BIOLOGICAL OPINION

Effects of Golden-Winged Warbler Habitat Creation
by the Natural Resources Conservation Service
on the Indiana Bat (*Myotis sodalis*)

Somerset County, Pennsylvania

Prepared by:
U.S. Fish and Wildlife Service
Pennsylvania Field Office

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Natural Resources Conservation Service
Harrisburg, Pennsylvania

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CONSULTATION HISTORY

August 27, 2012 – The Natural Resources Conservation Service (NRCS) conducts an online environmental review of a proposed golden-winged warbler (*Vermivora chrysoptera)* habitat creation project on the Engleka property. The automated response from the Service indicates further review of the project is required, and additional project information is requested by the Service.

September 5, 2012 – Representatives from the Service, NRCS, Pennsylvania Game Commission, and Indiana University of Pennsylvania meet to discuss golden-winged warbler habitat creation projects and their potential for adverse effects on the Indiana bat when conducted in known maternity and swarming habitat. The project proponents indicate the take minimization measures advised by the Service can be implemented, with the exception of retaining sufficient forest cover for Indiana bat foraging and roosting within the proposed treatment areas.

September 8, 2012 – NRCS conducts an online environmental review of a proposed golden-winged warbler habitat creation project on the Chaconas property. The automated response from the Service indicates further review of the project is required, and additional project information is requested by the Service.

September 10, 2012 – The Service receives correspondence from NRCS, which includes project information related to the Engleka and Chaconas habitat creation projects.

September 12, 2012 – Due to the potential for adverse effects on the South Penn Tunnel Indiana bat population, the Service and NRCS agree that formal consultation on the Engleka and Chaconas habitat creation projects is warranted. It appears the Service has sufficient information on file from NRCS to complete the formal consultation. The project will include all but one of the measures detailed in the Service's *Forest Management Practices for Conserving Indiana Bats*. NRCS also indicates that golden-winged warbler projects proposed within known maternity habitat will be abandoned or redesigned to avoid potential adverse effects on Indiana bats.

September 19, 2012 – Correspondence from the Service to NRCS, memorializing the agreement to proceed with formal consultation on the subject projects.

December 21, 2012 – The Service provides NRCS with the final biological opinion.

BIOLOGICAL OPINION

This biological opinion is based on project information provided by NRCS, as well as other supporting information available in Fish and Wildlife Service files. The complete administrative record of this consultation is on file at the Service's Pennsylvania Field Office.

DESCRIPTION OF THE PROPOSED ACTION

This biological opinion evaluates the effects of creating golden-winged warbler habitat within swarming habitat associated with the South Penn Tunnel, a Priority 3 Indiana bat hibernaculum.

The biological assessment describes activities that may adversely affect the Indiana bat, and addresses whether implementation of the project is or is not likely to jeopardize the continued existence of the Indiana bat.

Project Area

The project area includes two privately-owned properties in Allegheny and Northhampton Townships, Somerset County, Pennsylvania, referred to as the Howard Engleka and Ted Chaconas projects. These properties are located approximately 1.7 miles apart, and are approximately five miles southeast of the town of Berlin. Both properties are in the Brush Creek watershed in the Potomac Basin. They occur within the Allegheny Front Section of the Appalachian Plateaus physiographic province, east of the escarpment.

Most of the 368.3-acre Engleka tract is forested, with dominant tree species consisting of red maple, black locust and cherry ranging from 6-10 inches in diameter. The southern portion of the property supports some oaks that are 12-16 inches in diameter. There is an intermittent stream in the northwest corner of the property.

The 376.9-acre Chaconas track is forested, with much of the track dominated by northern red and white oaks (12-16 inches dbh). Lowland and riparian areas are dominated by large beech, sugar maple and red maple (12-26 inches dbh). The southeastern portion of the property (where the habitat treatment is proposed) consists of an Allegheny Hardwoods stand dominated by cherry, ash, beech and sugar maple (12-16 inches dbh).

Project Description

The NRCS recently formed a partnership with the Fish and Wildlife Service to conserve wildlife habitat for certain at-risk and federally-listed species. This initiative is called Working Lands for Wildlife, which is funded through NRCS's Wildlife Habitat Incentive Program (WHIP). In Pennsylvania, the target species for conservation include the federally-listed bog turtle (*Clemmys muhlenbergii*) and the at-risk golden-winged warbler. The goals of this initiative are to restore populations of declining wildlife species, provide landowners with regulatory certainty, and strengthen rural economies through productive working lands (NRCS, accessed at http://www.pa.nrcs.usda.gov/programs/whip/WLFW/WLFW.html on December 12, 2012). Through this program, applicants can receive funding from NRCS to carry out habitat conservation practices for the target species. NRCS develops the conservation plan for the target species, and the contract with the applicant specifies the terms for conservation plan implementation and federal funding.

In Pennsylvania, the golden-winged warbler focal area for habitat creation encompasses known Indiana bat hibernacula, swarming habitat and maternity habitat in several south-central counties, including Bedford, Blair and Somerset. In fiscal year 2012, several hundred acres of habitat creation were proposed in Pennsylvania, of which two projects are the subject of this biological opinion. The proposed federal action involves the creation of golden-winged warbler habitat on two privately-owned properties in Somerset County through NRCS's WHIP program under the Working Lands for Wildlife initiative for fiscal year 2012.

On the Engleka property, NRCS practice 647 (Early Successional Habitat Development and Management) is proposed on 10.2 acres of forest land. Existing forest cover would be removed, with the exception of approximately 12 of the largest trees per acre, including oaks, hawthorns, cherries and black locust ranging from 7 to 12 inches dbh. To reduce stump sprouting, very few maples will be retained. The proposed treatment is expected to create early successional habitat interspersed with widely scattered trees, allowing for growth of goldenrod and other forbs preferred by golden-winged warblers. No habitat treatments are proposed within 100 feet of the intermittent stream in the northwest corner of the property.

On the Chaconas property, 26.3 acres of existing forest cover would be converted to golden-winged warbler habitat using NRCS practice 647 (Early Successional Habiat Development and Management). Much of the overstory would be removed, including oak, cherry, red maple, sugar maple and ash ranging from 2 to 16 inches dbh. Some oak, cherry, hemlock, American beech and sugar maple over 13 inches dbh would be retained. Tree removal is not proposed in riparian areas.

On both the Engleka and Chaconas properties, the desired condition for golden-winged warblers is early succesional habitat with a mix of grasses, herbs, shrubs and scattered trees. This would be achieved by removing most of the forest overstory, in anticipation of achieving a suitable vegetation structure for golden-winged warblers beginning 4 to 5 years post-harvest. Harvested areas are considered ideal for golden-winged warblers when shrubs and regenerating trees are 10 to 20 feet high, which occurs from approximately 4 to 20 years post-harvest. After that, the closing canopy reduces habitat quality through reductions in structural diversity. Golden-winged warblers have been documented using harvests that have 10-25% herbaceous cover, 30-50% sapling and shrub cover, 10-20% tree cover and up to 30% bare ground (Bakermans *et al*. 2011).

Although the treatments are expected to provide golden-winged warbler habitat from 4 to 20 years post-harvest, the NRCS contract with the subject landowners would only be in place for about three years, as all treatments would be expected to be carried out within that period.

Minimization Measures

The NRCS has committed to implement the following measures to reduce the risk of adversely affecting Indiana bats. The Service has analyzed the effects of the proposed action considering the project and all project minimization measures will be implemented as proposed.

- Retain all snags, except where they pose a serious human safety hazard due to their location near a building, yard, road or powerline. A tree with less than 10% live canopy should be considered a snag. When possible, delay removal of hazard trees until bats are hibernating (between November 15 and March 31).

- Do not harvest or manipulate shagbark hickory trees (*Carya ovata*) unless the density of shagbark hickory exceeds 16 trees per acre. If present, maintain at least 16 live shagbark hickory greater than 11" dbh (diameter at breast height) per acre. If there are no shagbark hickory trees greater than 11" dbh to leave, then the 16 live shagbark hickory trees per acre must include the largest specimens in the stand.

- The following species of trees have been identified as having relatively high value as potential Indiana bat roost trees. This list is based on review of literature and data on Indiana bat roosting requirements. Other species may be added as they are identified. Other tree species with exfoliating bark, crevices or cavities could also serve as potential roost trees.

  shagbark hickory (*Carya ovata*)
  bitternut hickory (*Carya cordiformis*)
  mockernut hickory (*Carya tomentosa*)
  pignut hickory (*Carya glabra*)
  other hickories (*Carya* spp.)
  silver maple (*Acer saccharinum*)
  sugar maple (*Acer saccharum*)
  red maple (*Acer rubrum*)
  green ash (*Fraxinus pennsylvanica*)
  white ash (*Fraxinus americana*)
  eastern cottonwood (*Populus deltoides*)
  northern red oak (*Quercus rubra*)
  scarlet oak (*Quercus coccinea*)
  black oak (*Quercus velutina*)
  white oak (*Quercus alba*)
  chestnut oak (*Quercus prinus*)
  slippery elm (*Ulmus rubra*)
  American elm (*Ulmus americana*)
  black locust (*Robinia pseudoacacia*)

- At least 3 live trees per acre greater than 20" dbh (of the species listed above) should always be maintained in the stand. These must be the largest trees of these species in the stand. An additional 6 live trees per acre greater than 11" dbh (of the species listed above) must also be maintained. In areas of the stand where there are no trees greater than 20" dbh to retain, then 16 live trees per acre must be retained, and these must include the largest specimens of the preferred species (see list above) in the stand.

- No harvest or timber stand improvement activities will occur within 100 feet on both sides of perennial streams, and within 50 feet on both sides of intermittent or ephemeral streams.

- Do not cut trees between April 1 and November 15. This corresponds to the Indiana bat reproductive and spring/fall emergence and swarming seasons.

- Do not carry out prescribed burns in forest habitat between April 1 and November 15.

Conservation Measures

Conservation measures represent actions pledged in the project description that the action agency or the applicant will implement to further the species' recovery. Such measures may be tasks recommended in the species' recovery plan, should be closely related to the action, and should be achievable within the authority of the action agency or applicant. The beneficial effects of conservation measures are taken into consideration in the Service's conclusion of jeopardy or non-jeopardy to the listed species, and in the analysis of incidental take. If a conservation measure does not minimize impacts to affected individuals in the action area, the beneficial effects of the conservation measure are irrelevant to the determination of take levels, but may still be relevant to the conclusion of jeopardy or non-jeopardy to the listed species. With respect to the proposed projects, no conservation measures were identified by NRCS to further the conservation or recovery of the Indiana bat.

However, NRCS has indicated that golden-winged warbler habitat creation projects will not be carried out in known Indiana bat maternity habitat as this may impede recovery efforts in those areas. Also, NRCS has developed and implemented the Healthy Forest Reserve Program in Pennsylvania, to permanently protect known Indiana bat maternity habitat and swarming habitat. These efforts are consistent with NRCS's responsibilities under Section 7(a)(1) of the Endangered Species Act, for federal agencies to use their authorities to further the conservation and recovery of federally-listed species.

Action Area

The "action area" includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). It is the entire area within which direct and indirect project-associated environmental effects are anticipated to occur (*e.g.*, earth disturbance, habitat alterations, noise, flight path disruption).

The action area for these projects includes the 10.2-acre treatment area on the Engleka property and the 26.3-acre treatment area on the Chaconas property. The action area includes Indiana bat swarming habitat associated with the South Penn Tunnel hibernaculum.

STATUS OF THE SPECIES

Species Description

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter, and spends the summer in wooded areas. It is a medium-sized bat, having a wing span of 9 to 11 inches and weighing only one-quarter of an ounce. It has brown to dark-brown fur, and the facial area often has a pinkish appearance. The Indiana bat closely resembles the little brown bat (*Myotis lucifugus*) and the northern long-eared bat (*Myotis septentrionalis*). It is distinguished from these species by its foot structure and fur color.

Regulatory Status

The Indiana bat was officially listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001), under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The Endangered Species Act extended full protection to the species. Critical habitat was designated for the species on September 24, 1976 (41 FR 14914). Thirteen hibernacula, including 11 caves and two mines in six states, were listed as critical habitat. There is no designated critical habitat in the Commonwealth of Pennsylvania.

Life History

The Indiana bat is a migratory bat, hibernating in caves and mines in the winter (typically October through April) and migrating to summer habitat. Figure 1 depicts this annual chronology (USFWS 2007). Although some Indiana bat bachelor colonies have been observed (Hall 1962, Carter *et al*. 2001), males and non-reproductive females typically do not roost in colonies and may stay close to their hibernacula (Whitaker and Brack 2002) or migrate long distances to their summer habitat (Kurta and Rice 2002). Reproductive females have been documented to migrate up to 357 miles (Winhold and Kurta 2006) to form maternity colonies to bear and raise their young. However, some females form maternity colonies within only a few miles of their hibernacula. Both males and females return to hibernacula in late summer or early fall to mate and store up fat reserves for hibernation. By mid-November, male and female Indiana bats have entered hibernation. They typically emerge in April, at which time they again migrate to summer habitat. The Indiana Bat Draft Recovery Plan (USFWS 2007) provides a comprehensive summary of Indiana bat life history.

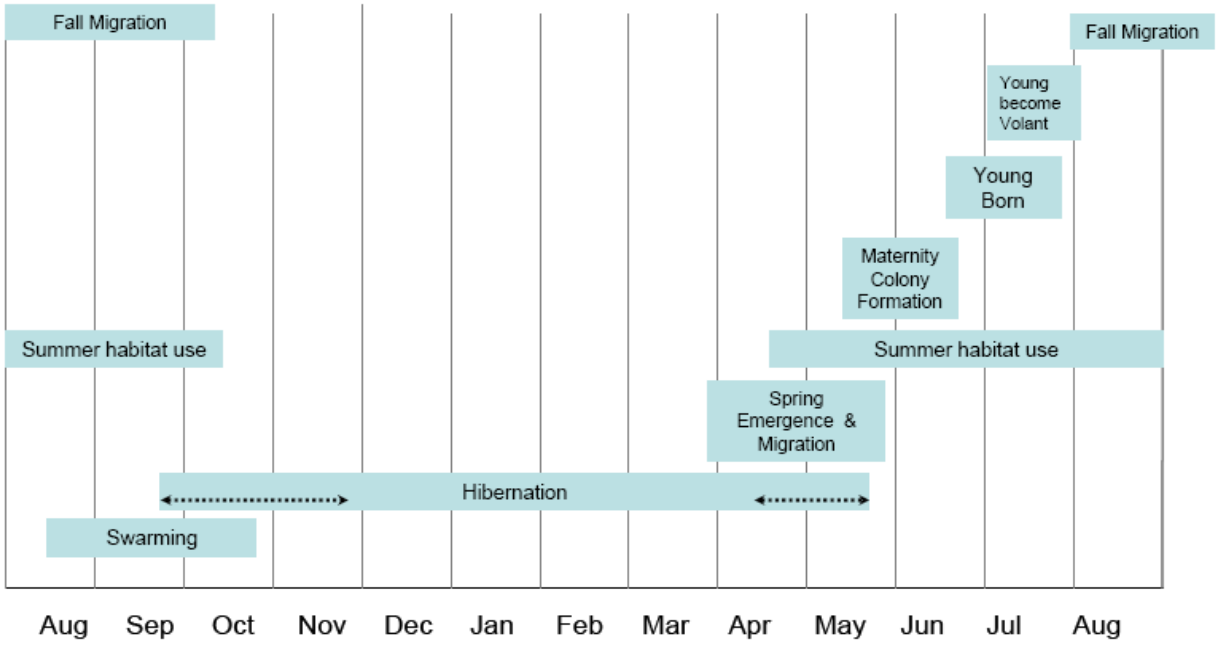

Figure 1. Indiana bat annual chronology

Survival and Reproduction

The average life span of the Indiana bat is 5 to 10 years, but banded individuals have been documented to live as long as 14 to 15 years (Humphrey and Cope 1977). No estimates of age structure have been made for winter populations, or for the population as a whole, due in part to the lack of an accurate technique for aging individuals once they are adults. To date, published estimates of the lifespan of the Indiana bat are based on survival after banding, from bats captured in winter. Using winter sampling of unknown-age bats over a 23-year period, Humphrey and Cope (1977) estimated annual survival. Survival rates following weaning are unknown, although they surmised that the lowest survival occurred in the first year after marking. Female survivorship in an Indiana population was 76% for ages 1 to 6 years, and 66% for ages 6 to 10 years. Male survivorship was 70% for ages 1 to 6 years, and 36% for ages 6 to 10 years. Following 10 years, the survival rate for females dropped to only 4 percent (Humphrey and Cope 1977).

Female Indiana bats, like most temperate vespertilionids, give birth to one young each year (Mumford and Calvert 1960, Humphrey *et al*. 1977, Thomson 1982). The proportion of female Indiana bats that produce young is not well documented. At a colony in Indiana, 23 of 25 female Indiana bats produced volant young during one year, and 28 females produced at least 23 young the following year (Humphrey *et al*. 1977). Based on cumulative mist-netting captures over multiple years, Kurta and Rice (2002) estimated that 89 percent of adult females in Michigan maternity colonies were in reproductive condition (pregnant, lactating, or post-lactating). Reproductive rates of the closely related little brown bat often exceed 95 percent (*i.e*., 95 percent of females give birth), but location and environmental factors (*e.g*., amount of rainfall and temperature) can lead to lower rates (Kurta and Rice 2002, Barclay *et al*. 2004).

The sex ratio of the Indiana bat is generally reported as equal or nearly equal, based on early work by Hall (1962), Myers (1964), and LaVal and LaVal (1980). Humphrey *et al*. (1977) observed a nearly even sex ratio (nine females, eight males) in a sample of weaned young Indiana bats. However, differential survival in adults has been suggested (Humphrey and Cope 1977, LaVal and LaVal 1980).

Diet

The Indiana bat feeds primarily on aquatic and terrestrial insects. Diet varies seasonally and variations exist among different ages, sexes, and reproductive status (USFWS 1999). Numerous foraging habitat studies have been completed for the Indiana bat. These studies found that Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands. Forested habitats are very important for foraging bats, but old fields and agricultural areas seem to also be somewhat important habitats in studies completed in Indiana, where forest habitat is limited and highly fragmented (USFWS 2007). At a study site near the Indianapolis International Airport, Sparks *et al*. (2005) found Indiana bats spending nearly 50% of their time foraging over agricultural fields with movements focused on a riparian corridor. Indiana bats are probably utilizing forest-field edges and crowns of large scattered trees within the open canopy habitats.

Drinking water is essential, especially when bats actively forage. Throughout most of the summer range, Indiana bats frequently forage along riparian corridors and obtain water from streams. However, ponds and water-filled road ruts in the forest uplands are also very important water sources for Indiana bats.

Habitat Characteristics and Use

In this section we provide summaries of habitat characteristics and habitat use by Indiana bats. The Indiana Bat Draft Recovery Plan (USFWS 2007) provides more comprehensive summaries and can be referred to for additional information.

During winter, Indiana bats are restricted to suitable underground habitats known as hibernacula. The majority of hibernacula consist of limestone caves, especially in karst areas of east central United States, but abandoned underground mines, railroad tunnels, and even hydroelectric dams can provide winter habitat throughout the species' range (USFWS 2007). Hibernacula with stable and/or growing populations of Indiana bats have stable low temperatures that allow the bats to maintain a low metabolic rate and conserve fat reserves through the winter.

Spring emergence occurs when outside temperatures have increased and insects are more abundant (Richter *et al*. 1993). In central Pennsylvania, spring emergence typically peaks in mid-April. Some bats may remain in close proximity to the cave for a few days before migrating to summer habitats. This activity is known as spring staging. Others head directly to summer habitat. Migration distances range from a few miles to over 300 miles (Winhold and Kurta 2006). Some males spend the summer near their hibernacula (Whitaker and Brack 2002), while others disperse longer distances. Males roost individually or in small groups. In contrast, reproductive females form larger groups, referred to as maternity colonies, in which they raise their offspring. The average maternity colony size is 50 to 80 adult females (Whitaker and Brack 2002). Non-reproductive females may roost individually or in small groups, but occasionally are found roosting with reproductive females. While Indiana bats primarily roost in trees, some colonies have been found in artificial roost sites (USFWS 2007).

Indiana bats exhibit strong site fidelity to their traditional summer colony areas and foraging habitat, returning to the same summer range annually to bear their young (Kurta *et al*. 2002, USFWS 1999). Several monitoring studies have documented female Indiana bats returning to the same area to establish maternity colonies from year-to-year (Humphrey *et al.* 1977; Gardner *et al.* 1991a, b; Callahan *et al.* 1997; Kurta and Murray 2002; Butchkoski and Hassinger 2002; Gardner *et al.* 1991a, Gardner *et al.* 1996), and to the same roost tree as long as that tree is available. Traditional summer sites that maintain a variety of suitable roosts are essential to the reproductive success of local populations. It is not known how long or how far female Indiana bats will search to find new roosting habitat if their traditional roost habitat is lost or degraded during the winter. If they are required to search for new roosting habitat in the spring, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration and pregnancy.

Gumbert *et al.* (2002) differentiated between roost tree and roost area fidelity in Indiana bats, and found that bats are faithful to both areas and particular trees within those areas. Indiana bats also show a high degree of fidelity to foraging ranges. Kurta and Murray (2002) documented recapturing 41 percent of females when mist netting within the same area in subsequent years. Indiana bat maternity colonies in Illinois, Indiana, Michigan, and Kentucky have been shown to use the same roosting and foraging areas year after year (Gardner *et al.* 1991b; Humphrey *et al.* 1977; Kurta and Murray 2002; Kurta *et al.* 1996, 2002). Roosting/foraging area fidelity may serve to maintain social interactions between members of the population. Bats using familiar foraging and roosting areas are thought to have decreased susceptibility to predators and increased foraging efficiency, as well as the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert *et al.* 2002).

Summering Indiana bats (males and females) roost in trees in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bats to roost between the bark and bole of the tree. Cavities and crevices in trees also may be used for roosting. A variety of tree species are used for roosts including, but not limited to, silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), eastern cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), shingle oak (*Quercus imbricaria*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), and sassafras (*Sassafras albidum*) (Rommé *et al*. 1995). Structure is probably more important than the species in determining if a tree is a suitable roost site; tree species that develop loose, exfoliating bark as they age and die are likely to provide roost sites.

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. Maternity colonies use a minimum of eight to 25 trees per season (Callahan *et al*. 1997, Kurta *et al*. 2002), and the primary and alternate roost trees tend to be clustered into roosting areas (Kurta *et al*. 1996, Kurta 2005). At sites with an abundance of suitable roosting habitat, roost trees tend to be more tightly clustered, with the distance between roosts as small as 1 meter (Kurta *et al*. 1996). However, where roosting habitat is sparse and fragmented, the maximum distance between roost trees used by the same colony has been reported to be 3.6 miles (Kurta *et al*. 2002).

In Missouri, Callahan (1993) 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 or to colonies that have undergone declines due to white-nose syndrome. 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 in 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, and may be used when temperatures are above normal or during precipitation. Shagbark hickories are good alternate roosts because they are cooler during periods of high heat and tight bark shields the bats from rain (USFWS 1999). On average, Indiana bats typically switch roosts every two to three days. Switching behavior is

influenced by reproductive condition of the female, roost type, weather conditions, and time of year (Kurta *et al*. 2002, Kurta 2005).

Despite the ephemeral nature of their roost trees, as long as adequate roosting opportunities are available in the general area, bats are probably not dependent on the continued suitability of a specific tree. There is evidence that colonies are able to relocate to other suitable roosting areas within the colony's home range after the loss of a roost tree. In Michigan, the focal point of a colony's maternity activity shifted 1.24 miles over a three-year period after the primary roost tree fell down. The area that they shifted to had been previously used by a single radio-tracked female for roosting during the summer prior to loss of the roost tree (Kurta *et al.* 2002). This is consistent with a number of other situations, where the bats moved to nearby roosts but retained the same commuting corridors and foraging areas once a primary roost tree of a maternity colony had been lost (Humphrey *et al*. 1977).

After grouping into maternity colonies, reproductively active females give birth to a single offspring in June or early July (Easterla and Watkins 1969, Humphrey *et al.* 1977). This life history strategy reduces thermoregulatory costs, which, in turn increases the amount of energy available for birthing and the raising of young (Barclay and Harder 2003). There are no documented occurrences in which a female Indiana bat has successfully given birth and raised a pup alone without the communal benefits, particularly thermoregulation, offered by establishment of a maternity colony. Studies by Belwood (2002) show asynchronous births among members of a colony. This results in great variation in size of juveniles (newborn to almost adult size young) in the same colony. In Indiana, lactating females have been recorded from June 10 to July 29 (Whitaker and Brack 2002). Young Indiana bats are capable of flight within a month of birth. Young born in early June may be flying as early as the first week of July (Clark *et al.* 1987), others from mid- to late July.

When young become capable of flight (early to late July), roosting behavior is similar to that in early summer. However, the maternity colony begins to disperse and use of primary maternity roosts diminishes, even though bats stay in the area prior to migrating back to their respective hibernacula. Bats become less gregarious and the colony utilizes more alternate roosts, possibly because there is no longer the need for the adult females to cluster to assist with thermoregulation and nurture the young.

This colonial roosting behavior is well documented for Indiana bat females at maternity colonies. Barclay and Kurta (2007) suggested four potential explanations for female aggregation (establishment of maternity colonies) in the summer: 1) roosts are limited, 2) foraging efficiency – members of a colony communicate regarding good foraging areas, 3) anti-predator mechanism, and 4) thermoregulation. Although there are probably many advantages to colonial roosting, the most important factor for Indiana bats is probably its thermoregulatory benefits (Humphrey *et al.* 1977; Kurta *et al.* 1996). Pups and adults in late pregnancy are poor thermoregulators (Speakman and Thomas 2003), and pre- and post-natal growth is controlled by metabolism and body temperature (Racey 1982). In the absence of clustering, the strict thermal conditions needed to support pre-natal and post-natal growth would not exist. Thus, colonial roosting is a life history strategy adopted by Indiana bats (like many other temperate zone bats) to improve their reproductive success (Barclay and Harder 2003). While there may be a loss or reduction of

these communal benefits below a threshold colony size, it remains an important component of Indiana bat behavior (Racey and Entwistle 2003; Callahan 1993; Gardner *et al.* 1991b).

Beginning in mid-August, Indiana bats migrate from the summer habitat to their fall habitat. Forested areas near hibernacula provide important foraging and roosting habitat for Indiana bats, especially during the fall and spring, when bats are building up their fat reserves prior to and after hibernation. From late August through mid-November, male and female Indiana bats occupy forest habitat in the vicinity of their hibernacula to roost, forage, and breed. Limited work has been done on roosting habitats of Indiana bats in spring and fall, and most data are associated with areas near hibernacula on the Daniel Boone National Forest in Kentucky (Kiser and Elliot 1996, Gumbert *et al*. 2002). These studies show that Indiana bats use roosting sites in the spring and fall that are similar to sites selected during summer, and that Indiana bats show fidelity to individual trees and roosting areas, within and among years. Trees used by the same individual tend to be clustered in the environment.

Home Range

Indiana bats occupy distinct home ranges, particularly in the summer (Garner and Gardner 1992). However, relatively few studies have determined the home ranges of Indiana bats, and these studies based their calculations on a small number of individuals. Further, direct comparison of the home range estimates between studies is difficult due to different methodologies used in collecting the data, inconsistency in terminology, and different methods of calculating home range size (Lacki *et al*. 2007). Home range size varies between seasons, sexes, and reproductive status of the females (Lacki *et al*. 2007).

Menzel *et al*. (2005) tracked seven female and four male Indiana bats from May to August in Illinois. In that particular study, no significant differences in home ranges between males and females were observed and home range estimates were subsequently grouped to obtain a mean summer home range of 357 acres. Watrous *et al*. (2006) calculated a mean home range of 205 acres for 14 female Indiana bats in Vermont. The Vermont results are similar to those obtained in Pennsylvania, where the size of the foraging areas used by females ranged from 96 to 276 acres (Butchkoski and Hassinger 2002). Kiser and Elliot (1996) identified minimum foraging areas for 15 Indiana bats (14 males, 1 female) at a hibernaculum in Kentucky. Their estimates ranged from approximately 69 to 734 acres, with a mean of 385 ± 249 acres.

Distribution and Status

Because the vast majority of Indiana bats form dense aggregations or "clusters" on the ceilings of a relatively small number of hibernacula (*i.e.*, caves and mines) each winter, conducting standardized surveys of the hibernating bats is the most feasible and efficient means of estimating and tracking population and distribution trends across the species' range. Collectively, winter hibernacula surveys provide the Service with the best representation of the overall population status and relative distribution that is available.

For several reasons, interpretation of the census data must be made with some caution. First, winter survey data have traditionally been subdivided by state due to the nature of the data

collection. As described below, each state does not represent a discrete population center. Nevertheless, the range-wide population status of the Indiana bat has been organized by state thus far. Second, as will be further discussed, available information specific to the "reproductive unit" (*i.e.*, maternity colony) of the Indiana bat is limited. While winter distribution of the Indiana bat is well documented, relatively little is known as to the size, location, and number of maternity colonies for the Indiana bat. As described below, the locations of more than 90% of the estimated maternity colonies remain unknown. Additionally, the relationship between wintering populations and summering populations is not clearly understood. For example, while it is known that individuals of a particular maternity colony typically come from one to many different hibernacula, the source (hibernacula) of most, if any, of the individuals in a maternity colony is not known. Figure 2 illustrates the range-wide distribution of known hibernacula and maternity colonies by county. As discussed above, the county distribution of hibernacula is expected to be better represented and more complete than that of the species' summer distribution.

There is limited information on the historic distribution and abundance of Indiana bats. However, paleontological evidence suggests that prehistoric abundance of Indiana bats may have exceeded our current population estimates, as well as historic estimates, by an order of magnitude (USFWS 2007). A summary of prehistoric and historic distribution and abundance can be found in the Indiana Bat Draft Recovery Plan (USFWS 2007).

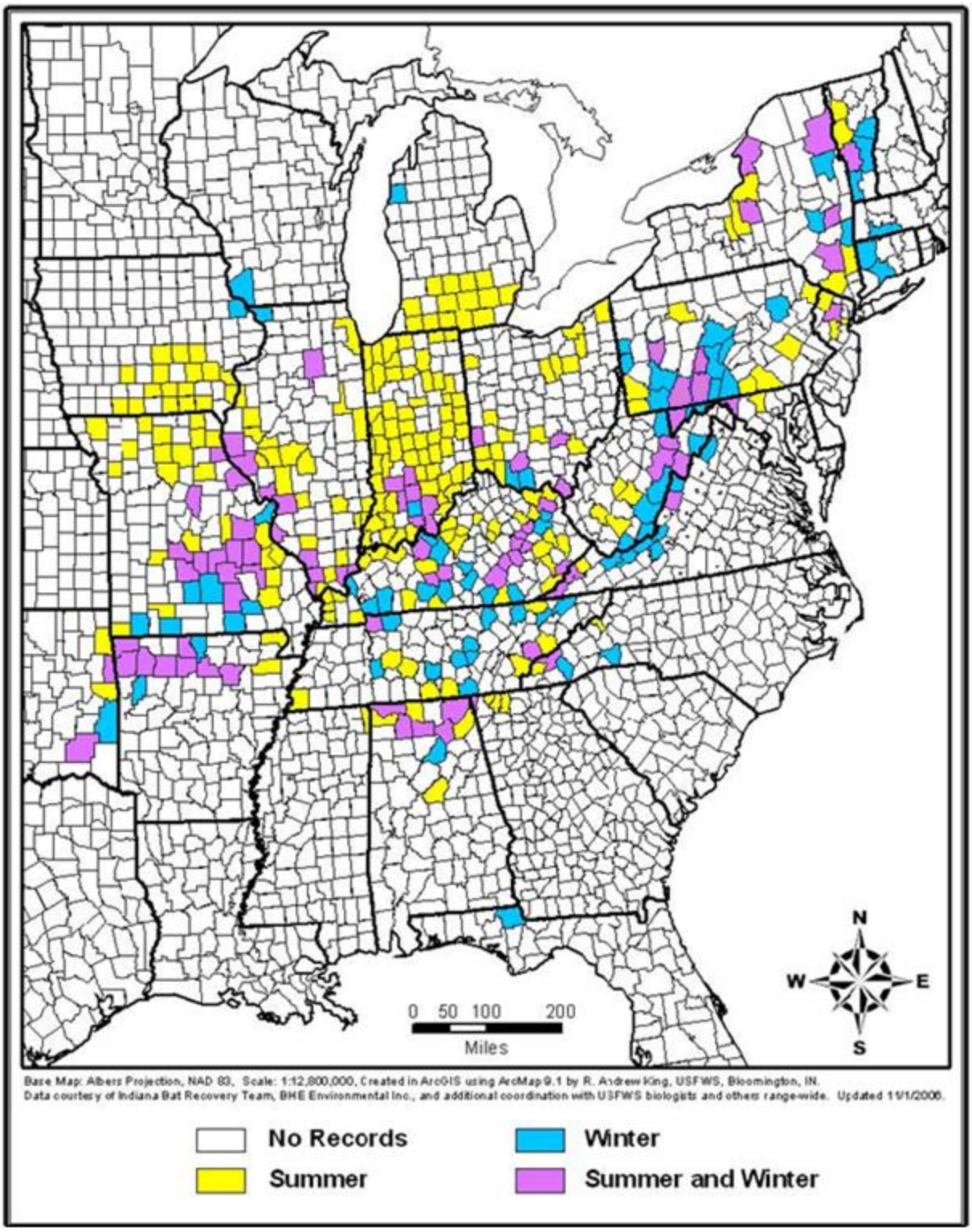

Figure 2. Distribution of counties with known summer and winter records of the Indiana bat as of publication of the Indiana Bat Draft Recovery Plan (USFWS 2007). Pennsylvania data updated and current through August 2012.

Current Abundance and Recent Trends

The Service compiled winter hibernacula survey information to develop the most recent range-wide population estimate of 424,708 Indiana bats. The declining trend in population size from 1981 to 2001 was reversed between 2003 and 2007, during which time the population rebounded to 467,947 bats (Figure 3). However, the 2009 survey results document a 11.2 percent population decline, some of which is attributed to white-nose syndrome (see "New Threats" section). Table 1 provides a detailed breakdown of the range-wide population estimates by Fish and Wildlife Service Region and by State from 2001 to 2011 (USFWS 2012).

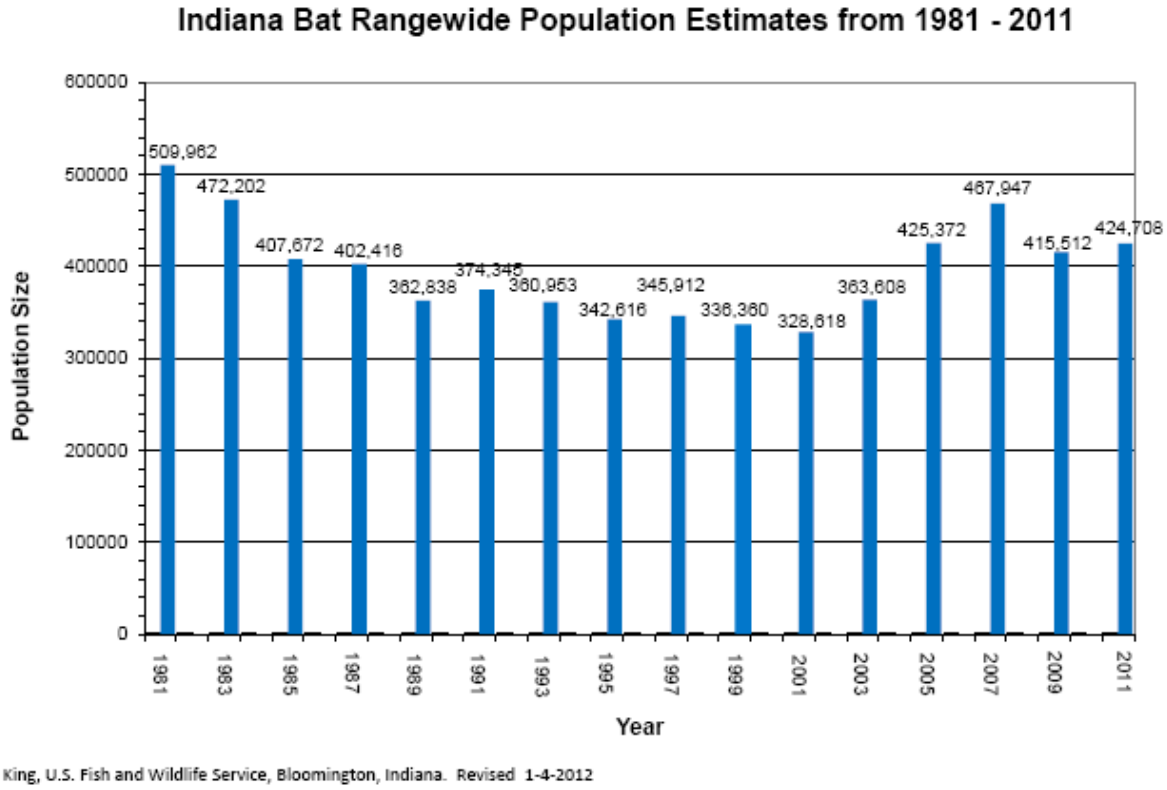

Figure 3. Indiana Bat Range-wide Population Estimates 1981-2011 (USFWS 2012)

The overall population distribution has not changed over the past several years. However, the abundance of Indiana bats in the northeast has declined significantly, and the threat to the species from white-nose syndrome (WNS) remains at a high level. Recovery efforts are primarily focused on the WNS investigation at this time because this poses a serious threat to the continued existence of the species throughout its range. When we consider the positive trends observed over the last several range-wide hibernacula counts (prior to WNS), along with the newly gathered information on WNS, we have concerns about the status of the species. As of the fall of 2011, the Service considers the population trend to be declining, with no expectation of a trend reversal in the foreseeable future.

Table 1. 2011 Range-wide Population Estimate for the Indiana Bat (USFWS 2012)

USFWS Region	State	2003	2005	2007	2009	2011	% Change from 2009	% of 2011 Total
Region 2	**Oklahoma**	**5**	**2**	**0**	**0**	**13**	**100+%**	**0.0%**
Region 3	Indiana	183,337	206,610	238,068	213,170	222,820	4.5%	52.5%
	Illinois	43,647	55,090	53,823	53,342	55,956	4.9%	13.2%
	Missouri	17,752	16,102	15,895	13,688	13,647	-0.3%	3.2%
	Ohio	9,831	9,769	7,629	9,261	9,870	6.6%	2.3%
	Michigan	20	20	20	20	20	0.0%	0.0%
	Total	**254,587**	**287,591**	**315,435**	**289,481**	**302,313**	**4.4%**	**71.2%**
Region 4	Kentucky	49,544	65,611	71,250	57,325	70,329	22.7%	16.6%
	Tennessee	9,802	12,074	8,906	12,721	12,786	0.5%	3.0%
	Arkansas	2,228	2,067	1,829	1,480	1,206	-18.5%	0.3%
	Alabama	265	296	258	253	261	3.2%	0.1%
	North Carolina	0	0	0	1	1	0.0%	0.0%
	Total	**61,839**	**80,048**	**82,243**	**71,780**	**84,583**	**17.8%**	**19.9%**
Region 5	West Virginia	11,443	13,417	14,745	17,965	20,358	13.3%	4.8%
	New York	32,529	41,745	52,779	34,045	16,052	-52.9%	3.8%
	Virginia	1,158	769	723	730	863	18.2%	0.2%
	Pennsylvania	931	835	1,038	1,031	518	-49.8%	0.1%
	New Jersey	644	652	659	416	5	-98.8%	0.0%
	Vermont	472	313	325	64	3	-95.3%	0.0%
	Total	**47,177**	**57,731**	**70,269**	**54,251**	**37,799**	**-30.3%**	**8.9%**
Rangewide Total:		**363,608**	**425,372**	**467,947**	**415,512**	**424,708**	**2.2%**	**100.0%**

2-yr. Net Change:	**61,764**	**42,575**	**-52,435**	**9,196**
2-yr. % Change:	17.0%	10.0%	-11.2%	2.2%

Categorization of Hibernacula

In the Indiana Bat Draft Recovery Plan (USFWS 2007), Indiana bat hibernacula are assigned priority numbers on the basis of winter population sizes and to protect essential hibernation sites across the species' range. Priority numbers are defined below.

Priority 1 (P1) – Essential to recovery and long-term conservation of Indiana bat, Priority 1 hibernacula typically have (1) a current and/or historically observed winter population ≥ 10,000 Indiana bats and (2) currently have suitable and stable microclimates. Priority 1 hibernacula are further divided into one of two subcategories, "A" or "B," depending on their recent population sizes. Priority 1A (P1A) hibernacula are those that have held 5,000 or more Indiana bats during one or more winter surveys conducted during the past 10 years. In contrast, Priority 1B (P1B) hibernacula are those that have sheltered ≥ 10,000 Indiana bats at some point in their past, but have consistently contained fewer than 5,000 bats over the past 10 years.

Priority 2 (P2) – Contributes to recovery and long-term conservation of Indiana bat. Priority 2 hibernacula have a current or observed historic population of 1,000 or greater, but fewer than 10,000 and an appropriate microclimate.

Priority 3 (P3) – Contribute less to recovery and long-term conservation of Indiana bat. Priority 3 hibernacula have current or observed historic populations of 50 to 1,000 bats.

Priority 4 (P4) – Least important to recovery and long-term conservation of Indiana bat. Priority 4 hibernacula typically have current or observed historic populations of fewer than 50 bats.

Current Winter Distribution

The following is a summary from the Indiana Bat Draft Recovery Plan and 5-year review (USFWS 2007, USFWS 2009a). As of October 2008, the Service had records of extant winter populations (*i.e.*, positive winter occurrence since 1995) at approximately 281 different hibernacula located in 19 states (Figure 4). Based on the 2005 winter surveys, there was a total of 23 Priority 1 hibernacula in seven states – Illinois (n=1), Indiana (n=7), Kentucky (n=5), Missouri (n=6), New York (n=2), Tennessee (n =1), and West Virginia (n=1). A total of 53 Priority 2 hibernacula are known from the aforementioned states, as well as Arkansas, Ohio, Pennsylvania, and Virginia. A total of 150 Priority 3 hibernacula have been reported in 16 states, and 213 Priority 4 hibernacula have been reported in 23 states. Winter surveys in 2009 found hibernating Indiana bats dispersed across 16 states. However, 86% of the estimated range-wide population hibernated in four states, including Indiana (49.0%), Kentucky (14.8%), Illinois (13.7%), and New York (8.4%) (Table 1).

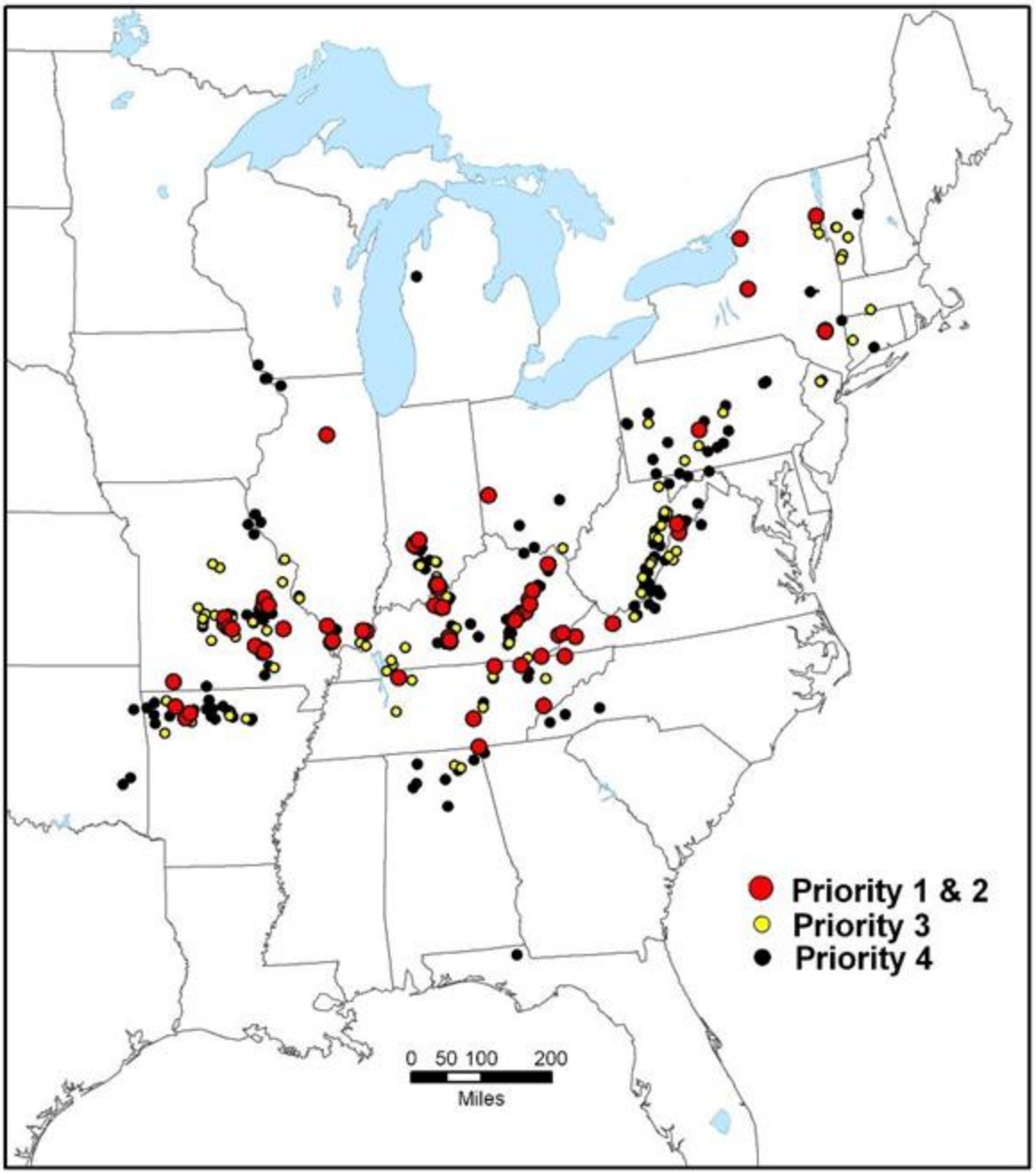

Figure 4. Distribution of known Indiana bat hibernacula and their current priority status (USFWS 2007). Source: Andrew King, U.S. Fish and Service, Bloomington, Indiana

Current Summer Distribution

The summer distribution of the Indiana bat covers a broader geographic area than its winter distribution (Figure 2). Most of the known summer occurrences are from the upper Midwest including southern Iowa, northern Missouri, much of Illinois and Indiana, southern Michigan, Wisconsin, western Ohio, and Kentucky. In the past decade, many summer maternity colonies have been found in the northeastern states of Pennsylvania, Vermont, New Jersey, New York,

West Virginia, and Maryland. Maternity colonies extend south as far as northern Arkansas, southeastern Tennessee, and southwestern North Carolina (Britzke *et al*. 2003, USFWS 2007). Non-reproductive summer records for the Indiana bat have also been documented in eastern Oklahoma, northern Mississippi, Alabama, and Georgia.

Maternity Colonies

The first documented Indiana bat maternity colony, located in east-central Indiana, was not discovered until 1971 (Cope *et al*. 1974). As of publication of the Indiana Bat Draft Recovery Plan (USFWS 2007), 269 maternity colonies in 16 states were considered locally extant. Of those 269 colonies, 54% (n=146) had been found within the past 10 years (*i.e.* since 1997), primarily through the use of mist-netting surveys. In the northeast (*e.g*., Pennsylvania, New York, Maryland, Vermont), several maternity colonies have been located through the use of radio-telemetry, as females have been tracked from hibernacula to summer habitat. Because maternity colonies are widely dispersed during the summer and difficult to locate, it is presumed that all the combined summer survey efforts have found only a small fraction of the maternity colonies that are thought to exist.

The total number of maternity colonies that exist range-wide is not known, but can be estimated based on population estimates derived from winter hibernacula surveys. Based on a range-wide population estimate of 467,947 bats, and assuming a 50:50 sex ratio and average maternity colony size of 50 to 80 adult females (Whitaker and Brack 2002), there were 3,802 (± 877) maternity colonies in 2007. Using the same set of assumptions, there were 3,450 (± 797) colonies in 2011, representing a loss of about 352 colonies over two years. However, this simple mathematical approach fails to incorporate regional variations in the decline, the effects of white-nose syndrome, and the social structure of maternity colonies. A decline in hibernating populations due to WNS may manifest itself first as a reduction in the size of maternity colonies, then the loss of whole colonies if the number of surviving colony members is too small to allow the colony to persist. In areas where WNS is just beginning to move through, maternity colonies are likely to be affected – at least initially – only by the loss of members from WNS-affected hibernacula. However, in areas where WNS has affected bat populations for multiple years, resulting in very high mortality rates, entire maternity colonies have probably been eliminated because all of the hibernating populations that supported those colonies have been decimated. If the resulting reduction in colony size is substantial, the colony may collapse because so few females remain to form the social clustering that is characteristic of the species and likely contributes to its survival and successful recruitment of young. Regardless of how one estimates the number of maternity colonies, the declining hibernating population translates to a declining summer population.

Adult Males

Male Indiana bats are found throughout the range of the species, but in summer are most common in areas near hibernacula (Gardner and Cook 2002). Because they typically roost solitarily in the summer, they are less likely to be detected by mist-netting than adult females, which tend to occur in high-density maternity colonies.

Threats

From 1965-2001, there was an overall decline in Indiana bat populations, with winter habitat modifications having been linked to changes in populations at some of the most important hibernacula (USFWS 2007). Most of these modifications were human-induced for either commercialization of the cave, control of cave access, or for mining. Improper gating and other structures have rendered many historical hibernacula unavailable to Indiana bats. Other documented threats involving hibernacula include human disturbance, vandalism, flooding of caves for reservoirs, destruction by limestone quarries, and indiscriminate collecting, handling, and/or banding of hibernating bats. Natural alterations of hibernacula can include flooding, entrance and passage collapse, and blocked sinkholes, all of which can alter the temperature regime within the cave and even prevent entry by bats. Both natural and human-induced changes to hibernacula can alter the climate required by Indiana bats, which in turn adversely affects the population.

Summer habitat modification is also suspected to have contributed to the decline of bat populations; however, it is difficult to quantify how forest management or disturbance may affect Indiana bats. Forests used by foraging and roosting Indiana bats during spring, summer, and autumn have changed dramatically from pre-settlement conditions. Forests have been fragmented in areas, fire has been suppressed, and much of the vegetation in flatlands (*i.e.*, prairie) has been converted to agriculture (USFWS 1999). Summer habitat can include extensive forests or small woodlots connected by hedgerows. The removal of such habitats is occurring rapidly in some portions of the Indiana bat's range due to residential and commercial development, mining, oil and gas development, and infrastructure development, including roadways and utility corridors. Even in areas of relatively abundant habitat, permanent and temporary impacts to forest habitat pose a risk of Indiana bat mortality during tree felling activities. Furthermore, the ongoing, permanent loss of forests and woodlots may have a significant cumulative effect on the species as habitat is lost, fragmented and degraded, and as maternity colonies are displaced from habitat to which they exhibit fidelity.

In addition, chemical contamination while bats are outside of hibernacula has been suggested as a cause for the decline of Indiana bats (USFWS 1999). The degree to which acute or chronic toxicity may be contributing to population declines is still unknown. However, additional research should improve our knowledge of the effects of chemical contaminants on bats. More recently, climate change has been suggested as a cause of population shift from southern to northern hibernacula (Clawson 2002).

Due to the species low reproductive potential, threats that increase mortality or decrease recruitment are of particular concern. In cases where threats have been reduced (*e.g.*, hibernacula have been properly gated to preclude disturbance), increases in population size have been noted. However, any increases in the population are expected to be gradual because biologically the species is not capable of responding through an increased reproductive rate (*e.g.*, in response to low population densities or the amelioration of threats).

New Threats

White-nose syndrome (WNS) is a malady of unknown origin that is killing cave-dwelling bats in unprecedented numbers in the northeastern United States. This affliction was first documented at four sites in eastern New York in the winter of 2006-07, but photographic evidence emerged subsequently of apparently affected bats at an additional site, Howe's Cave, collected the previous winter in February 2006. Data suggest that a newly identified fungus (*Geomyces destructans*) (Gargas *et al*. 2009) is responsible, at least in part, for the impacts and mortality associated with WNS (Blehert *et al*. 2009).

The most obvious symptom of WNS is the presence of a white fungus on the face, wing, or tail membranes of many, but not all, affected animals. Behavioral changes are also indicative of WNS affliction, characterized by a general shift of animals from traditional winter roosts to colder areas, or to roosts unusually close to hibernacula entrances. Affected bats are generally unresponsive to human activity in the hibernaculum, and may even fail to arouse from torpor when handled. Bats at affected sites are regularly observed flying across the mid-winter landscape, and on occasion, carcasses of little brown bats by the hundreds to thousands have been found outside affected hibernacula with more found inside. Affected animals appear to be dying as a result of depleted fat reserves, and mortalities are first apparent months before bats would be expected to emerge from hibernation.

Overall mortality rates (primarily of little brown bats) have ranged from 81% to over 97% at several of the sites where data have been collected for at least two years (Hicks *et al*. 2008). While little brown bats appear to be the most affected of the cave-wintering bat species in the Northeast, Indiana bats have also been greatly impacted by WNS. It is important to note, however, that most of these species do not form large clusters in the winter, as little brown bats and Indiana bats do, and so they are not easily counted. Therefore, we have poor baseline estimates for other species at most sites by which to compare post-WNS abundance estimates.

WNS has been confirmed in at least 190 bat hibernacula in 16 states (Connecticut, Indiana, Kentucky, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Vermont, West Virginia, Vermont, and Virginia), as well as four Canadian provinces (Frick *et al*. 2010, Turner *et al*. 2011, Figure 5 below). Significant bat mortality (> 50% of known population) has been observed at several of these locations, especially in the northernmost regions. Through the winter of 2008/09, the distribution of WNS was mainly along the Appalachian Mountain range, which coincides with numerous bat hibernacula. However, in 2010 and 2011, WNS made a significant jump westward and was confirmed or suspected to occur far west of the Appalachian Mountains, in the States of Missouri, Oklahoma, Ohio, Indiana, Kentucky and Tennessee (Figure 5).

The annual distribution of WNS appears to be expanding rapidly from the initially affected hibernacula in western Albany/eastern Schoharie Counties, New York. The initial five sites where WNS was found in 2006 and 2007 were all within 15 km of a point that has come to be defined as the "epicenter." By April 2008, all of the hibernacula surveyed within 130 km of the epicenter were affected by WNS, and the farthest extent of the affliction reached approximately 200 km to a site near Watertown, New York. By the winter of 2008/09, affected sites had been

discovered as far as 900 km from the epicenter, and by the winter of 2009/10, WNS had been confirmed 1300 km from the epicenter (Figure 5).

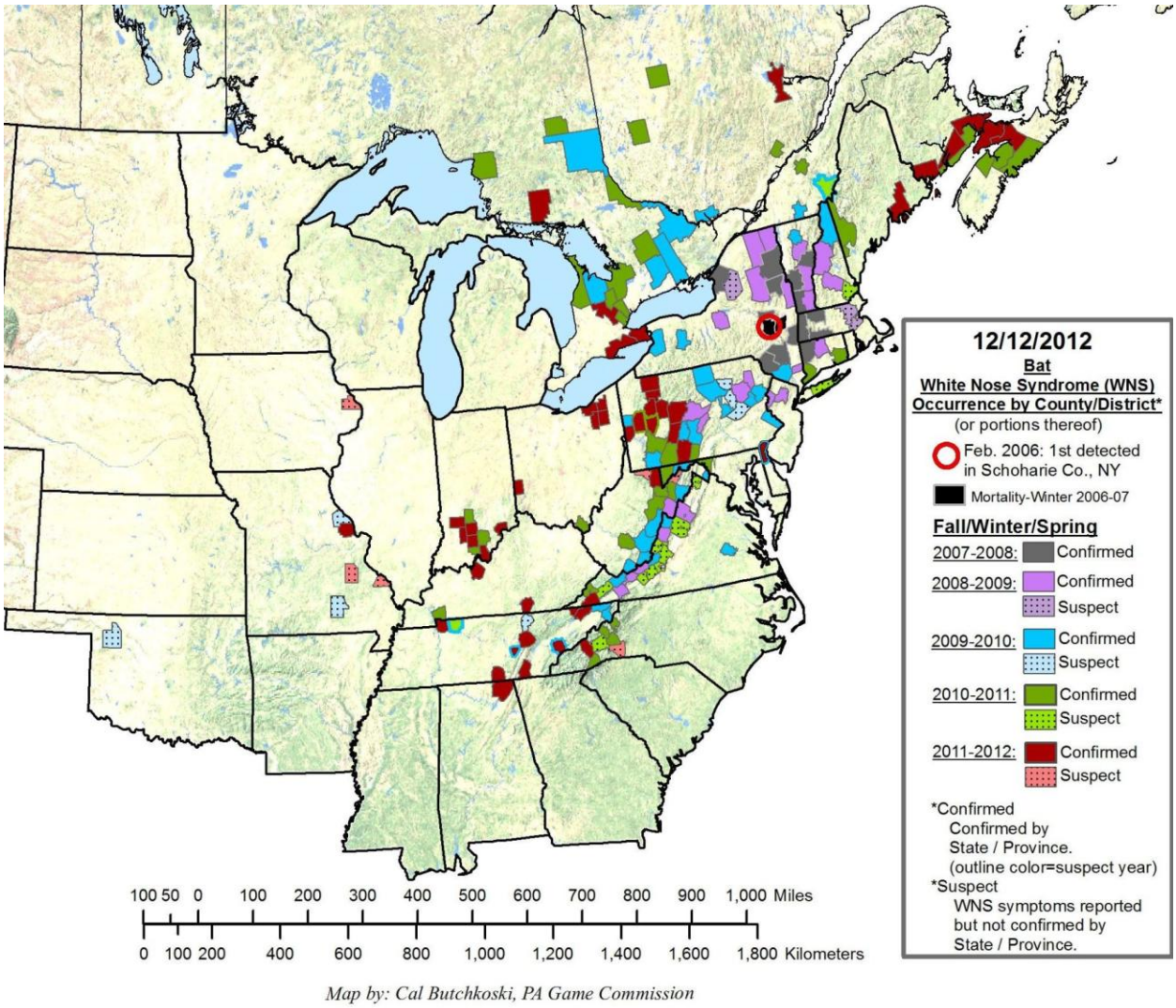

Figure 5. Distribution of counties and provinces affected by white-nose syndrome (WNS)

Research and field observations over the past few years have led to a better understanding of how WNS is and may be transmitted. The temporal presentation of WNS among bats in a single New York cave in 2006 to numerous sites in nine contiguous northeastern states by 2009 suggests that WNS is spread from bat-to-bat, and very likely from bat-to-hibernaculum and hibernaculum-to-bat (Hicks *et al*. 2010). This means of transmission is consistent with the rate of spread observed from 2006 through 2009, based on assumptions from available tracking data for local bat movements and from knowledge of inter- and intra-specific bat contact at spring, summer, and fall roosting and staging sites. However, an equally plausible, additional mode of transport for *Geomyces destructans*, the likely causative agent for WNS, is by anthropogenic

sources. Fungal spores and other microscopic organisms can easily become attached to skin, hair, clothing, and equipment with which they come in contact, and it is possible that such elements could remain viable for weeks or months after leaving a subterranean environment. Hard evidence that people are, or have been, responsible for transporting WNS to naïve hibernacula is currently not available. However, the occasionally discontinuous nature of the spread of WNS, especially to recently discovered sites in West Virginia and Virginia, does suggest that something other than bat-to-bat transmission is responsible. Another piece of supporting evidence for anthropogenic spread is the coincidental observation that many of the recently affected sites are also popular destinations for recreational users of caves and mines. In fact, the site where WNS was first documented photographically, Howe's Cave, is itself directly connected to one of the most visited commercial cave systems in the northeastern U.S. Therefore, although currently anecdotal, there is evidence to suggest that the spread of WNS may be multifactorial, and so precaution must be exercised to reduce any and all activities that may contribute to the continued transport of potential causative agents of WNS.

Another outstanding question regarding the effects of WNS is the degree to which susceptibility may vary by species within and among caves (*e.g.*, due to differences in cave microclimates, bat densities, *etc*.), or if observed symptoms are expressed differentially by species. For example, the New York State Department of Environmental Conservation (NYSDEC) has reported that observed mortality rates may differ between Indiana bats and little brown bats, even within the same site. While susceptibility may be influenced by cave micro-climate and other factors, varying levels of susceptibility by species have emerged over the past few years. Within a five-state area affected by WNS for multiple years (New York, Pennsylvania, Vermont, Virginia, West Virginia), population monitoring at 42 hibernacula documented a 98% decline in northern long-eared bats, 91% decline in little brown bats, 75% decline in tricolored bats (*Perimyotis subflavus*), 72% decline in Indiana bats, 41% decline in big brown bats (*Eptesicus fuscus*), and 12% decline in eastern small-footed bats (*Myotis leibii*) (Turner *et al*. 2011).

It is unclear how long symptoms take to manifest after exposure to the causative agent(s), but field observations indicate the time lapse between initial detection of the visible fungus and mass mortality of bats ranges from a few weeks to over a year (Turner *et al*. 2011). Recent captive inoculation trials at the USGS National Wildlife Health Center have demonstrated bat-to-bat transmission of *Geomyces destructans*, and data analyses are currently on-going which will advance knowledge about the disease process (David Blehert, National Wildlife Health Center, personal communication.) While it appears that bats are highly vulnerable to WNS during the hibernation period, it is not known to what degree or under what conditions WNS may be spread during other periods, such as during fall swarming and summer communal roosting.

Despite all of the unanswered questions about WNS, there are now five years of population monitoring data which provide valuable insights into the effects of WNS. Considering WNS has been affecting hibernating bat populations for the longest in New York (since February 2006), data from that State may provide the best indication of the effects of this disease on bats, including Indiana bats. By 2010, all known Indiana bat hibernacula in New York had been documented with WNS. However, the apparent effects of WNS on Indiana bats varied between affected hibernacula. Some Indiana bat hibernating populations have declined by 92 to 100%, while counts of Indiana bats at other WNS-affected New York hibernacula have declined to a

lesser extent (Hicks *et al*. 2008, Turner *et al*. 2011). For example, there has been a 21% decline at the Barton Hill Mine, and a 77% decline at Glen Park Cave (Turner *et al*. 2011).

Geomyces destructans has recently been confirmed in four European countries, including Germany, Hungary, Switzerland (Wibbelt *et al*. 2010), and France (Puechmaille *et al*. 2010). Sampling suggests the fungus is widespread in Europe, yet death rates similar to those in North America have not been observed in Europe over the past several decades of annual censuses. While bats with this fungus have been observed in several European hibernacula, these bats are not exhibiting the detrimental symptoms typical of WNS in North America. Based on these findings, it has been hypothesized that bat species in Europe are immunologically or behaviorally resistant to *G. destructans* because they have co-evolved with the fungus (Wibbelt *et al*. 2010). The authors did note that European hibernating populations tend to be very small (<1000 bats) and that this in itself may make the bats less vulnerable to the transmission and effects observed in North America. However, the spread and effects of WNS in North America suggest host density alone is not responsible for the observed deaths; bat populations appear to be reacting to an exotic pathogen to which they have not been previously exposed. Considering *G. destructans* has been detected on five different European myotis species – all of which appear to have resistance to it – there is hope that some level of resistance exists or will develop in North American myotis species, including the Indiana bat.

In summary, WNS has now been documented in 16 states, and the degree of impact to bats appears to vary greatly by site and species. Based on observations of continued mass-mortality at several sites, we anticipate the loss of Indiana bats to continue in the Northeast and mid-Atlantic regions. Based on the significant westward movement of WNS in 2010 and 2011, we anticipate that WNS will continue to spread rapidly, moving into and through the Midwest, South and eventually Great Plains over the next few years. The degree to which climate or other environmental factors may influence the spread of WNS, or the severity of its impact on affected bats, is unknown. At this time, there is no concrete evidence of resistance to WNS among survivors, although some affected hibernacula continue to support low numbers of bats five years into WNS exposure, and a few hibernacula have substantially lower mortality levels than most. If current trends for spread and mortality at affected sites continue – and there is currently no indication that they will not – WNS threatens to drastically reduce the abundance of many species of hibernating bats in much of North America in what may only be a matter of years. Population modeling indicates a 99% chance of regional extinction of the little brown bat within the next 16 years due to WNS (Frick *et al*. 2010). The closely related Indiana bat is just as vulnerable to regional extinction (if not more so) due to its smaller range-wide population and social behavior traits that increase the risk of bat-to-bat transmission. The declining mortality rates at some New York hibernacula and the apparent resistance of European myotis species to *G. destructans* suggest that some level of resistance may exist or develop within North American myotis species. The resistance in European bats may hold the key to preventing bat extinctions in North America due to WNS.

In addition to the recently-identified threat of WNS, it appears that Indiana bats are vulnerable to collisions with fast-moving, man-made objects, such as wind turbines and vehicles (Arnett *et al*. 2008, Russell *et al*. 2009). While such fatalities seem counterintuitive due to the species' ability to echo-locate, it appears bats are not always able to detect and evade objects that are moving at

a high rate of speed. A dead Indiana bat and numerous little brown bats have been found along a heavily-traveled highway in central Pennsylvania, in the midst of an Indiana bat maternity colony. In addition, five Indiana bat fatalities have been documented at wind facilities in Indiana (Good *et al*. 2011), West Virginia, Ohio and Pennsylvania. Collision-related fatalities probably far exceed those documented, as there is an extensive road network in the range of the Indiana bat as well as hundreds of operating turbines, presenting a perpetual risk to bats. Furthermore, fatalities are not likely to be found or documented because bat carcasses are small, cryptic and readily scavenged, and few mortality surveys are conducted. Collision-related fatalities are typically considered an additive source of mortality, and as such, they have the potential to remove WNS survivors and exacerbate population declines.

Previous Incidental Take Authorizations

All previously issued Service biological opinions involving the Indiana bat have been non-jeopardy. These formal consultations have involved a variety of action agencies, including 1) the U.S. Forest Service (USFS) for activities implemented under various Land and Resource Management Plans on National Forests in the eastern United States, 2) the Federal Highway Administration (FHWA) for various transportation projects, 3) the U.S. Army Corps of Engineers (Corps) for various water-related projects, 4) the Department of Defense for operations at several different military installations, and 5) the Office of Surface Mining (OSM) for coal mining activities nationwide. Additionally an incidental take permit has been issued under section 10 of the Endangered Species Act to an Interagency Taskforce for expansion and related development at the Indianapolis Airport in conjunction with the implementation of a habitat conservation plan (Six Points Road Interchange HCP). Links to previously issued biological opinions can be found at the Fish and Wildlife Service's website (http://www.fws.gov/midwest/endangered/mammals/inba/inbaBOs.html).

It is important to note that in some of these consultations (*e.g*., those related to the Forest Service's Land and Resource Management Plans), survey information was lacking or incomplete. As Federal agencies are not required to conduct surveys, often the Service relied on a host of valid factors in helping the Federal agency determine whether Indiana bats were likely to be present. To ensure the Federal agency and Service met the mandate of Section 7(a)(2), if the best available information suggested that Indiana bats may be present, the assumption was often made that one or more maternity colonies occurred within the action area. Although this approach, we believe, fully accords with the intent of the Congress in writing the ESA, it likely resulted in an over-estimate of the number of individuals or colonies that may have been impacted by Federal actions.

Nearly all National Forests within the range of the Indiana bat have requested formal consultation at the programmatic level. Most of the previously authorized habitat loss on National Forests has not been a permanent loss. Rather, it has been varying degrees of temporary loss (short-term and long-term) as a result of timber management activities. Conservation measures implemented by the Forest Service as part of the proposed action, as well as reasonable and prudent measures provided by the Service to minimize the impact of the annual allowable take for each of the National Forests, have ensured an abundance of available

remaining Indiana bat roosting and foraging habitat on all National Forests, and the persistence of any known or newly discovered maternity colonies.

The remaining incidental take statements have been issued to other federal agencies (*e.g.*, Federal Highway Administration, Corps of Engineers, Department of Defense). Unlike those issued for National Forest Land and Resource Management Plans, many of these projects were certain to affect habitat known to be occupied by Indiana bats. To minimize adverse effects on Indiana bats due to the permanent or temporary loss of habitat, the action agencies agreed to implement various conservation measures. These typically included minimization of project footprints; seasonal tree cutting restrictions to avoid direct effects on female Indiana bats and young; protection of known primary and alternate roost trees with appropriate buffers; retention of adequate roosting and foraging habitat to sustain critical life history requirements of Indiana bats in the future; permanent protection of habitat; and habitat enhancement or creation measures to provide future roosting and foraging habitat.

Take has often been authorized in the form of harm through habitat loss (*i.e.*, acres of forest) because of the difficulty of detecting and quantifying take of Indiana bats. This is due to the bat's small body size, widely dispersed individuals under loose bark or in tree cracks/crevices, and the unknown spatial extent and density of much of the summer population. Where more detailed information about Indiana bats is available (*e.g.*, via telemetry studies), incidental take statements have included an estimate of the number of Indiana bats that are likely to be taken.

While the above biological opinions contained detailed effects analyses and estimated the amount of incidental take anticipated, this was not the case for the biological opinion issued to the Office of Surface Mining in 1996. In that opinion, the Service determined that surface coal mining activities conducted pursuant to the Surface Mining Control and Reclamation Act of 1977 would not jeopardize the continued existence of any federally listed species. The opinion did not quantify incidental take, but directed OSM and State Regulatory Authorities to coordinate project reviews with the Service to develop and implement species-specific protective measures. With regard to the Indiana bat, such measures were recently standardized across the species range for coal mining activities (USFWS 2009b). These national guidelines provide for seasonal restrictions on tree cutting, and either reforestation of a portion of the mined lands or off-site conservation of forest habitat. Hundreds of acres of known Indiana bat habitat, and thousands of acres of potential habitat, are lost annually due to coal mining. The cumulative effects of this habitat loss are not known, although in some cases an attempt is made to assess effects on individual maternity colonies or hibernating populations and to quantify take. State Regulatory Authorities have been charged with coordinating with the Service, integrating species-specific protective measures into mining permits, quantifying and tracking incidental take, and ensuring that federally listed species, including the Indiana bat, are not jeopardized. Due to the disparate levels of project coordination and record-keeping from state-to-state, as well as sporadic integration of species-specific protective measures in mining permits, it is not known how much Indiana bat habitat has been lost range-wide over the past 15 years (since issuance of the 1996 BO), or how many maternity colonies and hibernating populations have been harmed or lost due to coal mining activities.

Two biological opinions (*i.e.*, Great Smoky Mountains National Park, and Laxare East and Black Castle Contour Coal Mining project) and their associated incidental take statements anticipated the loss of a maternity colony. However, the other biological opinions did not anticipate losses of this magnitude. Required monitoring for at least three formal consultations (Camp Atterbury, Newport Military Installation, and Indianapolis Airport) has confirmed that the affected colonies persisted through the life of the project and continue to exist today. We recognize that given the philopatric nature of Indiana bats and their long lifespan, the full extent of the anticipated impacts may not yet have occurred. Only with long-term monitoring will we be able to determine the true effectiveness of those conservation measures, and be able to judge whether our assumptions about project effects are accurate. However, the effects of WNS may confound monitoring, making it difficult to discern whether population declines have resulted from WNS, some aspect of the project, or both.

One biological opinion has been issued for take of Indiana bats due to wind turbine operation. In 2011, the Service issued a non-jeopardy biological opinion to the Department of Energy for the Monarch Wind Facility, whose 25-year operation of 12 turbines is expected to result in the take of six Indiana bats during fall migration.

There have been three previous actions with incidental take authorization (via issuance of a biological opinion) for the Indiana bat in the Commonwealth of Pennsylvania: 1) the Land and Resource Management Plan for the Allegheny National Forest in northwestern Pennsylvania, 2) the U.S. 6219 Transportation Improvement Project in Somerset County, and 3) the Canoe Creek Intersection Improvements Project in Blair County. In addition, numerous coal mining projects have proceeded pursuant to the 1996 biological opinion issued to OSM. These projects affected hundreds of acres of summer and fall habitat, as well as maternity colonies and hibernating populations. One Indiana bat maternity colony in Greene County, Pennsylvania has been affected to the point that it may become extirpated in the near future due to the combined effects of white-nose syndrome and habitat loss resulting from coal mining.

Recovery

The first Indiana bat recovery plan was completed and approved in October 1983 (USFWS 1983). An agency draft of a revised plan was published in 1999 (USFWS 1999), but was never finalized. A revised draft recovery plan was published in 2007 (USFWS 2007), and although this plan has not been finalized, it represents the most complete synthesis of research, life history, status, and threat information, and therefore serves as a source of the best available information for the species.

The 2007 plan outlines actions necessary to recover the species. Briefly, these actions include 1) conserve and manage hibernacula and their winter populations, 2) conserve and manage summer habitat to maximize survival and fecundity, 3) plan and conduct research essential for recovery, and 4) develop and implement public information and an outreach program. The recovery program outlined in the 2007 draft plan focuses on protection of hibernacula, but also increases the focus on summer habitat. It is important to note that recovery planning and implementation are ongoing processes that do not culminate in the issuance of an official recovery plan for a species. For example, WNS was not a threat at the time of the release of the 2007 plan, but is

now the primary threat being addressed by the Service.

In consideration of the conservation needs of the Indiana bat, the Service has proposed the use of Recovery Units to establish and focus recovery efforts. Recovery units are management sub-units that are geographically identifiable and essential to the recovery of the entire listed entity. Indiana bat recovery units have been delineated to conserve genetic and demographic robustness, and ensure this wide-ranging species continues to survive and recover within its historic range. The Service's proposed delineation of Recovery Units relied on a combination of preliminary evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in macro-habitats and land use. When Recovery Unit delimitations suggested by these factors were geographically close to state boundaries, the Recovery Unit borders were shifted to match the state boundaries in order to facilitate future conservation and management. The Service is planning and implementing recovery efforts within the four Recovery Units (RU) for this species: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (USFWS 2007).

The proposed projects are located within the Appalachian Mountains Recovery Unit, which made up 7.7% of the range-wide Indiana bat population in 2011 (USFWS 2012). WNS has been documented throughout most of this RU. Based on the decline of Indiana bats in the adjacent Northeast RU (62% decline between 2005 and 2011), populations in the Appalachian Mountains RU are also expected to also decline precipitously over the next few years due to WNS.

A 5-year review of the Indiana bat's status was completed and published in September 2009 (USFWS 2009a). In light of the ongoing threat of WNS, the Service changed the "degree of threat" to the Indiana bat from "moderate" to "high." The high category means "extinction is almost certain in the immediate future because of a rapid population decline or habitat destruction", whereas the moderate category means "the species will not face extinction if recovery is temporarily held off, although there is continual population decline or threat to its habitat". Prior to emergence of the WNS threat, the Service considered the Indiana bat to have a "high" recovery potential (*i.e.*, biological/ecological limiting factors and threats were well understood and intensive management was not needed and/or recovery techniques had a high probability of success). The Service now considers the Indiana bat to have a "low" recovery potential, because WNS is poorly understood and we currently have very limited ability to alleviate this threat. Consequently, the Recovery Priority Number for the Indiana bat was changed from "8" to "5", reflecting a species that currently faces a high degree of threat and has a low recovery potential.

ENVIRONMENTAL BASELINE

Under Section 7(a)(2) of the ESA, when considering the "effects of the action" on federally listed species, the Service is required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all Federal, State, or private actions and other activities in the action area (50 CFR 402.02), including Federal actions in the area that have already undergone Section 7 consultation, and the impacts of State or private actions that are contemporaneous with the consultation in process. As such, the environmental baseline is "an analysis of the effects of past

and ongoing human and natural factors leading to the current status of the species, its habitat (including critical habitat), and ecosystem, within the action area (Service and National Marine Fisheries Service [NMFS] 1998, page 4-22)." The environmental baseline is, therefore, a "snapshot" of the species' health at a given point in time, but it does not include the effects of the proposed action.

Status of the Species in Pennsylvania

Hibernating Population

There are 18 known Indiana bat hibernacula in Pennsylvania, distributed among ten counties, including Armstrong, Beaver, Blair, Centre, Fayette, Huntingdon, Lawrence, Luzerne, Mifflin and Somerset. These hibernacula include limestone caves, mines (limestone, anthracite coal), and an abandoned railroad tunnel. The total known Indiana bat hibernating population in Pennsylvania was estimated to be 1,038 bats in 2007 (USFWS 2012), with the largest concentration being found in the J.D. Hartman Mine (a.k.a. Canoe Creek hibernaculum) in Blair County. This is the State's only Priority 2 hibernaculum, with Indiana bat population counts ranging from approximately 600 to 800 over the past decade. There are three Priority 3 hibernacula in Pennsylvania with extant populations, but only two of them (*i.e*., South Penn Tunnel and Long Run Mine) support Indiana bat populations exceeding 100 bats.

White-nose syndrome was first detected in eastern Pennsylvania during the winter of 2008-2009, and by 2011, it had been documented across much of the State (PGC 2009, Figure 5). In April 2010, WNS was documented at the Hartman Mine hibernaculum, where the total bat population (of all species combined) had declined by 50 percent, from approximately 30,000 to 15,000 bats. Although the Game Commission did not attempt a full assessment and count of bats during this survey, they did not observe any clinical signs of WNS on the 82 Indiana bats that were observed (C. Butchkoski, Pennsylvania Game Commission, *in litt*. 2010). By 2011, WNS had been confirmed at all but one of Pennsylvania's Indiana bat hibernacula.[1]

In Pennsylvania, the biennial Indiana bat survey scheduled for 2009 was called off in an attempt to reduce the risk of spreading WNS. Consequently, the 2009 population data (USFWS 2012) reflect a carry-over of data from the 2007 count. This suggests a stable Indiana bat population from 2007 to 2009 in Pennsylvania, when in fact, it is likely that a WNS-induced population decline had begun to occur. The 2011 estimates for Pennsylvania (USFWS 2012) represent probable Indiana bat declines based on cursory surveys at a few sites, as the 2011 biennial survey was also cancelled. Based on the effects of WNS in the northeastern United States (Hicks *et al*. 2008, Langwig *et al*. 2010, Turner *et al*. 2011), Pennsylvania's Indiana bat hibernating population is expected to decline by at least 70%, with the decline at individual sites ranging from 20 to 100%.

Summer Population

Potential summer habitat occurs throughout Pennsylvania. Eleven Indiana bat maternity colonies have been identified in nine counties, including Adams, Armstrong, Bedford, Berks, Blair,

[1] WNS has not been confirmed (yet) at the one hibernaculum where access has been denied.

Greene, Somerset, Washington and York. Three of these maternity colonies are located with the swarming areas of Priority 2 and Priority 3 hibernacula. Most of the maternity sites were found by radio-tracking Indiana bats emerging from their hibernacula in the spring and following them to their summer habitat. These radio-telemetry studies have also tracked bats to maternity habitat in Maryland and West Virginia. The two Maryland maternity sites identified during the 2005 spring migration study were approximately 84 and 92 miles, respectively, to the southeast of the Hartman Mine (Butchkoski and Turner 2005).

The Indiana bat summer population in Pennsylvania is expected to decline commensurate with the decline in regional hibernating populations, as discussed above. This is expected to result in a decline in the size and/or number of maternity colonies.

Critical Habitat

There is no federally designated critical habitat for the Indiana bat in Pennsylvania.

Threats

The primary threats to Indiana bats in Pennsylvania are white-nose syndrome, and habitat losses due to a wide variety of land development and land use practices that remove forest. Forest habitat losses occur due to coal and non-coal mineral mining, wind power development, oil and gas development, commercial development and residential development. Habitat loss and degradation also results from various forestry practices that fail to retain suitable roosting and foraging habitat for Indiana bats (*e.g*., high-grading, clear-cutting, shelterwood cuts).

Status of the Species within the Action Area

Swarming Habitat

The two project areas (*i.e*., the action area) are located approximately 5.5 and 7.0 miles south of the South Penn Tunnel, a P3 Indiana bat hibernaculum. This Indiana bat hibernating population was first discovered in 1999, and is monitored by the Pennsylvania Game Commission during biennial mid-winter counts. They have documented an increase in this population – from 23 bats in 1999, to 139 bats in 2007. In 2011, bats at this site were confirmed to have signs of WNS (G. Turner, Pennsylvania Game Commission, *in litt*. 2011) but no official counts were conducted.

A fall telemetry study was carried out at the South Penn Tunnel hibernaculum in an attempt to identify fall (swarming) habitat used by male and female Indiana bats. During this study, eight female and nine male Indiana bats were radio-tagged. Female bats roosted as far as 11.1 miles from the hibernaculum, and foraged as far as 12.0 miles from the hibernaculum. Male Indiana bats roosted as far as 7.9 miles from the hibernaculum, and foraged as far 9.3 miles from the hibernaculum (Chenger *et al*. 2007).

Although none of the radio-tracked bats were documented to use forest habitat within the proposed project areas, only a small percentage of the population was tracked for a short period of time. While the foraging and roosting areas for most of the Indiana bats seasonally present at

South Penn Tunnel have not been identified, both project areas are well within the maximum extent of the fall roosting and foraging range identified during the study. Consequently, both project areas include roosting and foraging habitat that may be used during the fall by one or more Indiana bats associated with the South Penn Tunnel population.

Spring and Summer Habitat

A spring radio-telemetry study was also carried out on the Indiana bat population at the South Penn Tunnel (Chenger and Sanders 2007). This study led to the discovery of maternity colonies and habitat for adult males within 13 miles east, northeast, and southeast of the South Penn Tunnel (Chenger and Sanders 2007). During the spring telemetry study, 15 Indiana bats were fitted with transmitters and 11 of these, including five females and six males, were followed through migration to their presumed summer roosting areas.

The five females settled into roost tree clusters scattered over a four-mile reach of the valley near Shawnee State Park, forming one or possibly two maternity colonies. The Shawnee maternity colony is far enough from the project areas that it will not be affected by project activities. However, no summer mist-netting has been carried out in either of the two proposed project areas. Consequently, it is not known whether a maternity colony may be using forest habitat in the project areas.

The six males that were followed from the South Penn Tunnel to their summer habitat all established roosting and foraging areas within approximately eight miles of the hibernaculum. Exit counts from male roost trees never exceeded one, suggesting the males all roosted solitarily. Unlike the females, the males roosted and foraged in hilly areas and around low order streams. Four of the males roosted and foraged in relatively steep terrain on the eastern slope of the Allegheny Front.

Although none of the radio-tracked males was documented to use forest habitat within the proposed project areas, only a small percentage of the population was tracked for a short period of time and both project areas are well within the maximum extent of the male summer ranges identified during the study. Consequently, both project areas include roosting and foraging habitat that may be used during the spring and summer by one or more males associated with the South Penn Tunnel population.

Factors Affecting the Species' Environment within the Action Area

The projects areas are predominantly forested, and most likely used for homesteads, recreation and timber production. In addition to land use activities, WNS is beginning to affect Indiana bats in this geographic area. It has been confirmed at the South Penn Tunnel hibernaculum, and is now confirmed or suspected to occur in several southwestern Pennsylvania counties (Figure 5). Furthermore, the South Penn Tunnel population has and continues be affected by wind farms, as well as forest habitat loss due to coal mining, oil and gas development, residential and commercial development, road construction, and timber harvesting.

EFFECTS OF THE ACTION

"Effects of the action" refers to the direct and indirect effects of an action on listed species or critical habitat, together with the effects of other activities interrelated and interdependent with that action which will be added to the environmental baseline. The ESA defines indirect effects as those caused by the proposed action and that are later in time, but are still reasonably certain to occur (50 CFR §402.02). Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. In conducting its effects analysis, the Service must consider the direct and indirect effects of the action in conjunction with the effects of other past and present federal, State, or private activities within the action area. The Service must also consider the cumulative effects of future State or private activities that are reasonably certain to occur within the action area.

Within the two project areas, 36.5 acres of forest habitat will be affected during golden-winged warbler habitat creation. Most of the overstory trees will be cut to establish early successional habitats dominated by herbaceous vegetation and shrubs. Over the next 20 years, tree saplings would emerge and become dominant. Over the next 30 to 70 years, pole timber would become established and mature to sawtimber. While some larger-diameter trees would be retained at the time of the habitat creation and while these reserved trees may have or develop roost tree characteristics, the overall forest structure is expected to become unsuitable for Indiana bat foraging and roosting due to a substantial decline in tree canopy cover and closure. If no further actions are implemented to set back forest succession, the treatment stands would be expected to revert to suitable Indiana bat habitat over a period of 40 or more years. The forests adjacent to the project areas would continue to provide suitable foraging and roosting habitat, provided this habitat is not lost or degraded by development or additional timber harvests.

As discussed below, the proposed projects will affect Indiana bats associated with the South Penn Tunnel population through loss of their spring, summer and fall foraging and roosting habitat. The effects of the action depend, to a great extent, on the reaction of Indiana bats to changes in their environment. While most of the habitat impacts will occur during tree removal, most of the effects likely to result in take of the species will occur during the first year after tree removal.

No critical habitat is located within the action area; therefore, no adverse effects on designated critical habitat are anticipated. Minimization measures are considered part of the proposed action, so the effects of these measures in reducing effects on Indiana bats are considered as well.

Swarming Habitat Loss and Its Effects

The project areas occur within the swarming range associated with the South Penn Tunnel hibernaculum. Due to the proximity of this hibernaculum to the project areas, there is a detailed discussion of how Indiana bats associated with the hibernaculum use fall habitat (see “Status of the Species within the Action Area”). In the fall, radio-tracked females tended to forage and roost in the same valley that the Shawnee maternity colony used during the summer, while males tended to forage and roost in higher elevation, hilly areas and around low order streams (Chenger

et al. 2007). Although none of the radio-tracked bats foraged or roosted in the area of the proposed projects, these areas are within the maximum radius (12 miles) that Indiana bats were found to swarm in the fall (Chenger *et al*. 2007). Considering only 12% of the hibernating population (17 of 139 bats) was tracked, the swarming habitat for 88% of the population has not been identified, but likely occurs within the identified swarming radius.

Assuming the radio-tracked males are representative of the male swarming population, we would expect approximately half of the males to forage and roost within one mile of the hibernaculum and the remainder to occupy individual territories scattered throughout suitable forest habitat within the swarming radius. Based on the distribution of forest habitat within the swarming radius, we estimate that potentially one or two males forage and/or roost in the proposed golden-winged warbler habitat creation areas. These are the individuals who would be most affected by the loss of forest habitat. Based on the previous fall telemetry studies, it seems less likely that females would be present in the project areas during the fall swarming period, but considering the very limited extent of the study their presence cannot be ruled out.

Forested areas near hibernacula provide important foraging and roosting habitat for Indiana bats, especially during the fall and spring, when bats are building up their fat reserves prior to and after hibernation. From late August through mid-November, male and female Indiana bats occupy forest habitat in the vicinity of their hibernacula to roost, forage, and breed. The proposed projects will remove 36.5 acres of swarming habitat for the South Penn Tunnel population.

While limited work has been done on fall roosting habitats of Indiana bats, it appears that they use roosting sites in the fall that are similar to sites selected during summer, and that Indiana bats show fidelity to individual trees and roosting areas, within and among years. In addition, roost trees used by the same individual tend to be clustered in the environment. Consequently, if the proposed habitat treatment areas occur within an individual bat's home range, there is a risk that the relatively large treatment area (10.2 or 26.3 acres) may affect most or all of that individual's roost trees. Whenever roosts and foraging sources are eliminated, bats are forced to seek new habitat and expand their range, potentially reducing foraging success and exposing bats to increased predation and competition.

Removal of a roost tree while Indiana bats are present would likely result in the direct killing, injuring, or harassing of individual bats. To avoid this potential, NRCS has committed to implement a seasonal restriction on tree cutting, whereby trees would only be cut from November 15 to March 31, when Indiana bats are hibernating. Based on this seasonal restriction, we do not anticipate any direct adverse effects from the felling of roost trees. In addition, Indiana bats will not be subject to the noise and disturbance associated with tree cutting and removal.

However, if roost trees are removed it will result in indirect effects on the bats that return to this area in subsequent years to roost. When roost trees remain suitable for roosting from one year to the next, Indiana bats often use the same trees. The premature removal of a roost tree will force bats to relocate to another roost tree upon their return. Due to the ephemeral nature of roost trees, Indiana bats have adapted to find replacement roosts. However, this becomes more of a

challenge if multiple roost trees are lost at the same time. As discussed above, the relatively large habitat treatment blocks increase the likelihood of impacting multiple roost trees. In addition, the tendency of Indiana bats toward roost tree and roost area fidelity may mean that Indiana bats would at least initially return to reserved roost trees in the habitat treatment areas. This would place those bats at an increased risk of death or injury, as flight paths through open areas would increase exposure to predation, and as reserved trees would be more vulnerable to wind-throw.

With respect to foraging habitat, the effect of tree clearing on individual bats will depend on the location and size of their home ranges with respect to the cleared areas. Using 200 acres as a reasonable home range size for Indiana bats in Pennsylvania (Butchkoski and Hassinger 2002), and assuming the two proposed projects are far enough apart that they would not affect the same individuals, tree clearing associated with the projects would be expected to affect 5 to 13% of an individual's home range. Although this may not represent an appreciable reduction in the amount of habitat, individual Indiana bats will have to adjust to this habitat loss by adjusting the size or configuration of their home range and will have to simultaneously adjust to perturbations elsewhere within the home range. Indiana bats using the affected forest areas for foraging will probably have alternative habitat available near the project area, but they will likely have to shift or expand their home range into areas previously unused by them to make up for the loss of habitat.

The impact of shifting flight patterns, foraging areas and/or roosting areas will vary from bat to bat. However, considering the effects of the project will occur in conjunction with baseline effects and the anticipated effects of other stressors (*e.g.*, additive mortality from wind turbine operation, white-nose syndrome, previous and ongoing habitat loss), we anticipate that these adjustments in home range may result in physiological responses sufficient to cause impaired reproduction, decreased health and body condition, decreased longevity, and potentially death.

Summer Habitat Loss and Its Effects

As no mist-net surveys have been conducted in or near the project areas, it is not known whether an Indiana bat maternity colony(ies) is present in the action area. If a maternity colony is present in the vicinity of either project area, the colony and one or more individuals associated with the colony would experience a net loss of roosting and/or foraging habitat. However, no direct take of female Indiana bats or their young would occur during the summer maternity season due to the seasonal restriction on tree cutting.

Based on previous radio-telemetry studies, it is expected that most of the male Indiana bats associated with the South Penn Tunnel remain within the swarming radius of that hibernaculum throughout the spring, summer and fall. Based on the distribution of forest habitat within the swarming radius, we estimate that potentially one or two males forage and/or roost in the proposed golden-winged warbler habitat creation areas.

The effects of the loss of roosting and foraging habitat on Indiana bats using the project area(s) during the summer is expected to be similar to the effects described above (see "Swarming Habitat Loss and Its Effects").

Duration of the Effect

Tree cutting will occur over a single winter, when Indiana bats are hibernating. Therefore, we would expect the effects on individual Indiana bats to occur primarily during the first spring, summer, fall and winter following the habitat loss. By the second season following tree removal, we anticipate the affected bats would find replacement roosts in the surrounding forests and would be occupying adjusted home ranges. Considering forest loss will occur within a landscape that is 70% forested, it is likely that Indiana bats will continue to use forests in the vicinity of the project areas. However, we would expect the hibernating population as a whole to experience a relatively long-term net loss of foraging and roosting habitat until such time as the treatment areas revert to a forest condition that is suitable for Indiana bats.

Effect of the Take on the Population Unit

Individuals that experience adverse effects from the proposed habitat treatments would be expected to be associated with the South Penn Tunnel hibernating population. As discussed above, the effects of habitat loss would be limited to potentially one or two Indiana bats. The effects are more likely to result in injury (decreased fecundity, decreased body condition) than death, although in combination with other stressors (*e.g.*, WNS, other habitat losses) the proposed action could contribute to death. If the proposed action contributes to the death of an Indiana bat, the relative contribution of the proposed action is expected to be small in comparison with other stressors, such as WNS. Due to the small number of affected individuals, the scale of the effect, and the short duration of the effect, this level of take is not expected to compromise the survival or recovery of the affected population unit.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. In addition, the collective effects of similar types of projects (*e.g.*, wind projects) on Indiana bats are not considered "cumulative effects" under the Endangered Species Act, unless those projects are proposed within the identified action area.

The action area is mostly forested, and likely to be used periodically for timber production. However, with the exception of tree removal associated with golden-winged warbler habitat creation, the Service is not aware of any specific timber harvest plans on these privately-owned lands, so it is not possible to assess in detail the potential impacts from future timber harvesting. If timber harvesting is done without consideration for Indiana bats, it is very likely that the species will be harmed and harassed, primarily through the felling and loss of roost trees and foraging habitat. However, lands in the vicinity of Indiana bat hibernacula are recorded in the Pennsylvania Natural Heritage Program's online environmental review web tool, increasing the likelihood that projects planned in this area will undergo coordination with the Service to incorporate measures to avoid or minimize potential adverse effects on Indiana bats.

Individual bats and the South Penn Tunnel population to which they belong will not experience forest loss from the proposed projects as an isolated event. Rather, these projects are two of many that have occurred and are proposed to occur within the swarming range associated with the South Penn Tunnel population. Other past, present, and proposed sources of habitat loss and additive mortality include timber harvests, wind farms, oil and gas development, road development, coal mining and residential development.

CONCLUSION

After reviewing the current status of the Indiana bat, the environmental baseline, the effects of the action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Indiana bat. There is no critical habitat for the Indiana bat in or near the action area. Therefore, this action will not affect any federally designated critical habitat.

The implementing regulations for section 7 define "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402). This definition directs us to assess whether an *appreciable decrease* in the *probability* of survival and recovery is expected. Appreciable means noticeable, perceivable, or measureable. Therefore, our jeopardy analysis focuses on determining whether the anticipated reductions in the species' reproduction, numbers, or distribution would reasonably be expected to noticeably, perceivably, or measurably decrease the species' probability of survival and recovery.

An action would jeopardize a species if it appreciably reduced the species' ability to survive and retain sufficient resilience to allow recovery from endangerment. Survival is a condition characterized by a species with a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. Recovery would be compromised if an action made it difficult for a species to retain sufficient resilience to allow recovery from endangerment or if an action impeded the removal of threats to the species so self-sustaining and self-regulating populations can be supported as persistent members of native biotic communities (USFWS 1998, p. 4-35).

In the "Effects Analysis" we evaluated impacts to individual bats and the population unit to which they belong (South Penn Tunnel hibernating population). We concluded the effects of habitat loss would be limited to potentially one or two Indiana bats, and that effects are more likely to result in injury (decreased fecundity, decreased body condition) than death, although in combination with other stressors (*e.g.*, WNS, other habitat losses) death could result. While there may be a slight reduction in the number or reproductive potential of Indiana bats due to habitat loss, this reduction is not expected to appreciably reduce the likelihood of the species' survival and recovery, as the projects are not likely to appreciably impair the hibernating population's ability to persist. Therefore, the Service has concluded the proposed projects are

not likely to jeopardize the continued existence of the species.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations under Section 4(d) of the ESA prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Because incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity, this Incidental Take Statement is valid only upon receipt by the applicant of all appropriate authorizations and permits from federal, State and local permitting authorities. These permits/authorizations may include, but are not limited to, permits under section 404 of the Clean Water Act from the Corps of Engineers; section 401 Water Quality Certification and Chapter 105 Dam Safety and Encroachment Permit from the Pennsylvania Department of Environmental Protection; and an approved Erosion and Sedimentation Control Plan from the County Conservation District. Again, this incidental take statement (along with its exemption from the section 9 prohibitions of the Endangered Species Act) is valid only upon receipt of all required permits and authorizations.

The measures described below are non-discretionary, and must be undertaken by the NRCS so that they become binding conditions of any permits, contracts and/or approvals, as appropriate, for the exemption in Section 7(o)(2) to apply. The NRCS has a continuing duty to regulate the activity covered by this incidental take statement. If the NRCS 1) fails to require the applicant or contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, contract, authorization, or funding document; and/or 2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NRCS must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(I)(3)).

AMOUNT OR EXTENT OF TAKE

The proposed creation of golden-winged warbler habitat is expected to result in the incidental take of Indiana bats, as described in the "Effects Analysis". The project minimization measures will reduce the risk of harming Indiana bats, but not eliminate it. The incidental take is not expected to compromise the hibernating population's ability to persist.

As discussed in the Effects Analysis, up to two Indiana bats may be harmed due to the loss of 36.5 acres of foraging and roosting habitat within the swarming area associated with the South Penn Tunnel hibernaculum. Considering a seasonal restriction on tree clearing will be implemented to avoid the direct take of bats while trees are being felled, take is most likely to occur as a reduction in the health (condition) or fecundity of affected males or females, which constitutes injury, a form of harm. In combination with other stressors (*e.g.*, WNS, other habitat losses) the effects of the action could contribute to the death of up to one Indiana bat, but the relative contribution of the proposed action is expected to be small in comparison to other stressors. Consequently, this opinion does not authorize take in the form of death. Take is expected to occur within the first two years following tree clearing.

The actual level of incidental take will be difficult to detect or quantify for the following reasons: 1) the population density of Indiana bats in the action area is expected to be diffuse and seasonally present; 2) individuals are small and cryptic making them difficult to locate; 3) finding dead or injured specimens is unlikely; 4) any losses in the hibernating population will be exacerbated by, and difficult to separate from, declines resulting from WNS.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Indiana bat.

1. Implement measures to reduce the risk of taking Indiana bats.
2. Monitor and report take.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, the NRCS must ensure that the applicant complies with the following terms and conditions, which implement the reasonable and prudent measures described above and outline monitoring/reporting requirements. These terms and conditions are non-discretionary.

1. For each habitat restoration project, carry out all tree cutting in a single season, and do not exceed the forest impacts disclosed in the project description (*i.e.*, 10.2 and 26.3 acres).
2. Incorporate all project minimization measures (pp. 6-7 of this biological opinion) into NRCS contracts and management plans for the subject projects.
3. Fully implement all project minimization measures (pp. 6-7 of this biological opinion).

4. Monitor compliance with the project minimization measures and provide a report to the Fish and Wildlife Service (Pennsylvania Field Office) within 3 months of the completion of tree cutting at each project site. Include representative photos of each project area to document the condition of habitat before and after golden-winged warbler habitat creation.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid the adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information.

The Service has identified the following actions that, if undertaken by NRCS, would further the conservation and assist in the recovery of the Indiana bat.

1. Implement NRCS programs and projects in a manner that contributes to the conservation and recovery of the Indiana bat. The Healthy Forest Reserve Program is an excellent example of such a program.
2. Coordinate with the Service's Pennsylvania Field Office on the golden-winged warbler habitat creation projects proposed for 2013, to ensure the combined effects of multiple projects consider, and to the extent possible, avoid adverse effects on federally-listed species.

To be kept informed of actions minimizing or avoiding adverse effects, or benefiting listed species or their habitats, the Service requests notification of the implementation of the conservation recommendations carried out.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined by the Natural Resources Conservation Service. As written in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law), and if (1) the amount or extent of incidental take is exceeded; (2) new information reveals the agency action may affect listed species or critical habitat in a manner or to an extent not considered in this BO; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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Clinton Riley, Field Office Supervisor Date

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