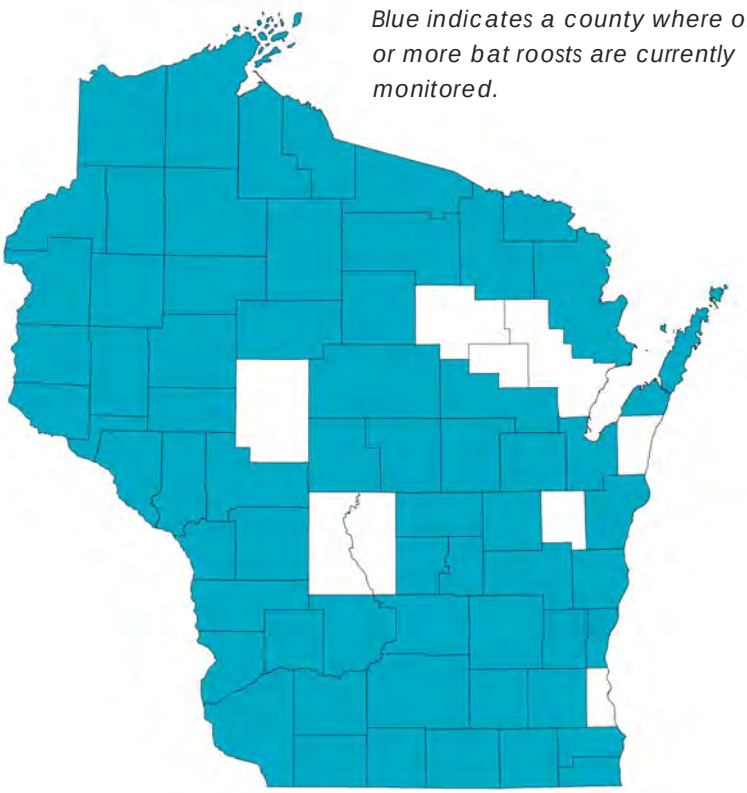
A little brown bat ready to go with its temperature logger backpack that will record what conditions the bat is hibernating in a cave or mine in winter. The goal is to recover the dataloggers in spring when bats return to summer roosts.

- **University of Wisconsin-Madison project investigating bat diet and the importance of bats as pest control in the state.** Amy Wray, PhD student of Dr. Claudio Gratton and Dr. Zach Peery, coordinates a project collecting guano and insect samples at summer roosts around southern Wisconsin. The guano is analyzed genetically and the project will get a detailed look at diet of bats roosting in agricultural landscapes. The project began in 2014 and last summer was the final field season, but with five years of data, Amy can track colonies and their diet as WNS invaded the state. Some of the participating landowners collect guano for Amy, while other sites get full surveys of bat activity, guano, and insect collections. From analyzing collected guano, Amy has found that both little brown bats and big brown bats consume mosquitoes![4] Amy has also looked at historical diets for little brown bats and big brown bats by analyzing carbon and nitrogen isotopes in hair samples from museum specimens. Stay tuned for more information on that!

- **Linking hibernation site conditions with surviving bats.** In the western United States, bat biologists know little about where and in what conditions hibernating bats spend the winter. White-nose syndrome was found in Washington state in 2016, but tracking the disease and its impacts in the region has been difficult because biologists can't simply go underground and monitor bats. Based on the impacts of WNS on bats in the East, research suggests that some underground conditions are more conducive to growth of the fungus. To figure out if bats in western US might see the same declines in bats due to hibernacula conditions, biologists from US Forest Service developed tiny backpack dataloggers which record temperature and humidity. The backpacks are attached to the bats in late summer, carried through the winter and retrieved in spring when the bats return. USFS wanted to be able to compare what they find in western US with bats tagged in the Midwest, so in early August, we tagged bats at four Wisconsin roost sites reported through the roost monitoring project. We look forward to seeing the backpacks and results in the spring when bats return!

Continuing the Bat Roost Monitoring Project

Over the past ten years (yes it's been ten years since we started roost monitoring!), 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 landowners and volunteers are extremely valuable and we will continue monitoring current (and future!) roosts 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. If you know of a bat roost in a county lacking a monitored roost, or even in a county where bats are currently monitored, please feel free to report it!



Blue indicates a county where one or more bat roosts are currently monitored.

Based on surveys conducted by you, bat colonies in Wisconsin appear to be stabilizing following impacts from WNS. As we determine what potentially recovering populations look like, the data you collect about your roosts help us understand that not all colonies are affected equally, and some habitat may be more suitable than other habitat now that fewer bats are on the landscape. Thanks to you we can also learn about reproduction and whether bats in the region might fully recover, or if what we observe now is the "new normal" for little brown bats.

Little brown bats roost in a kiosk sign in Oneida County. Photo: K. Ortman

The bat roost monitored project is able to thrive because of the incredible work of volunteers and landowners. **We 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 truly 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 preparing for the disease. It may seem excessive, but thank you. We cannot continue the program without your help and support.

Heather Kaarakka
Bat Roost Project Coordinator

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

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

608.266.2576

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

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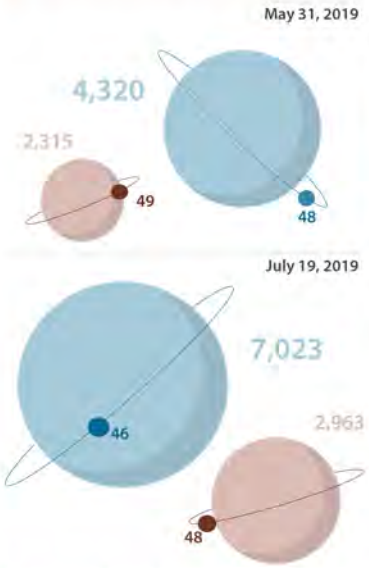
2019 Roost Monitoring Report

774 surveys
were completed in 2019, counting
13,408 bats

Great Wisconsin Bat Count

The goal was to count as many roosts as possible in a single weekend.

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



Attics and bat houses attract large crowds

In 2019, attics and bat houses hosted the largest numbers of little brown bats.

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

Where do bats live?

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

Meet a couple of our bat species

Two bats that use artificial roosts in Wisconsin are the big brown bat and the eastern pipistrelle

Eastern Pipistrelle
Perimyotis subflavus

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

Big Brown Bat
Eptesicus fuscus

This beetle-eater uses barns and other buildings as roosts in summer. They usually overwinter in caves and mines, but occasionally hibernate in buildings.

A bat colony's 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.

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 2019

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

Produced by the Wisconsin Department of Natural Resources and the Bureau of Natural Heritage Conservation | 101 S Webster St, Madison, WI 53707 | DNRBureauofNaturalHeritageConservation@wisconsin.gov