# U.S. FISH AND WILDLIFE SERVICE
# NORTHEAST REGION
# INDIANA BAT CONSERVATION STRATEGY

Prepared
January 2018

## 1 INTRODUCTION

The U.S. Fish and Wildlife Service (Service) Northeast Region (Region 5) has developed this conservation strategy for the Indiana bat (*Myotis sodalis*) to assist our staff, federal and state partners, and the general public with understanding the current needs of the species. With that common understanding, we can work together to improve the status of the species.

This document is intended to serve as a foundational source of information for future consultations under section 7 of the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), habitat conservation plans (HCPs) or general conservation plans (GCPs) under section 10(a)(1)(B) of the ESA, and for proactive non-regulatory efforts.

## 2 SPECIES PROFILE[1]

### 2.1 STATUS OF THE SPECIES

The Indiana bat was one of 78 species first listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967).

Thirteen winter hibernacula (11 caves and 2 mines) in six States were designated as critical habitat for the Indiana bat in 1976 (41 FR 187). At the time the critical habitat was designated, no primary constituent elements were identified. Therefore, the Service has identified the physical and biological features that make the designated caves or mines important to the conservation of Indiana bats. The important conservation features include:

- The mine or cave's physical structure, configuration, and all openings that create and regulate suitable microclimates for hibernating bats within.
- The associated karst hydrology and stream recharge area/watershed.
- The amount and condition of surrounding forested habitat that is used by the bats during the pre-hibernation swarming period each fall and post-hibernation staging each spring.

[1] A more detailed life history, resource needs, and status information for the Indiana bat can be found in various documents at https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=A000 and https://www.fws.gov/Midwest/endangered/mammals/inba/index.html

The current range of the Indiana bat includes much of the eastern half of the United States, from Oklahoma and Iowa east to Vermont, and south to northern Alabama. The species has greatly declined in most of its former range in the eastern United States due to the impacts of white-nose syndrome (WNS). The current draft revised recovery plan (Recovery Plan) (Service 2007) delineates recovery units (RUs) based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 1). To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all four RUs.

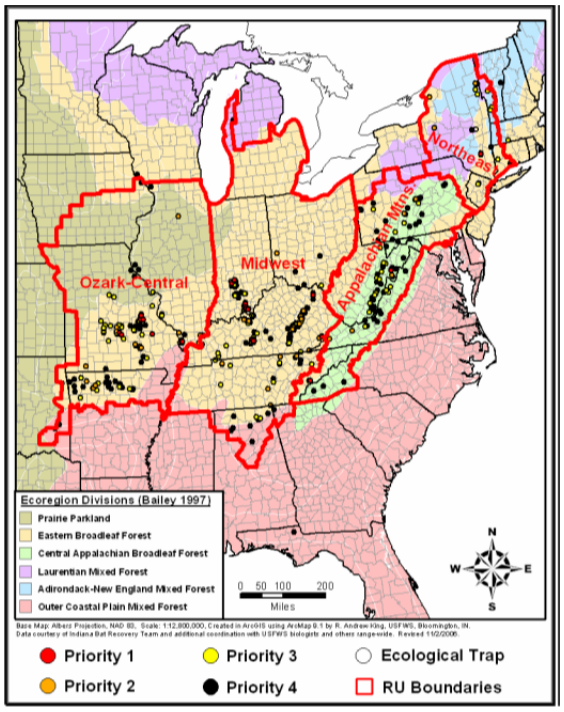


**Figure 1.** Indiana Bat Recovery Units. Note: hibernacula located outside of the Recovery Unit boundaries have not had an Indiana bat record for over 50 years (Service 2007).

The range-wide status of the species is declining (Figure 2) with significant declines in the Northeast, Appalachia, and Midwest RUs (Service 2017). According to the 2017 Range-wide Population Estimate for the Indiana Bat, the total known Indiana bat population is estimated to be approximately 530,705, a 133,927 (20%) decrease from the 2007 range-wide estimate (Service 2017).

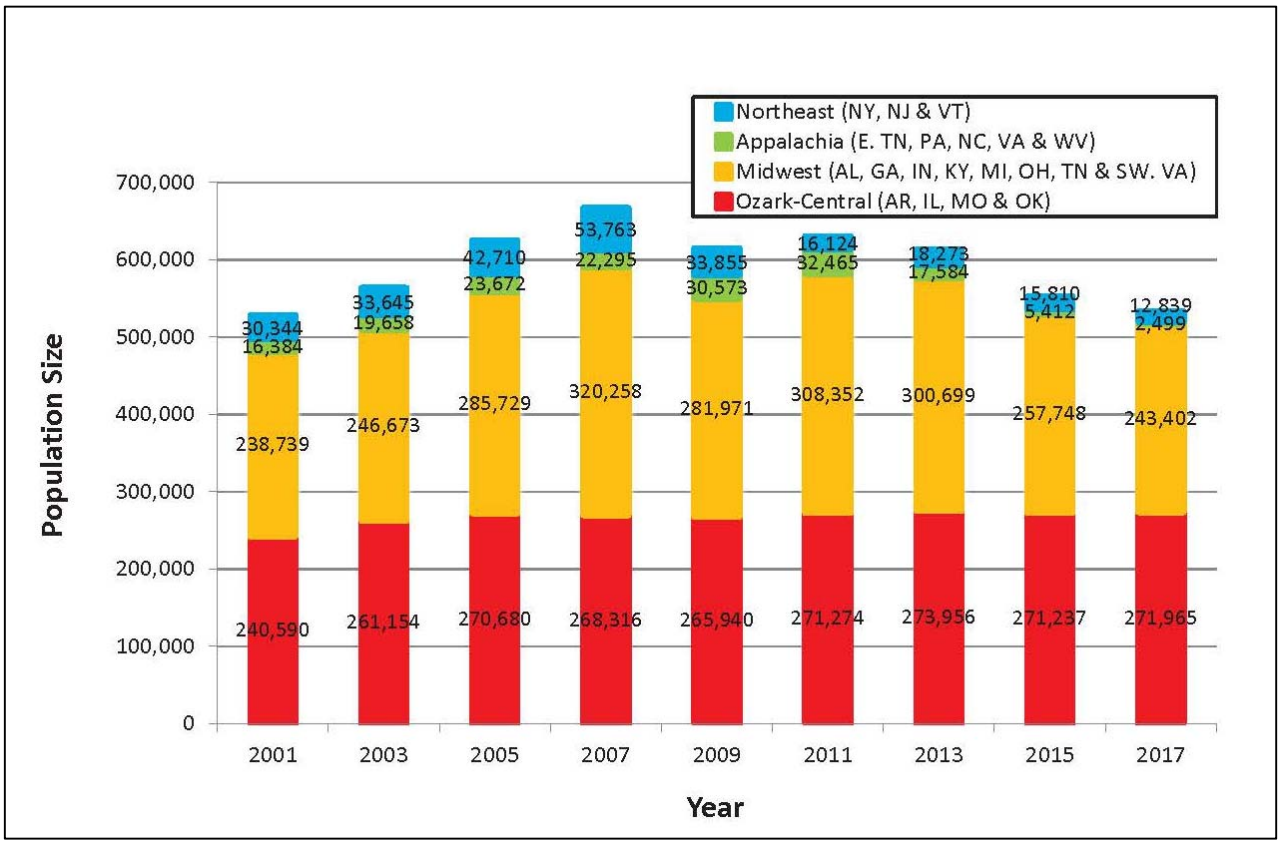


**Figure 2.** Indiana bat population estimates by recovery unit from 2001 to 2017 (Service 2017).

## 2.2 RESOURCE NEEDS

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in mines and caves in the winter and spends summers in wooded areas. The key stages in its annual cycle are: hibernation, spring staging and migration, pregnancy, lactation, volancy/weaning, fall migration, and swarming (Figure 3). All periods outside of the hibernation period can also be considered as the "active season" for Indiana bats. While varying with weather and latitude, Indiana bats generally hibernate between mid-fall through mid-spring each year. Spring migration is generally mid-March to mid-May each year, as females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Young are born between late May and early June, when females give birth to a single offspring (pup). Lactation then lasts 3 to 5 weeks until weaning, which is shortly after young become volant (able to fly) in mid- to late-July. Fall migration occurs between mid-August and mid-October.

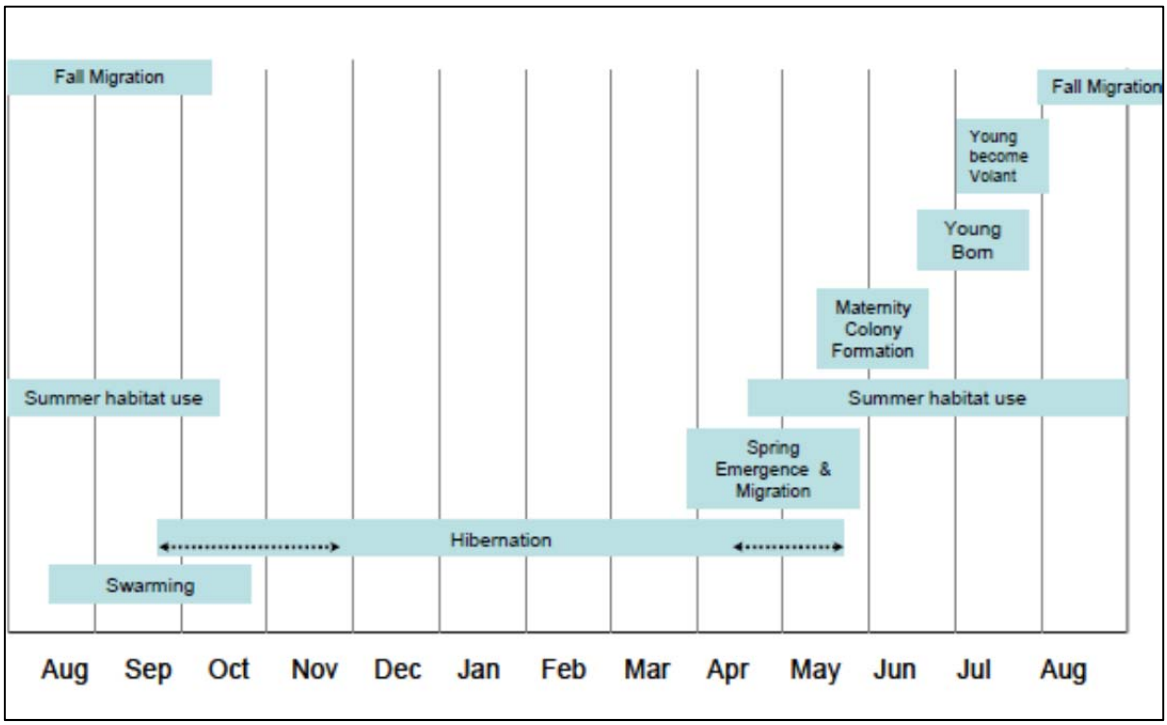


**Figure 3.** Indiana Bat Annual Chronology (Service 2007).

The basic resource needs for the Indiana bat across the species entire range are safe winter hibernation sites; forested spring staging/fall swarming habitat; connected forested summer habitat for roosting, foraging, and commuting; forested migratory stopover habitat; safe migration passage; insects; and clean drinking water (e.g., streams, riparian areas, and wetlands).

### 2.2.1 WINTER HABITAT/BEHAVIOR

Suitable winter habitat (hibernacula) includes underground caves and cave-like structures (e.g., abandoned or active mines, railroad tunnels). Temperature, humidity, air flow, surrounding habitat, stability, and other factors must be suitable for a structure or part of a structure to be used as a hibernaculum. Caves that meet requirements for Indiana bats are rare, as there are few occupied locations compared to the number of caves across the range. Most Indiana bats hibernate in caves or mines where the ambient temperature remains below 10ºC (50.0ºF), but infrequently drops below freezing (Hall 1962, Myers 1964, Henshaw 1965, Humphrey 1978). Caves that historically sheltered the largest populations of hibernating Indiana bats were those that provided the largest volumes and structural diversity, thus ensuring stable internal temperatures over wide ranges of external temperatures, with a low likelihood of freezing (Tuttle and Kennedy 2002). Indiana bats generally hibernate in large clusters, sometimes with other species, with densities of 300 to 484 bats per square foot (Service 2007). Indiana bats have shown a high degree of philopatry to the hibernacula used, with many returning to the same hibernacula annually.

### 2.2.2 SUMMER HABITAT/BEHAVIOR

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies. Suitable summer habitat[2] for the Indiana bat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel (e.g., fencerows, riparian forests, or other wooded corridors). Suitable roost trees include a wide variety of tree species (generally ≥5 inches dbh) with suitable structure (e.g., presence of cracks, crevices, or peeling bark). However, maternity colonies generally use trees greater than or equal to 9 inches dbh. Overall, roost tree structure appears to be more important to Indiana bats than a particular tree species or habitat type. Females appear to be more habitat specific than males presumably because of the warmer temperature requirements associated with gestation and rearing of young. Roosts are warmed by direct exposure to solar radiation, thus trees exposed to extended periods of direct sunlight are preferred over those in shaded areas. However, shaded roosts may be preferred in very hot conditions. As larger trees afford a greater thermal mass for heat retention, they appear to be preferred over smaller trees.

Foraging habitat may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. At a landscape scale, Indiana bats generally prefer forest patches near aquatic features to developed or agricultural lands (Humphrey et al. 1977, Sparks et al. 2005, Watrous et al. 2006, Womack et al. 2013, Jachowski et al. 2014, Kniowski and Gehrt 2014), although this may vary across the range depending on forest and water availability. Indiana bats feed on emerged aquatic and terrestrial flying insects with moths, caddisflies, flies, mosquitoes, and midges comprising major prey items (LaVal and LaVal 1980, Brack and LaVal 1985, Kurta and Whitaker 1998, Lee and McCracken 2004, Feldhamer et al. 2009).

Coloniality is a requisite behavior for reproductive success. Female Indiana bats form maternity colonies in roost trees and exhibit fission-fusion behavior where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, bats switch roosts often, typically every 2–3 days (Foster and Kurta 1999, Kurta et al. 2002, Kurta 2005, Carter and Feldhamer 2005). Bats switch roosts for a variety of reasons, including, temperature, precipitation, predation, parasitism, and to make use of ephemeral roost sites (Carter and Feldhamer 2005). The need to investigate new potential roost trees prior to their current roost tree becoming uninhabitable (e.g., tree falls over), may be the most likely scenario (Kurta et al. 2002, Carter and Feldhamer 2005, Timpone et al. 2010). Indiana bats show strong philopatry to their summer maternity areas, and even interannual fidelity to specific roost trees for as long as they remain standing (Kurta 2005).

Indiana bat roost trees have been described as either primary or alternate depending on the number of bats in a colony consistently occupying the roost site. In Missouri, Callahan (1993)

[2] See the Service's current summer survey guidance at https://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html for our latest definitions of suitable habitat and the Draft Indiana Bat Recovery Plan (Service 2007) at http://www.fws.gov/northeast/nyfo/es/IndianaBatapr07.pdf for additional details

defined primary roost trees as those with exit counts of more than 30 bats on more than one occasion; however, this number may not be applicable to small-to-moderate sized maternity colonies. Indiana bat maternity colony size can vary greatly, but typical colonies contain less than 100 adult females (Service 2007). Kurta (2005) summarized summer habitat information from 11 states and found most exit counts at primary roosts are at least 20–100 adults with a typical maximum of 60–70 adults in a primary roost at any given time. Primary roost trees are almost always located in either open canopy sites or bats are using the portion of a tree that is above the canopy cover of the adjacent trees (Callahan et al. 1997, Kurta et al. 2002). Alternate roost trees can occur in either open or closed canopy habitats. Maternity colonies use a minimum of 8–33 trees per season (Callahan et al. 1997, Kurta et al. 2002, Silvis et al. 2014). However, not every bat in each colony can be radio-tracked continuously and simultaneously, so it is likely that these are conservative estimates of the number of trees used by all members of the maternity colony over an entire season.

Summer home ranges include both roosting and foraging habitat and travel/commuting areas between those habitats. Observed home ranges for individual bats associated with Indiana bat maternity colonies vary widely (205.1-827.8 acres [83-335 ha]) (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Jachowski et al. 2014, Kniowski and Gehrt 2014). In addition, the Service has provided guidance[3] for determining an area that may be occupied by a maternity colony and is generally considered areas within 2.5 miles (4.0 km) of documented roosts.

### 2.2.3 MIGRATION AND STOPOVER HABITAT/BEHAVIOR

Indiana bat migration distances between hibernacula and summer colonies have been documented as far as 357 miles (574.5 km) in the Midwest (Winhold and Kurta 2006) and much shorter distances observed in the Northeast (Service 2011; Q. 18). Migration is an energetically demanding behavior for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low and females are pregnant. Males and non-reproductive females may summer near hibernacula, or migrate to summer habitat some distance from their hibernaculum. Little information is currently known about stopover habitat locations.

### 2.2.4 FALL SWARMING AND SPRING EMERGENCE HABITAT/BEHAVIOR

This is similar habitat as discussed above for summer, but located around winter hibernacula. Upon arrival at hibernacula in mid-August to mid-November, Indiana bats "swarm," a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day. Swarming continues for several weeks and mating occurs during the latter part of the period. After mating, females enter directly into hibernation but not necessarily at the same hibernaculum where mating occurred. A majority of bats of both sexes hibernate by the end of November (by mid-October in northern areas). Most Indiana bat swarming activity is believed to be concentrated within 10–20 miles (16.1-32.2 km) of hibernacula in the fall (Service 2011). In the spring, bats may spend a few hours or days around hibernacula or migrate immediately to summer habitat. Due to the tendency of male and non-reproductive female Indiana bats (and periodically females associated with maternity colonies) to

[3] https://www.fws.gov/midwest/endangered/mammals/inba/pdf/inbaS7and10WindGuidanceFinal26Oct2011.pdf question #4

spend the summer months near hibernacula, swarming habitat is likely to be used as summer habitat as well. The number of Indiana bats using swarming habitat can vary from a few dozen to tens of thousands of Indiana bats depending on the local hibernating population size.

## 2.3 THREATS

### 2.3.1 INTRODUCTION

Current threats to the Indiana bat are discussed in detail in the Recovery Plan (Service 2007) and 5-Year Review (Service 2009). Traditionally, occupied habitat loss/degradation, winter disturbance, and environmental contaminants have been considered the greatest threats to Indiana bats. The Recovery Plan identified and expounded upon additional threats including collisions with man-made objects (e.g., wind turbines). The 2009 5-Year Review included WNS, now considered the most significant obstacle to the recovery of the species.

### 2.3.2 WHITE-NOSE SYNDROME

First documented in New York in 2006, WNS, a disease caused by the fungus *Pseudogymnoascus destructans* (*P.d.*) has emerged as a threat to hibernating North American bats. The most current WNS map can be found at https://www.whitenosesyndrome.org/maps/. The disease has serious implications for Indiana bat recovery; between 2007-2017 the disease resulted in a 20% decline in the range-wide population of Indiana bats.

White-nose syndrome has resulted in smaller Indiana bat population sizes and entire loss of some hibernating populations. This would either result in entire loss of associated maternity colonies or significant reductions in maternity colony size. Losses have not been equal across RUs to date, as WNS continues to move from east to west (see Figure 2). This threat has reduced the overall resiliency of the species to withstand other cumulative threats. For example, Erickson et al. (2016) modeled the interaction of WNS and wind turbine mortality and the interaction resulted in a larger population impact than when considering the effects of either stressor alone.

### 2.3.3 IMPACTS TO BATS IN ACTIVE SEASON

Bats may be exposed to a variety of stressors (e.g., noise, smoke, tree removal, collision with vehicles, and collision with turbines) during the active season (Service 2007, 2009, 2016). Depending on the proximity to and extent of these stressors, responses of the bats may vary from nothing (negligible) to injury or death.

### 2.3.4 IMPACTS TO BATS IN WINTER

Indiana bats are particularly vulnerable during the winter because they are in a torpid state and extremely sensitive to the effects of disturbance, and they often congregate by the hundreds or thousands in tight clusters so disturbance to a small area can affect the entire population of a hibernaculum. Various activities may directly impact wintering bats. Indiana bats may be disturbed (woken up) more frequently than normal, resulting in increased use of fat reserves essential for hibernation. They may also be injured or killed if buried, crushed, flooded out, or

suffocated during changes to the hibernacula. Hibernating bats have also experienced death or injury due to vandalism/animal abuse (Service 2007).

### 2.3.5 Loss/degradation of Hibernacula

As stated above, Indiana bats have specific winter habitat requirements with few sites occupied by most of the species each winter. As of 2017, 87% of Indiana bats currently occur at just one location in the Northeast RU. In the Appalachia RU, 67% of Indiana bats occur at two locations. This concentration of bats after WNS puts the species at tremendous risk should anything happen at these locations.

Some activities (e.g., completely filling in or excavating) may completely destroy hibernacula or prevent bats from entering/exiting a location. Other activities may not appear to damage a site but in fact alter its temperature, humidity, or structural stability that render the site unavailable to Indiana bats. Examples include filling or opening individual or multiple entrances, vibration sufficient to affect structural integrity, or changing the course or volume of drainage that may flood hibernacula.

### 2.3.6 Loss/degradation of Maternity, Swarming, or Migratory Stopover Habitat

The destruction and degradation of Indiana bat habitat is identified as a longstanding and ongoing threat to the species (Service 2009). Not all forests are occupied by Indiana bats and it is a Service priority to document areas that are actually used by the species to ensure conservation efforts are focused in these areas. There are multiple causes of forest conversion within the range of the Indiana bat including urbanization and development, as well as energy (e.g., coal, oil, gas, wind) production and distribution.

Depending on their characteristics and location, forested areas can function as summer maternity habitat, staging and swarming habitat, migration or foraging habitat, or sometimes combinations of more than one habitat type. Tree clearing can have a variety of impacts on the bat depending on the quality, amount, and location of the lost habitat, and the time of year of clearing.

In addition to tree clearing, other stressors include degradation of remaining habitat due to noise or lighting. Loss or degradation of streams and wetlands that serve as foraging areas and sources of drinking water may also be important. Additional details regarding types of impacts that are often associated with summer habitat loss or degradation can be found in the Recovery Plan (Service 2007) and the Service's 2016 Revised Programmatic Biological Opinion (BO) for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat found at https://www.fws.gov/midwest/endangered/section7/fhwa/index.html

### 2.3.7 Biological Constraints

In addition to extrinsic factors affecting Indiana bats, there are several instrinsic biological constraints to consider when developing a conservation strategy.

High Indiana bat adult female survival is required for stable or increasing growth rates (Thogmartin et al. 2013). Given the significant declines in populations across much of the range, it is now also essential to minimize impacts to reproductive potential for surviving Indiana bats. However, healthy adult females have a maximum of one pup per year. Thus, the ability of the species to increase reproductive success is very limited. This is also not a species that you can quickly improve habitat for as you can for some species (e.g., planting wild blue lupine and grasses for Karner blue butterflies). Further, improving habitat quality cannot boost potential reproductive output beyond one pup per year. Indiana bats are also not a species for which captive management can be used to grow new populations of the species to repopulate currently suitable habitat.

## 2.4 CONSERVATION AND RECOVERY GOAL, NEEDS & STRATEGIES

### 2.4.1 GOAL

Defined as the purpose of the ESA in section 2 is "to provide a means whereby the *ecosystems* upon which endangered species and threatened species depend may be conserved . . . ." Therefore, broadly, our goal is to provide a means whereby the ecosystems (habitat) upon which Indiana bats depend may be conserved and provide for healthy populations of Indiana bats across its range. Ultimately, the goal is to remove the need for protection of the Indiana bat under the ESA.

### 2.4.2 NEEDS

Conservation and recovery of the Indiana bat will require capturing the species' ecological, behavioral, and genetic representation and providing redundancy and resiliency at the species level by conserving healthy bat populations across the species' current range, and managing threats acting upon the species.

To do this, our current focus addresses the following four conservation needs:

1. Managing the effects of WNS;
2. conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
3. conserving and managing maternity colonies and their habitat; and
4. conserving migrating bats.

We offer additional detail by conservation need.

#### 2.4.2.1 MANAGING THE EFFECTS OF WNS

The key steps of managing the impacts of WNS are being explored through the WNS National Plan and may include:

- Avoiding/minimizing the transmission of *P.d.*;
- implementing measures to control *P.d.* should effective, non-harmful measures become available; and

- restoring and protecting populations affected by WNS, with emphasis on populations that are seemingly more resilient to the disease.

Examples of specific strategies include:

- Providing funding to determine why some sites have much higher mortality for Indiana bats than others;
- testing management strategies to reduce effects of WNS on Indiana bat colonies; or
- protecting hibernacula or colonies that have been impacted by WNS (see Needs 2, 3, and 4 below).

#### 2.4.2.2 CONSERVING AND MANAGING WINTER COLONIES, HIBERNACULA, AND SURROUNDING SWARMING HABITAT

Protecting as many hibernacula as possible helps spread the risk that any site (and the associated wintering population) may be impacted by a given threat. Protecting hibernacula with are variety of conditions (winter bat size, size of site, microclimate) may be important for ensuring the ability for species adaptation over time and this may be particularly important as we determine why some sites demonstrate higher mortality from WNS than others. In addition, we need to understand if there is any genetic basis for differences in survival rates and how those bats are spread across the landscape. In the Northeast, >75% of all Indiana bats now hibernate in one hibernacula in New York. Many other hibernacula that harbored Indiana bats prior to WNS still support Indiana bats, but in smaller numbers. With WNS on the landscape, maintaining multiple locations for wintering bats is increasingly important because it is likely that the extent of the disease will vary among these hibernacula. At some sites, Indiana bats already appear to be less influenced by WNS than others are. Until we fully understand this situation, we should conserve all known Indiana bat hibernacula (to conserve the potential genetic or behavioral diversity and adaptive capacity, e.g. representation). Also, ensuring that we maintain a variety of suitable hibernacula with varying size and microclimates will help provide resiliency and redundancy (multiple populations) to the species.

At this time, it is prudent to provide safe winter hibernacula for all remaining Indiana bats in the Northeast. The habitat surrounding the hibernacula is also important to the bats' annual lifecycle. During fall swarming, fat supplies for Indiana bats are replenished as they forage in the vicinity of the hibernaculum. Indiana bats put on significant weight in the fall (Hall 1962, LaVal and LaVal 1980). This pre-hibernation weight gain may be even more important for bats exposed to WNS. *P.d.* invades the skin of hibernating bats and disrupts both their hydration and hibernation cycles. Hibernating bats awake repeatedly during the winter, burning up limited fat reserves. Bats with larger fat reserves may have an increased chance of surviving WNS.

The key steps in conserving and managing winter colonies, hibernacula, and surrounding swarming habitat include:

- Maintaining both large and small hibernating populations;

- maintaining or providing appropriate physical structure, airflow, and microclimate of the hibernacula;
- maintaining suitable foraging habitat (forests, streams, wetlands, and riparian areas) connected and in close proximity to hibernacula (e.g., fall swarming/spring staging); and
- avoiding disturbance of hibernating bats which can lead to excessive arousal and premature depletion of fat reserves; and minimizing disturbance of bats during the swarming period that can lead to disruptions in mating and foraging activity.

Examples of specific strategies include:

- Permanent protection (e.g., fee title, easement) of hibernacula;
- gating sites that have risk of trespass/vandalism;
- permanent protection of foraging habitat surrounding hibernacula (with priority given to areas in the immediate vicinity of the hibernacula); and
- restoration or enhancement of swarming/foraging habitat where limited.

#### 2.4.2.3 CONSERVING AND MANAGING MATERNITY COLONIES AND THEIR HABITAT

Maternity colonies are essential to successful reproduction in Indiana bats; to our knowledge, an adult female cannot bear and raise a pup outside of a maternity colony. Multiple (redundant), healthy (resilient) maternity colonies are needed across the ecological diversity (representation) of the species. Similar to the hibernating colonies, we have more to learn about the species long-term response to WNS and whether genetic or behavioral differences may result in better survival of individuals of some colonies.

Although we know where more than 200 Indiana bat maternity colonies are located, less than 10% of those estimated to exist have been identified, and many portions of the range of the species have not been surveyed to determine if maternity colonies could be present. Therefore, the first step in conserving and managing maternity colonies is locating those colonies via spring emergence radio tracking or summer surveys. The majority of maternity colonies in the Northeast RU have been located using this method. Tracking is needed from multiple sites in the Appalachia RU although it is increasingly difficult to find sites with enough bats available for tracking efforts in this RU.

Other key steps include:

- Ensuring a sufficient number of healthy, self-sustaining maternity colonies persist in order to support the regional population (i.e., RU population) by managing and controlling threats acting, singly and cumulatively, upon the fitness of maternity colonies; and
- maintaining the ecological processes that ensure the continued availability of roosting, foraging, and commuting habitat needed to support maternity colonies.

Examples of specific strategies include:

- Avoiding lethal impacts to bats whenever possible;

- avoiding/minimizing loss of documented habitat, and permanent protection (fee title, easement) of documented habitat (vs. presuming suitable habitat is occupied);
- restoring travel corridors or roosting/foraging habitat to expand existing occupied habitat where suitable habitat is limited; and
- monitoring colonies to evaluate fitness and provide information needed to manage threats.

#### 2.4.2.4 CONSERVING MIGRATING BATS

Indiana bats migrate between their hibernacula and summer habitat.

The key steps in conserving and managing migrating bats include:

- Understanding bat migration, including migratory routes, behaviors, and differences between fall and spring migration;
- maintaining safe and suitable migration pathways across the species range and limiting lethal impacts during migration;
- conserving and managing important migratory stopover habitat; and
- identifying limiting factors and manage threats during migration at levels that will not impede recovery.

Examples of specific strategies include:

- Avoiding lethal impacts to bats whenever possible;
- operating wind turbines to avoid periods of anticipated Indiana bat risk;
- conducting radio telemetry to track migratory movements; and
- permanent protection (fee title, easement) of documented stopover habitat.

## 3 CONSERVATION STRATEGY TOOLS

Given all of the potential strategies listed above, when considering the declining status of the species (particularly in the Northeast RU and Appalachia RU), the various stressors facing Indiana bats, intrinsic limiting factors, and the conservation needs of Indiana bats, the most important thing that we can do for this species in the near term is to avoid impacts whenever possible. In particular, we should avoid lethal impacts to adult females (during all life stages) and reduce all remaining impacts to those that will be short-term in duration. An essential component of avoiding impacts is finding remaining maternity colonies. For the remaining impacts that cannot be avoided, mitigation should be focused on the most critical needs.

The two primary avenues for addressing potential impacts to Indiana bats are through section 7 and section 10 of the ESA. Federal agencies are encouraged to develop landscape conservation strategies and proactive conservation programs through section 7(a)(1). Federal agencies consult with the Service to avoid jeopardizing the Indiana bat through section 7(a)(2). Private actions that may result in incidental take of Indiana bats are addressed through Section 10(a)(1)(B). Research and monitoring activities are often authorized through section 10(a)(1)(A) permits. Other aspects of the ESA are also important (e.g., land acquisition through section 6). The following section provides potential tools for use under various sections of the ESA.

## 3.1 SECTION 7 TOOLS

### 3.1.1 INTRODUCTION

There are multiple options available for conserving Indiana bats under section 7 of the ESA. For example, action agencies and the Service can complete project-specific, batched, or landscape level consultations. Batched and landscape level consultations serve to expedite review and provide consistency to action agencies.

The Service routinely consults on individual projects with potential impacts to the Indiana bat. There are several examples of batched or programmatic consultations in place at individual locations (e.g., National Forests, Department of Defense installations). There is one landscape level consultation with the Federal Highway Administration, Federal Railway Administration, and Federal Transit Administration (Service 2016) available for use across the entire range of the Indiana bat. This consultation has the added benefit of an assisted effects determination key available for online screening and consistency checks by the project sponsor. Additional similar consultations at state, regional, or range-wide scales would be beneficial.

We offer additional thoughts on landscape level consultations below as a preferred tool for increased use in the Northeast Region.

### 3.1.2 LANDSCAPE LEVEL CONSULTATIONS

Landscape level consultations should incorporate directives from section 7(a)(1) and section 7(a)(2) of the ESA. Section 7(a)(1) of the ESA directs each federal agency to carry out programs for the conservation of threatened and endangered species in consultation with the Service. Section 7(a)(2) of the ESA directs each federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. Therefore, when viewing these two subsections together, the ESA requires action agencies to provide conservation programs for species that should be implemented at a landscape level such that the agency will continue to meet its conservation mandate despite the often unavoidable impacts of its mission-driven programs and site-specific projects.

Both 7(a)(1) and 7(a)(2) responsibilities can be achieved by undertaking proactive measures to stabilize or enhance the condition of the Indiana bat and/or its habitat. Thus, section 7(a)(1) can be used to support section 7(a)(2) by clearly identifying the conservation needs of the Indiana bat and developing relevant actions that address those needs. Essentially, 7(a)(1) provides a "conservation framework" for federal agencies to guide implementation of their programs at the landscape level consistent with the purpose of conserving ecosystems upon which these species depend.

This type of conservation planning will enable federal agencies to better synchronize their actions and programs with the conservation and recovery needs of the Indiana bat. Such planning can help federal agencies develop specific, pre-approved design criteria to ensure their actions are consistent with the conservation and recovery needs of the species. Thus, early

planning (before specific projects are fully designed) provides action agencies with the information needed to make appropriate adjustments to projects to avoid, minimize, and mitigate adverse effects to species while there is still the maximum flexibility to modify project designs and identifies opportunities for action agencies to implement proactive conservation. Both of these benefits will greatly facilitate and expedite the project-specific section 7(a)(2) consultation process.

Programmatic consultations, agreements, and procedures are advantageous methods for streamlining the consultation process and generating time and cost savings for the action agency and applicant, as well as for the Service. Addressing species conservation programmatically with a proactive, strategic, landscape-level programmatic approach can encompass more projects and can provide greater more effective mitigation on a landscape level basis. Planning consultations on a programmatic level will increase regulatory certainty and flexibility, decrease regulatory conflict and delays, and significantly streamline consultations for individual projects. This is beneficial to the Service, the action agency, and the applicant.

## 3.2 SECTION 10 TOOLS

### 3.2.1 INTRODUCTION

There are multiple options available for conserving Indiana bats under section 10 of the ESA. For example, recovery permits, HCPs, and GCPs. As of the winter of 2017-2018, there are multiple recovery permits (primarily for presence/probable absernce netting) and several HCPs and associated incidental take permits (ITPs) that are being implemented in Region 5. Most HCPs involve a single project location (e.g., wind project) but the TransCanada (NiSource) HCP extends across 14 northeastern, midwestern, and southeastern states. There are several additional HCPs in development involving Indiana bats.

We offer additional thoughts on GCPs below as a preferred tool for increased use in the Northeast Region.

### 3.2.2 GENERAL CONSERVATION PLANS

There are no GCPs currently completed for the Indiana bat anywhere across the range. Region 5 of the Service is interested in developing one or more GCPs for various stressors/activity types. We anticipate that GCPs will benefit the Indiana bat, the applicant, and the Service. For example, under a GCP, each applicant is not required to spend the time and money to develop a separate HCP and the Service would not be required to develop brand new National Environmental Policy Act analyses. Instead, a more streamlined approach would be used.

While the development of a GCP requires an initial increase in workload for Service personnel, this would pay off in the future, as individual projects will involve less work than that required for the development of a traditional HCP. Upon finalization of a GCP, the Regional Office/Field Office will be able to process individual applications and associated ITPs can be issued expeditiously.

## 3.3 S7/S10 NEUTRAL

### 3.3.1 AVOIDANCE AND MINIMIZATION MEASURES

In future regulatory documents (e.g., GCPs, HCPs, ESA section 7 consultations), avoidance and minimization measures will be designed to do the following:

- Find maternity colonies (e.g., presence/absence (P/A) surveys).
- Avoid all adverse impacts to hibernacula and to hibernating bats.
- Avoid lethal impacts (e.g., from tree felling, smoke operations) to bats during the active season whenever possible.
    - When that is not possible, avoid conducting activities anticipated to result in lethal impacts during critical active season time periods in occupied and assumed occupied summer habitat (May-August) and within 5 miles (8 km) of hibernacula (August-October and April-May).
- Minimize loss of roosting and foraging habitat and connections between them.
- Minimize alteration of roosting and foraging habitat and connections between them.
- Minimize loss of spring staging and fall swarming habitat.
- Minimize loss of migratory stopover habitat.

### 3.3.2 HABITAT CONSERVATION

As stated above, conserving documented hibernacula, documented summer habitat, and documented migratory stop-over habitat are essential for the conservation of the Indiana bat. This can be done as part of the regulatory arena or through proactive non-regulatory efforts. In many cases, funding opportunities are associated with compensatory mitigation, but this is not the only opportunity for the Indiana bat.

#### 3.3.2.1 HABITAT CONSERVATION MECHANISMS

Options for habitat conservation include directly acquiring lands (Fee or permanent easement) or gating hibernacula, buying credits at conservation banks, or use of in-lieu fee programs. Sites may be protected through proactive efforts or through actions associated with regulatory requirements.

*Proactive Habitat Conservation*

Indiana bats are known to occur at several national wildlife refuges (NWRs) across the range. During future NWR planning efforts, it may be possible to incorporate additional Indiana bat sites. States have access to various grants including section 6 (e.g., Recovery Land Acquisition and HCP Land Acquisition) that may be used towards protecting Indiana bat habitat. Other partners (e.g., land trusts) may also have opportunities to conserve lands. Some WNS funds may support actions such as gating important hibernacula.

*Regulatory*

Individual – Permittee-responsible

Project sponsor or permittee-responsible compensatory mitigation (PRM) involves a conserved and managed mitigation site associated with a specific proposed action. The project sponsor either identifies the site, protects the site (fee-title or easement), and retains responsibility for ensuring the required compensatory mitigation is completed and successful or they provide funding to a conservation entity (e.g., land trust) to conduct these activities. Permittee-responsible compensatory mitigation may be on-site or off-site.

Current Service-approved examples in Region 5 include hibernacula protection and maternity colony habitat protection associated with HCPs (e.g., Beech Ridge) and BOs (e.g., Fort Drum Connector, Fort Drum).

Landscape-scale Approaches

An alternative to individual mitigation projects is the development of programmatic landscape-scale approaches. These have the advantages of advance planning and economies of scale to: (1) achieve a net gain in species' conservation; (2) reduce the unit cost of mitigation; and (3) improve regulatory process efficiency.

Conservation Banking

Landscape-scale mitigation promotes consolidated mitigation sites (e.g., conservation banks). A conservation bank is a site, or suite of sites (i.e., umbrella bank), that is conserved and managed in perpetuity, and provides ecological functions and services expressed as credits for specified species or resources, that are later transferred or sold to others for use as compensation for impacts occurring elsewhere to the same species. The sponsor of a conservation bank may be a private entity, non-profit organization, or a government agency.

There are multiple advantages of using conservation banks for mitigation including:

- Avoidance of a piecemeal approach to conservation efforts that often results in small, non-sustainable parcels of habitat scattered throughout the landscape;
- the protection of sites that are a component of a landscape-level strategy for conservation of high-value resources;
- cost effective compensatory mitigation options for small projects, allowing for effective offsetting of the cumulative adverse effects that result from numerous, similar, small actions;
- an increase in public-private partnerships that plan in advance and a landscape-scale approach to mitigation to provide communities with opportunities to conserve highly valued natural resources while still allowing for community development and growth;
- greater capacity for bringing together financial resources and scientific expertise not practicable for small conservation actions;
- economies of scale that provide greater resources for design and implementation of compensatory mitigation sites and a decreased unit cost for mitigation;

- improved administrative and ecological compliance through the use of third-party oversight;
- greater regulatory and financial predictability for project proponents, greatly reducing the uncertainty that often causes project proponents to view compensatory mitigation as a burden; and
- expedited regulatory compliance processes, particularly for small projects, saving all parties time and money.

Current options in Region 5 include two conservation banks for Indiana bats in Pennsylvania.

In-Lieu Fee Program

Another option for projects with unavoidable adverse effects to the Indiana bat is to contribute funds to an "in-lieu fee" (ILF) program. In-lieu fee programs involve the restoration, establishment, enhancement, and/or preservation of habitat through funds paid to a governmental or nonprofit natural resources management entity (i.e., ILF program sponsor) to satisfy compensatory mitigation requirements for impacts to specified species or habitat (definition adapted from 33 CFR 332.2). In-lieu fee programs collect fees from permittees that have been approved by the Service to use ILF programs instead of providing PRM. In-lieu fee program sponsors may be non-profit organizations or government agencies. Fees collected by ILF sponsors are placed in an ILF account, and funds are disbursed from that account to purchase land or perform an activity, as specified in the ILF instrument. This approach alleviates time constraints in the development and approval process of advanced mitigation sites and conservation banks and is useful when other conservation options are not available.

Current Service-approved options in Region 5 that address habitat conservation: The Conservation Fund's (TCF) Range-wide ILF Program. The Pennsylvania Field Office's Indiana Bat Conservation Fund (IBCF) continues to be used as an ILF program, but we anticipate that once enough conservation banks are established, this program will no longer be offered and the focus will be to spend down the funds in the IBCF.

#### 3.3.2.2 HABITAT CONSERVATION LOCATIONS

*Identifying Potential Conservation Areas*

Conservation efforts should be focused where the bats are documented to occur across the landscape throughout its life history. As previously referenced, there is good information about the locations of most Indiana bat hibernacula although additional sites are occasionally found (e.g., the recent discovery of a large hibernaculum in Missouri). Conversely, although we know where more than 200 Indiana bat maternity colonies are located, less than 10% of those estimated to exist have been identified. We have limited information on migratory routes between hibernacula and summer habitat from tracking Indiana bats during spring emergence and almost no data are available about Indiana bat fall migration.

*Known Hibernacula and Associated Swarming Habitat*

While Indiana bats may use habitat in the fall as far as 10-20 miles (16.1-32.2 km) from hibernacula, conservation efforts should be focused in closer proximity (e.g., 5 miles [8 km]) to the hibernaculum of interest.

*Known Maternity Colonies*

Protection of summer habitat should be focused within maternity colony home ranges associated with documented captures, roosts, and/or foraging locations.

### 3.3.3 INDIANA BAT RESEARCH PROJECTS AND SURVEYS

In addition to funding specifically tied to various projects, action agencies (including the Service) or project sponsors may periodically have funding sources available that could be targeted towards research designed to benefit Indiana bats.

#### 3.3.3.1 INDIANA BAT RESEARCH PROJECTS

We recommend focusing on targeted research to: (a) address information gaps related to life history, summer and winter habitat needs, and migration patterns; (b) assess effectiveness of and refine conservation measures to achieve meaningful conservation while minimizing regulatory burden; and (c) address impacts from WNS (Bats for the Future Fund). Example priority actions include locating and determining the status of maternity colonies in WNS-affected areas.

#### 3.3.3.2 SURVEYS

*Proactive Surveys*

Agencies and/or project sponsors can fund proactive surveys to learn more about current bat distribution and migration pathways across the landscape. Types of surveys include spring emergence radio tracking, fall radio tracking, summer netting, and summer acoustics. Periodically new hibernacula (e.g., during portal surveys) are also discovered. By conducting proactive surveys the Service will be able to better identify areas of conservation concern and focus mitigation and research efforts within those areas.

We consider funding of proactive surveys (particularly spring and fall migration studies) as a reasonable mitigation project for Indiana bats because of the difficulty in finding Indiana bats across the summer landscape in parts of the range.

*Presence/Probable Absence Surveys*

In additional to proactive surveys that are not associated with a specific project, P/A surveys can be an important tool to focus conservation efforts and reduce unnecessary regulatory burden on the public.

When a listed species may occur in a project area but no prior surveys have been completed, there are generally two options: (a) conduct surveys to determine if the species is present; or (b) to assume the species is present and implement avoidance, minimization, and mitigation measures. If the action agency, or the applicant, selects to assume presence, the Service is then expected to provide the benefit of the doubt to the species concerned (H.R. Conf. Rep. No. 697, 96th Cong., 2nd Sess. 12 (1979)), which may lead to conservation measures that would not have been necessary if surveys had been conducted and presence was not found.

For example, if the action agency or project sponsor assumes presence of Indiana bats in suitable summer maternity habitat, the action agency or project sponsor would then implement avoidance and minimization measures. If adverse impacts cannot be fully avoided, formal consultation with an action agency would be required or if the action has no federal nexus, the Service would recommend the project sponsor develop an HCP. Determining appropriate conservation measures can be difficult for projects anticipated to have population-level impacts and we recommend conducting P/A surveys for these types of projects.

Summer P/A surveys are not recommended when:

- There is no suitable summer habitat.
- There is suitable summer habitat but no effects are anticipated to the Indiana bat or the habitat.
- We already have known Indiana bat occurrence information.
- Adequate prior surveys (following Service P/A protocols) have been negative.[4]
- Impacts to individual bats can be avoided or minimized to the point where any adverse effects are considered insignificant or discountable (i.e., not likely to adversely affect).
- Some adverse effects to individuals are anticipated (formal consultation is required or HCP and ITP recommended) but no significant effects to populations are anticipated.

Summer P/A surveys (or prior documentation of presence from spring emergence studies) are recommended when:

- Population-level impacts are anticipated.
- Geographic area has had no prior survey work and basic P/A information is essential to determine whether assumption of presence is reasonable and cumulative removal of habitat is occurring.

Summer P/A surveys (or prior documentation of presence from spring emergence studies) are necessary for:

- Determining conservation focus areas for mitigation.
- Determining whether a site should be considered as a conservation bank.

[4] Unless otherwise agreed to by the Service, negative presence/probable absence survey results obtained using Indiana bat summer survey guidance are valid for a minimum of 2 years from the completion of the survey unless new information (e.g., other nearby surveys) suggest otherwise.

# 4 SUMMARY

Given the current declining status of the species in the Northeast Region, avoiding lethal impacts to Indiana bats (especially adult females) whenever possible is an important goal. In areas of known or assumed presence, application of time-of-year restrictions for tree clearing or other activities that may result in lethal impacts is an option for avoiding that specific effect. However, if applicants are assuming presence this can result in challenging situations for assessment of remaining impacts associated with loss of core roosting, foraging, and commuting habitat. We recommend increasing the number and locations of proactive (spring emergence radio telemetry, acoustics, and netting) surveys. We also recommend project-related presence/probable absence surveys in geographic locations with limited occurrence information and for projects with the likelihood of greater severity to populations. Increased information about documented species occurrence will also assist with proactive or mitigative conservation efforts such as habitat protection.

Given that impacts cannot be avoided in all situations, we also recommend increasing the use of streamlining tools such as GCPs, programmatic consultations, conservation banks, and the TCF ILF.

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