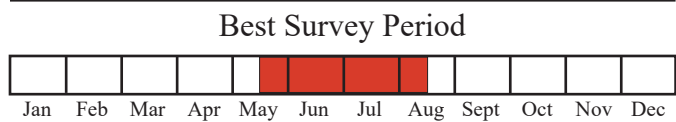
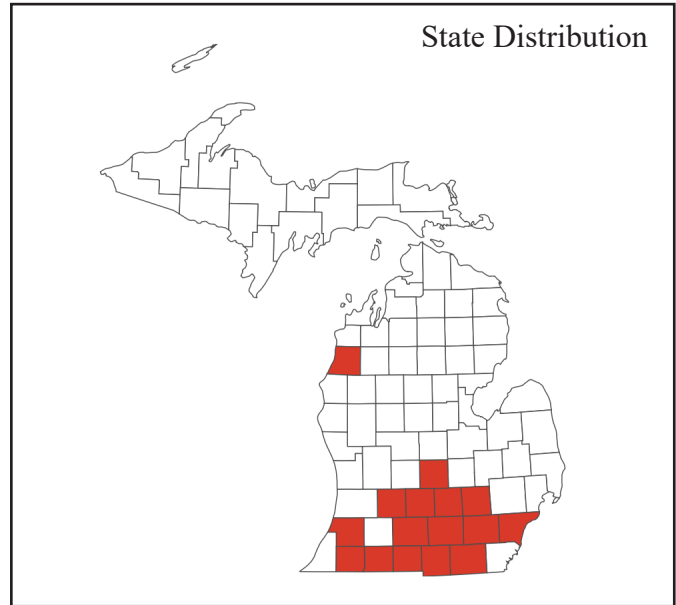




Photo by Nicolette Sexton



State and Federal Status: State Endangered (legally protected) / Federal Endangered

Global and State Rank: G2 (globally imperiled) / S1 (state critically imperiled)

Family: Vespertilionidae (evening bats)

Total Range: The Indiana bat range extends from eastern Oklahoma and Iowa in the west to the Canadian border in New York, New England and northern New Jersey in the east (Clark et al., 1987; Saugey et al., 1990). Its northern limits reach into Michigan, New York, and Vermont (Evers, 1992; Kurta and Teramino, 1994; NatureServe, 2026) and southern limits into northern Alabama and Arkansas (NatureServe, 2026), with additional uncommon reports outside of this range (e.g., Florida, Marks and Marks, 2006). In winter, a majority of the population congregates in a limited number of suitable hibernacula (e.g., mines and caves), primarily in karst regions of Missouri, Kentucky, Indiana, and Ohio (USFWS, 2019; ICF, 2023).

State Distribution: In Michigan, most Indiana bat records come from the southern three tiers of

counties as well as a dam spillway in Manistee County. The northernmost summer record comes from Clinton County, but the species may occur further north (Kurta, 2008). Although a small number of Indiana bats overwinter in Manistee County, it is unknown where these bats spend the summer (Kurta and Rice, 2002; Kurta, 2008). There are currently 26 element occurrences (EOs) within the Michigan Natural Heritage Database, 10 of which are historical and 16 are ranked as extant (MNFI, 2026). Most of the data within the Natural Heritage Database was collected prior to the discovery of white-nose syndrome in Michigan, so the species' current distribution is largely unknown.

Recognition: The Indiana bat is a small-bodied bat with a total length of 73–100 mm and weight that varies from 6 to 11 g (Kurta, 2008). The dorsal fur is generally fine, fluffy, grayish brown and appears dull, while the ventral fur is slate gray at the base and grayish white at the tips with a cinnamon tinge (Thomson, 1982). Ear height ranges from 12 to 15 mm and the tragus is short (slightly less than half the height of the ear), narrow, and not sharply pointed (Thomson, 1982; Morgan et al., 2019). Wing membranes and ears are dark brown or black



while the tip of the nose is lighter in color and appears pinkish in some lighting (Kurta, 2008). The wing membranes and body are similar in color, unlike the little brown bat (*M. lucifugus*) that generally has higher contrast coloration (IDNR, 2017). The length of the forearm ranges from 36 to 40 mm (average 38 mm) and the wingspan ranges from 229 to 279 mm (Kurta, 2008; Feldhamer et al., 2015). The calcar is a cartilaginous spur that extends from the ankle and is used to support the wing membrane. This structure is keeled in Indiana bat. The toe hairs do not extend past the claws of the hind feet (Thomson, 1982; Kurta, 2008; Morgan et al., 2019).

Both the little brown bat and northern long-eared bat (*M. septentrionalis*) are commonly confused with Indiana bats. These species are best distinguished by close, in-hand inspection. Northern long-eared bats may have longer ears than little brown and Indiana bats. They also have a long, pointed, spear-shaped tragus in contrast to the blunt-tipped tragus of the Indiana bats and little brown bats. However, ear length in northern long-eared bats is highly variable and tragus shape and length are generally more reliable for identification between the three species (Kurta, 2008; Morgan et al. 2019). Unlike Indiana bats, little brown bats have long toe hairs that extend beyond the toenails and have non-keeled calcars (Figure 1; Fenton and Barclay, 1980; Kurta, 2008; Morgan et al. 2019). From a distance, little brown bat fur is glossier in appearance and lighter in color than that of the Indiana bat, which often appears more gray in color (Fenton and Barclay, 1980; Morgan et al. 2019).

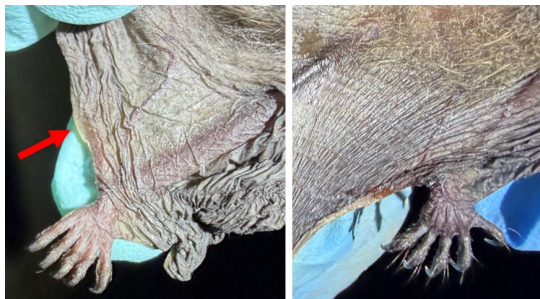


Figure 1. Comparison of the feet of Indiana bat (left) and little brown bat (right). The red arrow is pointing to the keel of the calcar. Photos by Nicolette Sexton

Indiana bats can also be identified using acoustic monitoring of echolocation calls; however, little brown bats share similar call characteristics and are very difficult to differentiate. Indiana bat echolocation calls last 1.9 to 7.8 milliseconds (ms) and sweep from 90 to 37.5 kHz on average (Figure 2; Szewczak, 2022). Their longer-duration calls (>4.5 ms) can be distinctive due to a secondary flat section of the call before the tail of the call, but some longer little brown bat calls can share this feature as well (Szewczak, 2022). Indiana bat calls are often difficult to distinguish from other *Myotis* species.

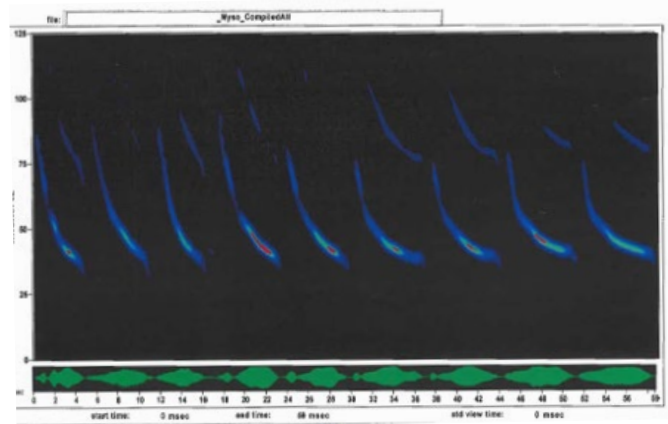


Figure 2. Spectrogram of an Indiana bat echolocation repertoire (compiled by Brian Klatt).

Survey Guidelines: Indiana bats are sensitive to human disturbance during breeding periods and hibernation, and special survey precautions should be taken to not disturb them during these times (NatureServe, 2026). Disturbances during hibernation may cause bats to prematurely use their fat reserves and the disturbance of breeding colonies can cause young bat pups to lose their grip and fall to their death (NatureServe, 2026). Common survey techniques include the use of harp traps and mist nests from May 15th to August 15th to avoid disturbance during sensitive hibernation and breeding periods. Mist nets should be set up perpendicular to travel corridors such as streams, rivers, and logging trails and should be spaced at least 30 meters apart. Nets should be checked every 10 minutes beginning at sunset and surveys should continue for five hours (USFWS, 2026). In addition, acoustic surveys are a cost-effective way to survey for bats. Acous-



tic detector/microphone placement is critical for recording high-quality calls for analysis. Suitable sites include forest-canopy openings, areas near water sources, fence rows, road/stream corridors, and wooded edges (Britzke et al., 2010; USFWS, 2026).

The U.S. Fish and Wildlife Service updates the Range-Wide Indiana Bat and Northern Long-Eared Bat Survey Guidelines each year. The most recent survey guidelines document can be found here: [USFWS Bat Survey Guidelines](#).

As with any other wild mammals, bats should not be handled casually or without protective equipment. When bats are handled, they will often bite in self-defense, and sick individuals are more likely to be caught in surveys. In addition, there are various measures that we must take to protect bats from pathogens that we can transmit to them (e.g., white-nose syndrome). Following the established protocol regarding handling techniques, protective equipment, decontamination and pre-handling vaccinations will reduce the risk of disease transmittal to and from humans (Aguilar-Setién et al. 2022).

Habitat: Indiana bat summer habitat consists of a wide variety of forested settings throughout their range. These include woodlots that contain potential roost trees, as well as fencerows, riparian forests, and other wooded corridors with variable tree densities and tree canopy closures (USFWS, 2026). Indiana bats generally form colonies and forage in riparian and mature floodplain habitats (Clark et al., 1987). In Michigan, they are associated with floodplain forest and southern hardwood swamp natural communities; however savanna habitats (e.g., bur oak plains, oak openings) adjacent to riparian corridors are thought to have been historically important roost sites due to their preference for high sun exposure of roost trees at the northern limit of their range (MNFI, 2026). They typically roost underneath exfoliating bark or occasionally in crevices of dead trees with a diameter at breast height ≥ 5 inches (USFWS, 2026). Over 95% of the Indiana bat roost trees found in Michigan are elm (*Ulmus*),

maple (*Acer*), and ash (*Fraxinus*) trees (Kurta and Rice, 2002; Kurta, 2008). Occasionally oak (*Quercus*), hickory (*Carya*), and cottonwood (*Populus deltoides*) trees are also used in Michigan; however, despite their frequent use in southern states, live shagbark hickory (*Carya ovata*) trees are an uncommon roost site in Michigan (Kurta, 2008). Most roost trees in Michigan are located along streams or other locations within forested wetlands (Kurta, 2017). Pregnant females migrate to Michigan and arrive in late April or May, when they form maternity colonies in large dead trees (greater than 23 cm in diameter) (Kurta, 2008, 2017; Thomson, 1982). Most male Indiana bats remain near their hibernacula; however, a small number migrate to Michigan where they roost solitarily (Kurta, 2008). LaVal et al. (1977) reported that a population of adult male Indiana bats in Missouri foraged mainly under the forest canopy and rarely over water, whereas female and juvenile Indiana bats generally forage in riparian habitats (LaVal and LaVal, 1980).

Indiana bats use caves and mines as winter hibernacula. Most of the global Indiana bat population hibernates in relatively few caves and mines in Indiana, Missouri, Kentucky, and Illinois (Kurta, 2008; USFWS, 2019). The Indiana bat's preferred hibernacula are large, cool (3.9–4.6 °C), moist (85–95% relative humidity), and structurally diverse (including large rooms connected by extensive passageways, with some of the passages being vertical) (Kurta, 2017). Kurta and Teramino (1994) reported a single female Indiana bat hibernating with approximately 15,000 bats of other species (mostly little brown and northern long-eared bats) at the spillway of Tippy Dam, a hydroelectric facility in Manistee County, Michigan. Since this discovery, both adult male and female Indiana bats have been observed in the spillway (Kurta et al., 1997), and banded individuals have been recaptured two or more years after their original capture, indicating fidelity to the dam (Kurta, 1998). An estimated 20 Indiana bats hibernate in this spillway, which is about 450 km northeast of the closest reported Indiana bat hibernaculum in LaSalle County, Illinois (Kurta and Teramino, 1994). This spillway is the



only significant hibernaculum for bats in the Lower Peninsula of Michigan (Kurta and Rice, 2002).

Biology: Indiana bats migrate into the Great Lakes basin beginning in late April (Kurta, 2017). Most Indiana bats, especially females, migrate 100–500 km north to summer habitat in northern Illinois, Indiana, Ohio, Missouri, and smaller amounts in southern Michigan (Kurta and Murray, 2002; Kurta and Rice, 2002). Once bats arrive at their summer roosting sites (late April or May in Michigan) females cluster into maternity colonies while males roost solitarily (Kurta, 2008). The largest colony recorded in Michigan was 61 bats in Lenawee County; however, most colonies in Michigan are smaller (15–30 adults). During a season, a colony may utilize over 20 different roost trees that are found in clumps 1–100 yards apart (occasionally up to 5 miles apart) with individuals switching roosts every one to three days (Kurta, 2008).

In late summer or early fall, prior to hibernation, Indiana bats swarm at the entrances of hibernacula, with peaks in early September and mid-October (Cope and Humphrey, 1977; Thomson, 1982). Most mating takes place during this swarming period, with smaller amounts occurring in winter through April, as females begin spring migration (Cope and Humphrey, 1977; Thomson, 1982). Females often mate during their first fall, with some waiting until their second year, while males reach maturity during their second fall (USFWS, 2007). All bats found in Michigan use delayed fertilization, meaning they mate in the fall, store sperm through the winter, and ovulate after hibernation (Kurta, 2008). Gestation lasts 60 days resulting in pups being born in Michigan in mid-to-late June (Kurta, 2005, 2008).

Female Indiana bats give birth to one young that has closed eyes and pink skin with a few hairs. The keel on the calcar is not yet developed on newborn pups but develops by the time they begin to fly (Thompson, 1982; Kurta, 2008). Female Indiana bats respond to vocalizations made by their own offspring and will attempt to recover their offspring

if they fall from the roost (Kurta, 2008). Juvenile bats are weaned after 25–37 days and most can fly at about four weeks of age, with the first volant (flying) juveniles appearing in Michigan in July and August (Humphrey et al., 1977; Kurta, 2008; NatureServe, 2026). Parental behaviors performed by female Indiana bats include checking on young, transporting non-volant young to suitable areas of a roost, and tandem mother-young flights as young become volant (Humphrey et al., 1977; Thomson, 1982).

Indiana bats are primarily nocturnal, spending most of the daylight hours in a day roost and, at night, feeding and using night roosts to rest between bouts of feeding. Indiana bats in a maternity colony in Eaton County, Michigan were observed leaving their day roost 18–32 minutes after sunset, with newly volant juveniles leaving the roost after the adults, and returning to the roost 10–40 minutes before dawn (Murray and Kurta, 2004; Kurta, 2008). Lactating females will generally return to the maternity site 2–4 times each night, likely to feed their young (Murray and Kurta, 2004). In Michigan, Kurta and Whitaker (1998) found that Indiana bat diets consisted of caddisflies (Trichoptera; 55.1% of diet), flies (Diptera; 25.5%), moths (Lepidoptera; 14.2%), and beetles (Coleoptera; 1.4%). The Indiana bat foraging areas in Michigan reportedly range from 1.25–2.5 miles from a roost tree and they appear to avoid flying over large open spaces, even when it would considerably decrease the distance back to their roost (Murray and Kurta, 2004). Water is acquired from moisture within prey and by dipping their mouths into a body of water on the wing (Kurta, 2008).

Starting in late August, Indiana bats begin their migration to southern hibernacula to begin swarming, but some stragglers, likely juveniles, remain in southern Lower Michigan into September and October (Kurta, 2008). The Indiana bat has been called the “cluster” or “social” bat because of the large, dense clusters (average of 3,200 per square meter [300 per square foot]; LaVal and LaVal, 1980) that they form during winter hibernation



(Figure 3; Thomson, 1982). These clusters may help regulate their body temperature and possibly allow them to hibernate in mines or caves with a wider range of temperatures than other, less colonial species (IDNR, 2017). The clusters form rapidly and are generally found on the ceilings or walls of hibernacula and, while the clustering sites are used yearly, the sex and age ratios within the clusters vary yearly as well as within one winter season (Thomson, 1982). These compact clusters may contain as many as 5,000 individual bats, with a typical range of 500–1,000 bats per cluster (Thomson, 1982). Cluster size has been reported to vary with temperature, with smaller, more active clusters found in warmer regions of a hibernaculum and larger, more stable groups in colder regions (Clawson et al., 1980; USFWS, 2007). In spring, bats will leave hibernacula from April to early June, and females leave before males (Henshaw and Folk, 1966; Cope and Humphrey, 1977; LaVal and LaVal, 1980).



Figure 3. Clusters of hibernating Indiana bats found on the ceiling of a mine in Illinois. Each cluster contains hundreds of individual bats. Photo by Brittany Rogness

An adult Indiana bat banded in Michigan during summer was discovered hibernating in Kentucky six years later, making the bat at least 7.5 years old, however maximum ages of banded individuals have been recorded as 15 years for females and 14 years for males (Kurta, 2008; NatureServe, 2026).

Parasites include several species of mites in the families Macronyssidae and Spinturnicidae, flatworms (Trematoda), tapeworms (Cestoda), and apicomplexa of the genus *Eimeria* (Thomson, 1982; Bennett et al., 2025). One of the most common mite species associated with this host is *Macronyssus crosbyi* (Whitaker et al., 2000).

Conservation/Management: White-nose syndrome, habitat loss, environmental contaminants, turbine collisions, invasive species, and winter disturbance are significant range-wide threats to the Indiana bat (USFWS, 2009). After the Indiana bat's original federal listing in 1967, the overall population decreased until 2007, although a population increase occurred from 2001 to 2007 in hibernacula in Illinois, Indiana, Kentucky, New York, and West Virginia (USFWS, 2019). The period of initial population decline was originally attributed to declines at high-priority hibernacula caused by mining, blocking of entrances, and tourism in Kentucky, Missouri, and Indiana (USFWS, 2007). An increasing population trend was observed from 2007 to 2009 (USFWS, 2019), followed by significant downward range-wide population trends from 2009 to present. This trend was caused by white-nose syndrome (WNS) spreading throughout the species' range (USFWS, 2019).

A fungal pathogen, *Pseudogymnoascus destructans* (syn. *Geomyces destructans*), is the causative agent of WNS. WNS is an often-fatal disease that attacks hibernating bats, causing them to arouse more frequently, using up their limited fat reserves that are required to survive hibernation (Warnecke et al. 2012; NatureServe, 2026). Since it was found in North America, WNS has spread across the entire range of the Indiana bat. All known Indiana bat hibernacula are assumed to be WNS-affected.



Since the winter of 2007–2008, millions of bats have died due to the disease (USFWS, 2019). WNS has caused an overall estimated 90% decline in hibernating bat populations across North America and may cause regional and range-wide extinction among multiple bat species including the Indiana bat (Frick et al, 2010; Turner et al., 2011; Thogmartin et al., 2013). Since the discovery of WNS in North America, Indiana bat populations have declined around 70% in infected hibernacula and summer abundance has decreased by 60% across their range (Turner et al., 2011; Pettit and O’Keefe, 2017). Some bat species are showing some resistance to WNS (e.g., little brown bats; Dobony and Johnson, 2018); however, the low reproductive rates and long lifespan of bats slow the recovery of affected populations (USFWS, 2019).

A long-term threat to Indiana bats has been the destruction and degradation of winter hibernacula and summer habitat (i.e., forests). Many important hibernacula have been protected through acquisition and conservation easements, but other important sites remain vulnerable to vandalism, entrance modification, microclimate changes, and surrounding land use change (USFWS, 2019). In 2019, 59% of Priority 1 hibernacula sites and 38% of Priority 2 hibernacula sites were considered protected (USFWS, 2019). In addition, human disturbance of hibernating bats was originally identified as a primary threat to the Indiana bat and remains a threat at several important hibernacula across the bat’s range (USFWS, 2007). Disturbance includes recreational caving, cave tours and other commercial uses of caves/mines and vandalism (USFWS, 2019). Changing the structures within a mine or cave changes the airflow and temperature, and it may impact the suitability of hibernacula for Indiana bats (USFWS, 2007).

Loss of summer habitat impacts Indiana bats during their sensitive maternity periods (IDNR, 2017). A decrease in forested habitat reduces the availability of suitable roost trees for maternity colonies. Human activity has resulted in fewer suitable roost trees by removing snags and reducing disturbances

that naturally create them (e.g., flooding, fire; Carter and Feldhamer, 2005; Wolff et al., 2009). Like other bats, Indiana bats have high fidelity to summer habitat sites; therefore, tree removal, especially clearcutting, in forested habitats, even when bats are not present, can reduce reproductive success (USFWS, 2007). Maintaining foraging habitat and travel corridors between fragmented habitat patches is crucial for successful foraging (Williams-Guillén et al., 2016; IDNR, 2017; USFWS, 2019).

Both the original Indiana bat recovery plan (USFWS, 1983) and the 2007 recovery plan (USFWS, 2007) identified environmental contaminants such as pesticides (e.g., DDT, PCBs) as causes of their decline. The longevity of bats can lead to large accumulations of contaminants. Indiana bats can be directly exposed to contaminants when agricultural fields are sprayed while they are roosting and are also exposed to them when ingesting residue found on their insect prey (IDNR, 2017). High exposure to these contaminants can suppress their immune systems, making them more susceptible to diseases such as WNS, and can lead to higher metabolic rates, which depletes their fat reserves for hibernation (O’Shea and Johnston, 2009; Kannan et al., 2010). Prey reduction due to contaminants such as insecticides is also a concern (Gibbons et al., 2015). Widely used organophosphates and carbamates do not accumulate in the body but are highly toxic nerve agents that have been detected in nearly all Indiana bats that have been tested, potentially impacting their thermoregulation, flights, and movements (USFWS, 2007; Eidels et al., 2007, 2016).

Large-scale fatalities of bats, most frequently hoary (*Lasiurus cinereus*), eastern red (*Lasiurus borealis*), and silver-haired bats (*Lasionycteris noctivagans*), have occurred at wind energy facilities across the range of the Indiana bat (Arnett et al., 2008, 2011; Arnett and Baerwald, 2013; Frick et al., 2017; Pruitt and Reed, 2018; NatureServe, 2026). The only well-documented method to reduce fatalities currently is limiting the operation of wind turbines during high-risk periods such as nights with low wind speeds during fall migration periods, which



can reduce fatalities 44–93% (Arnett et al., 2011). As of 2022, 39 Indiana bat fatalities have been documented at wind energy facilities in Illinois, Indiana, Iowa, Ohio, Missouri, Pennsylvania, and West Virginia; however, not all facilities monitor bat fatalities and small numbers of dead bats are often found during ground searches (USFWS, 2019; Pruitt and Reed, 2022). Erickson et al. (2016) modeled how wind turbine mortality and WNS would impact population dynamics of the Indiana bat. Their simulations predicted localized extirpation of smaller winter colonies. WNS, however, had a predicted range-wide effect and together with turbine mortalities, a large predicted impact across both small and large population sizes. Wind energy is expected to expand substantially by 2030 and the impacts of this expansion on bat populations need further study (NatureServe, 2026).

The emerald ash borer (*Agrilus planipennis*) is a non-native beetle that was introduced and has spread across Michigan, killing hundreds of millions of ash trees (USFWS, 2019). The impacts of this invasive species on Indiana bats have not yet been quantified. Dying ash trees may temporarily benefit Indiana bats by providing abundant available roosting habitat (USFWS, 2019); however, the long-term loss of canopy ash is predicted to be detrimental by eliminating future availability of suitable roost trees and causing declines in insect diversity and abundance (USFWS, 2019). Kurta et al. (1996) reported a preference for green ash (*F. pennsylvanica*) over silver maple (*Acer saccharinum*) among maternity roost sites in Michigan. Ash trees are a significant source of roost trees in areas such as southern Michigan. These areas may see adverse impacts that may fragment maternity colonies and reduce reproductive success (Kurta et al., 2002).

Bats are preyed upon by many predators including owls, hawks, weasels, snakes, and raccoons. These animals utilize the high concentrations of bats at roosts, and some will wait at roost entrances to capture bats that are entering or leaving. Opportunistic predation by native wildlife species is a natural pro-

cess; however, domestic cats have also developed the ability to capture many bats due to their proximity to human structures (Gillette & Kimbrough, 1970; Fenton & Barclay, 1980; Sparks et al., 2003).

Maintenance of adequate habitat for all life stages should be monitored every year or two in occupied Indiana bat locations depending on pattern of decline or impacts. Gates or other barriers can be used to allow bats to enter and exit abandoned mines or caves without human interference (USFWS, 2007; IDNR, 2017). A limiting factor in the Indiana bat's summer range is the deforestation of riparian habitats through the cutting of large, dead trees. Stream channelization, bank modification, and agricultural development along stream banks have also contributed to summer habitat destruction. Forest management should increase summer roosting and foraging habitat by protecting mature, wooded areas, leaving large, dead trees standing, and maintaining wide vegetation buffer strips. Cutting of snags, canopy removal, and general land clearing activities along streams and rivers should be avoided, especially when Indiana bats are present in their summer habitat (ICF, 2023). This species would likely benefit from natural and manual reforestation of former floodplain forest sites. In addition, girdling to produce snags and providing artificial roosts such as bat boxes allows for a continuous availability of suitable roost sites (IDNR, 2017). Land managers should also try to reduce or eliminate burdock (*Arctium minus*), an invasive plant that produces seed heads that can trap bats and cause death from exposure (Norquay et al., 2010).

Special care is required while studying bats to protect both the bat and the researcher. Do not touch a bat unless you are properly permitted to do so, have the proper personal protective equipment, are fully vaccinated against rabies, and are able to perform the proper decontamination protocol. Everything that touches a bat or its hibernaculum must be properly decontaminated to prevent the spread of WNS to other bats and hibernacula. Cave and mine tours should also take special care and provide decontamination stations for visitors as they can transport



P. destructans spores on their clothing from one hibernaculum to another (Zhelyazkova et al., 2020; Shapiro et al., 2021).

Research Needs: To effectively conserve the Indiana bat, more research is needed to better understand the impacts of WNS, the viability of currently known EOs, and potential management actions that can be implemented to improve their survival and reproduction. Further research is also needed to better understand the impacts of climate change, invasive species such as the emerald ash borer, environmental contaminants, and increasing wind energy on Indiana bats and their habitat.

Related Abstracts: Cave, floodplain forest, southern hardwood swamp, oak openings, bur oak plains, little brown bat, northern long-eared bat, red-shouldered hawk, short-eared owl, long-eared owl

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