2020 ROOST MONITORING REPORT

By Heather Kaarakka

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Wisconsin Bat Program
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Bat "condo" sketch by Heather Kaarakka

WISCONSIN BAT PROGRAM

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As everyone is well aware, the pandemic upended daily life in 2020 and summer bat roost monitoring was no exception. But, if we've learned anything about our volunteers and monitors it is that you are an exceptionally dedicated group of scientists! This year you conducted nearly 600 emergence surveys and counted over 12,000 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 2020!

Big brown bat snug in a bat house. Photo: D-M. Staccia.

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] .

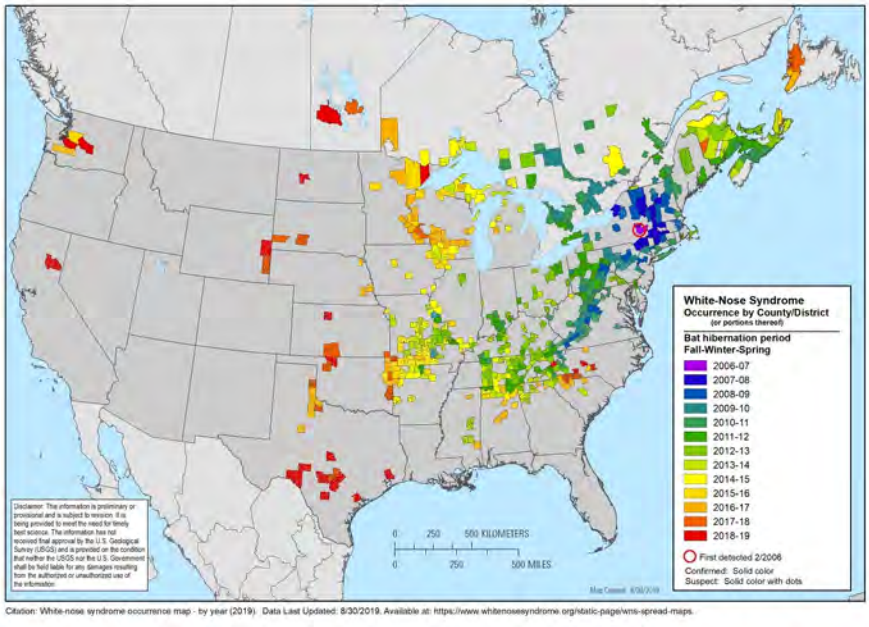
A single little brown bat can consume up to 1,000 mosquito-sized insects in one hour!

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 2020.

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.

Big brown bats peak out of a single-chamber bat house in Vilas County. Photo: M. Peczynski

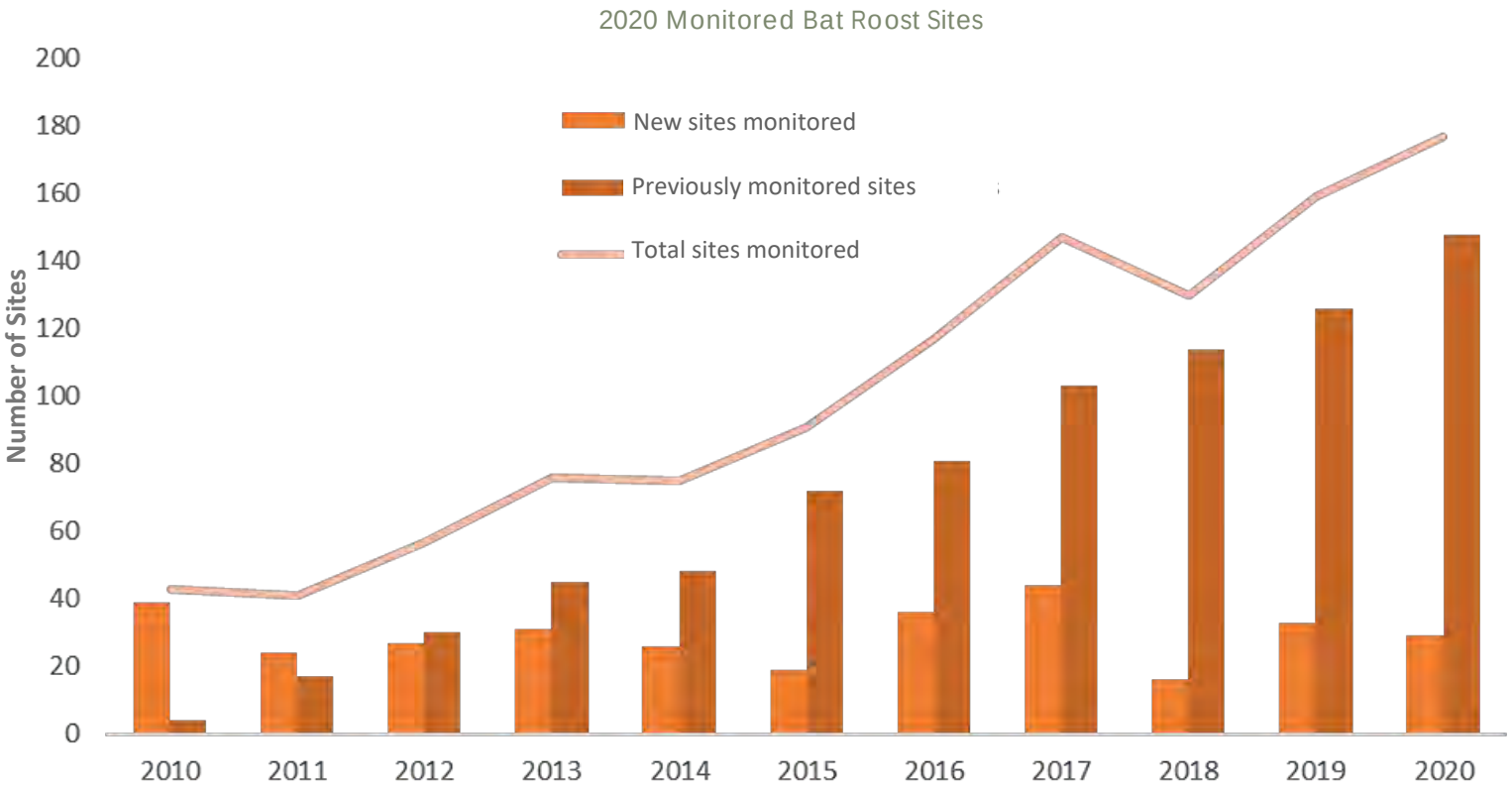
Roost monitoring in 2020

This year, 206 volunteers conducted nearly 600 emergence surveys in 52 counties from March to October. Volunteers monitored 178 roosts in summer of 2020 including 29 newly reported roost sites!

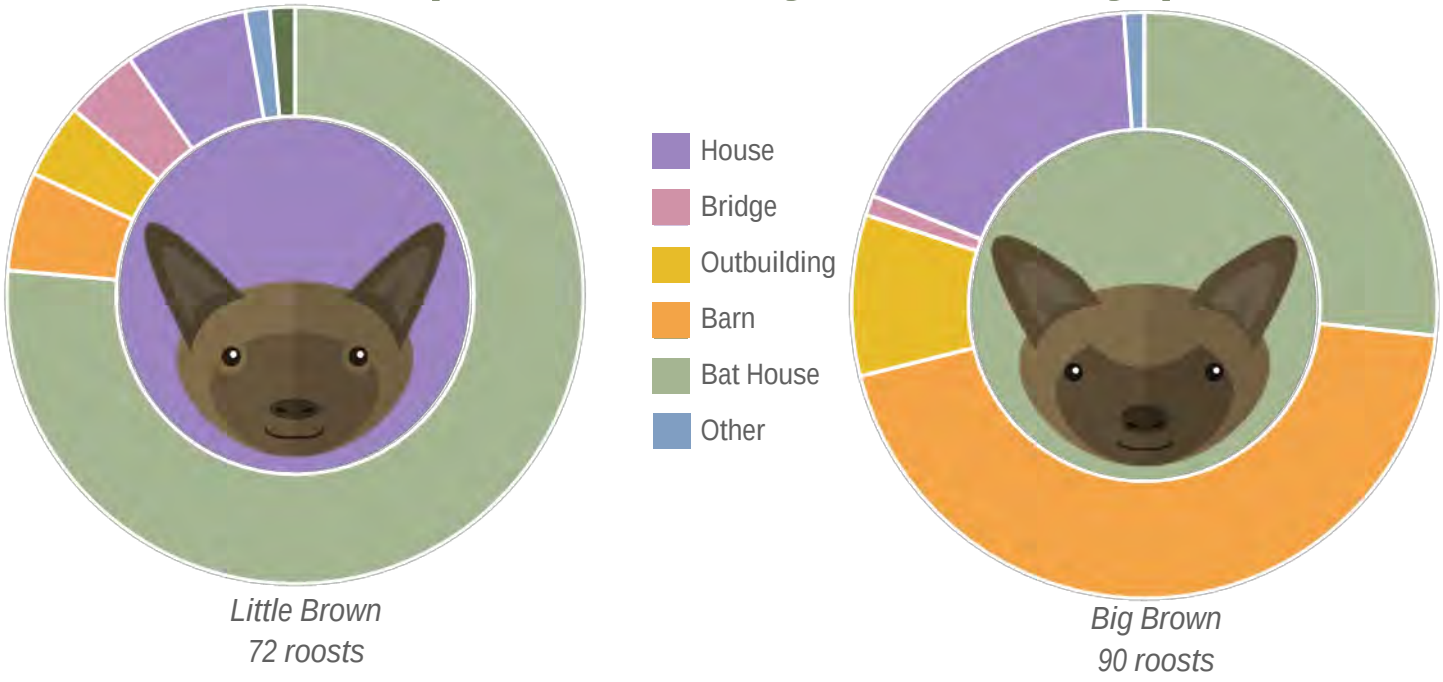
In 2020, the **total little brown bats** counted– **7,771**– was down again from the 2016 total count, but fewer little brown bat sites were surveyed this year and this number is similar to the total count in 2019. The **total number of big brown bats** counted – **4,792**– was up yet again since 2017—2019. Total numbers counted are estimated from the highest counts at each site. Six eastern pipistrelles were counted at only one site in 2020. Little brown bat roosts comprised 40% of monitored sites in 2020. Big brown bats were counted in 50% 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: New big brown bat pups were observed in a bridge roost in Lafayette County.

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

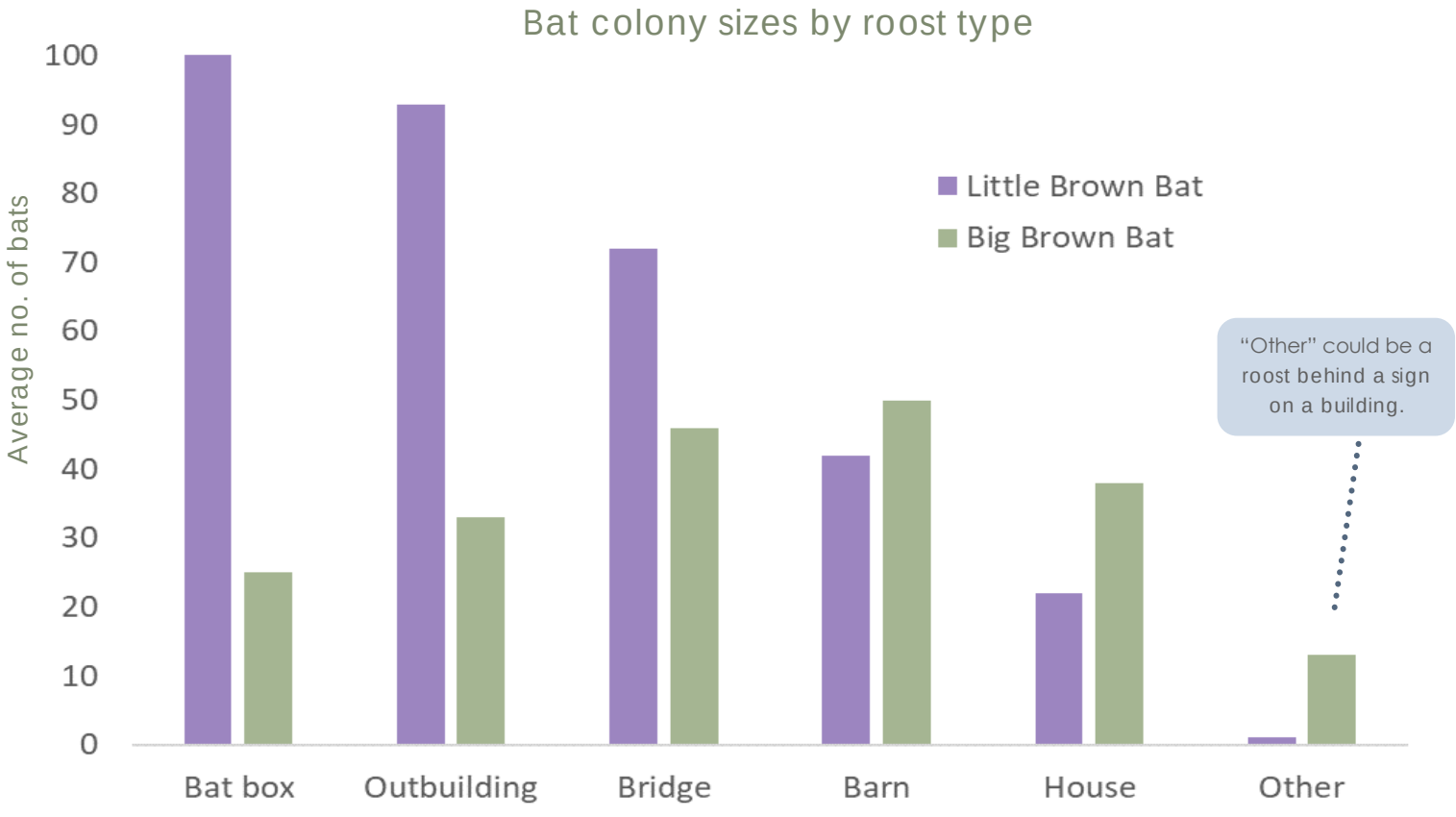


Little Brown
72 roosts

Big Brown
90 roosts

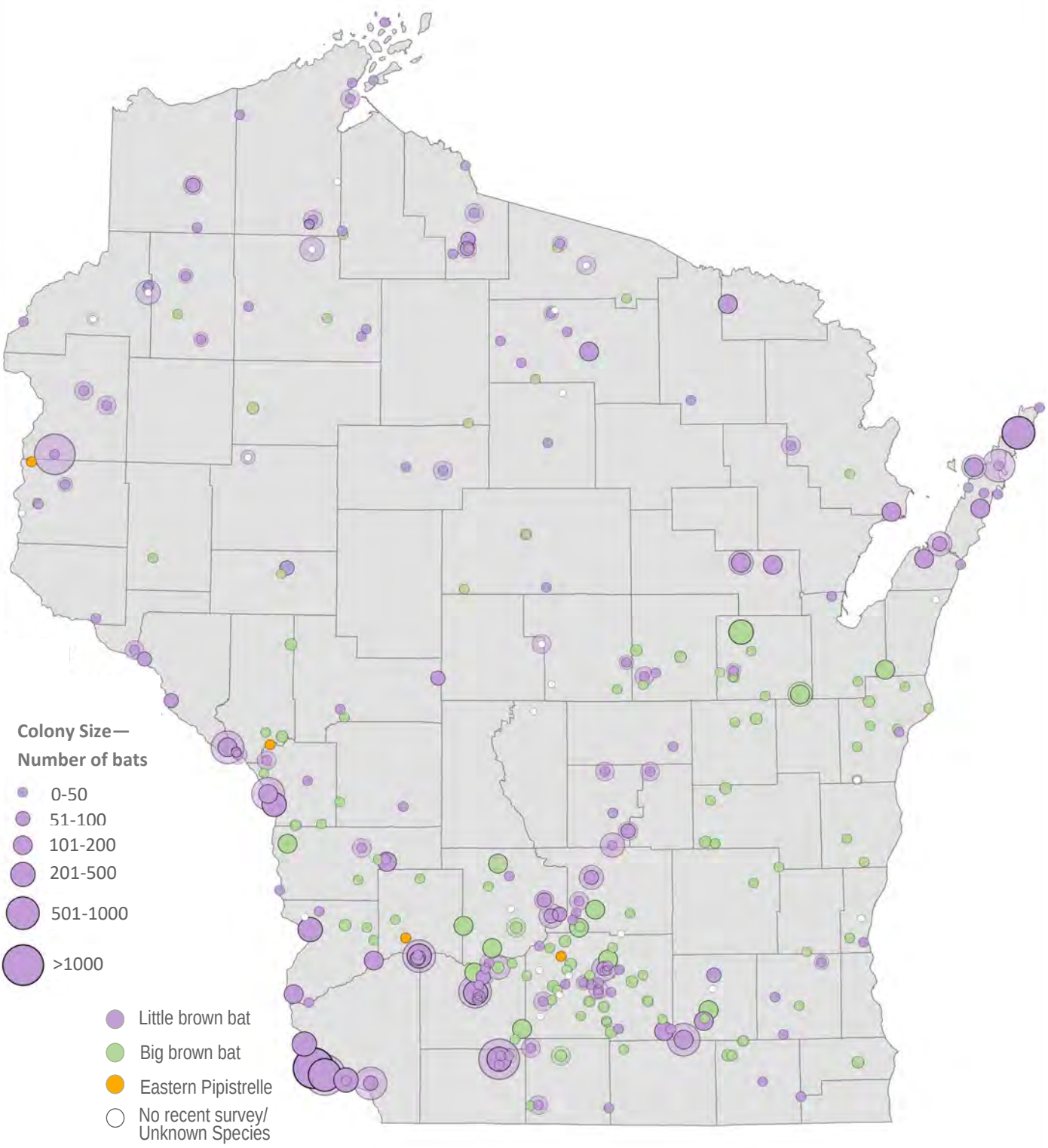
Above: Sites of each species are split by type of roost. Little brown bats were found most often in bat houses, and big brown bats preferred barns.

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 in summer) had several average little brown bat roost colony sizes by type between 300 and 600 bats. Below for 2020, the highest little brown bat average colony size barely reached 100 bats, however several large little brown bat sites were not surveyed in 2020.



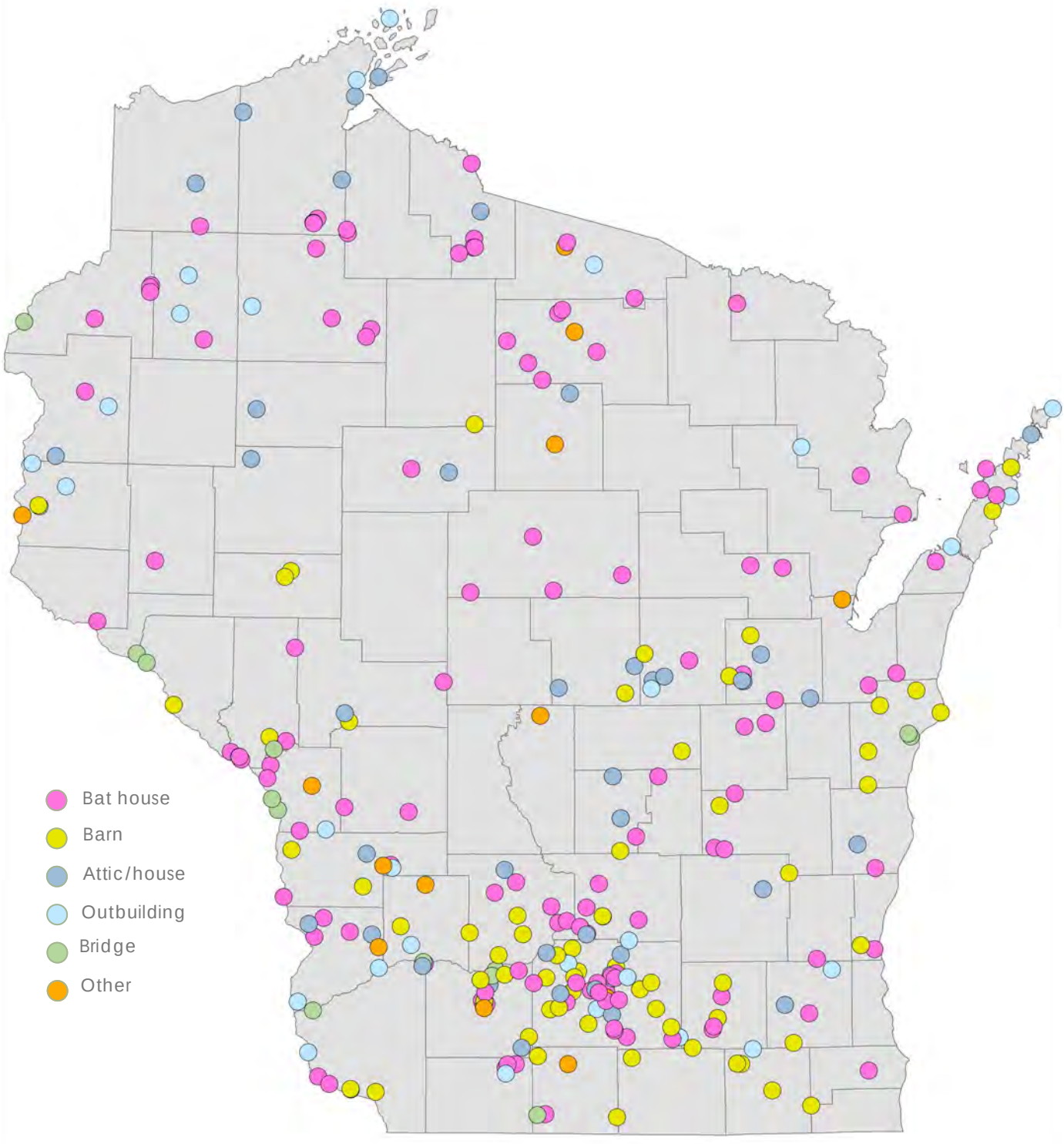
Bat roosts by size

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 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.

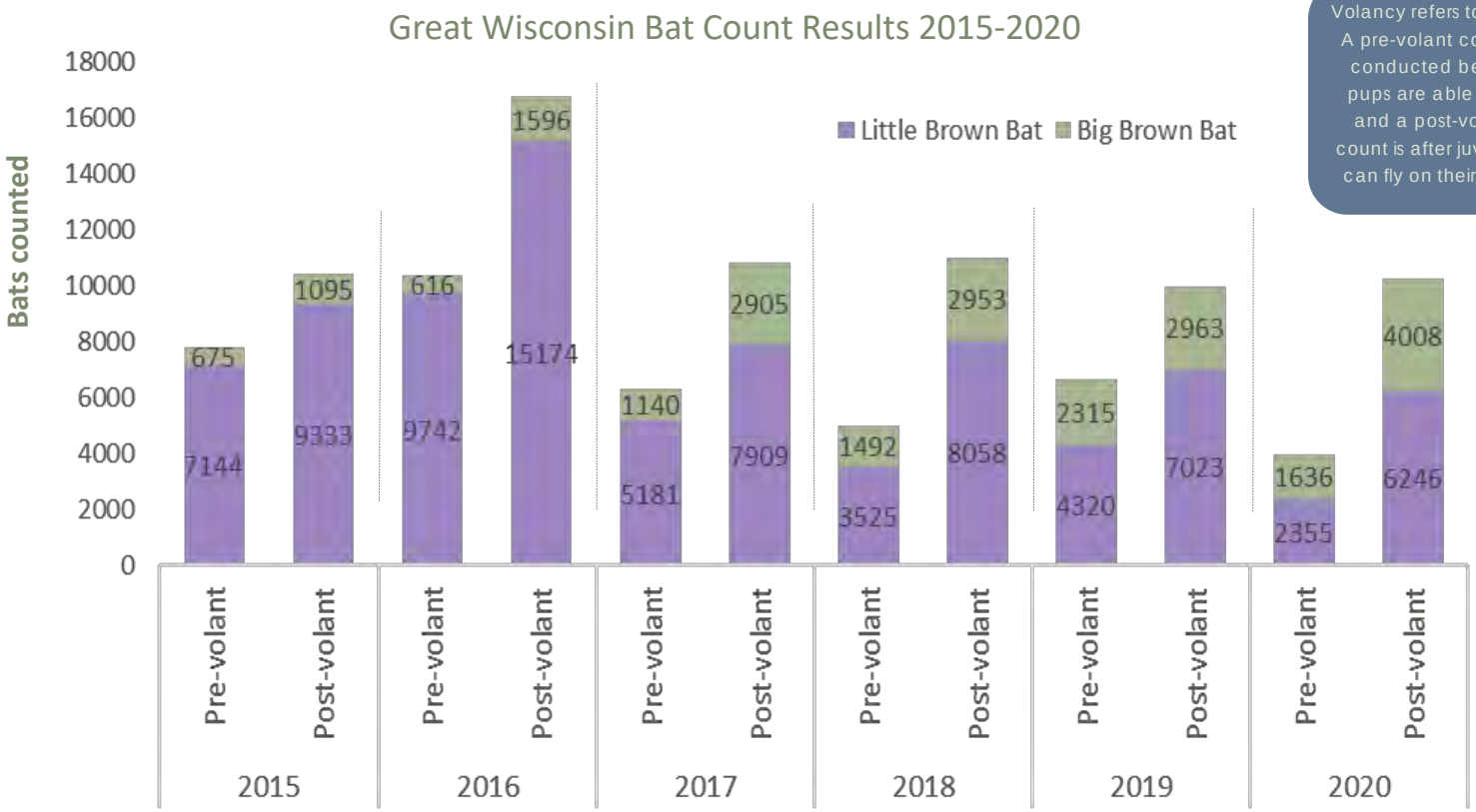


Sixth annual Great Wisconsin Bat Count

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. This year looked a little different, but monitors still counted **3,991** bats in June and **10,254** bats in July!

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 in 2015

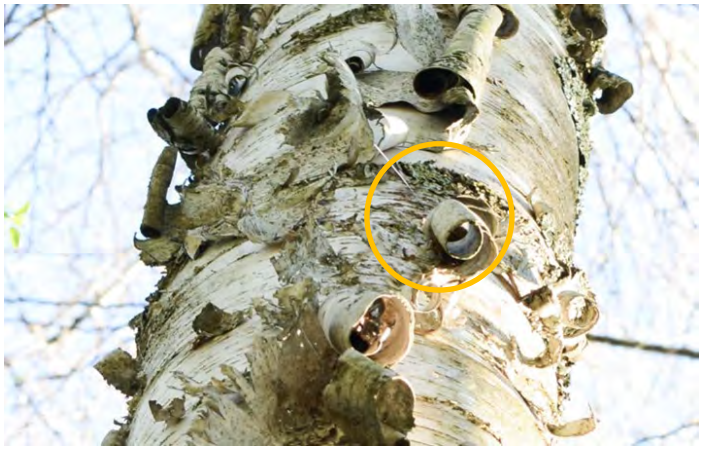
Migratory roosts

Most bats in North America have two distinct habitats—in summer bats need places to roost and forage, and in winter bats either go to underground sites to hibernate or migrate south to warmer conditions. For species that hibernate underground (little brown bat, northern long-eared bat, eastern pipistrelle and big brown bat) we have a pretty good idea of places where they spend the winter and thanks to roost monitors, we know where some little brown bats and big brown bats spend their summers. But what about in between winter and summer habitat? Hibernating bats may make short migrations, usually less than 50 miles though sometimes more than 100 miles. These bats typically can't make a 100 mile migration in one night, although it has happened (95 miles traveled by an Indiana Bat on one spring night![3]). If bats need to travel long distance but can't make it the whole way in one night, they likely use temporary roost sites during migration. At these transient roosts bats will rest, forage and then move along.

Though very little is known about roost site selection during spring and fall migration, it is possible bats don't have the same requirements as summer roosts and these temporary roosts may be chosen based on location rather than specific conditions such as temperature. For example in late summer and sometimes early spring we observe solitary bats roosting on the sides of our office building in Madison. These bats may stay for a day or a week.

In addition to observing big brown and little brown bats during the shoulder seasons in Madison, migratory bats such as silver-haired bats have also been seen roosting on the trunks of trees. The lakes in Madison

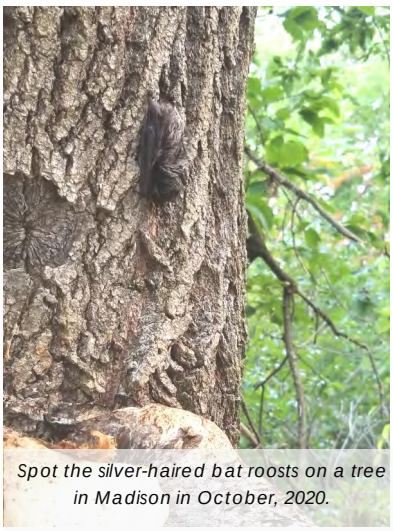
A big brown bat roosts in a sheltered place on the DNR office building in April.



A tricolored bat (in yellow circle) tracked during spring migration from a hibernation site in Pierce County, WI was found roosting alone in a birch tree about 35 miles away along the St. Croix River. The transmitter antenna can be seen protruding from the bark.

may be an important landmark that bats use to navigate long distances. Other important bodies of water that we think bats use to navigate include the Lake Michigan shoreline and the Mississippi River corridor. It is common to see silver-haired bats and eastern red bats on buildings and trees in Milwaukee in fall as they move south.

Female little brown bats and eastern pipistrelles may also roost together for a short time before settling on a maternity roost to use for the summer. For example, one roost monitor has noted for several springs that little brown bats roost readily in their bat box until early June when they disappear presumably moving to another bat house or building for the summer. In Indiana, researchers observed eastern pipistrelles using building eaves as "prematernity roosts" before moving to trees to form maternity colonies[4], possibly because the leaves that these bats roost in were not fully out yet when bats return from hibernacula. Or it may help the colony form up after hibernating in different locations[4].

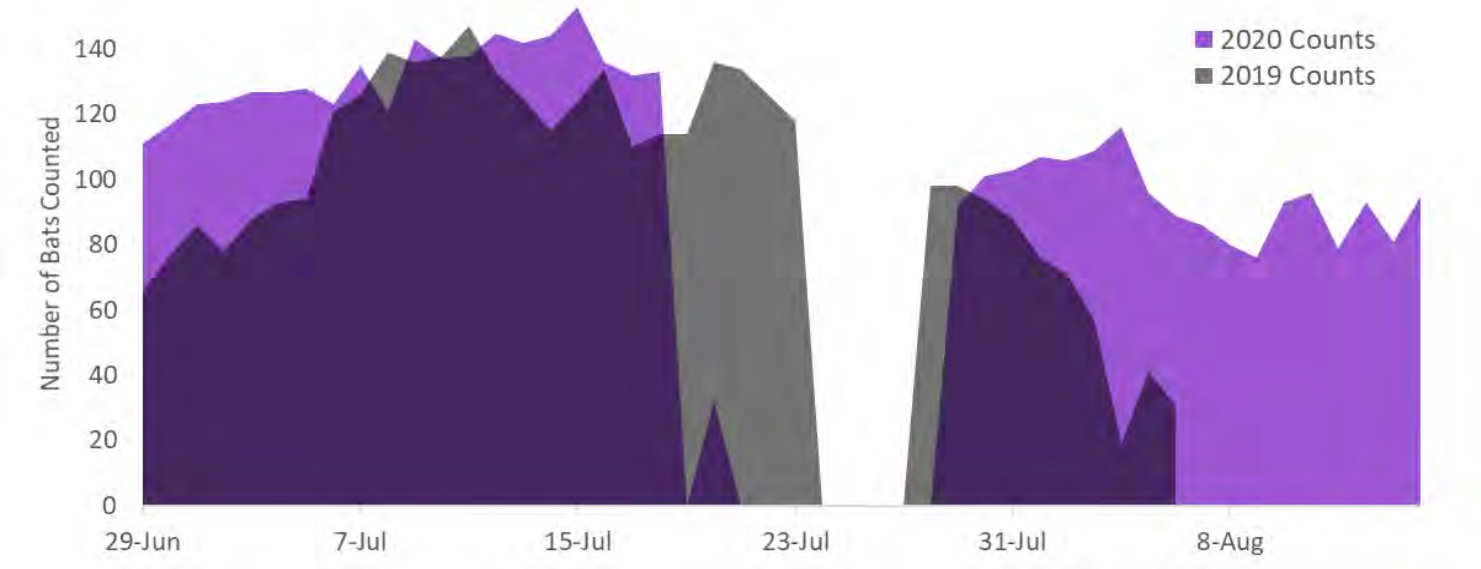


Spot the silver-haired bat roosts on a tree in Madison in October, 2020.

We still have much to learn about this important aspect of bat roost ecology. Understanding requirements of bats, especially in spring can help us better support bats during these energetically costly time periods.

Continued daily emergence counts

Though roost monitoring looked a little different this year, remote monitoring of bats was something we were able to continue. We again placed thermal cameras at little brown bat roosts which turned on shortly after sunset and recorded emergence every night. Like everything this year, we had to adapt to the changing situation and were able to put out cameras in late June, about a month later than in 2019. We left the cameras much later into the season and retrieved them in mid-September because we were curious about how long bats stay at summer roosts. As a reminder, we think bats begin leaving summer roosts as early as the beginning of August to swarm and mate at caves and mines. We were interested in learning if all bats leave within a short period of time of or if it takes a month or more to have an empty bat house. At a site in Madison where we surveyed last year and this year, the daily counts in 2020 were slightly higher than in 2019 (see below). At the end of July the number of bats counted dropped significantly each day in 2019, but in 2020 the numbers remained high. It's unclear why the bats may behave differently between years, however we learned after 2019 surveys that we began recording too late in some cases and bats may have already started emerging before the camera turned on resulting in fewer bats. In 2020 we were able to get more complete counts.



Above: Daily bat counts from a Madison roost in July to August 2019 and 2020. Gaps in late July both years were because the battery ran out or the camera was pointed away from the bat house.

We still have a month of daily counts left to complete at the Madison bat house, but the last days of the camera (Sept 16-Sept 17) showed that 23 little brown bats were still present! We're interested in learning how quickly the bats move on in late August to go from 95 bats on Aug 16 to 23 bats on Sept 17.

Despite some missing data we can begin to observe yearly variation in numbers of bats in boxes thanks to the cameras. We also develop even more questions. For instance, are more bats in 2020 indicating that this colony is recovering and even increasing? We look forward to more analysis and even more data next year!

Thank you to all the landowners and managers who allowed us to continue daily recording at their important bat roosts!

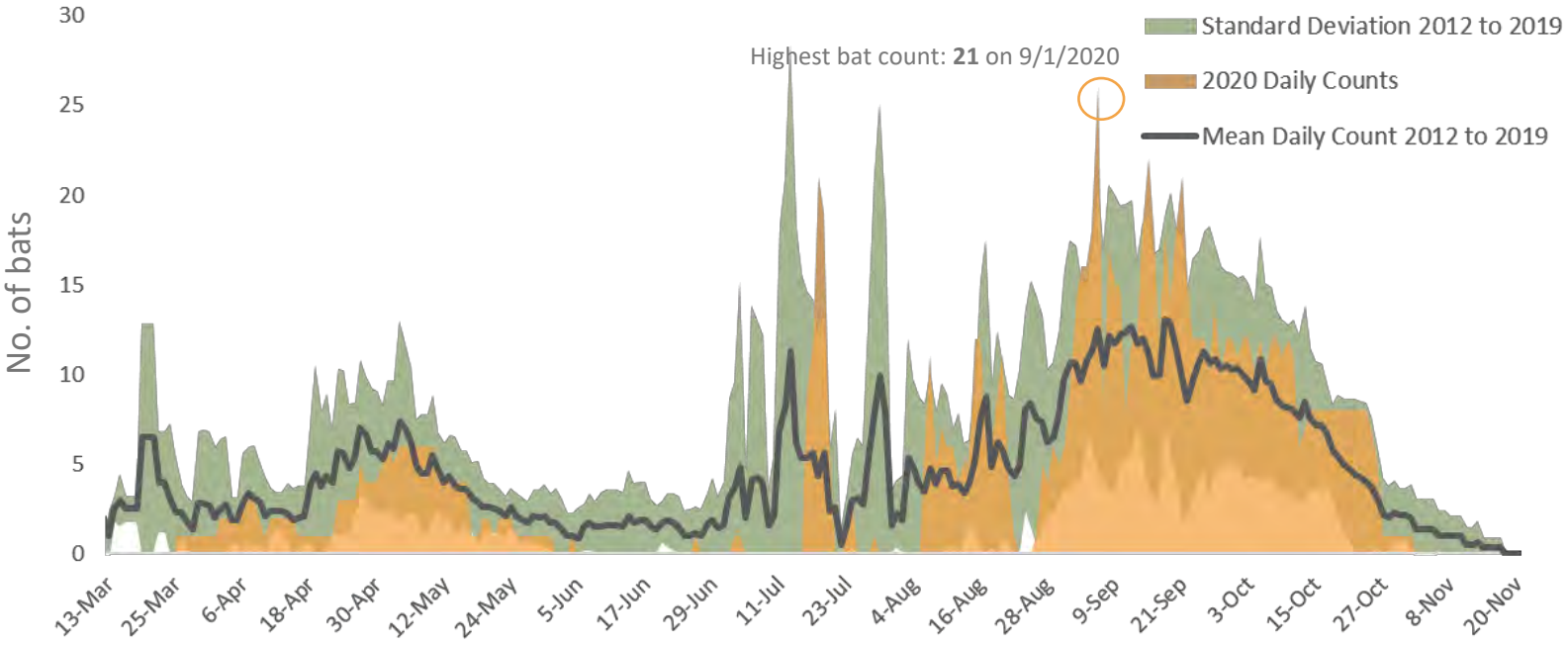
A little brown bat (in circle) emerges from the Madison bat house in 2020. We alter the colors in the footage so that we can more easily see the bats.

Big Brown Bat Roost Daily Counts

Daily surveys also continued at the big brown bat house in Waukesha County! The most bats counted this year was 26 in early September. The highest number of bats counted each surveyed year has been between 17 in 2018 and 49 2013. When the most bats are counted has also varied over the years. The most bats ever counted at this bat house (49) was observed in mid-July, likely due to volant juveniles exploring, whereas the high count from 2020 was observed on September 1 possibly from bats moving from summer to winter habitat.

We again saw spikes in numbers 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 2020. Though the exact timing of arrival and number of bats varies, it is interesting to see how much bats can be creatures of habit!

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



Daily bat counts from the bat house in Waukesha County. This site has been surveyed daily every year since 2012! In this graph, the brown indicates counts from 2019, the black line indicates the average number of bats at the roost daily over the past seven years, and green indicates how much variation in bat numbers there was on that day over the past 8 years.

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. Several 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 bats meaning these roosts continue to house significant colonies in the age of WNS. This winter we plan to look at 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 we've been watching, this one has seen a slight increase in bat numbers this year since steep drops in 2017 and 2018. Photo: J.P White

Through banding bats at many summer roost sites we've learned that many colonies have bats that are surviving white-nose syndrome infection. During coordinated summer roost work with USGS Wildlife Health Center in 2020 we recaptured three female bats who were banded in 2017. These recaptures suggest that some bats are indeed surviving white-nose syndrome and not simply bats redistributing among roosts.

Left: Banding efforts like this one in 2015 are the way we've been able to recapture marked individuals years later and assess survival.

How Wisconsin Bat Program uses information from volunteers

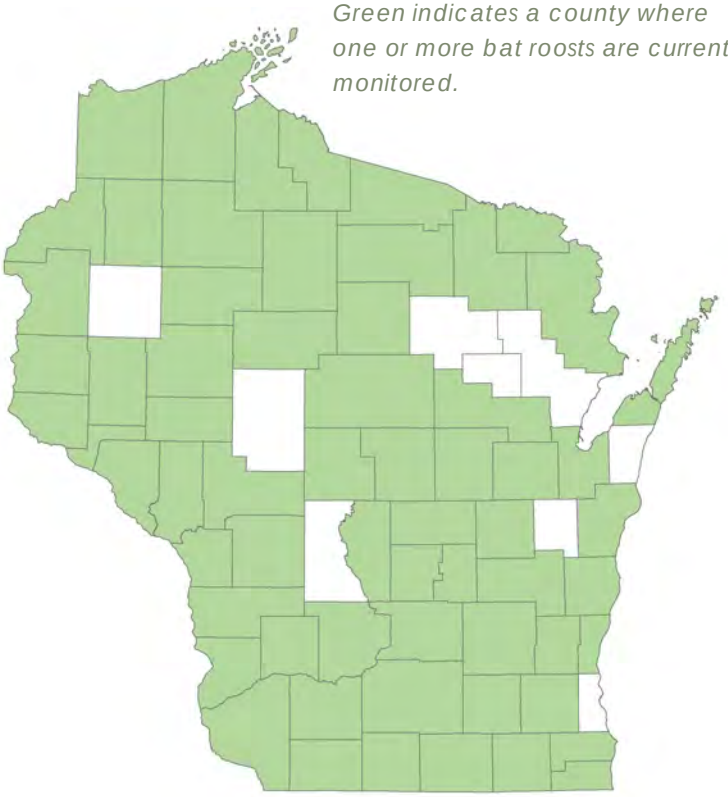
Reported and monitored bat roosts are important for furthering research and understanding of bats and white-nose syndrome in Wisconsin. Thanks to the efforts of volunteers and landowners, Wisconsin is unique and fortunate to have an established database of summer roost sites throughout the state which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

A data logger backpack retrieved from under a bat house after it had fallen from a bat who carried it through the winter. These backpacks were designed by Ted Weller, USFS, to record conditions in sites where bats hibernate. This backpack was put on a bat in Aug 2019 at a summer roost and found in spring 2020 at the same roost.

- **University of Wisconsin-Madison project investigating bat diet and the importance of bats as pest control in the state.** Amy Wray finished the guano—bat diet project in early December! Over four years she and her team collected guano samples from 10 little brown bat and big brown bat roosts in southern Wisconsin, analyzed over two million insects from her traps and quantified the potential impact of dramatic loss of little brown bats due to WNS. Amy and her team found that both little brown bats and big brown bats eat a wide variety of insects and there is some overlap of the diets for the two bats, but the amount of overlap didn't change over time or since WNS. So it's unclear whether big brown bats will fill the dietary niche of the little brown bats now that there are fewer of them. Amy and her team also looked at how many insects were trapped at her sites and found a brief increase in the number of midges after declines in little brown bats from WNS. They found little brown bats do consume a lot of different types of midges, so this could suggest that locally little brown bats were checking midge populations. Amy and her team found that both bat species consumed 24 pest insects like leaf rollers, cutworms and fruit flies, but the genetics analysis she was conducting can only identify type of insect, not how many are consumed, so it is difficult to quantify how many pests our bats eat every summer. Regardless, the work of Amy and her team has been an important part bat research in Wisconsin and we have learned a lot from the project.
- **Linking hibernation site conditions with surviving bats.** The USFS temperature backpacks applied to bats at summer roosts last year spent a winter on bats and we were able to find several under one of the bat houses! Unfortunately due to the pandemic we were unable to trap bats and recover more backpacks, but they were intended to be temporary so the backpacks came off the bats on their own. We await results from the backpacks we retrieved this summer.
- **Differences in declines at summer roosts.** Some declines observed at summer roosts due to WNS 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. This winter, using count data collected pre– and post-WNS at little brown bat roosts across the state we plan to investigate what might play roles in the differences in declines that we see. Does distance to water or how long the roost has existed impact how much a site declined? Learning these details can help us determine management of summer roosts moving forward.

Continuing the Bat Roost Monitoring Project

Over the past eleven 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 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!



Green 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:
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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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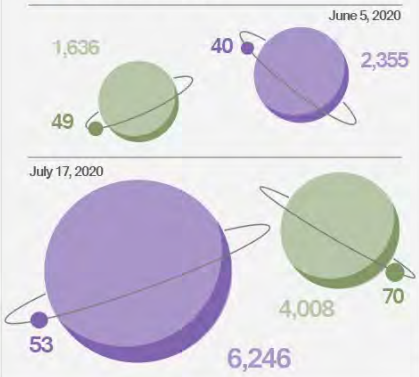
596 surveys were completed in 2020, counting **12,844 bats**

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



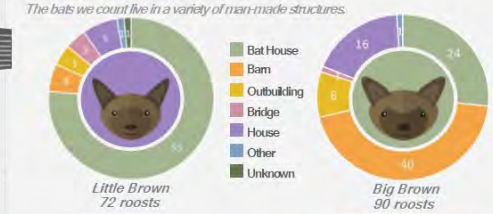
206 volunteers reached for their clicker-counters to help count bats this summer

Bat houses, outbuildings draw bat crowds

In 2020, bat houses, outbuildings and bridges housed the largest numbers of little brown 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 little brown bat and big brown 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

Big brown bat

Eptesicus fuscus

This bat likes to eat a variety of beetles, moths and other insects, and prefers to roost in barns and bat houses in summer. In winter these bats hibernate in caves and mines and occasionally buildings.

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 2020

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