THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Agriculture and Natural Resources

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White-Nose Syndrome

A Deadly Disease of Bats

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White-nose syndrome (WNS), named for the fuzzy white fungus appearing on the noses of infected bats (Figure 1), is an emerging disease responsible for the death of over 6 million bats in the past 6 years. First discovered in New York during the winter of 2006–2007, WNS has spread rapidly across eastern North America. Given the economic and ecological benefits bats provide through insect control, WNS raises concern over potential impacts to a number of different ecosystems.

Figure 1. Bat with white fungus on nose. *Photo courtesy Ryan von Linden/New York Department of Environmental Conservation.*

Benefits of Bats

Bats are frequently misunderstood by the general public, but despite public attitude, bats provide multiple benefits. With over 1,200 species worldwide, bats provide a number of ecological services from plant pollination and seed dispersal to pest control and contributions to the medical field. The majority of the 45 bat species in the United States are insectivores, meaning their diet consists solely of insects. They are the primary predators of night flying insects and because true flight requires a substantial amount of energy, bats must consume large amounts of food. A single little brown bat, a common species in Ohio, can consume 50–100% of its body weight in insects each night. Bats can travel miles in a single night to feed, providing valuable insect control in many different ecosystems such as forests, urban areas, and agricultural landscapes. In Ohio, there are 11 species of bats, each consuming tons of nocturnal insects every year. Ohio bats feed on many different insects including moths, beetles, flies, true bugs, and hoppers.

Bat Life History

Ohio bats are active from early spring through fall, but during the winter months, when insects are mostly unavailable, bats must hibernate, migrate, or do both to survive. In Ohio, some bats will migrate great distances, such as the red, hoary, and silver-haired bats. Where these species travel to and from is largely unknown, making this stage of their life cycle an area of particular interest to bat researchers. Other species will partake in somewhat shorter spring and fall migrations to caves and abandoned mines

where they spend the winter months hibernating. In Ohio, these "hibernacula" (a place where an animal hibernates) are mostly located in the southern and eastern parts of the state, where mining historically occurred. It is in these caves and abandoned mines where bats encountered WNS.

What is White-Nose Syndrome (WNS)?

WNS was first documented on hibernating bats in a cave in New Albany, New York, during the winter of 2006–2007. Infected bats appeared to have a white substance on their noses, later identified as a fungal growth, which gave rise to the name, "white-nose" syndrome. Dead bats were also found on the cave floor, with the same white fungus present on their bodies. While the cause of death was unclear at the time, it was deduced that this white fungal growth was connected to the deaths of these bats. In the next few years, WNS spread over 400 miles through hibernacula in New York and several other northeastern states. Unprecedentedly high mortality rates of bats were reported, ranging from 70–90% in some caves to 95–100% in others. In the four winters since its discovery, WNS has spread to over 20 states in the northeast, Midwest, and southeast United States. It has spread as far west as Oklahoma and Missouri, into several Canadian provinces, killed over 6 million bats, and is still spreading (Figure 2).

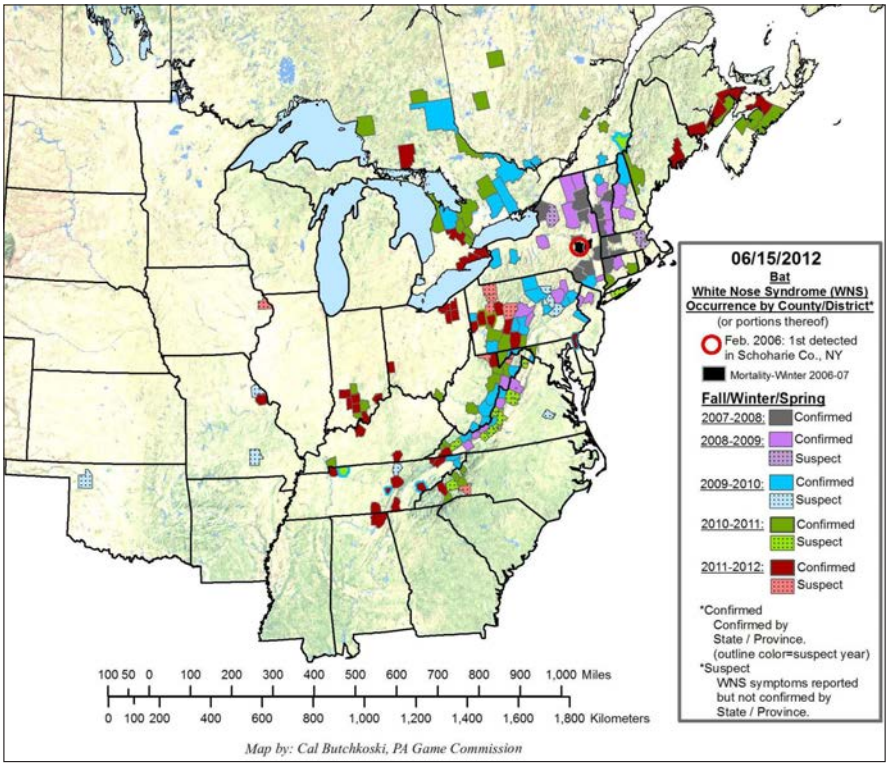

Figure 2. As the disease continues to spread, maps of infected states are constantly being updated. *Updated maps can be found at: www.WhiteNoseSyndrome.org.*

Has WNS been found in Ohio?

WNS was confirmed in Lawrence County, Ohio, in March 2011. It was found in an abandoned mine closed to the public within the Wayne National Forest during a bat survey. During the winter of 2012, WNS was again found, this time in Preble County and in several northeast Ohio counties. Based on reports from other states already impacted by WNS, high mortality rates are attained 2–3 years after WNS is first found. Only time will tell the extent to which Ohio bat populations are impacted.

What causes WNS?

For several years, the cause of WNS was a mystery. The white fungal growth was identified as *Geomyces destructans (G. destructans),* a fungus previously undiscovered in the United States. *G. destructans* is a fungus associated with cool, damp conditions. The caves and mines where bats hibernate provide the optimal climate for the fungus, which grows at temperatures ranging from 41 to 57 degrees Fahrenheit. The caves also provide a host—the hibernating bats. For several years following its discovery, it was still unclear as to whether *G. destructans* was the primary cause of the disease or a symptom of something larger. In 2011, the mystery was solved. Scientists reported the cause of WNS was indeed the fungus *G. destructans.*

How does WNS kill bats?

Despite the name "white-nose" syndrome, the fungus not only appears on the noses of infected bats but also the wings, ears, tail membranes, and feet. While the fungus is the most visual sign that a bat is infected, there are also behavioral signs of infection, and sometimes these occur before the actual fungus.

Such behavior signs include bats waking from hibernation more often than normal, bats moving closer to entrances of the hibernaculum, and bats flying outside a hibernaculum during winter, often during the day.

Many aspects of WNS are still unknown, such as how *G. destructans* results in the death of a bat. There are two prevailing theories currently under investigation. Both stem from the fact that WNS disrupts the hibernation cycle of infected bats, causing them to wake more often than uninfected bats. Bats will occasionally wake from hibernation to dispel waste, hydrate, or to stretch their limbs. It takes a significant amount of energy for a bat to arouse itself from hibernation. If this happens more than normal, a bat may deplete its energy reserves and will need to replenish them with food in order to survive the winter. Bats infected with WNS have been reported to wake from hibernation two times more frequently than uninfected bats. The reason why is still unknown. One theory is hunger. This may be why bats infected with WNS are seen flying from caves during the winter; they are looking for food that is not available.

The second theory as to why bats are waking more often from hibernation stems from the damage *G. destructans* causes to the wings of infected bats. *G. destructans* is unique in that it invades the skin tissue of bats, actually digesting live cells. For most mammals, a fungal infection does not invade living skin tissues but remains on the surface and often triggers an immune response such as itching, swelling, or welts. *G. destructans,* on the other hand, does not stay on the bat's skin surface nor does it trigger an immune response; it proceeds to digest live skin cells unopposed. Cases of long-term infection can result in numerous holes in a bat's wings. Because bats rely on their wings for water balance, circulation, and thermoregulation during hibernation, this type of damage to the wings may have serious consequences, such as dehydration or homeostatic imbalance.

Current research on WNS is centered on all aspects of the disease, including the mechanism in which *G. destructans* causes death. The sooner answers to these and other questions are provided, the better equipped biologists will be to combat the disease.

How is WNS spread?

Since the discovery of *G. destructans,* biologists have identified a multitude of non-pathogenic *Geomyces* species in North American caves. However, when the *destructans* species is present in the cave, it infects bats and causes WNS. Once one bat is infected, the disease can be transmitted bat-to-bat. Unfortunately, the manner in which bats hibernate facilitates the spread of WNS. Bats form tightly packed clusters (Figure 3) during hibernation in order to conserve heat and energy. When one bat within the cluster becomes infected, the entire cluster is at risk.

In addition to bat-to-bat spread, the fungus can also be spread from cave to cave by humans. Fungal spores have been found stuck to clothing and caving equipment. Human spread of the fungus may explain how WNS was able to spread so quickly over a large geographic area.

Figure 3. Bats cluster together during hibernation. *Photo courtesy Tim Krynak.*

Can humans contract WNS?

No evidence exists that would indicate WNS or *G. destructans* is infectious to humans. In addition, the temperatures *G. destructans* needs to grow are well below the temperatures of the human body.

Where did WNS come from?

G. destructans has been documented in Europe, leading biologists to suspect that the fungus traveled overseas to the United States by way of humans. It has been reported on bat species in Europe; however, the mass mortalities seen in the United

States are not occurring in Europe. These discoveries suggest that European bats may have coevolved with *G. destructans* and therefore developed a resistance to WNS. Further understanding of their susceptibility may help U.S. bats resist WNS.

What species of bats are affected by WNS?

All cave hibernating bats risk contracting WNS. Of the 45 bat species in the United States, over half are cave hibernating bats. Currently, 7 different species have been confirmed with WNS—the little brown bat, big brown bat, northern myotis, eastern small-footed bat, tri-colored bat, Indiana bat, and gray bat. With the exception of the gray bat, all of these species are present in Ohio. Species at greatest risk are those that hibernate in large clusters, such as the little brown bat and the Indiana bat. The Indiana bat is a federally and state endangered species, meaning populations are already small and isolated, putting this species at an even greater risk, possibly extinction, from WNS.

What are the environmental and economic impacts of WNS?

WNS may be the worst wildlife disease of the century due to its rapid spread and high mortality rates. Bats are a component of many different ecosystems, each of which depends on a diversity of species in order to sustainably function in the way humans depend. However, the biological role of bats is more than a contribution to ecosystem biodiversity. They are also important insectivores, and their mass consumption of insects, particularly night-flying insects, may be the greatest loss suffered.

Bats' insect control services benefit neighborhoods, crop fields, forests, and backyards across the country. In 2006, a study based in south-central Texas reported the annual value of Brazilian free-tailed bats at approximately $741,000, with a range of $121,000–$1.7 million, compared to the $6 million value of the annual cotton crop.

Recently, research extrapolated from these findings has attributed yearly savings of over $3 billion in pesticide application costs across the United States to bats' pest control services. In Ohio, it is difficult to attach a monetary value to bats because factors such as crop type, yield, and pests are different from those in Texas. However, studies have reported bats feeding on several Ohio crop pests, but the degree and extent of their effect across the state is still unknown. Perhaps when the impacts of their absence are studied in the northeastern states first affected by WNS, the scope and degree of environmental and economic impacts will be fully recognized.

What is the future of bats?

Bats are long-lived—some species have been documented living 20+ years—but they do not reproduce quickly. Other mammals their size, mice for example, have multiple litters of young per year and multiple young per litter. Bats reproduce only once a year and birth only 1–3 pups. This means that if something were to dramatically reduce bat populations, as is the case with WNS, it would take a long time for those populations to recover. Depending on the severity of the decline, bat populations may never recover to what they were pre-WNS.

Figure 4. Hibernating little brown bats; single bat in center with white-nose syndrome. *Photo courtesy Ryan von Linden/New York Department of Environmental Conservation.*

What is being done about WNS?

In order to reduce the risk of potential human spread of WNS to uninfected caves, cave closures have been enacted in much of the northeast. These cave closures prevent public access into the caves. States across the United States that have not detected WNS are taking proactive measures and also limiting public access to caves used by hibernating bats. To date, this is the only tool currently available for slowing the spread of WNS. Because there is a great

need for research on WNS, access into hibernacula by biologists and other researchers must be allowed. Therefore, decontamination protocol has been created to ensure that all clothing and equipment entering and exiting a cave or mine is decontaminated.

Despite the absence of a cure, the rapid spread and mass mortalities of WNS have given rise to a national effort to combat this disease. A broad partnership of nearly 100 federal, state, and tribal agencies, academia, researchers, non-government organizations, and international partners are working together on research efforts, identifying strategies, and taking actions to slow the spread and find a cure for WNS. In 2010, the **National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats** was created, an important step in guiding the response and communications of federal, state, and tribal agencies, and other partners across the country.

In Ohio, state and federal agencies are working cooperatively to monitor Ohio's bat population, conduct disease surveillance, and coordinate efforts to stop the further spread of WNS.

How You Can Help

Bats are an integral part of many ecosystems, and the important role they play must be understood before their survival becomes a priority. Spread the word of their importance and the consequences of WNS. In addition, there are other ways you can help ensure bats' survival:

- Respect all cave closures and do not enter caves or mines where bats may be hibernating.
- Biologists entering caves or mines should adhere to decontamination protocols.
- Report unusual behavior and signs of WNS such as:
  - —Bats with white fungus on the body
  - —Bats seen flying outside during cold temperatures
  - —Dead or dying bats on the ground, buildings, trees, or other structures during cold winter months
  - —Bats clustered near entrances of hibernacula
  - —Report to: **Ohio Division of Wildlife: 1-800-WILDLIFE**
- Reconsider eviction of bats from human structures if no health threat exists. If bats must be evicted, safely exclude bats outside the months of May–August.
- Donate to bat conservation organizations.
- Support legislation for funding of WNS research.

Additional Resources

Ohio Division of Wildlife WNS page:
http://bit.ly/WhiteNoseSyndrome

U.S. Fish and Wildlife Service WNS page:
www.WhiteNoseSyndrome.org

U.S. Geological Service WNS page:
www.fort.usgs.gov/wns

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