Biological Opinion

Tennessee Field Office's Participation in Conservation Memoranda of Understanding for the Indiana Bat and/or Northern Long-eared Bat

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Executive Summary

The U.S. Fish and Wildlife Service (Service), Tennessee Ecological Services Field Office (TFO) proposes to participate in an indefinite number of voluntary Conservation Memoranda of Understanding (CMOU) with federal and non-federal entities that would provide recovery-focused conservation benefits for Indiana and northern long-eared bats associated with the removal of forested habitat that is suitable for these species throughout the Action Area over a 5-year period (the Action). The Action Area includes all lands within the boundaries of Tennessee and those portions of Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia that occur within 20 miles of the Tennessee state border.

The habitat removal associated with CMOU projects is limited to 100 acres per individual project and 10,000 acres of habitat per species (with no overlap in species coverage, a maximum of 20,000 acres). This habitat removal would result in adverse effects to Indiana and northern long-eared bats due to the potential for death, injury, and/or disruption of normal behavior patterns from the destruction, modification, and/or fragmentation of forested habitats that are known to support, or may support, these species. Through the CMOU process, project proponents would provide mitigation to compensate for these habitat impacts, resulting in a net conservation benefit to these species.

The proposed CMOU program provides a voluntary option to Endangered Species Act (ESA) section 7(a)(2) consultations for federal agencies that must ensure their actions do not jeopardize Indiana bats or northern long-eared bats, and must obtain exemption for taking of these species that is incidental to those actions. Likewise, it provides a voluntary option to ESA section 10(a)(1)(B) permits for non-federal entities who must obtain an exception for taking that is incidental to their actions. Projects that may qualify for CMOUs cannot have substantial or unpredictable impacts based on project-specific details (e.g., location, timing, etc.), to the two species of bats without additional analysis and project-specific impact avoidance and minimization measures. This Biological Opinion (BO) evaluates the adverse effects of CMOU projects and the beneficial effects of compensatory mitigation measures that project proponents would implement or fund in association with their participation in a CMOU. The TFO does not authorize, fund, or carry out a project that is the subject of a CMOU, but does determine whether entering a CMOU with a project proponent is an appropriate method to address the proponent's need for compliance with the ESA, which this BO addresses.

The TFO determined the proposed action may affect, and is likely to adversely affect, the Indiana bat and the northern long-eared bat, and requested formal consultation. The Southeast Regional Office (RO), serving as the intra-Service consulting office, has determined in this BO that the proposed action will not jeopardize the continued existence of the Indiana bat or the northern long-eared bat, and will not adversely modify designated critical habitat for the Indiana bat. Critical habitat for the northern long-eared bat is not designated or proposed. The BO includes an Incidental Take Statement that exempts taking of the two bat species that is incidental to the proposed Action from the prohibitions against taking listed species.

Consultation History

October 16, 2015 The U.S. Fish and Wildlife Service's Tennessee Field Office (TFO) requests initiation of Formal Consultation with the U.S. Fish and Wildlife Service's Southeast Regional Office (RO). The request is accompanied by a supporting Biological Assessment, and the Conservation Strategy for Forest-Dwelling Bats in Tennessee.

November 4, 2015 The RO advised the TFO that new regional guidance on Memoranda of Understanding will apply to the proposed program of bat Conservation Memoranda of Agreement. The RO will use the term Conservation Memoranda of Understanding instead, and until the Department's Regional Solicitors have approved delegation of authority for such instruments to the field level, the Assistant Regional Director must sign.

November 23, 2015 The RO contacted the TFO to clarify the 5-year acreage total of the proposed Action. The TFO agrees to revise the proposed 10,400 acres total per species to 10,000 acres, consistent with the 2,000 acres per year limit on activity. The TFO also clarified the types of additional conservation measures that the TFO would consider when projects may affect bats during sensitive time periods, for which the program requires more project-specific review and coordination.

Biological Opinion

A Biological Opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR §402.02). "To jeopardize the continued existence of a listed species" means 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 the species (50 CFR §402.02).

This BO addresses the effects of the Service's Tennessee Ecological Service's Field Office (TFO) proposal to participate in Conservation Memoranda of Understanding (CMOU) for the federally-endangered Indiana bat (*Myotis sodalis*) and the threatened northern long-eared bat (*Myotis septentrionalis*) (the Action). For this intra-Service consultation, the TFO is the federal action agency, and the Service's Southeastern Regional Office (RO) is the consulting office.

The Service has designated critical habitat for the Indiana bat, but the Action excludes activities located within critical habitat. Critical habitat has not been designated or proposed for the northern long-eared bat. Therefore, this BO does not address effects to critical habitat.

1 Proposed Action

The Action is the TFO's proposed participation in an indefinite number of voluntary CMOUs with Federal and non-Federal entities for projects that may affect Indiana and/or northern long-eared bats. These CMOUs would provide recovery-focused conservation benefits for Indiana and northern long-eared bats as mitigation for the removal of up to 10,000 acres of forested habitat (species' occupancy is either known or potential) for each species. With no overlap in species coverage, which is unlikely, CMOUs could cover a maximum of 20,000 acres of forested habitat removal throughout Tennessee and portions of adjacent states (Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia) that are within 20 miles of the Tennessee border. CMOUs are a primary mechanism for implementing the TFO's "Conservation Strategy for Forest-dwelling Bats in Tennessee" (Strategy).

The proposed CMOU program provides a voluntary option to section 7(a)(2) consultations for federal agencies that must ensure that their actions do not jeopardize Indiana bats or northern long-eared bats, and must obtain an exemption for taking of these species that is incidental to those actions. Likewise, it provides a voluntary option to section 10(a)(1)(B) permits for non- federal entities that must obtain an exception for taking that is incidental to their actions. The TFO's biological assessment (BA) for the proposed CMOU program describes the characteristics of projects that may qualify for CMOUs, which are limited to forested habitat removal of a maximum extent (per project and for the program as a whole). Eligible projects may not result in substantial or unpredictable impacts to the two species of bats, based on project-specific details (e.g., location, timing, etc.), without additional analysis and project-specific impact avoidance and minimization measures. The BA describes the adverse effects of CMOU projects and the beneficial effects of compensatory mitigation that project proponents would implement or fund by participating in a CMOU. The TFO does not authorize, fund, or carry out a project that is the subject of a CMOU, but does determine whether entering a

CMOU with a project proponent is an appropriate method to address the proponent's need for compliance with the ESA, which this BO addresses.

1.1 Action Area

"Action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes all lands within the geo-political boundaries of Tennessee and those portions of Alabama, Arkansas, Georgia, Kentucky, Mississippi, Missouri, North Carolina, and Virginia that occur within 20 miles of the Tennessee state line (the Action Area). This Action Area corresponds with the scope of the Strategy and recognizes that projects associated with CMOUs: (a) are likely to occur at scattered and undeterminable locations across the state of Tennessee; (b) may cross into adjacent states; and (c) will vary in size and distribution on the landscape.

An analysis of land cover within Tennessee and within the Action Area using the 2011 National Land Cover Database supports applying a description of Tennessee to the entire Action Area, as those portions of adjacent states included in the Action Area are very similar to the adjoining portion(s) of Tennessee. Land use in Tennessee varies across the state. Major categories include: agricultural farmland, livestock farmland, forest, streams and wetlands, residential development, industrial development, natural resource mines, infrastructure construction, urban development, and others. Today, much of Tennessee's natural habitat has been altered and continues to be altered.

Approximately 16 percent (2.2 million acres) of Tennessee's forest land is in public ownership, much of that providing important conservation values for fish and wildlife (Oswalt 2014). The U.S. Forest Service has the largest public forest land holding in Tennessee, with state ownership following. Other significant public forest land ownerships lie with the Department of Defense, National Park Service, and U.S. Fish and Wildlife Service (Oswalt 2014). There are also several non-governmental organizations (NGOs) actively preserving and conserving biologically important lands within Tennessee. The lands in conservation ownership by these NGOs are included in the 84 percent of Tennessee which remains privately owned and play an important role by providing natural and semi-natural habitats to support wildlife diversity. One recent trend among the forest industry is the divestment in forested lands. The industry owned 1.3 million acres (10 percent) of forestland in the state in 1999 and owned 374,000 acres (3 percent) in 2009 (Oswalt et al. 2012).

A 2012 Forest Inventory and Analysis published by the U.S. Forest Service (Oswalt 2014) reported that 13.9 million acres of Tennessee's land base is forestland. Tennessee's forests are most heavily concentrated in the middle and eastern thirds of the state. The predominant forest type is oak-hickory, which constitutes 72 percent of the total forestland acreage (Oswalt 2014). The average age of Tennessee's forests generally increased during the years 1961 to 2009, with a decline in acreage of early successional habitats and number of small-diameter trees (Oswalt et al. 2012). Between 2004 and 2009, there was a net increase in Tennessee forest land by about 204,637 acres. The western and central parts of the state were important in this increase as agricultural lands reverted to forest. During this time frame, approximately 350,543 acres of forest were lost – primarily to agricultural land (especially in central Tennessee) and urban development (especially in eastern Tennessee). Forest loss and fragmentation have been somewhat evenly spread across the state, with smaller loss on the Cumberland Plateau.

1.2 Description of the Proposed Action

The following sections are summarized from the BA. Please refer to that document for more information.

1.2.1 Conservation Strategy

To implement the proposed process, the TFO has developed a document, titled "Conservation Strategy for Forest-dwelling Bats in Tennessee" (Strategy), which becomes effective as of the signature date of this BO. This Strategy will supersede the January 2012 "Interim Indiana Bat Mitigation Guidance for the State of Tennessee" and is included as an Appendix to the BA.

The Strategy is available for voluntary use by Federal agencies and non-Federal entities, and it identifies the compensatory mitigation measures that project proponents may implement or fund under a CMOU framework to assist in the conservation and/or recovery of Indiana and/or northern long-eared bats within the Action Area. The measures include: (a) protection of known and previously unprotected Indiana and/or northern long-eared bat habitat with a demonstrated significance to either or both species; (b) contribution of funds to Tennessee's Imperiled Bat Conservation Fund (IBCF) sufficient to achieve identified mitigation needs if other measures are impractical or have limited value to Indiana and northern long-eared bat conservation and/or recovery; and (c) other activities that provide a tangible conservation benefit to forest-dwelling bats proposed to the TFO for a case-by-case evaluation.

1.2.2 Conservation Memoranda of Understanding

In executing a CMOU, the TFO will ensure proper implementation of the Strategy. While all CMOUs will outline each cooperator's (i.e., the TFO's and the project proponent's) commitments and responsibilities under the CMOU, the provisions of each CMOU will vary due to a variety of factors. Within these provisions, the TFO may choose to establish a process for either increasing or decreasing the mitigation ratios set forth in the Strategy. The TFO will ensure that any deviation is appropriate for the impacts proposed and does not undermine the goals of the Strategy. The TFO will justify and document each deviation in the CMOU or in a memo to the project file. Execution of a CMOU for projects with adverse effects in a neighboring state will require the advance, written approval of the Service Field Office(s) involved.

CMOUs will be both programmatic and project-specific in nature. Programmatic CMOUs will describe routine or recurring project types that typically include the same or similar types of potential adverse effects to Indiana and northern long-eared bats for which it is possible to accurately quantify potential adverse effects to Indiana and northern long-eared bat summer habitat on an acreage basis. Therefore, the TFO anticipates that programmatic CMOUs can streamline routine or recurring projects and provide significant benefits to Indiana and/or northern long-eared bats by ensuring that potential impacts are quantified and conservation and/or recovery benefits are provided. The TFO may also develop programmatic CMOUs for non-linear projects where there is sufficient basis to do so, such as phased development clearing, mining, or other projects where blocks of habitat are affected according to a schedule and impacts are accurately quantified.

Project-specific CMOUs apply to projects that are not routine or recurring (i.e., one-time impacts) where the potential adverse effects to Indiana and/or northern long-eared bats are quantifiable. As of

August 20, 2015, the TFO had entered into 46 project-specific CMOUs exempting the incidental take associated with up to 257.8 acres of forest habitat alteration during a period of just over 3.5 years. The currently proposed CMOU process updates that process for Indiana bats and incorporates the northern long-eared bat as a second covered species.

The TFO proposes to enter into CMOUs based on the Strategy with the following limitations:

1. Projects implemented under these CMOUs will affect no more than 10,000 acres (not to exceed 2,000 acres annually) of known and/or potential Indiana bat habitat.
2. Projects implemented under these CMOUs will affect no more than 10,000 acres (not to exceed 2,000 acres annually) of known and/or potential northern long-eared bat habitat.
3. Agreement periods will not exceed 5 years and will end on or before October 16, 2020.

At that time, the TFO will re-initiate formal consultation on implementation of the CMOUs and Strategy to ensure that their continued use will not jeopardize the continued existence of the species or adversely modify designated critical habitat. The TFO will also re-evaluate the effectiveness of the Action, including the Strategy, to determine if the anticipated conservation and/or recovery benefits for Indiana and northern long-eared bats were achieved. If these evaluations determine that: (a) the continued use of CMOUs and implementation of the Strategy will not jeopardize the species or result in the adverse modification of designated critical habitat; and (b) the implementation of the CMOUs and Strategy has achieved the expected conservation and/or recovery benefits, the TFO may elect to continue use of CMOUs and the Strategy. If the TFO determines that the Strategy has not achieved the anticipated recovery-focused conservation benefits, the TFO may terminate its use or modify the process to achieve those benefits.

1.2.3 Covered Activities

The types of impacts to Indiana and northern long-eared bats that are addressed in this BO and covered by the CMOUs are limited to those adverse effects caused by the removal of forested habitats. Projects with additional types of impacts to either species will require additional coordination with the TFO to ensure compliance with the ESA.

CMOUs may involve permanent or temporary losses of forested habitat. Losses may occur while bats are likely present (occupied) or during the hibernation period when bats are not present (unoccupied). Impacts may occur in areas where Indiana and/or northern long-eared bats have been documented (known habitat) or where the presence of one or both of these species is presumed (potential habitat). Known habitats for either species may include fall swarming/spring staging habitats around documented hibernacula and summer habitats around documented capture/detection records. All suitable habitats are considered potential habitats for both summer and fall/spring swarming) uses unless probable absence of the species for that use has been demonstrated (i.e., through surveys).

Additional coordination between the TFO and the CMOU cooperator is required when proposed activity would adversely affect known or potential maternity summer habitat while bat pups are non-volant (June 1 through July 31) and during the spring staging period (March 15 through April 15) for sensitive portions of known swarming habitats. This additional coordination will consider project-specific circumstances to minimize impacts to these species during their most sensitive life stages. Additional conservation measures may include, but are not limited to:

- conducting habitat surveys and, when possible, shifting the project footprint accordingly to minimize habitat loss;
- when possible, ensuring that trees with the characteristics of suitable roost trees (large diameter, cavities, loose bark, etc.) are not felled during the sensitive time period.

The "Explanation of Terms" section and Appendix A of the Strategy provide additional information about habitat types affected under CMOUs. Projects with adverse effects to designated critical habitat for the Indiana bat, which is comprised entirely of known hibernacula, are excluded from the Action and are not addressed in this BO. The Service has not proposed critical habitat for the northern long-eared bat.

1.2.4 Conservation Benefits

The TFO's Strategy identifies conservation goals for Indiana and northern long-eared bats in the Action Area. Projects covered under CMOUs will include mitigation for their impacts to one or both of the species, and compensatory mitigation will address one or more conservation goals in the Strategy such that benefits to the species will exceed (at a programmatic scale) what is needed to offset impacts, yielding a net conservation benefit or gain. Conservation benefits as well as impacts are generally tracked by acres and type (i.e., swarming, maternity, etc.) of habitat, as it is the loss of habitat that drives the adverse effects evaluated in this BO.

CMOUs may achieve conservation benefits directly through actions implemented by the project proponent or indirectly through the IBCF. Regardless of the mechanism, compensatory actions must align with the goals of the Strategy, which are established to maximize the benefits to the species by protecting and managing these species during their most sensitive life stages.

2 Indiana Bat

The following sections are summarized from the BA. Please refer to that document for more information.

2.1 Status of the Species/Critical Habitat

The Indiana bat was 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 ESA subsequently extended full legal protection from unauthorized take 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.

The Service published a recovery plan (USFWS 1983) that outlined recovery actions. A revised draft recovery plan was noticed in the Federal Register for public review and comment on April 16, 2007 (USFWS 2007), but has not been finalized. The Service's Bloomington, Indiana Field Office completed a 5-Year Review of the Indiana bat (USFWS 2009), which concluded that not all of the recovery criteria for the Indiana bat had been achieved.

2.1.1 Species Description

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the

winter and summers in wooded areas. It is a medium-sized bat, having a wing span of 9 nine 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 characteristics such as foot structure, ear structure, and fur color.

2.1.2 Life History

Life Cycle
The Indiana bat hibernates in caves and mines during the winter and migrates to summer habitat. 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 may migrate long distances to their summer habitat (Kurta and Rice 2002). 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, all Indiana bats have entered hibernation. They typically emerge in March or April, at which time they again migrate to summer habitat.

Longevity
The average life span of the Indiana bat is 5 to 10 years, but banded individuals have been documented living as long as 14 and 15 years (Humphrey and Cope 1977).

Reproduction
Female Indiana bats, like most temperate members of the family Vespertilionidae, give birth to one pup each year (Mumford and Calvert 1960; Thomson 1982). 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).

Seasonal Distribution Patterns
Summering Indiana bats (males and females) roost in trees in riparian, bottomland, and upland forests. Male bats disperse throughout the range and roost individually or in small groups, with many staying near hibernacula (i.e., caves and mines) and roosting individually or in small groups (Whitaker and Brack 2002). Reproductive females form larger groups in which they raise their pups, referred to as maternity colonies.

This life history strategy of colony formation reduces thermoregulatory costs, which in turn, increases the amount of energy available for birthing and raising of pups (Barclay and Harder 2003 as cited in USFWS 2007). Most documented maternity colonies have 50 to 100 adult bats (USFWS 2007). When pups become capable of flight in early to late July, the maternity colony begins to disperse and the 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 relies more heavily on alternate roosts.

When arriving at their traditional hibernacula in August or September, Indiana bats undergo "swarming" activity. Some male bats may begin to arrive at hibernacula as early as July. Studies suggest that the majority of foraging habitat in spring and autumn is within 2 miles of the hibernacula but can extend to 5 miles or more. Therefore, it is not only important to protect the caves in which the bats hibernate,, but also to maintain and protect the quality and quantity of roosting and foraging

habitat within 5 to 10 miles of each Indiana bat hibernaculum.

During swarming, males are active over a longer period of time at cave entrances than females, probably to mate with females as they arrive. Soon after mating, females enter hibernation. Most bats are hibernating by the end of November, but hibernacula populations may continue to increase (USFWS 2007). The time frame during which Indiana bats cluster and hibernate is encompassed by the period of October through April.

Most Indiana bats emerge in late March or early April. Females emerge first, followed by the males. The timing of annual emergence varies across the range depending on factors such as hibernacula latitude, elevation, and weather conditions. During the period immediately after hibernation and prior to migration, the bats undergo activity typically referred to as "staging," during which they forage for a few days or weeks near their hibernacula before moving to their traditional summer roosting areas. Shortly after emerging from hibernation, the females become pregnant via delayed fertilization from the sperm that has been stored in their reproductive tracts through the winter (USFWS 2007). Most populations leave their hibernacula by late April. Migration is stressful for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low. As a result, adult mortality may be the highest in late March and April.

2.1.3 Habitat Characteristics and Use

Winter
Indiana bats roost in caves or mines with configurations that provide a suitable temperature and humidity microclimate (Brack et al. 2003; USFWS 2007). Hibernacula often contain large populations of several species of bats.

Spring emergence occurs when outside temperatures have increased and insects (forage) are more abundant (Richter et al. 1993). Some bats may remain in close proximity to the cave for a few days before migrating (commonly referred to as spring "staging"), while others may fly directly to summer habitats.

Summer
Home range size may vary between seasons, sexes, and reproductive status of females (Lacki et al. 2007). Without site-specific data, the Service generally considers the potential home range for an Indiana bat to include all suitable habitat within 2.5 miles of documented roost(s) (USFWS 2011), recognizing that the area of actual use may be just a portion of that area.

Summer - Maternity
Indiana bats exhibit strong site fidelity to their traditional summer colony areas and foraging habitat, returning to the same areas annually to give birth (Kurta et al. 2002; Garner and Gardner 1992; USFWS 2007). Indiana bat maternity colonies typically occupy multiple roosts in riparian, bottomland, and upland forests. 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, we assume 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 pregnancy and migration.

Indiana bats prefer forests with old-growth characteristics, such as large trees, scattered canopy gaps, and open understories (USFWS 2007). However, research is demonstrating adaptability in the species' use of habitats. Recent research has documented bats using upland forest for roosting and pastures with scattered trees for foraging. The Indiana bat may persist in highly altered and fragmented forest landscapes for some unknown period of time.

Summer – Non-maternity

Non-reproductive females and males may roost individually or in small groups, but they occasionally are found roosting with reproductive females. While Indiana bats primarily roost primarily in trees, some colonies have used artificial roost structures (e.g., buildings and bat boxes) (USFWS 2007).

Many male Indiana bats appear to remain at or near hibernacula during summer (Whitaker and Brack 2002). Because males typically roost individually or in small groups, the average size of their roost trees tends to be smaller than that of female maternity colonies. Males may roost occasionally in caves. Males have also demonstrated summer site fidelity and have been recaptured in foraging areas that were used in prior years (USFWS 2007).

Roost Trees

Suitability of a roost tree is determined by its condition (i.e., dead or alive), suitability of loose bark, solar exposure, spatial relationship to other trees, and proximity to water sources and foraging areas. Roost longevity is variable due to many factors, especially the rate at which bark sloughs off or the tree falls down. Trees in excess of 16 inches diameter at breast height (dbh) are considered optimal maternity colony roost sites, but trees in excess of 9 inches dbh are often used as alternate maternity roosts. Male Indiana bats have been observed roosting in trees as small as 2.5 inches dbh (Gumbert et al. 2002). Females have been documented using roost trees as small as 5.5 inches (Kurta 2005). Weather influences bat behavior and habitat use (Humphrey et al. 1977).

Foraging

The Indiana bat feeds primarily on insects, both aquatic and terrestrial. Diet varies seasonally and between individuals of different age, gender, and reproductive status (USFWS 1999). 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 forested upland areas are also important water sources. Like most bats, the Indiana bat forages primarily at night and during twilight hours.

2.1.4 Status and Distribution

Reason for Listing

From 1965 through 2001, there was an overall decline in Indiana bat populations, and winter habitat modifications were linked to population reductions at some of the most important hibernacula (USFWS 2007). Summer habitat modification is also suspected to have contributed to the decline of bat populations; however, it is difficult to determine the degree to which forest management and/or disturbance affects Indiana bats. Environmental contaminants (USFWS 2007), climate change (Clawson 2002), and collisions with man-made objects such as wind turbines, communication towers, and vehicles (Good et al. 2011) are all considered potential threats to Indiana bats.

Due to the species' low reproductive potential (i.e., one or zero pups produced per adult female each year), threats that result in increased mortality or decreased recruitment are of particular concern.

While reducing threats can yield population increases, these increases are gradual because of the species' low reproductive rate.

Rangewide Trends

The Service's Bloomington Field Office has collated the population data gathered during the 2007 through 2015 biennial winter hibernacula censuses from throughout the Indiana bat's range and preliminarily determined that the Indiana bat's 2015 range-wide population stands at approximately 523,636 bats, which is a 9.8 percent decrease over the 2013 range-wide population estimate of 580,717 bats (Figure 1). These numbers include a new Priority 1 hibernaculum discovered in Missouri in 2012. To avoid an artificial spike in population trends, the additional 123,000 bats were added to population estimates back to 1981 (USFWS 2014a). The range-wide, biennial population estimates had been increasing from 2001 to 2007, indicating that the species' long-term decline had been arrested and likely reversed (USFWS 2014a). The observed range-wide decline since 2007 is likely attributable to white-nose syndrome (WNS) (see Figure 2 and discussion below), especially for decreased population estimates in the Northeast Recovery Unit.

Current Winter Distribution

Winter surveys in 2012–2015 found hibernating Indiana bats dispersed across 16 states. However, over 90 percent of the estimated range-wide population hibernated in four states: Indiana (35 percent), Missouri (35 percent), Kentucky (13 percent), and Illinois (11 percent) (USFWS 2015a). For more information on wintering bat distribution, abundance, and potential genetic variation, see the Indiana Bat Draft Recovery Plan (USFWS 2007).

Current Summer Distribution

Summer distribution of the Indiana bat is dispersed across a wider geographic area than its winter distribution. Most 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, Georgia, Alabama, Mississippi (Piper Roby, pers. comm. 2014), and southwestern North Carolina (Britzke et al. 2003; USFWS 2007). Summer records for the Indiana bat have also been documented in eastern Oklahoma, northern Mississippi, Alabama, and Georgia. Some of these records may have involved maternity colonies.

Maternity Colonies

The first Indiana bat maternity colony was not discovered until 1971 in east-central Indiana (Cope et al. 1974). As of publication of the Indiana Bat Draft Recovery Plan (USFWS 2007), we have records of 269 maternity colonies in 16 states that are considered locally extant. Of these, 146 (54 percent) were found between 1997 and 2007, mostly during mist-netting surveys. Additional maternity colonies have been found throughout the range since then, but a range-wide tally has not been conducted since 2007. Because maternity colonies are widely dispersed during the summer and difficult to locate, it is likely that summer survey efforts have discovered only a small fraction of the maternity colonies that exist.

In areas where WNS has affected bat populations for multiple years, it is likely that entire maternity colonies have been eliminated or reduced in size. If the reduction in numbers is substantial, a colony may collapse, because too few females remain for the social clustering that is characteristic of the species and likely contributes to survival and successful recruitment. However, other maternity

colonies may form and stabilize at smaller sizes and eventually rebound. Regardless, the decline that is evident via hibernacula surveys must translate to a declining summer population with fewer and/or smaller colonies.

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 during summer, they are less detectable with mist net surveys than adult females, which tend to occur in high-density maternity colonies. However, males may also roost with maternity colonies.

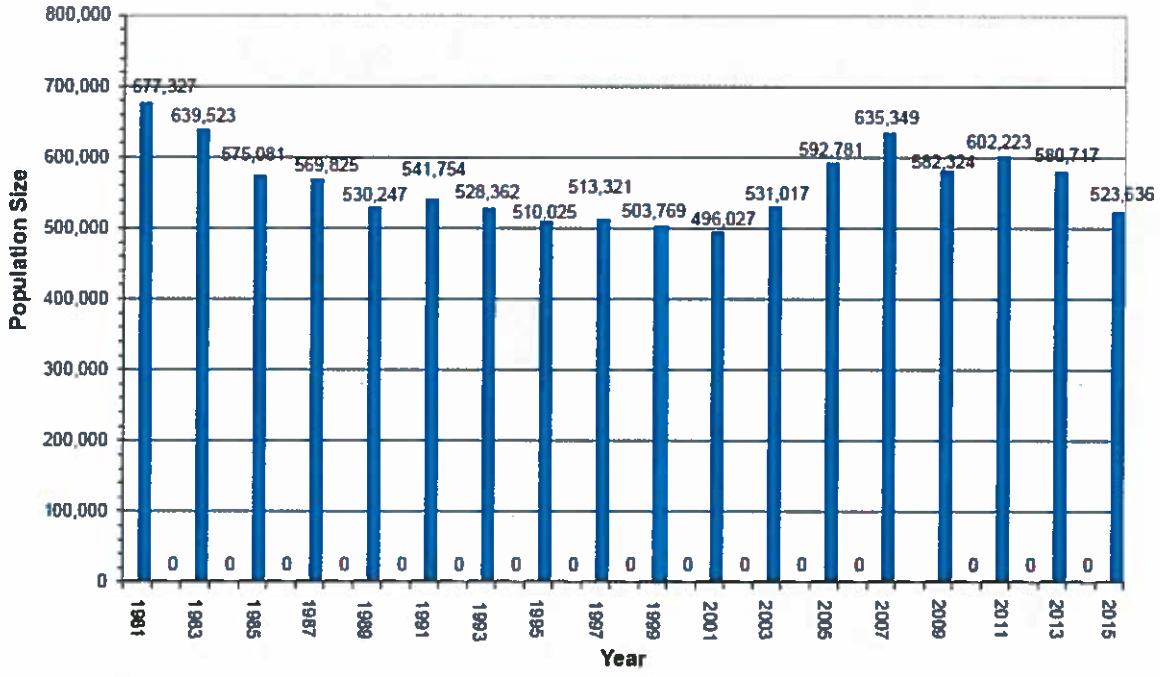

Figure 1: Indiana bat rangewide population estimates from 1981 through 2015.

2.1.5 Threats

White-nose Syndrome

Prior to the current white-nose syndrome (WNS) epizootic, significant disease outbreaks affecting populations of Indiana bats or other North American bat species were not known. As discussed in the BA, WNS has emerged as an unprecedented threat to hibernating bat species in North America, including the Indiana bat.

At the end of the 2013–2014 hibernating season, white-nose syndrome had been documented in 25 states and five Canadian provinces (see Figure 2), with the apparent degree of impact to bats varying greatly by site and species. Based on observations of continued mass mortality at several sites in the Northeast and mid-Atlantic regions, 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. If current trends for spread and mortality at affected sites continue, WNS threatens to drastically reduce the abundance of many species of hibernating bats in much of North America. Population modeling indicates a 99 percent chance of regional extinction of the little brown bat in the Northeast within the

next 16 years due to WNS (Frick et al. 2010). The closely-related Indiana bat may be equally vulnerable due to its smaller range-wide population and social behavior traits that increase the risk of bat-to-bat transmission of the fungus that causes WNS.

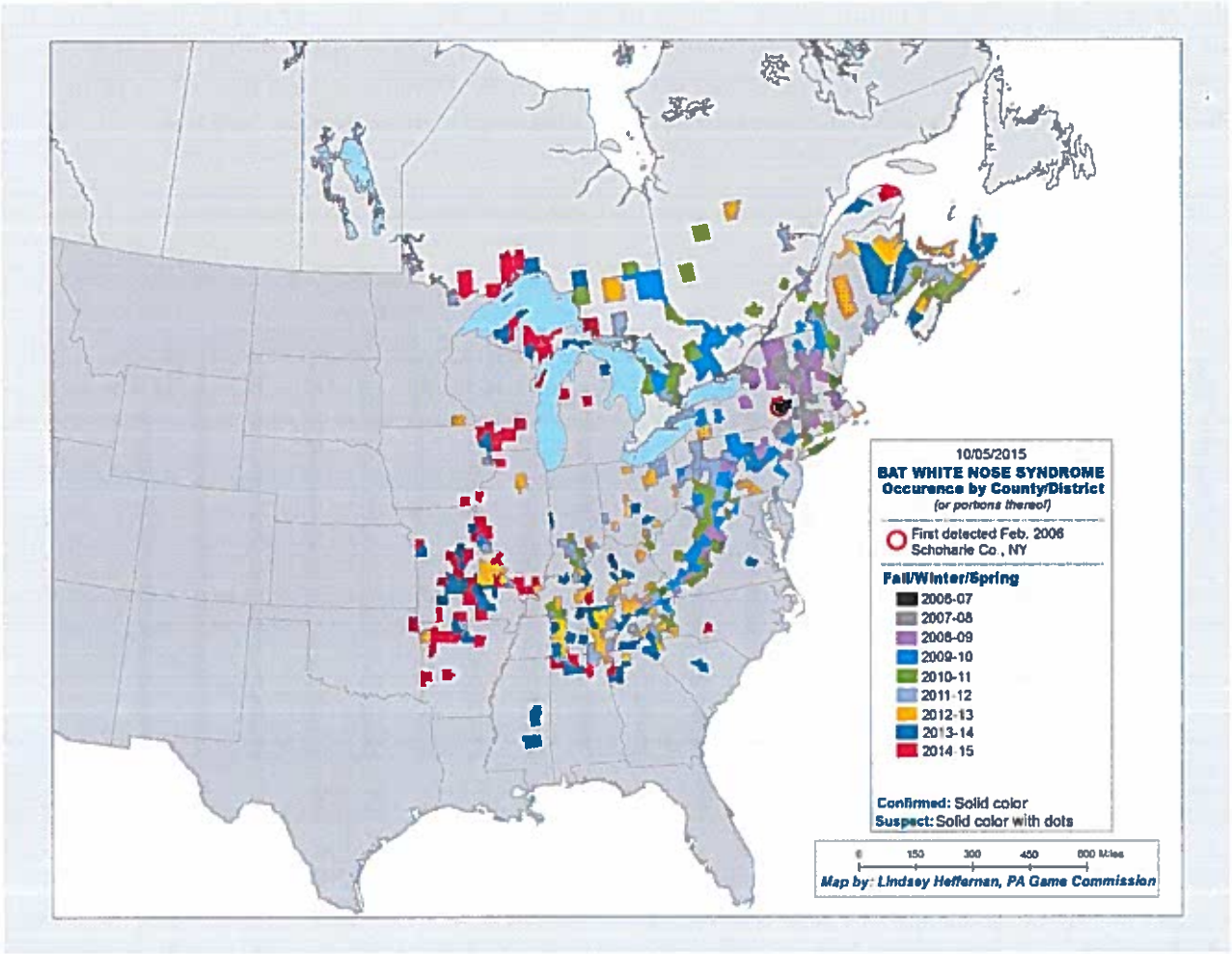

Figure 2: White nose syndrome (WNS) occurrence by county.

Impacts to Indiana bats have been inconsistent between affected hibernacula. The following is a summary of what has been observed in New York at the larger sites, comparing the most recent counts to the last count conducted prior to signs of WNS (generally 2005 or 2007 counts):

- Haile's Cave; 100 percent decline from 685 bats in 2005 to 0 every year since.
- Williams Preserve Mine; 98.5 percent decline from 13,014 in 2007 to 190 in 2010.
- Williams Lake Mine; 97.4 percent decline from 1,003 in 2007 to 26 in 2010.
- Glen Park; 73.6 percent decline from 1,928 in 2007 to 509 in 2010.
- Williams Hotel Mine; 66.5 percent decline from 24,317 in 2007 to 8,152 in 2010.
- Jamesville; 20.7 percent decline from 2,932 in 2007 to 2,324 in 2009.
- Barton Hill Mine; 13.7 percent increase from 9,393 in 2007 to 10,678 in 2010.

Based on observations of continued mass mortality at several sites, we anticipate the loss of Indiana bats to continue in the Northeast/mid-Atlantic regions as well as the Midwest in future winters. In

addition, we anticipate that WNS will continue to radiate out to new sites. The potential for climate or another environmental factor to influence the spread of WNS, or the severity of its impact on affected bats, remains unknown. Range-wide data collected during future winter surveys will continue to reveal the severity of the spread and impacts of WNS. Given the evidence to date, the Service considers WNS as the single-most destructive and significant threat to the Indiana bat. Additional information on WNS, which is constantly evolving, is available online at http://whitenosesyndrome.org/.

Wind Energy

There is growing concern that the Indiana bat and other bat species are threatened by the recent surge in construction and operation of wind turbines across the eastern U.S. Until the fall of 2009, no known mortality of an Indiana bat had been associated with the operation of a wind turbine/farm. The first documented wind-turbine mortality event occurred during the fall migration period in 2009 at a wind farm in Benton County, Indiana. Since that time, four additional deaths have been documented.[1] Detecting bat mortality at wind energy facilities requires special effort; therefore, we assume that other Indiana bat mortalities have likely occurred in addition to these five documented instances. In October 2011, the Service released the "Indiana bat Section 7 and Section 10 Guidance for Wind Energy Projects," which is being used range-wide.

2.1.6 Recovery Criteria

Since the Indiana bat's initial listing, the species' recovery efforts have been primarily focused on protection of important hibernacula (USFWS 1983). The proposed recovery program outlined in the draft Recovery Plan (USFWS 2007) has four broad components:

(a) range-wide population monitoring at the hibernacula with improvements in survey techniques;
(b) conservation and management of habitat (hibernacula, swarming, and summer);
(c) further research into the requirements of and threats to the species; and
(d) public education and outreach.

This recovery program continues to have a primary focus on protection of hibernacula, but also increases the focus on summer habitat and proposed use of Recovery Units.

Recovery Units

The Service's proposed delineation of Recovery Units (RUs) 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 (USFWS 2007). The Indiana Bat Draft Recovery Plan proposes four RUs for the species: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (USFWS 2007) (Figure 3). The Action Area is primarily contained within the Midwest RU but crosses into Appalachian Mountains RU for the included portions of North Carolina and Virginia. It also crosses into the Ozark-Central RU for the covered portions of Arkansas and Missouri.

[1] http://www.fws.gov/midwest/wind/wildlifeimpacts/inbafatalitiesJuly2013.html

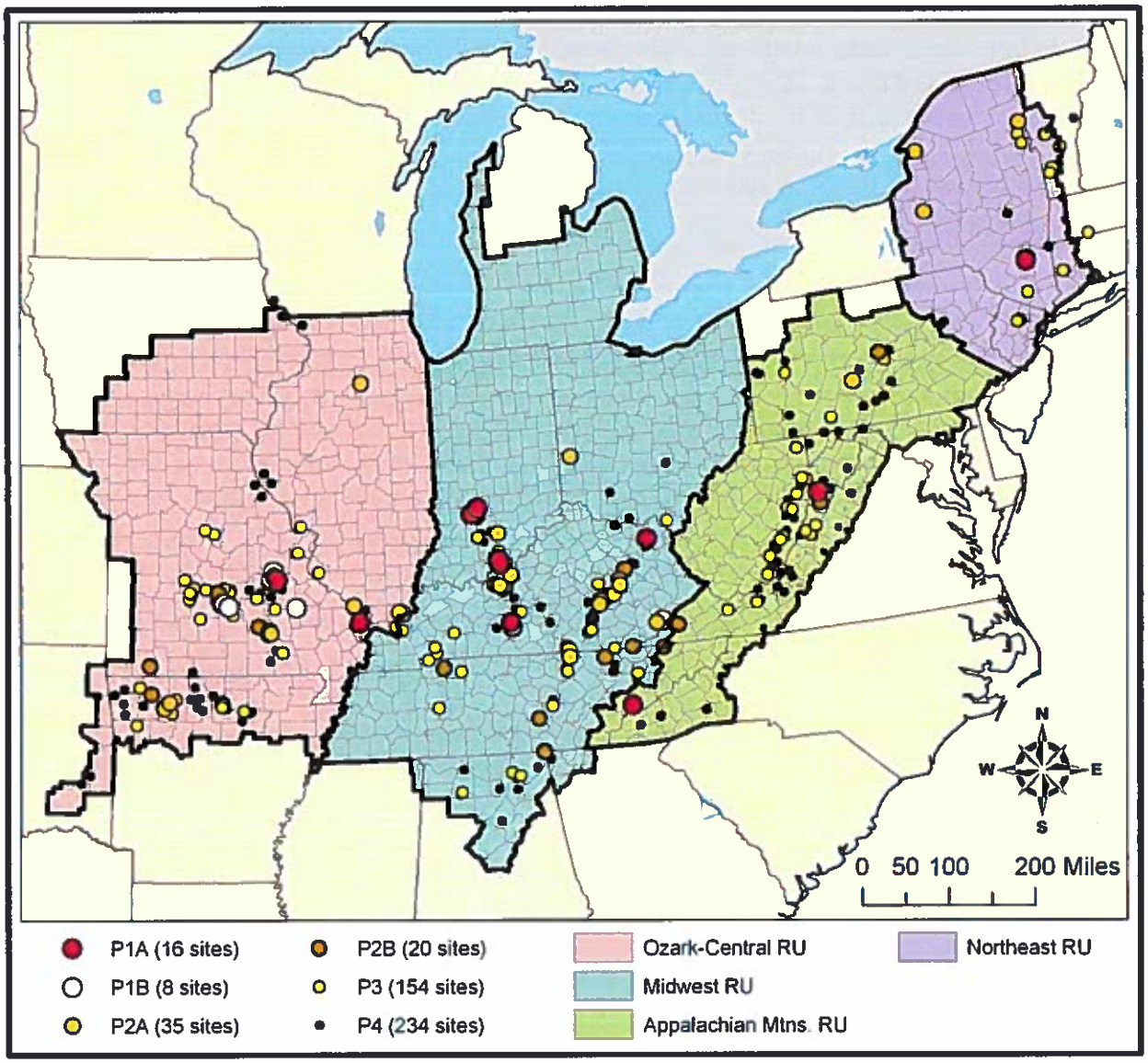

Figure 3. Recovery Units for the Indiana bat in relation to locations of known hibernacula, as proposed in the species' 2007 draft recovery plan.

2.1.7 Previous Incidental Take Exemptions

Prior formal consultations involving the Indiana bat have involved a variety of action agencies and project types. These have included:

- The Forest Service for activities implemented under various Land and Resource Management Plans (LRMPs) on National Forests (NFs) in the eastern United States;
- The Federal Highway Administration for various transportation projects;
- The U.S. Army Corps of Engineers (Corps), Federal Energy Regulatory Commission (FERC), Tennessee Valley Authority (TVA) and West Virginia Department of Environmental Protection for various water-related and coal mining projects;
- The Department of Defense for operations at several different military installations;
- The National Park Service for vegetation management and prescribed burn activities; and

- The Fish and Wildlife Service for the management of National Wildlife Refuges and section 10 activities.

A summary of the formal consultations completed since 1998 is discussed below and provided in Appendix A. Formal consultations on the Indiana bat completed prior to 2000 were omitted from the analysis, because the incidental take provided prior to 2000 is of little relevance to the current status of the species for the following reasons:

- the effects of the take occurred more than 15 years ago, making meaningful interpretation difficult or impossible;
- data regarding current population levels and other information are available that give us a better picture of the species' status; and
- the authorized take in many biological opinions has been superseded by new biological opinions.

In conducting many of these consultations, Indiana bat presence/absence survey information was unavailable, and the Service often relied on a variety of factors to assist the action agency in determining if Indiana bats were present. For example, if survey information indicated that Indiana bats were present in nearby areas, the action agency often assumed that Indiana bats were present in the action area and could be subject to incidental take. Further, if the best scientific and commercial data available indicated that an Indiana bat maternity colony could be present, a maternity colony was generally assumed to be present within the Action Area. This type of conservative approach is generally protective of Indiana bats because it tends to over-estimate the incidental take that may occur. In most such cases, including the Action, the Service analyzes the effect of the worst case for incidental take on the proposed action, but acknowledges that the worst case is unlikely to occur. The fact that the worst case is unlikely to occur is greatly due to implementation of conservation measures related to the CMOU process and other actions by the action agency to avoid and/or minimize incidental take.

Previous consultations have addressed impacts to hibernating or swarming bats, known maternity areas, or summer habitat that was assumed occupied. Due to the various life stages affected, the types of conservative assumptions made (as discussed above), and the difficulty in documenting actual take to Indiana bats (as more fully described in each biological opinion and the Incidental Take Statement section of this BO), different methods have been used to estimate the amount of actual and/or potential take. The Service has estimated take either by estimating numbers of affected roost trees, acres of potentially suitable and/or occupied habitat, numbers of individual bats or maternity colony population densities, or acres of potentially suitable and/or occupied habitat, depending on consultation-specific circumstances. Appendix A shows that biological opinions have exempted take of Indiana bats on 3,003,762 acres of habitat since 2000.

Of this exempted take, approximately 228,985 acres have been superseded by new biological opinions, which reduce the total take acreage to 2,774,777 acres range-wide. It is important to subtract the acreage of incidental take exempted in those BOs that are no longer in effect to avoid double-counting the affected acres. For example, the 2004 and 2007 biological opinions for the Daniel Boone NF Revised LRMP both exempt take on the same 54,350 acres of the forest.

Of the 2,774,777 acres of exempted take currently active, approximately 2,620,141 acres (93.7 percent) are for the U.S. Forest Service, primarily for NF LRMPs which are typically valid for a 10-

year period. In assessing the acreage of incidental take exempted in these biological opinions, the Service multiplied any per-year incidental take issued for an LRMP by 10 (standard effective period for an LRMP) to obtain the total exempted incidental take. This practice over-estimates incidental take, because many of the management actions that may result in incidental take occur more than once at the same locations during a 10-year period. For example, forest stands on the Northeast Research Station are harvested multiple times over many years, with each harvest counted as a separate acre of annual take (USFWS 2005b). Prescribed fire is another activity common on NFs that, while being given an annual acreage of exempted take, this take does not occur on geographically distinct locations each year. Rather, it often involves replicated burns on the same sites at recurring intervals. Therefore, it is difficult, for the reasons discussed previously in this section, to measure the effects of previously authorized take without knowing the details of each biological opinion and closely evaluating the outcome of each consultation. Even when we have the details of a biological opinion and are able to evaluate the outcome, we may not be able to draw realistic conclusions regarding the short- and/or long-term effect of any incidental take that has occurred due to the difficulty in monitoring and estimating incidental take of Indiana bats.

Several NFs and one Forest Service Research Station within the range of the Indiana bat have completed consultation at a programmatic level. Consultation under section 7 of the ESA is necessary to ensure Federal agency actions are not likely to jeopardize the continued existence of listed species or result in the destruction or modification of critical habitat of such species. The Service concluded that implementation of the proposed Forest Plans was unlikely to jeopardize the continued existence of the Indiana bat and issued incidental take statements with the biological opinions. Although these incidental take statements accounted for the potential take of reproductive females, we have not confirmed population declines or the loss of any maternity colonies on a NF as a result of Forest Plan implementation.

The Service believes we have not yet confirmed take of an Indiana bat maternity colony on NFs for two reasons. First, , we have discovered the location of only 14 maternity colonies on the affected NFs (Daniel Boone NF (7), Hoosier NF (2), Mark Twain NF (1), Monongahela NF (1), Nantahala NF (1), and Shawnee NF (2)). Surveys to identify and confirm other maternity colonies on the Daniel Boone NF and other NFs are ongoing but are not systematic. The NFs covered by these biological opinions generally conduct some form of Indiana bat population monitoring, including mist net surveys, acoustical monitoring, and hibernacula surveys, as appropriate. These surveys have served to document: (a) continued presence of Indiana bats on the forests; (b) discovery of new maternity colonies on the subject forests; or (c) continued apparent absence of Indiana bats where presence was assumed. Second, each Forest Plan includes conservation measures (i.e., standards and guidelines) that are protective of Indiana bats and their habitat and additional reasonable and prudent measures required under the applicable biological opinion. These conservation measures and reasonable and prudent measures are designed to protect all known and newly-discovered maternity colonies, and to ensure an abundance of suitable Indiana bat habitat on the NFs.

Incidental take exempted on NFs is typically monitored and reported by acres of habitat lost, altered, or otherwise affected by a covered project. Based on the anticipated levels of take provided in the biological opinions for NF LRMPs, over 95 percent of these acres are affected by varying degrees of temporary loss as a result of timber management activities or prescribed burns (USFWS 2005a). However, much of this incidental take is assumed to occur and is based on a conservative assumption of take. Recording of actual incidental take is difficult, if not impossible, in most situations due to the difficulties in knowing if Indiana bats are actually present within an affected area and whether

they are actually harmed, harassed, or killed. The Service or a federal action agency seldom has complete information when initiating a proposed project that could adversely affect Indiana bats and even more seldom is able to document that an actual take has occurred (e.g., finding a dead Indiana bat during project implementation). However, each biological opinion requires that the NF monitor and report the amount of habitat that is altered annually, which represents the best data available on the amount of take that may have occurred.

Exempted incidental take does not account for the expected habitat gains (beneficial effects) associated with many NF projects. Prescribed burning on NFs operating under programmatic biological opinions may improve foraging and roosting habitat for Indiana bats by increasing the number of snags, creating scattered canopy gaps, opening up the understory, and increasing the available prey base. Many of the management plans include standards that avoid cutting trees that are most likely to contain a maternity colony or a roosting bat. For example, the Monongahela NF Plan calls for retaining all shagbark hickories with a dbh of 5 inches or more within its timber harvest areas as well as retaining a minimum number of snags per acre.

A number of incidental take statements have also been issued to other Federal agencies conducting activities that were determined not likely to jeopardize the Indiana bat. Unlike the incidental take statements issued for the NFs LRMPs, some of these other Federal agency actions were certain to impact known, occupied habitat for Indiana bats. To minimize the effect of these projects, the Federal action agencies agreed to implement various conservation measures and to implement the reasonable and prudent measures (if any) contained in the respective biological opinions for those projects. Some of the measures implemented in these proposed actions included: (a) seasonal clearing restrictions to avoid disturbing female Indiana bats and pups; (b) protection of all known primary and alternate roost trees with appropriate buffers; (c) retention of adequate suitable roosting and foraging habitat to sustain the maternity colonies into the future; and (d) permanent protection of areas and habitat enhancement or creation measures to provide future roosting and foraging habitat opportunities.

The extent of exempted take since 2000 for non-U.S. Forest Service projects (including other Federal agencies and Habitat Conservation Plans (HCPs)) is estimated at 154,636 acres of suitable habitat as a surrogate measure of the take. One of the largest non-USFS incidental take exemptions included in this analysis is the Service Kentucky Field Office's (KFOs) 2008 Indiana bat Conservation Memoranda of Agreement biological opinion, which exempted the taking associated with up to 40,000 acres of habitat over 5 years (8,000 acres/ per year over 5 years). Fewer than 1,300 acres of the 24,000 acres exempted were actually used. Before the 2008 opinion expired, the KFO revised the CMOU program and issued a biological opinion in 2011 that reduced the incidental take exempted to 12,500 acres over 5 years. Of these acres, less than 3,000 acres have been used to date.

The largest non-U.S. Forest Service take authorization was issued to NiSource as part of its 50-year habitat conservation plan (HCP), which allows up to 69,900 acres of habitat loss over a 50-year period. The take statement associated with this HCP was issued in 2013.

With the exception of three consultations (Fort Knox, Great Smoky Mountains National Park, and Laxare East and Black Contour Coal Mining projects), none of the biological opinions and associated incidental take statements issued for non-Forest Plan activities anticipated the loss of a maternity colony. The Fort Knox biological opinion (1999) exempted take of two potential maternity colonies and individual Indiana bats, without specifying the form of the take (harm and/or harassment).

Surveys in 2004 and 2006 in the immediate area where the take was anticipated showed that at least one maternity colony (and possibly two) was present (Hawkins, et. al 2008). We have no data that tracks the take of maternity colonies for the Great Smoky Mountains National Park biological opinion, but additional monitoring of the maternity colony following the completion of the 2004 BO for the Laxare East and Black Castle Contour projects documented a colony much larger than previously anticipated. Additional project modifications subsequent to that discovery resulted in the retention of all known roost trees and protection of some potential foraging areas. That consultation was reinitiated in 2006, concluding that, while the colony would experience adverse effects, it should be able to persist through the life of the project.

Required monitoring for three additional 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 (tendency to return to a home area) nature of Indiana bats and the long lifespan of the species, the full extent of the anticipated impacts may not yet have occurred. Further, the fitness of these colonies has not been evaluated. These monitoring results indicate, however, that the conservation measures to avoid and minimize the impacts of Federal projects are apparently effective at preventing the loss of maternity colonies.

In summary, we believe the impacts to the species of the take exempted to date via section 7 consultations are limited to the scale of each action area. As many of these consultations necessarily made conservative assumptions about Indiana bat presence, we believe that the number of Indiana bats actually exposed to the effects of the Federal actions has been less than anticipated. Range-wide population trends (USFWS 2014) for the species show population increases between 2001 and 2007, prior to the arrival of WNS, suggesting that the net effect of the exempted take did not impact the species as a whole. Population declines between 2007 and 2013 are most likely due to WNS. Furthermore, pre- and post-project implementation monitoring of several maternity colonies preliminarily suggests that proposed conservation measures together with reasonable and prudent measures of take statements appear to be effective in avoiding and minimizing adverse effects.

2.2 Environmental Baseline

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Indiana bat, its habitat, and ecosystems within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

2.2.1 Status of the Species within the Action Area

The Action Area's surface land coverage is approximately 66,258 square miles, which represents about 11 percent of the total range of the Indiana bat. The occupied range of the species (i.e., the collective home ranges of all individuals) within both the total range and the Action Area is unknown, but is likely considerably smaller than the total range and Action Area, respectively, due to the presence of unsuitable habitats and unoccupied suitable habitats within both. According to our records, the Indiana bat is known from many locations within the Action Area, which we summarize herein.

The Action Area lies near the southern edge of the species' range, and numerous records of the species occupying summer and winter habitat exist. Occurrences of the species are clearly tied to the availability of the suitable summer and winter habitat. Absent anthropogenic or natural alterations, potential winter habitat is static on the landscape, because the caves and other underground features the species uses for hibernation occupy fixed and relatively persistent locations. However, the species will move from one winter habitat area to another to take advantage of better conditions in hibernacula, to take advantage of new hibernacula (e.g., mines), or to abandon hibernacula that humans or other factors have altered or disturbed.

Within the Action Area, there are 83 known Indiana bat hibernacula. One of these, White Oak Blowhole Cave, is a Priority 1 hibernaculum (defined as harboring current or historic winter populations greater than 10,000 individuals and not identified as an ecological trap) (USFWS, unpublished data 2014), and it is designated as critical habitat (USFWS 2007). White Oak Blowhole Cave had an estimated population of 1,117 Indiana bats in 2015, which represents approximately 0.2 percent of the range-wide estimated population (523,636) and 13.6 percent of the Indiana bats known to hibernate within the Action Area (8,236) (USFWS, unpublished data). Due to the effects of white-nose syndrome, the hibernating Indiana bat population of White Oak Blowhole Cave dropped in 2015 and was surpassed by the populations of three P2 hibernacula within the Action Area - Wind Cave in Kentucky (2,878 individuals), Bull Cave (1,246 individuals), and Wolf River Cave (1,351 individuals).

Many Indiana bat hibernacula in the Action Area occur in areas of public or private conservation ownership. Of particular note are the Great Smoky Mountains National Park in the eastern part of the state, Fall Creek Falls State Park in the eastern part of middle Tennessee, and the Bridgestone-Firestone state Wildlife Management Area, also in the eastern part of the mid-state area. Several hibernacula lie along the western escarpment of the Cumberland Plateau in the north portion of the state. Ownership and management of these is divided between state organizations, private conservation organizations, and private individuals.

Summer records for the species occur at individual sites and in clusters across the action area. Approximately 20 maternity areas have been documented along with some locations used by solitary males and non-reproductive females. Like the hibernacula, these known maternity colonies are scattered throughout the state with recent, notable areas near White Oak Blowhole Cave (a P1 hibernaculum in east Tennessee), in Wilson County of middle Tennessee, and in McNairy and Benton Counties in the western central portion of the state.

The BA provided a discussion of available forested land cover surrounding 22 known maternity roosts in Kentucky (Service's Kentucky Field Office, unpublished data), with forest cover ranging from 7.10 to 92.8 percent forest within a 2.5-mile radius of the record. Although such a comprehensive analysis has not occurred in Tennessee, similar habitat conditions are considered to exist at maternity sites. In general, the habitat availability at known maternity sites appears to reflect the overall distribution of forest cover for the state. Based on the wide distribution and availability of summer habitat across the Action Area, Indiana bats can be expected to occur at any location where its habitat needs can be met. Occupancy rates documented for the Indiana bat during summer presence / probable absence surveys in Kentucky have averaged 1.4 percent for post-WNS survey sites in potential maternity habitat. Based on similar habitat conditions and geographic proximity, this occupancy rate is considered appropriate for Tennessee. Given this occupancy rate and the continuing discovery of new maternity colonies, Service biologists believe more maternity colonies

exist within the Action Area than are currently documented.

2.2.2 Factors Affecting Species Environment within the Action Area

It is difficult to identify specific factors affecting the Indiana bat's environment within the Action Area, because the Action Area has been defined as the state of Tennessee and all portions of adjoining states that occur within 20 miles of the Tennessee border. This BO is based on analysis at a programmatic level rather than at an individual project scale. However, we are able to determine that there are a number of current and long-term land uses and demographic trends which could affect Indiana bats within the Action Area.

Forest Loss and Fragmentation

Unlike most winter sites, summer habitat for Indiana bats is typically not static. It changes over time in its location, quality and quantity and is influenced by changes in land use, management, and forest structure. These changes are natural or driven by human influence. Based on the similarities between Tennessee and the Action Area that were previously discussed in the "Action Area" section of this BO and the BA, the Service considers the following discussion of forest loss and fragmentation in Tennessee as representative of trends across the Action Area.

Forest loss is the conversion of forestland to another land use. Urban development and conversion to agricultural uses have been the most recent sources of forest loss in Tennessee (Oswalt et al 2009). However, as some land use is converted from forest, other land is becoming forested. This is evidenced by the relative stability of Tennessee's forested land use over the last 50 years, which has remained near 50 percent statewide (Oswalt 2012), although local trends vary. Forest fragmentation is the conversion of larger forest tracts into smaller tracts. A 2012 study concluded that only 45 percent of eastern U.S. forestland was considered intact within 4.4-hectare blocks, and variation ranged from 13 to 78 percent (Riiters et al. 2012).

Forest loss and fragmentation affect the location, quality, and quantity of available summer habitat for Indiana bats, particularly at the local level. Forest loss reduces local habitat availability and fragmentation reduces habitat quality. Although the acreage of forest loss and forest gain are relatively balanced in Tennessee during recent decades at a total forest cover of about 50 percent, new forest requires decades before it becomes suitable roosting habitat. Protecting important summer habitat will likely become a critical aspect of the species' recovery following the population declines due to WNS (Johnson et al. 2012).

White-nose Syndrome

A general overview of white-nose syndrome (WNS) and its effects on bat populations was previously provided in the section on the Status of the Species. This section will focus on its effects within the Action Area.

Tennessee has an aggressive WNS surveillance and monitoring program which began in 2009 with compilation of pre-WNS data in anticipation of its arrival. White-nose syndrome was first documented in Tennessee in 2010, when it was confirmed at two caves and suspected in four others (Lamb and Wyckoff 2010, Flock 2013). One cave was confirmed for WNS in Tennessee during 2011; and nine were confirmed in 2012, with two of those being updated to a status of confirmed in 2012 (Flock 2013). In 2013, a total of 29 caves were confirmed and one suspect, with significant mortality due to WNS first documented in Tennessee in 2013 (Flock 2013). In 2013, the number of

counties in the state in which WNS was confirmed was 31; and 46 cumulative counties were confirmed for the disease by the end of winter 2014 (Flock 2014).

Indiana bats exhibited declines in population densities during winter of 2015 at eight of the 12 hibernacula for which long-term trend data is available. Population increases at two sites and stable trends at two other sites were documented in 2015 (TWRA 2015, unpublished data). The Indiana bat census reflected a 68.2 percent population decrease for Tennessee from 2013 (15,569 bats) to 2015 (4,952 bats) (USFWS 2015a). This decrease can be attributed primarily to the population decrease documented at White Oak Blowhole Cave, which was historically Tennessee's strongest Indiana bat hibernating population. The species recent censuses for Indiana bats at that cave were 9,076 in 2013, 1,753 in 2014, and 1,117 in 2015 (TWRA 2015, unpublished data). Although Tennessee's portion of the Appalachian Indiana Bat Recovery Unit population decreased by 81.8 percent from 2013 to 2015, the Tennessee portion of the Midwest Recovery Unit increased in size during that time frame from 2,369 to 2,551 individuals (USFWS 2015).

Although the population and trend data following the arrival of WNS at Tennessee hibernacula is difficult to interpret at this time, it is not demonstrating the near or total loss of Indiana bat populations exhibited in the northeastern United States. Tennessee's Indiana bat winter and summer population densities are currently considered to be in transition as the species responds to WNS.

Other Factors

Numerous land use activities that could impact Indiana bats and that likely occur within the Action Area include: timber harvest, all-terrain vehicle (ATV) recreational use, recreational use of caves, underground and surface coal and limestone mining, gas production, wind power, and development associated with road, residential, industrial and agricultural activities. These private actions occur within the Action Area, but we are unaware of any quantifiable information relating to the extent of private timber harvests within the Action Area, the amount of use of off-highway vehicles within the Action Area, or the amount of recreational use of caves within the Action Area. Similarly, the Service does not have any information on the amount or types of residential, industrial, or agricultural development that have or will occur within the Action Area. Therefore, the Service is unable to make any determinations or conduct any meaningful analysis of how these actions may or may not adversely and/or beneficially affect Indiana bats. It is possible that these activities, when they occur, may have direct, indirect, and/or cumulative effects on Indiana bats and their habitats in certain situations. For example, a private timber harvest during summer months within an unknown maternity colony may cause adverse effects to that maternity colony. In stating this, however, we can only speculate as to the extent or severity of those effects, if any.

2.3 Effects of the Action

This section addresses the direct and indirect effects of the Action on the Indiana bat, including the effects of inter-related and inter-dependent activities. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the proposed action but are later in time and reasonably certain to occur.

2.3.1 Factors Considered

Our analysis considered the following factors:

- Proximity of the action – We describe known species locations and designated critical habitat in the Action Area.
- Distribution – We describe where the Action will occur and the likely impacts of the activities.
- Timing – We describe the likely effects in relation to sensitive periods of the species' lifecycle.
- Nature of the effects – We describe how the effects of the Action may be manifested in elements of a species' lifecycle, population size or variability, or distribution, and how individual animals may be affected.
- Duration – We describe whether the effects are short-term, long-term, or permanent.
- Disturbance frequency – We describe how the Action will be implemented in terms of the number of events per unit of time.
- Disturbance intensity – We describe the effect of the disturbance on a population or species.
- Disturbance severity – We describe how long we expect the adverse effects to persist and how long it would it take a population to recover.

Proximity of the action

The Action Area lies near the southern edge of the Indiana bat's range. Numerous records exist documenting that this species occupies summer and winter habitats within the Action Area. Winter habitat is generally limited to the karst regions where suitable caves can be used for hibernation, but summer habitat is widely distributed throughout the Action Area where suitable forested habitat exists. For the Indiana bat, one designated critical habitat site is located in the Action Area – White Oak Blowhole Cave in Blount County, Tennessee. No summer habitat has been designated as critical habitat for the species.

Distribution

The effects of the Action will vary depending on the location of the cooperator's project-specific impacts and the selected avoidance, minimization and compensation (mitigation) measures. Impacts associated with the implemented mitigation will typically occur in areas where Indiana bats are known or are expected to occur while those impacts associated with project-specific impacts will typically occur within the project footprint. However, it is certain that the Action, project-specific impacts, and mitigation measures approved under the Action will occur within the Action Area, and primarily within the boundaries of Tennessee. Incidental take exempted under the original and first revision of this biological opinion were widely distributed across Tennessee with occasional clusters of impacts near areas of new development where Indiana bats are known to be present. The first iteration of the Conservation Strategy only addressed impacts to Indiana bats, as the northern long-eared bat was not yet proposed for listing.

The positive effects associated with the selected mitigation measures will typically occur at a priority site within the Recovery and Mitigation Focus Area (RMFA) in which impacts occurred. As described in the Strategy, priority sites within the RMFAs were recognized based on a variety of factors (e.g., known presence of Indiana bat populations and/or existing conservation ownership) that suggest these areas have the highest likelihood of supporting Indiana bat summer and/or winter populations in the long-term. The convergence of the mitigation efforts from one or more projects into the priority sites will maximize the recovery-focused conservation benefits for Indiana bats in Tennessee and the Action Area.

Timing

Adverse effects related to the timing of the Action are indeterminable, because the projects which trigger implementation of the Strategy are driven by unpredictable external factors (e.g., market forces). However, we expect some impacts will occur during the sensitive maternity (mid-March through mid-August, see Status of the Species section) and fall swarming (late-August through mid-November) periods. Projects occurring during these periods are expected to result in harm and harassment of adults and pups due to the removal of roost trees, degradation of habitat, alteration of travel and foraging areas, and other indeterminable habitat-related effects. During the non-volant period (June 1 through July 31) for Indiana bat pups, habitat removal in known and potential maternity areas will require project-specific review and may require additional mitigation measures so that mortality of pups is minimized or avoided.

During the spring staging period (generally mid- or late-March to mid-April), Indiana bats are still concentrated around hibernacula. The bats have just emerged from hibernation with depleted fat reserves and are preparing to migrate to their summer roosting areas. The Action limits impacts to northern long-eared bats by recognizing a 0.5-mile buffer around known hibernacula. Staging is not expected to occur beyond this buffer, and projects proposing habitat alteration within this buffer will require project-specific review to determine the appropriateness of the mitigation measures.

Bats are most sensitive to disturbance during hibernation (generally mid-November through March). The Action excludes from CMOUs projects that would cause adverse effects to hibernating Indiana bats or their hibernacula; however, the removal of potential and known forested active-season habitat may occur during the hibernation period. Because Indiana bats frequently return from hibernation to forested habitats and specific roost trees used the previous year, the winter removal/alteration of active-season habitat likely has an indirect adverse effect on Indiana bats. The Service does not expect the alteration of normal behavior patterns associated with a return to altered habitats in the Action Area to result in the injury or mortality of Indiana bats. However, these impacts may degrade their habitats through the loss of roost trees, the alteration of travel and foraging areas, and other indeterminable habitat-related effects. The additional energetic cost to Indiana bats returning to altered habitat is unknown, but may be significant, particularly for pregnant females and bats returning from WNS-infected hibernacula. We recognize that the disruption of normal behaviors associated with the removal of active-season habitats while bats are hibernating could result in harm (actually kill or injure bats through reduced reproduction or fitness), but based on best available information at this time, is not reasonably certain to occur.

Nature of the Effect

Habitat alteration and mitigation measures associated with the Action will have a variety of effects on individual Indiana bats, maternity colonies, and swarming populations, including:

a) eliminate known and potential foraging and roosting habitat through removal and/or conversion of that habitat (e.g., removal of maternity roost trees, summer and swarming roost trees, and foraging habitat);
b) alter habitat (e.g., fragmentation of foraging and roosting habitats, modification of travel corridors);
c) result in alteration and/or modification of normal behaviors (e.g., reproduction effects, foraging effects, and sheltering behaviors);
d) potentially cause the mortality and/or injury of individual bats;
e) protection of previously unprotected winter habitat;
f) protection and/or management of summer and swarming habitats; and

g) funding of priority research and monitoring needs for Indiana bats.

Critical habitat for the Indiana bat is excluded from the Action.

Duration
The majority of the beneficial effects of the Action will be permanent, as will most of the adverse effects associated with each project-specific CMOU. We expect protected lands will be protected and managed in perpetuity, and we expect that most impacts will also result in the permanent loss of forested northern long-eared bat habitat. Some project-specific actions will only temporarily affect forested bat habitat, such as forest management projects, where forest stands are managed, thinned or allowed to regenerate over time and may have both adverse and beneficial effects to Indiana bats.

Disturbance Frequency
The frequency with which project-specific occur is indeterminable; however, the spatial extent of adverse effects is limited to 100 acres per project and to 2,000 acres per year per species. Based on these limits, the Action could involve as few as 20 projects annually, but a larger number of smaller projects. The TFO has historically reviewed fewer than 100 projects per year, and the majority are small (typically less than 10 acres). As of August 20, 2015, the TFO had entered into 46 project-specific CMOUs authorizing up to 257.80 acres of forest habitat-related incidental take that occurred over a period slightly over three and one-half years. The vast majority of projects covered under CMOUs resulted in less than ten acres of forest removal. Of the 46 project-specific CMOUs developed during this timeframe, only four projects affected 10 acres or more, and the mean impact size was 5.6 acres. The number of project-specific CMOUs completed during the calendar years of 2012 to 2014 were five in 2012, seven in 2013, and 15 in 2014. Seventeen CMOUs were completed in 2015 as of August 2015.

Disturbance Intensity
The Action will result in some incidental take of Indiana bats, mostly in the form of harassment. We believe that under most circumstances harassed bats will relocate to similar habitats within or near the Action Area. The Action (up to 10,000 acres) will affect less than 0.05 percent of the habitat available within the Action Area (22,050,662 acres) over its 5-year duration and less than 0.01 percent of available forested habitat in a given year (0.05 percent ÷ 5 years = 0.01 percent per year).

Disturbance Severity
CMOUs apply only to projects that affect less than 100 acres of forested habitat in order to limit the severity of disturbance to northern long-eared bats. Projects that may affect hibernacula are excluded. Projects that affect more than 100 acres of forested habitat, occur in known maternity areas during the period when pups are non-volant (June 1 through July 31), or occur in sensitive area such as the 0.5- mile radius surrounding all northern long-eared bat hibernacula, require project- specific evaluations. For those projects that are accepted for inclusion in the Action, but which also require project-specific reviews, additional mitigation measures may be required in the CMOU. Additional mitigation measures may include, but are not limited to: increased habitat replacement ratios, identifying potential roost trees for impact avoidance, alternative approaches or equipment to remove habitat, etc., as informed by site-specific information.

In most cases, it is unlikely that a project will result in the immediate death of an individual bat. Most adverse effects are reduced fitness of bats due to increases in energy expenditure (behavioral modification) in response to the loss of roost trees, foraging areas, and/or travel corridors. Based on

the wide availability of suitable habitat within the Action Area, we anticipate that affected volant bats will relocate to alternate roost trees and foraging areas. By restricting projects to 100 acres or less, it is unlikely that the Action would cause the loss of an entire home range, but could cause the removal of all or most trees used for roosting. The worst-case scenario is felling a primary maternity roost tree when the pups are not volant. Belwood (2002) anecdotally describes the effects of such a worst-case scenario for Indiana bats as summarized below.

On July 8, 1996, in a residential suburb of Cincinnati, Ohio, private landowners felled a dead maple tree that was at risk of falling on their house. After felling the tree, the landowners noticed 34 Indiana bats that had scattered across the yard, including one dead lactating female and 33 non-volant pups (16 males and 17 females), three of which were dead. The surviving pups were placed in either a man-made bat house near the fallen tree or under loose bark on the downed maple. The placement of pups was completed at dark and almost immediately adult bats, presumably Indiana bats, began circling over the downed tree and bat house. The site was revisited the following morning and two dead juveniles were found in the bat house. A thorough examination of the bat house, the felled maple tree (all loose bark was removed) and the surrounding yard revealed no other carcasses, suggesting that the adult females returned for the non-volant pups. Reproductive females were caught in the vicinity a few weeks later, suggesting also that the colony relocated nearby after this event (Belwood 2002).

Although this description is anecdotal, Belwood (2002) provides some important information for evaluating the effects of a worst-case scenario:

a) the majority of the Indiana bats (60 out of presumably 66) survived the felling of a primary maternity roost during a period of non-volancy for the pups;
b) the adults and pups responded differently; the adults flew out and the pups scattered on the ground after the felling, which allowed the adults to retrieve and relocate the non-volant pups; and
c) the colony appeared to persist in the area, with the presumed discovery of the same colony in a new roost tree only 20 meters from the original roost tree just 5 weeks after the initial discovery.

Based on this information, the recovery rate for the affected maternity colony would have been relatively short for this incident that occurred prior to the introduction of white-nose syndrome, perhaps two to three maternity seasons and was unlikely to have a measurable effect on the population as a whole. This is important as such a catastrophe is considered to be potentially the most severe disturbance that may occur as a result of the Action; however, its likelihood is very low since tree clearing is restricted during the typical non-volant period of June 1 through July 31.

2.3.2 Analysis for Effects of the Action

Federal and non-federal entities who enter CMOUs with the TFO agree to implement the mitigation measures described in the Strategy. These measures are part of the effects that CMOU projects have on Indiana bats and their habitats. Projects implemented under CMOUs may adversely affect Indiana bats by removing or altering their roosting habitat. In addition to roosting habitat loss, projects may cause a decrease in the quality of habitat remaining within the Action Area, including increased habitat fragmentation, loss of foraging areas, loss of travel corridors, increased disturbance, and other forms of habitat degradation. The following sections describe the general effects of projects covered under CMOUs and are summarized from the BA; please refer to the BA for more information.

2.3.2.1 General Habitat Removal

Disturbances caused by activities covered under the CMOUs may cause bats to flush from their roost trees during daylight or otherwise modify their normal behavior. The noise and vibration generated during habitat removal will likely occur during daylight hours and at variable distances from occupied roost trees. The novelty and intensity of these perturbations will likely dictate the range of responses to them. For instance, bats roosting at some distance from the disturbance or habitat removal may initially be startled by unusual noises in the distance but may habituate to the noises if they are of low volume or if some distance is maintained between the roost and the disturbance. At closer distances and increasing noise or vibration levels, bats may be startled to the point of fleeing from their roosts, which could increase the risks of injury, mortality, predation, abandonment of non-volant pups, and other adverse effects. Non-volant pups that are abandoned permanently are unlikely to survive.

Alternatively, bats that roost within or close to habitat removal areas will likely be subjected to increased levels of disturbance frequency and intensity. As a result, Indiana bats displaced by these activities may be forced to use different roost trees. These roost trees may be less suitable (e.g., more easily accessed by predators) than the roosts from which they were displaced. Habitat conditions surrounding the disturbance area will likely determine the quality of any alternative roosts that are used.

We also anticipate that Indiana bats may change roosting areas by temporarily or permanently abandoning their current roosts and seeking roosts that are further away from the active disturbance area. This has been supported by a few accounts in the literature. For example, Callahan (1993) noted that the likely cause of the Indiana bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree, and female bats in Illinois used roosts at least 1,640 feet (500 meters) from paved roadways (Garner and Gardener 1992). However, there are also studies showing that some amount of shifting roost tree usage is a normal behavior for Indiana bats (Kurta et al. 2002; Kurta 2005; Barclay and Kurta 2007; Foster et al. 2007) and is not only a response to an active disturbance.

Some literature has reported that Indiana bats used roosts near areas undergoing significant disturbance. In one study near Interstate 70 and the Indianapolis Airport, a primary maternity roost was located 1,970 feet (0.6 kilometer) south of the interstate. This primary maternity roost was not abandoned despite constant noise from the interstate and airport runways. However, the roost's proximity to Interstate 70 may be related to a general lack of suitable roosting habitat in the vicinity and due to the fact that the noise levels from the airport were not novel to the bats (i.e., the bats had apparently habituated to the noise) (USFWS 2002). Therefore, we cannot definitively conclude that Indiana bats will shift or abandon their roosts as a result of adjacent disturbances, but interpret roost shifting associated with disturbance as an adverse effect.

The Indiana bat appears able to adapt to some level of habitat loss and/or modification change within its summer and swarming habitats. However, the impact of these losses and modification on the fitness of the Indiana bat is unknown. Any activity that requires additional expenditures of energy to find new foraging areas, roost sites, or travel corridors can be expected to reduce a bat's fitness to some extent.

In addition to habitat loss, project-specific impacts may result in a decrease in the quality of habitat

remaining within the Action Area. Factors that may lead to a loss in the quality of the remaining habitat include increased habitat fragmentation, loss of foraging areas and travel corridors, and the degradation of these habitats. Over time, it is expected that fragmentation of habitat in the Action Area will increase as impacts continue to occur.

2.3.2.2 Impacts to Summer Habitats

For the Indiana bat, maternity habitat is suitable summer habitat used by juveniles and reproductive (i.e., pregnant, lactating, or post-lactating) females. The Service's Kentucky Field Office (KFO) analyzed available forest habitat data for known Indiana bat maternity colonies in Kentucky and found that maternity colonies occur in areas with percent forest cover ranging from 8.8 percent to 94.6 percent. The range of percent forest cover adjacent to maternity colonies appears similar in Tennessee. We have no data for measuring the fitness of a given maternity colony relative to the amount of habitat available to each colony. Because new maternity colonies are occasionally discovered when new areas are surveyed, the TFO believes that there are more maternity colonies within the Action Area than are documented (known). Therefore, projects that modify or remove suitable Indiana bat maternity habitat (where probable absence has not been demonstrated) are considered to have the potential to affect maternity colonies.

Regardless of how the habitat is removed, Indiana bats in a maternity colony or roosting individually (i.e., non-reproductive females and males) could be stressed, injured or killed as a result of the tree or branch striking the ground or due to being dislodged from the roost tree (i.e., falling to the ground). Although volant bats are able to leave a tree prior to or during the direct impact, females are less likely to depart if they have flightless (i.e., non-volant) pups present (usually between June 1 and July 31). Flightless pups are not capable of leaving their roost tree and, therefore, may be harmed, harassed, and/or killed. Once the pups become volant, their likelihood of surviving the removal of the tree in which they are roosting increases.

Project-specific review is required for all projects within known or potential maternity habitat that would occur between June 1 and July 31, while the pups are non-volant. In most cases, CMOU projects will not result in the removal of suitable habitat during that timeframe, in order to minimize the negative impacts to maternity colonies. In limited situations, project-specific evaluations may determine that the proposed project is unlikely to cause injury or mortality, because suitable maternity roosts are identified and their removal avoided, or emergence counts show that the potential roosts trees are not occupied at that time.

While the loss of an occupied primary maternity roost would result in the greatest immediate impact, the loss of multiple roost trees could cause displaced individuals to expend increased levels of energy while seeking out replacement roost trees. However, given the available forested acreage within most maternity areas and the relatively small project sizes approved under this action, it is unlikely that any of the projects implemented under these CMOUs would result in the loss of all roosts for an entire maternity colony.

Increased energy expenditure during a sensitive period of a bat's reproductive cycle (e.g., pregnancy), could cause spontaneous abortion or other stress-related reproductive delays or losses in fecundity, particularly among individuals that are already stressed due to WNS or other factors. These stresses and delays in reproduction could also cause lower fat reserves and lead to lower winter survival rates (USFWS 2002). For example, females may give birth to pups with lower birth weights or pups may

have delayed development rates (i.e., late into the summer). This could, in turn, affect the overwinter survival of these young-of-the-year bats if they enter fall migration and winter hibernation periods with inadequate fat reserves.

Non-reproductive adults are less vulnerable to summer habitat impacts than reproductive females and juveniles, because they have lower energy requirements. However, the loss of summer habitat and increased energy expenditures associated with finding new roosting habitats, increased foraging distances, or disrupted travel corridors would reduce their fitness to some degree as well. By restricting the acreage removed under a CMOU to 100 acres or less, the Service believes that the effects of this forest loss on both maternity colonies and non-reproductive adults are reasonably minimized.

These stresses are anticipated, though to a lesser extent, even when the habitat is removed while bats are not present. Bats returning to summer home ranges are stressed from hibernation and migration. Time and energy spent finding replacement roosts add to the stress on these individuals

Limited survey effort for Indiana bats in Tennessee has identified only a small number of maternity colonies. Therefore, the Service finds it unlikely that all maternity colonies within the Action Area are known and assumes all suitable habitats have the potential to contain a maternity colony unless survey data indicates otherwise. The Service assumes that maternity colonies require an average of 397 acres of habitat per colony (Menzel et. al 2005), that colonies do not overlap, and that each maternity colony represents 120 Indiana bats (60 adult females + 60 pups) (USFWS 2007).

The KFO reviewed Indiana bat presence/probable absence survey data collected in Kentucky between 2011 and 2014 (after WNS was first documented there) and found that Indiana bats were detected at 1.4 percent (8 of 569 sites) of suitable mist-net sites. The TFO considers this detection probability applicable to Tennessee, based on proximity and similarity of habitat between the states. Applying this occupancy rate to 10,000 acres of potential maternity habitat within the Action Area over a 5-year period, we estimate that Indiana maternity colonies occur on only 140 acres. These 140 acres represent a fraction of the area that one maternity colony, comprised of 120 bats, would occupy:

- 10,000 acres suitable habitat = 10,000 acres potential maternity habitat;
- 10,000 acres potential maternity habitat × 0.014 occupancy rate = 140 acres;
- 140 acres ÷ 397 acres per maternity colony = 0.353 potential maternity colonies, which we round up to 1 colony; and
- 1 potential maternity colony X 120 bats per colony = 120 bats.

The Service anticipates that CMOU projects in potential summer habitat will affect up to 1 Indiana bat maternity colony or 120 bats over a 5-year period. A small, but indeterminable, portion of these 120 Indiana bats are expected to be injured or killed by the Action. Disruption of normal behavior as a result of physical disturbance and/or habitat modification or degradation will account for the vast majority of adverse effects.

2.3.2.3 Impacts to Fall Swarming/Spring Staging Habitats

Swarming is a sensitive period for Indiana bats. This is when mating occurs and bats are actively foraging to store sufficient fat reserves to survive winter hibernation. While all bats are volant during this period and, therefore, less vulnerable to injury or death during the felling of a tree, the removal of

suitable habitat during periods of occupation will certainly result in disturbance to roosting bats and additional energy expenditures seeking new roosting sites with less time for foraging, which could result in reduced weight gain. Lower weight gains during fall swarming could result in reduced survival and/or reproductive success.

During the spring staging period (mid- or late-March to mid-April), Indiana bats are concentrated around the hibernacula. The bats have just emerged from hibernation with depleted fat reserves and are preparing to migrate to their summer roosting areas. For female Indiana bats, this migration may span hundreds of miles. The Action requires project-specific review for proposals within 1 mile of Indiana bat P1 and P2 hibernacula and within 0.5 mile of P3 and P4 hibernacula. Staging is not expected to occur beyond these buffers.

Stress associated with the removal of swarming/staging habitat is compounded when associated with a WNS-infected hibernaculum. White-nose syndrome is wide-spread across the Action Area and currently uninfected sites are likely to become infected during the course of the proposed Action. Bats coming out of WNS-infected hibernacula likely have lower body-weights and damaged tissues compared with bats emerging from uninfected sites. These stresses are anticipated, though to a lesser extent, even when the habitat is removed while the bats are not present.

Based on the most recent (primarily 2014-2015) winter counts conducted at known Indiana bat hibernacula, approximately 8,236 Indiana bats hibernated within the Action Area. Project-specific forested habitat removal associated with CMOUs executed from 2011 through the third quarter of 2015 did not occur within known swarming buffers. However, the TFO addressed through formal consultation one project that affected swarming habitat during this same time frame, which we use to estimate how the proposed Action may affect such habitats. This project affected 32.5 acres of swarming habitat associated with one P3 and three P4 hibernacula, which represents 12.6 percent of the 257.8 acres of forested habitat removal associated with CMOU projects during the years 2011-2015 (see section 1.2.2).

Assuming a similar level (12.6 percent) of impacts to swarming habitat across the 10,000 acres of the proposed Action, and allowing for a slightly greater amount of habitat removal than the current impact rate (15 percent), the Action will result in anticipated impacts to an estimated 1,500 acres (10,000 acres X 0.15 = 1,500 acres) of Indiana bat swarming habitat for the over a 5-year period. Based on the TFO's inventory of known hibernacula and land cover data for the Action Area, this anticipated impact is partitioned proportionally among P1, P2, and P3/P4 hibernacula to reflect existing conditions throughout the Action Area, as follows:

- Forested areas within the 10-mile swarming buffers around P1 and P2 hibernacula represent 3.4 and 34.5 percent, respectively, of the total acreage of existing swarming habitat across the Action Area.
- Forested areas associated with 5-mile buffers around P3 and P4 hibernacula together represent 62.1 percent of the Action Area's total swarming habitat.

We use the most recent winter count data to estimate the density of Indiana bats using Action Area swarming habitats that are within 10 miles of P1 and P2 hibernacula, and within 5 miles of P3 and P4 hibernacula, assuming within these circles an even distribution of bats and 52 percent forest cover:

- 1,117 bats in P1 hibernacula ÷ 104,552 acres of associated swarming habitat = 0.01068 bats per acre;

- 5,950 bats in P2 hibernacula ÷ 2.0 million acres of associated swarming habitat = 0.00298 bats per acre; and
- 1,169 bats in P3 and P4 hibernacula ÷ 3.62 million acres of associated swarming habitat = 0.00032 bats per acre.

P3 and P4 swarming habitats are combined due to the large number of sites and relatively low number of bats for these hibernacula. We do not combine P1 and P2 swarming habitats because of the large difference in potential bat density, as documented during historic censuses.

"Total Acres Affected" in Table 1 below is calculated by multiplying the "Anticipated Percent of Impact" listed above to the 1,500 acres of Indiana bat swarming habitat that we anticipate projects covered under the proposed Action will affect. "Estimated Bat Density" listed above is then multiplied by the "Total Acres Affected" to arrive at the estimated number of "Bats Affected Over 5 Years," rounded up to the nearest whole number.

Table 1. Estimated number of Indiana bats affected by the Action within a maximum of 1,500 acres of known swarming habitats (10-mile radius around known Priority 1 and 2 hibernacula; 5-mile radius around known Priority 3 and 4 hibernacula).

Swarming Habitat	Anticipated Percent of Impact	Total Acres Affected	Estimated Bat Density (Bats/Acre)	Bats Affected Over 5 Years
Priority 1	3.4	51.0	0.01068	1
Priority 2	34.5	517.5	0.00298	2
Priority 3 & 4	62.1	931.5	0.00032	1
TOTAL	100.0	1,500.0	-------	4

Very little, if any, of the take associated with these four Indiana bats is expected to be due to injury or mortality resulting from the Action. Disruption of normal behavior as a result of physical disturbance and/or habitat modification or degradation will account for the majority of impacts.

2.3.2.4 Conservation Benefits

Based on the information provided in the BA, the Service finds that CMOUs will provide recovery-focused conservation benefits in addition to the minimization measures that are typically implemented through section 7 consultations. These conservation benefits will more than offset the negative impacts to the Indiana bat caused by the covered projects for the reasons discussed in the BA, which include, but are not limited to:

- Mitigation sites are generally larger than impact sites.
- Mitigation sites are strategically located to maximize benefits to the species.
- Impacts to known habitat are mitigated at a minimum of 1:1, and are most often mitigated at a ratio of 1:1 to 4:1 or higher.
- Projects providing compensatory mitigation through the CMOU process where presence of Indiana bats is presumed but the species is absent will not result in adverse effects to Indiana bats.

Cooperators in CMOUs may choose to purchase or protect known hibernacula, maternity, or

swarming areas, offer other acceptable mitigation, or make a contribution to the Tennessee IBCF. IBCF funds are held by the Kentucky Natural Lands Trust (KNLT), an independent non-profit land trust,; and use of these funds is a collaborative effort among KNLT, the TFO, and several federal, state, and private conservation organizations that are involved with bat and/or forest conservation in Tennessee. These collaborators identify potential projects and use funds from the Tennessee IBCF to achieve the following objectives: (a) winter habitat protection and management; (b) summer habitat protection, conservation, and restoration; and (c) priority forest-dwelling bat research and monitoring needs. These mitigation measures provide a recovery-focused conservation benefit for forest-dwelling bats by offsetting suitable habitat loss regardless of the timing of the impacts.

2.3.3 Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The description of the Action and covered activities, specifically states that activities beyond the scope of the effects analysis on the removal of forested habitat are not part of this Action and must be addressed under a separate process for ESA compliance. Further, the Action is a voluntary process available to projects that would occur without the Action, relying on other ESA compliance processes as applicable (section 7 consultations, section 10(a)(1)(B) permits). Based on this information and the Service's review of the BA, there are no foreseeable interrelated or interdependent actions associated with this project.

2.4 Cumulative Effects

In the context of a consultation, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under section 7 of the Act.

Land use activities that may affect Indiana bats and that are likely to occur within the Action Area include: timber harvest, ATV recreational use, recreational use of caves, and development associated with road, residential, industrial, and agricultural development and related activities. These private actions are likely to occur within the Action Area, but the Service is unaware of any quantifiable information about the extent of private timber harvests within the Action Area, the amount of use of off-highway vehicles within the Action Area, or the amount of recreational use of caves within the Action Area. Similarly, the Service does not have any information on the amount or types of residential, industrial, or agricultural development that have or will occur within the Action Area. Therefore, the Service is unable to make any determinations or conduct any meaningful analysis of how these actions may or may not adversely and/or beneficially affect the Indiana bat. It is possible that these activities may have cumulative effects on Indiana bats and their habitat in certain situations (e.g., a private timber harvest during summer months within an unknown maternity colony may cause adverse effects to that maternity colony). In stating this, however, we can only speculate as to the extent or severity of those effects, if any.

2.5 Conclusion

After reviewing the current status of the Indiana bat, the environmental baseline for the Action Area, the effects of the proposed Action, and cumulative effects, it is the RO's biological opinion that the

Action is not likely to jeopardize the continued existence of the Indiana bat. The Action does not affect designated critical habitat for the Indiana bat; therefore, it is not likely to destroy or adversely modify critical habitat.

The Indiana bat is declining throughout its range as a result of WNS. Although the beneficial effects of the Action are not expected to reverse this decline, we have determined that its combined beneficial and adverse effects will not appreciably reduce the species' reproduction, numbers, and distribution. We support this determination with the following rationale from our Analysis for the Effects of the Action (section 2.3.2):

- Impacts to the species reproduction and numbers are limited by the avoidance and minimization measures required under the Strategy (e.g., exclusion of hibernacula, restrictions on tree removal during the non-volant and spring staging periods, and within close proximity to hibernacula).
- Direct adverse effects that meet the definition of take are primarily in the form of harassment, i.e., fleeing disturbance associated habitat modification, causing additional energy expenditure and reduced fitness. To a lesser degree, we expect similar indirect effects (reduced fitness) resulting from habitat modification while bats are not present due to the additional energy expenditure associated with relocating to alternative habitats. In both cases, we anticipate that bats will recover within 1–2 years.
- Due to the relative abundance of forested habitats in the Action Area, impacts to maternity colonies and their reproductive success are likely short- term (2–3 years), and would only affect a small portion of the range-wide population.
- No reduction in the distribution of the species is expected, as impacts are dispersed across a large Action Area and limited at the project and programmatic scales.
- The conservation benefits provided by the Action are expected to promote the survival and recovery of the species through activities that include, but are not limited to:
  - protecting and managing known priority hibernacula;
  - protecting and managing existing forested habitat that support known maternity and swarming northern long-eared bat populations, particularly those that would expand existing conservation ownerships;
  - protecting and managing additional conservation lands that contain potential habitat for the species, particularly those that would expand existing conservation ownerships; and
  - funding priority research and monitoring activities that support the conservation and recovery of the species.

2.6 Incidental Take Statement

Section 9 of the ESA and Federal regulations under section 4(d) of the Act 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 mortality or injury of wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harassment is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by disturbing it to such an extent as to significantly disrupt normal behavioral patterns which 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 prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the TFO so that they become binding conditions of any grant, contract, or permit issued to an applicant, contractor, or permittee for the exemption in section 7(o)(2) to apply. The TFO has the continuing duty to regulate the activity covered by this Incidental Take Statement. If the TFO: (a) fails to assume and implement the terms and conditions; or (b) fails to require an applicant, contractor, or permittee to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the grant, contract, or permit document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the TFO must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement.

2.6.1 Amount or Extent of Take Anticipated

The level of incidental taking anticipated in this BO resulting from projects implemented under CMOUs between the TFO and the respective project proponent(s) is not more than 124 Indiana bats: 120 in summer habitats (see section 2.3.2.2); and 4 in spring/fall habitats (see section 2.3.2.3). This taking is expected in the form of harm and/or harassment. The mechanisms of this taking and the basis for our estimation of its extent are described in section 2.3 (Effects of the Action) of this BO. In summary, harm will occur when removing or altering roosting habitat directly kills or injures a bat, or impairs breeding, feeding or sheltering behavior to the extent that a bat does not survive or reproduce. Harassment will occur when removing or altering habitat and other project-related disturbances significantly disrupts breeding, feeding, or sheltering behavior creating the likelihood of injury (e.g., reduced fitness or reproductive success). Other than the rare circumstance of felling trees while individuals, especially non-volant pups, are roosting in those trees, most of the taking of Indiana bats is anticipated as sub-lethal harassment.

SPECIES	INDIVIDUALS	TAKE TYPE
Myotis sodalis	124	Harm and Harass; some small indeterminable portion will be harm, but most take will be due to harassment.

The Service anticipates the incidental taking of Indiana bats associated with CMOU projects will be difficult to detect for the following reasons:

- the individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to observe;
- the species forms small (i.e., 25 to 100 reproductive females) maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- finding dead or injured specimens during or following project implementation is unlikely; and
- most incidental take is in the form of non-lethal harassment and not directly observable.

Due to the difficulty of detecting take of Indiana bats caused by the proposed Action, the Service will monitor the extent of taking using the acreage of suitable habitat that CMOU projects remove or alter, which is up to 10,000 acres over a 5-year period, with no more than 2,000 acres occurring in any calendar year. This surrogate measure is appropriate because all anticipated taking will result from habitat removal/alteration and activities associated with that alteration, and because it sets a clear standard for determining when the extent of taking is exceeded.

2.6.2 Effect of the Take

In this BO, the RO has determined that the anticipated level of incidental take is not likely to jeopardize the continued existence of the Indiana bat.

2.6.3 Reasonable and Prudent Measures

The RO believes that the conservation measures included in the proposed Action (described in section 1.2.3 of this BO) are sufficient to minimize take of the Indiana bat. Therefore, the only reasonable and prudent measure that is necessary or appropriate at this time pertains to take monitoring as required under 50 CFR §402.14(i)(3):

> The TFO will ensure that the extent of incidental take, as measured by the surrogate acres of suitable forested Indiana bat habitat, caused by projects undertaken by Federal and non- federal entities who participate in voluntary CMOUs for those projects with the TFO does not exceed 2,000 acres annually and 10,000 acres cumulatively during the 5 years following the signature date of this BO.

2.6.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the TFO must comply with the following Terms and Conditions, which carry out the Reasonable and Prudent Measures described above. These Terms and Conditions are non-discretionary:

1. The TFO shall keep records of the levels of incidental take exempted under this BO that are applied to CMOUs. These records shall track the acres of habitat affected under each agreement and specify whether the affected habitat is known summer habitat, presumed summer habitat, or swarming habitat. The TFO shall periodically audit projects implemented by CMOU cooperators to verify compliance with the Conservation Strategy for Forest-dwelling Bats in the Tennessee and the CMOUs. The selection of projects for these audits is at the TFO's discretion, but shall occur at least once each year of the duration of this BO.

2. The TFO, its cooperators, and any of their contractors (CMOU parties) must take care when handling dead or injured Indiana bats or any other federally listed species that are found at CMOU project sites in order to preserve biological material in the best possible state and to protect the handler from exposure to diseases, such as rabies. CMOU parties are responsible for ensuring that evidence for determining the cause of death or injury is not unnecessarily disturbed. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this BO is exceeded and to ensure that the terms and conditions are appropriate and effective. Parties

finding a dead, injured, or sick specimen of any endangered or threatened species, must promptly notify the Service's Division of Law Enforcement at 1875 Century Blvd., Suite 380, Atlanta, Georgia 30345 (Telephone: 404/679-7057) and the TFO at 446 Neal Street, Cookeville, Tennessee 38501 (Telephone: 931/528-6481). The TFO is then responsible for notifying the RO Ecological Services program office at 1875 Century Boulevard, Suite 200, Atlanta, Georgia 30345 (Telephone 404/679-7085).

The Reasonable and Prudent Measures and implementing Terms and Conditions are designed to minimize the impact of incidental taking. The Service believes that no more than 124 Indiana bats will be incidentally taken, mostly by harassment, as a result of habitat alteration associated with the Action on no more than 10,000 acres of potential and known forest habitat within the Action Area over the next 5 years, and on no more than 2,000 acres during any calendar year. Exceeding this level of habitat alteration during the course of the action would represent new information requiring a re-initiation of consultation and review of the Reasonable and Prudent Measures provided (see Section 5, Reinitiation Notice).

3 Northern Long-Eared Bat

The following sections are summarized from the BA; please refer to the BA for more information.

3.1 Status of the Species/Critical Habitat

The Service published its decision to list the northern long-eared bat as a threatened species on April 2, 2015 (80 FR 17974-18033). The effective date of this final rule is May 4, 2015. Critical habitat has not been proposed for the northern long-eared bat.

3.1.1 Species Description

The northern long-eared bat (*Myotis septentrionalis*) is a medium-sized bat species, weighing an average 5 to 8 grams, with females tending to be slightly larger than males (Caceres and Pybus 1997). Pelage colors include medium to dark brown fur on its back; dark brown, but not black, ears and wing membranes; and tawny to pale-brown fur on the ventral side (Nagorsen and Brigham 1993, as cited in USFWS 2013; Whitaker and Mumford 2009). As indicated by its common name, the northern long-eared bat is distinguished from other Myotis species by its large ears, which average 17 millimeters (mm) (Whitaker and Mumford 2009) and, when laid forward, extend beyond the nose but less than 5 mm beyond the muzzle (Caceres and Barclay 2000). The tragus (ear cartilage) is long (averaging 99 mm), pointed, and often curved (Nagorsen and Brigham 1993, as cited in USFWS 2013; Whitaker and Mumford 2009).

3.1.2 Life History

Life Cycle

The northern long-eared bat is a migratory bat, hibernating in caves and mines in the winter (typically October through April) and migrating to summer habitat. While the northern long- eared bat is not considered a long distance migratory species, short migratory movements between summer roost and winter hibernacula covering between to 56 km (34.8 mi) and 88.5 km (55 mi) have been documented (Nagorsen and Brigham 1993, as cited in USFWS 2013; Griffith 1945). In general, northern long-

eared bats arrive at hibernacula in August or September, enter hibernation in October and November, and leave the hibernacula in March or April (Caire et al. 1979; Whitaker and Hamilton 1998; Amelon and Burhans 2006). The spring migration period likely runs from mid-March to mid-May, with females giving birth (parturition) in late May or early June (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009). However, parturition may occur as late as July (Whitaker and Mumford 2009). Fall migration likely occurs between mid-August and mid-October.

Longevity
Adult longevity is estimated at about 18.5 years (Hall et al. 1957). Most mortality for many bat species, including northern long-eared bats, occurs during the juvenile stage (Caceres and Pybus 1997).

Reproduction
Northern long-eared bats typically breed from late July in northern regions to early October in southern regions. Breeding commences when males begin to swarm at hibernacula and initiate copulation activity (Whitaker and Hamilton 1998; Whitaker and Mumford 2009; Caceres and Barclay 2000; Amelon and Burhans 2006). Copulation occasionally occurs again in the spring (Racey 1982). Hibernating females store sperm and delay fertilization until spring (Racey 1979; Caceres and Pybus 1997). Ovulation takes place at the time of emergence from hibernacula, followed by fertilization of a single egg, and resulting in a single embryo (Cope and Humphrey 1972; Caceres and Pybus 1997; Caceres and Barclay 2000). Gestation is approximately 60 days (Kurta 1995, as cited in USFWS 2013). Males are reproductively inactive until late July, with testes descending in most males during August and September (Caire et al. 1979; Amelon and Burhans 2006).

Maternity colonies consist of females and pups numbering from about 30 (Whitaker and Mumford 2009) to 60 individuals (Caceres and Barclay 2000). Garroway and Broders (2008) observed that lactating northern long-eared bats roost higher in taller trees situated in areas of relatively less canopy cover and tree density compared to other individuals. Parturition likely occurs in late May or early June (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009), but may occur as late as July (Whitaker and Mumford 2009).

3.1.3 Habitat Characteristics and Use

Winter
Northern long-eared bats will typically hibernate between mid-fall through mid-spring each year. Suitable winter habitat (hibernacula) for the northern long-eared bat includes underground caves and cave-like structures (e.g., railroad tunnels and abandoned or active mines, railroad tunnels). These hibernacula typically have large passages with significant cracks and crevices for roosting. Microclimate preferences for northern long-eared bats are similar to Indiana bats and include relatively constant, cool temperatures (0–9° Celsius), high humidity, and minimal air currents. Specific areas occupied during hibernation have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. Anecdotal reports not yet formally documented indicate that northern long-eared bats may occupy landscape features besides caves and mines during the winter (Mike Armstrong, pers. comm. 2014).

Summer

The northern long-eared bat typically occupies its summer habitat from mid-May through mid-August each year. During summer, northern long-eared bats roost singly or in colonies underneath bark or in cavities, crevices, or hollows of both live and dead trees and/or snags. Studies have found tree roost selection to differ slightly between male and female northern long-eared bats. Males more readily use smaller-diameter trees than females, suggesting that males are more flexible in their roost selection than females (Lacki and Schwierjohann 2001; Broders and Forbes 2004; Perry and Thill 2007). Males and non-reproductive females may also roost in sites, such as caves and mines.

Northern long-eared bats switch roosts often (Sasse and Pekins 1996), typically every 2–3 days (Foster and Kurta 1999; Owen et al. 2002; Carter and Feldhamer 2005; Timpone et al. 2010). Jackson (2004) tracked 30 northern long-eared bats over 2 years and found individuals used a mean of 8.6 different roosts (range 2–11), suggesting that the species probably needs multiple suitable roosts within relatively close proximity.

The home range for northern long-eared bats may vary by sex. Broders et al. (2006) found home ranges of females were larger than males. Northern long-eared bats are often found roosting in intact, cluttered, interior (Broders et al. 2006; Henderson et al. 2008) and older (Carter and Feldhamer 2005; Lacki and Schwierjohann 2001; Perry and Thill 2007) forests. Roost selection is likely adaptable and variable depending on forest characteristics (Ford et al. 2006). Northern long-eared bats readily exploited alterations to forest structure, likely due to enlargement of existing or creation of new canopy gaps (Johnson et al. 2009).

Foraging Behavior

The northern long-eared bat has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Nagorsen and Brigham 1993, as cited in USFWS 2013; Brack and Whitaker 2001; Griffith and Gates 1985), with diet composition differing geographically and seasonally (Brack and Whitaker 2001). Foraging techniques include hawking and gleaning, in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, as cited in USFWS 2013; Ratcliffe and Dawson 2003). Northern long-eared bats' feeding activities seem to center on upland mature forests (Caceres and Pybus 1997), with occasional foraging over forest clearings, water, and along roads (van Zyll de Jong 1985). However, most foraging occurs on forested hillsides and ridges, rather than along riparian areas (Brack and Whitaker 2001; LaVal et al. 1977). This coincides with data indicating that mature forests are an important habitat type for foraging northern long-eared bats (Caceres and Pybus 1997). Like most bats, the northern long-eared bat forages primarily at night and during twilight hours.

3.1.4 Status and Distribution

The northern long-eared bat is found in the United States from Maine to North Carolina on the Atlantic Coast, westward to eastern Oklahoma and north through the Dakotas, even reaching into eastern Montana and Wyoming. In Canada, it is found from the Atlantic Coast westward to the southern Yukon Territory and eastern British Columbia. Historically, the species has been found in greater abundance in the northeast and portions of the Midwest and Southeast, and has been more rarely encountered along the western edge of the range.

Current Distribution and Abundance

The northern long-eared bat ranges across much of the eastern and north central United States (U.S.),

and all Canadian provinces west to the southern Northwest Territories and eastern British Columbia (Nagorsen and Brigham 1993, as cited in USFWS 2013; Caceres and Pybus 1997). Historically, the species has been most frequently observed in the northeastern U.S. and in the Canadian Provinces of Quebec and Ontario, with sightings increasing during swarming and hibernation (Caceres and Barclay 2000). However, throughout the majority of the species' range, its distribution is patchy, and historically was less common in the western portions of the range (Amelon and Burhans 2006).

Although they are typically found in low numbers in inconspicuous roosts, most records of northern long-eared bats are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species range in the United States, although many hibernacula contain only a few (one to three) individuals (Whitaker and Hamilton 1998). They are typically found roosting in small crevices or cracks on the walls and ceilings of caves or mines, making detection difficult, and are usually observed in small numbers (Griffin 1940; Caire et al. 1979; Van Zyll de Jong 1985; Caceres and Pybus 1997).

3.1.5 Threats -- White-nose Syndrome

White-nose syndrome (WNS) is currently considered the predominant threat to the species. For general information on WNS, please see section 2.1.5 of this BO or visit https://www.whitenosesyndrome.org/. This section focuses on the threat of WNS to the northern long-eared bat.

Hibernacula surveys show that the northern long-eared bat has experienced a sharp decline in the northeastern part of its range due to WNS. Researchers consider the northeastern U.S. very close to saturation for the disease, with the northern long-eared bat as one of the species most severely affected by the disease (Herzog and Reynolds 2012). Turner et al. (2011) compared the most recent pre-WNS census to the most recent post-WNS census for six cave bat species, including the northern long-eared bat. Turner et al. (2011) reported a 98 percent decline between pre- and post-WNS in the number of hibernating northern long-eared bats at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia. Data analyzed in this study were limited to sites with confirmed WNS mortality for at least 2 years and sites with comparable survey effort across pre- and post-WNS years. Langwig et al. (2012) evaluated hibernacula survey data from New York, Vermont, Connecticut, and Massachusetts, and reported larger declines in hibernacula with larger pre-WNS populations of northern long-eared bats, suggesting a density-dependent decline due to WNS. Although some species' populations stabilized at drastically reduced levels compared to pre-WNS (e.g., tri-colored bat and Indiana bat), each of the 14 populations of northern long-eared bats Langwig et al. (2012) evaluated became locally extinct within 2 years due to the disease, and were not yet re-established within 5 years post-WNS.

Because the species tends to roost in small cracks or crevices in cave ceilings, which makes the species more challenging to find during hibernacula surveys, hibernacula data in some states (particularly those with a greater number of caves with more cracks or crevices) may misrepresent the level of decline the species is experiencing (Turner et al. 2011). When dramatic declines due to WNS occur, the overall rate of decline appears to vary by site. Some sites experience the progression from the detection of a few bats with visible fungus to wide-spread mortality after a few weeks and at other sites after a year or more (Turner et al. 2011).

Long-term (i.e., including pre- and post-WNS) summer and swarming data for the northern long-

eared bat (e.g., maternity colony records and mist-net and fall swarm trapping, maternity colony records) is somewhat limited, because the species has only recently become one of conservation concern. However, the data that does exist corroborates the population decline observed in hibernacula surveys (Silvis et al 2015; Francl et al. 2012; Ford et al. 2011).

Although the northern long-eared bat is known to awaken from a state of torpor sporadically throughout the winter and move between hibernacula (Griffin 1940; Whitaker and Rissler 1992; Caceres and Barclay 2000), it has not been observed roosting regularly outside of caves or mines during the winter compared with other species that are less susceptible to WNS (e.g., big brown bat). Northern long-eared bats roost in areas within hibernacula that have higher humidity, possibly leading to higher rates of infection, as Langwig et al. (2012) found with Indiana bats. Also, northern long-eared bats prefer temperatures within hibernacula that range from 0–9°C (32–48°F) (Raesly and Gates 1987; Caceres and Pybus 1997; Brack 2007), which is within the optimal growth limits of *Pseudogymnoascus. destructans* (the fungus that causes WNS) (5–10°C) (41–50°F)) (Blehert et al. 2009). The northern long- eared bat may also spend more time in hibernacula than other species that are less susceptible to WNS (e.g., eastern small-footed bat), allowing more time for the fungus to infect and grow on bats. Northern long-eared bats typically enter hibernacula in October or November, and exit for spring migration in March or April (Caire et al. 1979; Whitaker and Hamilton 1998; Amelon and Burhans 2006). Furthermore, the northern long-eared bat occasionally roosts in clusters and often in the same hibernacula as other bat species that are also susceptible to WNS, which may increase their susceptibility to bat-to-bat transmission of WNS.

3.1.6 Previous Incidental Take Exemptions

Prior formal consultations and conferences involving the northern long-eared bat have involved a variety of action agencies and project types since December 2013. These include 20 projects that are summarized in Appendix B. In conducting many of these consultations, bat presence/absence survey information was unavailable, and the Service often relied on a variety of factors to assist the action agency in determining whether northern long-eared bats were present. Habitat was typically used as a surrogate measure of the level of anticipated take.

3.2 Environmental Baseline

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the northern long-eared bat, its habitat, and ecosystems within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the action under review.

3.2.1 Status of the Species within the Action Area

The final listing rule for the northern long-eared bat divides the U.S. portion of the species' range into four parts: eastern, midwest, southern, and western (80 FR 17976). Tennessee is considered part of the southern population of the species. Records for the northern long-eared bat occur statewide but are concentrated in the eastern part of the state where the greatest survey effort has occurred. Other than a few research projects, most northern long-eared bat summer capture records are from Indiana bat presence/absence surveys. Many of the known hibernacula are sites where winter surveys were conducted for other listed bat species such as the Indiana bat and, gray bat (*Myotis grisescens*), and Virginia big-eared bat (*Corynorhinus townsendii virginianus*).

Tennessee has 58 known northern long-eared bat hibernacula (80 FR 17976) and several potential hibernacula. There are 122 known hibernacula within the Action Area. Most of the hibernacula have winter counts of fewer than ten northern long-eared bats. This number is likely misleading though, since northern long-eared bats often roost singly, and often tucked up into small cracks and crevices, making accurate winter counts difficult (USFWS 2013). Consequently, reliable population numbers are not available for the northern long-eared bat within its range or within the Action Area. Further, the Service finds it likely that many more hibernacula exist across the Action Area than are currently known. Because hibernacula counts do not yield reliable population numbers for northern long-eared bats like they do for other bat species (e.g., Indiana bat), the Service is unable to estimate a population size for this species within the Action Area using hibernation data.

During the summer months, the northern long-eared bat has historically been considered relatively common within Tennessee. Northern long-eared bats were captured consistently in the state during pre-WNS summer netting surveys. According to TWRA (2014, unpublished data), over 1,000 individuals were captured during summer between 2002 and 2013. The species was caught during approximately 33 percent of the summer surveys conducted between 2000 and 2008 and in 31 percent of the surveys conducted between 2010 and 2012. Although survey data has not been compiled comprehensively since the appearance of WNS in Tennessee, anecdotal evidence suggests a decline in the species' summer presence. At Arnold Air Force Base in middle Tennessee, bat captures per net night of effort decreased from 2.00 in 2010 to 1.29 in 2011, 1.50 in 2012, 0.50 in 2013, 0.11 in 2014, and 0.03 in 2015 (Lamb 2015, unpublished data). During summer netting efforts at the Great Smoky Mountains National Park in eastern Tennessee, northern long-eared bat capture rates declined by 71 to 94 percent at all netting sites from 2009 to 2012 (NPS 2014, in litt.; Indiana State University 2015, in litt.).

Within Kentucky, more than 7,000 individual capture records for the northern long-eared bat represent approximately 1,500 unique locations (KFO, unpublished data). For summer captures (May 15 –through August 15), these data show a high degree of spatial overlap between summer maternity (juveniles and reproductive females) and non-maternity (adult male and non-reproductive adult females) records, i.e., where net sites include both maternity and non-maternity captures or where non-maternity captures are within known maternity areas. Of 1,825 non-maternity summer captures, 94 percent (or 1,712) were within a maternity area. The average distance between a non-maternity capture record and a maternity capture was 0.59 miles. For about 1,200 of these records, maternity and non-maternity captures occurred at the same location. While we do not know whether or how non-reproductive adults interact with maternity colonies, the strong correlation between maternity- and non-maternity capture records indicates concurrent usage of known habitat areas. Because of the proximity of Kentucky to Tennessee and similarity of habitat, the TFO considers that the observed overlap between reproductive females and other individuals applies to the Action Area as well.

3.2.2 Factors Affecting Species Environment within the Action Area

It is difficult to identify specific factors affecting the species environment within the Action Area, because the Action Area has been defined as the state of Tennessee and all portions of adjoining states within 20 miles of the Tennessee border. Further, this BO is based on analysis at a programmatic level rather than at an individual project scale. However, we are able to determine that there are a number of current and long-term land uses and demographic trends which could affect

northern long-eared bats within the Action Area.

Forest Loss and Fragmentation

Unlike most winter sites, summer habitat for northern long-eared bats is typically not static. It changes over time in its location, quality and quantity; and it is influenced by changes in land use, management, and forest structure. These changes are natural or driven by human influence. Based on the similarities between Tennessee and the Action Area that were previously discussed in the "Action Area" section of this BO and the BA, the Service considers the following discussion of forest loss and fragmentation in Tennessee as representative of trends across the Action Area.

Forest loss is the conversion of forestland to another land use. Urban development and conversion to agricultural uses have been the most recent sources of forest loss in Tennessee (Oswalt et al 2009). However, as some land use is converted from forest, other land is becoming forested. This is evidenced by the relative stability of Tennessee's forested land use over the last 50 years, which has remained near 50 percent statewide (Oswalt 2012), although local trends vary. Forest fragmentation is the conversion of larger forest tracts into smaller tracts. A 2012 study concluded that only 45 percent of eastern U.S. forestland was considered intact within 4.4-hectare blocks, and variation ranged from 13 to 78 percent (Riiters et al. 2012).

Forest loss and fragmentation affect the location, quality, and quantity of available summer habitat for northern long-eared bats, particularly at the local level. Forest loss reduces local habitat availability and fragmentation reduces habitat quality. Although the acreage of forest loss and forest gain are relatively balanced in Tennessee during recent decades at a total forest cover of about 50 percent, new forest requires decades before it becomes suitable roosting habitat. Protecting important summer habitat will likely become a critical aspect of the species' recovery following the population declines due to WNS (Johnson et al. 2012).

White-nose Syndrome

A general overview of white-nose syndrome (WNS) and its effects on bat populations was previously provided in the section on the Status of the Species. This section will focus on its effects within the Action Area.

Tennessee has an aggressive WNS surveillance and monitoring program which began in 2009 with compilation of pre-WNS data in anticipation of the disease's arrival. White-nose syndrome was first confirmed in Tennessee in 2010, when it was confirmed at two caves and suspected in four others (Lamb and Wyckoff 2010; Flock 2013). One cave was confirmed for WNS in Tennessee during 2011 and nine in 2012 (Flock 2013). In 2013, significant mortality due to WNS first documented in Tennessee, 29 caves were confirmed as WNS-positive, one cave was listed as WNS-suspect (Flock 2013). In 2013, the disease was evident in 31 counties in the state, and in 46 counties by the winter of 2014 (Flock 2014).

During Tennessee's bat hibernacula surveys in 2015, northern long-eared bats were found in only seven caves; and no more than three individuals were found at each site (USFWS, unpublished data). In 2014, the species was documented in 17 caves, with up to 35 individuals per hibernaculum. The population data following the arrival of WNS at Tennessee hibernacula is rather dynamic at this time, but is demonstrating an apparent rapid downward trend for the northern long-eared bat. The species' winter and summer population densities are currently in transition as the species responds to WNS.

Other Factors
Numerous land use activities that could impact northern long-eared bats and that likely occur within the Action Area include: timber harvest, ATV recreational use, recreational use of caves, underground and surface coal and limestone mining, gas production, and development associated with road, residential, industrial and agricultural development and related activities. These private actions occur within the Action Area, but the Service is unaware of any quantifiable information relating to these factors. Therefore, the Service is unable to make any determinations or conduct any meaningful analysis of how these actions may or may not adversely and/or beneficially affect northern long-eared bats. It is possible that these activities, when they occur, may have direct, indirect, and/or cumulative effects on northern long-eared bats and their habitats in certain situations (e.g., a private timber harvest during summer months within an unknown maternity colony may cause adverse effects to that maternity colony).

3.3 Effects of the Action

This section addresses the direct and indirect effects of the Action on the northern long-eared bat, including the effects of interrelated and interdependent activities. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the proposed action, but are later in time, and are reasonably certain to occur.

3.3.1 Factors Considered

Our analysis considered the following factors:

- Proximity of the action – We describe known species locations and designated critical habitat in the Action Area.
- Distribution – We describe where the Action will occur and the likely impacts of the activities.
- Timing – We describe the likely effects in relation to sensitive periods of the species' lifecycle.
- Nature of the effects – We describe how the effects of the Action may be manifested in elements of a species' lifecycle, population size or variability, or distribution, and how individual animals may be affected.
- Duration – We describe whether the effects are short-term, long-term, or permanent.
- Disturbance frequency – We describe how the Action will be implemented in terms of the number of events per unit of time.
- Disturbance intensity – We describe the effect of the disturbance on a population or species.
- Disturbance severity – We describe how long we expect the adverse effects to persist and how long it would it take a population to recover.

Proximity of the action
The Action Area lies near the southern edge of the range for the northern long-eared bat. Numerous records document that the species occupies both summer and winter habitats within the Action Area. Winter habitat is generally limited to the karst areas where suitable caves provide hibernacula, but summer habitat is widely distributed throughout the Action Area where suitable forested habitat exists. Critical habitat has not been proposed for the northern long-eared bat.

Distribution
The effects of the Action will vary depending on the location of the cooperator's project-specific impacts and the selected avoidance, minimization and compensation (mitigation) measure(s). Impacts associated with the implemented mitigation will typically occur in areas where northern long-eared bats are known or are expected to occur while those impacts associated with project-specific impacts will typically occur within the project footprint. However, it is certain that the Action, project-specific impacts, and mitigation measures approved under the Action will occur within the Action Area, and primarily within the boundaries of Tennessee. Incidental take exempted under the original and first revision of this Action were widely distributed across Tennessee with occasional clusters of impacts near areas of new development where Indiana bats were known to be present. The first two iterations of the Conservation Strategy only addressed impacts to Indiana bats, as the northern long-eared bat was not yet proposed for listing.

The positive effects associated with the selected mitigation measures will typically occur within a Recovery and Mitigation Focus Area (RMFA). As is described in the Strategy, priority sites within the RMFAs were chosen based on a variety of factors (e.g., known presence of northern long-eared bat populations and/or existing conservation ownership, among others) that suggest these areas have the highest likelihood of supporting northern long-eared bat summer and/or winter populations in the long-term. The convergence of the mitigation efforts from one or more projects into the RMFAs will maximize the recovery-focused conservation benefits for northern long-eared bats in Tennessee and the Action Area.

Timing
Adverse effects related to the timing of the Action are indeterminable, because the projects which trigger implementation of the Strategy are driven by unpredictable external factors (e.g., market forces). However, we expect some impacts will occur during the sensitive maternity (mid-March through mid-August, see Status of the Species section) and fall swarming (late-August through mid-November) periods. Projects occurring during these periods are expected to result in harm and harassment of adults and pups due to the removal of roost trees, degradation of habitat, alteration of travel and foraging areas, and other indeterminable habitat-related effects. During the non-volant period (June 1 through July 31) for northern long-eared bat pups, habitat removal in known and potential maternity areas will require project-specific review and may require additional mitigation measures so that mortality of pups is minimized or avoided.

During the spring staging period (generally mid- or late-March to mid-April), northern long-eared bats are still concentrated around hibernacula. The bats have just emerged from hibernation with depleted fat reserves and are preparing to migrate to their summer roosting areas. The Action limits impacts to northern long-eared bats by recognizing a 0.5-mile buffer around known hibernacula. Staging is not expected to occur beyond this buffer, and projects proposing habitat alteration within this buffer will require project-specific review to determine the appropriateness of the mitigation measures.

Bats are most sensitive to disturbance during hibernation (generally mid-November through March). The Action excludes from CMOUs projects that would cause adverse effects to hibernating northern long-eared bats or their hibernacula; however, the removal of potential and known forested active-season habitat may occur during the hibernation period. Because northern long-eared bats frequently return from hibernation to forested habitats and specific roost trees used the previous year, the winter removal/alteration of active-season habitat likely has an indirect adverse effect on northern long-

eared bats. The Service does not expect the alteration of normal behavior patterns associated with a return to altered habitats in the Action Area to result in the injury or mortality of northern long-eared bats. However, these impacts may degrade their habitats through the loss of roost trees, the alteration of travel and foraging areas, and other indeterminable habitat-related effects. The additional energetic cost to northern long-eared bats returning to altered habitat is unknown, but may be significant, particularly for pregnant females and bats returning from WNS-infected hibernacula. We recognize that the disruption of normal behaviors associated with the removal of active-season habitats while bats are hibernating could result in harm (actually kill or injure bats through reduced reproduction or fitness), but based on best available information at this time, is not reasonably certain to occur.

Nature of the Effect
Habitat alteration and mitigation measures associated with the Action will have a variety of effects on individual northern long-eared bats, maternity colonies, and swarming populations, including:

a) eliminate known and potential foraging and roosting habitat through removal and/or conversion of that habitat (e.g., removal of maternity roost trees, summer and swarming roost trees, and foraging habitat);
b) alter habitat (e.g., fragmentation of foraging and roosting habitats, modification of travel corridors);
c) result in alteration and/or modification of normal behaviors (e.g., reproduction effects, foraging effects, and sheltering behaviors);
d) potentially cause the mortality and/or injury of individual bats;
e) protection of previously unprotected winter habitat;
f) protection and/or management of summer and swarming habitats; and
g) funding of priority research and monitoring needs for northern long-eared bats.

Critical habitat has not been proposed for the northern long-eared bat.

Duration
The majority of the beneficial effects of the Action will be permanent, as will most of the adverse effects associated with each project-specific CMOU. We expect protected lands will be protected and managed in perpetuity, and we expect that most impacts will also result in the permanent loss of forested northern long-eared bat habitat. Some project-specific actions will only temporarily affect forested bat habitat, such as forest management projects, where forest stands are managed, thinned or allowed to regenerate over time and may have both adverse and beneficial effects to northern long-eared bats.

Disturbance Frequency
The frequency with which project-specific occur is indeterminable; however, the spatial extent of adverse effects is limited to 100 acres per project and to 2,000 acres per year per species. Based on these limits, the Action could involve as few as 20 projects annually, but a larger number of smaller projects. The TFO has historically reviewed fewer than 100 projects per year, and the majority are small (typically less than 10 acres).

Disturbance Intensity
The Action will result in some incidental take of northern long-eared bats, mostly in the form of harassment. We believe that under most circumstances harassed bats will relocate to similar habitats within or near the Action Area. The Action (up to 10,000 acres) will affect less than 0.05 percent of

the habitat available within the Action Area (22,050,662 acres) over its 5-year duration and less than 0.01 percent of available forested habitat in a given year (0.05 percent ÷ 5 years = 0.01 percent per year).

Disturbance Severity
CMOUs apply only to projects that affect less than 100 acres of forested habitat in order to limit the severity of disturbance to northern long-eared bats. Projects that may affect hibernacula are excluded. Projects that affect more than 100 acres of forested habitat, occur in known maternity areas during the period when pups are non-volant (June 1 through July 31), or occur in sensitive area such as the 0.5- mile radius surrounding all northern long-eared bat hibernacula, require project- specific evaluations. For those projects that are accepted for inclusion in the Action, but which also require project-specific reviews, additional mitigation measures may be required in the CMOU. Additional mitigation measures may include, but are not limited to: increased habitat replacement ratios, identifying potential roost trees for impact avoidance, alternative approaches or equipment to remove habitat, etc., as informed by site-specific information.

In most cases, it is unlikely that a project will result in the immediate death of an individual bat. Most adverse effects are reduced fitness of bats due to increases in energy expenditure (behavioral modification) in response to the loss of roost trees, foraging areas, and/or travel corridors. Based on the wide availability of suitable habitat within the Action Area, we anticipate that the affected bats will relocate to alternate roost trees and foraging areas. By restricting projects to 100 acres or less, it is unlikely that the Action would cause the loss of an entire home range, but could cause the removal of all or most trees used for roosting. Silvis et al. (2014) found it likely that a maternity colony would reform in such situations based on the species documented fidelity to home ranges over multiple years.

3.3.2 Analysis for Effects of the Action

Private and Federal entities who that enter into CMOUs with the TFO agree to implement the mitigation measures described in the Strategy. These measures are part of the effects that CMOU projects have on northern long-eared bats and their habitats. Projects implemented under CMOUs may adversely affect northern long-eared bats by removing or altering their roosting habitat and by decreasing the quality of habitat remaining within the Action Area via habitat fragmentation, loss of foraging areas, loss of travel corridors, increased disturbance, and other forms of habitat degradation. The following sections describe the general effects of projects covered under CMOUs and are summarized from the BA; please refer to the BA for more information.

3.3.2.1 Impacts to Summer Habitats

During the non-hibernation seasons, northern long-eared bats, especially females, often roost in live, damaged, and/or dead trees. It is the physical condition of the tree, not the tree species, which make these trees suitable for roosting. Stochastic events, such as lightning strikes or pest outbreaks, and other disturbances create and distribute trees in this condition within forested tracts and across the available forestlands.

Northern long-eared bat maternity colonies occur throughout the state. Records for the northern long-eared bat occur statewide, but are concentrated in the central and eastern parts of the state where the greatest survey effort has occurred in association with proposed development projects. Beyond a

few research projects, most northern long-eared bat summer capture records were results of Indiana bat presence/absence surveys. Historically, the northern long-eared bat was one of the most commonly captured species during summer mist-net surveys in Tennessee. Data compiled by the KFO shows that of the 1,825 non-maternity summer captures of northern long-eared bats in Kentucky (adult males and non-reproductive females), approximately 94 percent (1,712 individuals) were documented within three miles of a northern long-eared bat maternity capture record. It is unknown how non-reproductive adult northern long-eared bats interact with maternity colonies, but the strong correlation between maternity and non-maternity capture records indicates concurrent usage of summer habitats. The similarity of habitats between Kentucky and Tennessee, especially forest abundance, is strong. Based on this similarity and correlation between maternity and non-maternity captures in Kentucky, the TFO concludes it is appropriate to treat all summer (May 15–August 15) captures as indicative of maternity usage. Further, the TFO believes that there are more maternity colonies within the Action Area than are documented (known). Therefore, any project that affects suitable northern long-eared bat maternity habitat (where probable absence has not been demonstrated) may affect maternity colonies.

Habitat Removal – Summer

Summer habitat for northern long-eared bats occurs throughout Tennessee, and project-specific impacts implemented under the Action may occur anywhere within the Action Area. Impacts to summer habitat may occur during periods of occupation by northern long-eared bats (April 1 through August 15) or during periods when the habitat is unoccupied. In most cases, the death of an individual bat due to summer habitat removal would occur only when the bat is in a tree when it is felled. Further, the bat must be struck either during the felling or the subsequent fall of the tree. If not struck during the felling, volant bats would likely have the opportunity to escape the falling tree. Coincidence of all of these factors, combined with the minimization measure requiring project-specific analysis during the non-volant period, results in a correspondingly low probability of death of an individual northern long-eared bat.

The most common adverse effect associated with the removal of summer habitat is harassment of bats that are disturbed from their roost(s), abandoning higher quality habitat in order to distance themselves from the disturbance; and loss of suitable roosting, foraging, and/or travel habitat. However, the adverse effects of habitat removal are not limited periods when the bats are present at the impact sites. Northern long-eared bats returning to summer roosting areas have low fat reserves after hibernation and migration. Further, pregnant females have elevated energy needs. Habitat removal results in increased habitat fragmentation, loss of foraging areas, and travel corridors. The degradation of these habitats can result in reduced fitness and/or recruitment of northern long-eared bats that are presumably stressed already by causing them to expend additional time and energy reserves finding suitable roosting habitat and/or roosting in trees that are inferior to the roost trees that were removed.

These indirect effects of habitat removal are likely exacerbated for bats that have survived hibernation in a WNS-infected environment. A review of summer capture data by Francl et al. (2012) before and after the arrival of WNS in West Virginia showed a decline in capture rates for Indiana and northern long-eared bats following the arrival of WNS. For northern long-eared bats, there was also a decline in the proportion of juvenile captures later in the survey season, indicating reduced reproductive success following WNS.

Habitat Removal - Maternity

Northern long-eared bat known maternity colonies appear to be more prevalent in the heavily forested central and eastern portions of Tennessee than in other areas. However, this portion of the state has also received much greater survey effort (for Indiana bats), associated with the permitting requirements for surface coal mining activities. Despite this possible bias in survey effort, the predominance of maternity colonies in the central and eastern coal fields correlates well with the reported preference of northern long-eared bats for foraging and roosting in interior forests as compared with forest edges and more open habitats (Owen et al. 2003, Patriquin and Barclay 2003).

Adverse effects to northern long-eared bats from the removal of maternity roosting habitat may occur as described under section 4.3.2.1.2 of the BA. The likelihood of mortality during removal of maternity roosting habitat is highest between June 1 and July 31, when the pups are non-volant. Project-specific review is required for all projects within known or potential maternity habitat that would occur during this timeframe. In most cases, CMOU projects will not result in the removal of suitable habitat during the period of non-volancy. However, project-specific evaluations may result in a determination that the proposed project is unlikely to cause mortality, because suitable maternity roosts are identified and their removal avoided, or emergence counts show that the potential roosts trees are not occupied at that time.

While the loss of an occupied primary maternity roost would result in the greatest immediate impact, the loss of multiple roost trees could cause displaced individuals to expend increased levels of energy while seeking out replacement roost trees. Although the mean impact size for projects previously covered under CMOUs was 5.6 acres, impacts could be as large as 100 acres. Lacki et al. (2009) documented the size of roosting areas as less than 50 acres to over 100 acres; therefore, it is possible that a project could result in the loss of all the roosts for a maternity colony. While avoidance and minimization measures placed on projects should prevent this from occurring during the non-volant period, the loss of all maternity roosts prior to parturition could reduce the reproductive success of the colony (see previous discussion under Disturbance Severity).

Increased energy expenditure during pregnancy could cause spontaneous abortion, other stress-related reproductive delays, or losses in fecundity, particularly among females already under other environmental stresses (e.g., WNS). Delays in colony formation and/or parturition and pup growth could also reduce fat accumulation prior to hibernation and lead to lower winter survival rates (USFWS 2002). Such responses are anticipated, though to a lesser extent, even when habitat is removed when bats are not present.

Northern long-eared bats have been captured routinely during Indiana bat summer presence / probable absence surveys. Considering only the two recent post-WNS years of 2013 and 2014, the Service found that 14 percent of survey sites (44 out of 315) in Kentucky yielded northern long-eared bat captures. Based on proximity and similarity of habitat between Kentucky and Tennessee, we apply this detection probability to the Action Area. Assuming that 14 percent of the 10,000 forested acres included in the Action support northern long-eared bat maternity colonies and that each maternity colony requires 161 acres (Owens et al. 2003), the Service estimates that the Action would adversely affect up to 9 northern long-eared bat maternity colonies over a 5-year period. These 9 maternity colonies represent approximately 810 northern long-eared bats, assuming the mid-point of 30–60 adult females per colony, and that each gives birth to 1 pup (45 adult females + 45 pups = 90 bats) (USFWS 2014b):

- 10,000 acres × 0.14 occupancy rate = 1,400 acres
- 1,400 acres ÷ 161 acres per colony = 8.69 colonies, which we round up to 9 colonies
- 9 colonies × 90 bats per colony = 810 bats

3.3.2.2 Impacts to Swarming Habitats

There were 122 known northern long-eared bat hibernacula within the Action Area during the 2015 bat hibernacula census (Service, unpublished data). The Strategy specifically excludes impacts to caves and other potential hibernacula. In addition to avoiding impacts to hibernacula, the TFO has identified those areas within a 0.5-mile radius around all northern long-eared bat hibernacula as sensitive and requires project-specific coordination with the TFO to determine if the proposed project is appropriate for coverage under a CMOU.

Swarming season is a sensitive period for northern long-eared bats. This is when mating occurs and when bats are foraging to store sufficient fat reserves to survive winter hibernation. While all bats are volant during this period and, therefore, less likely to be killed during the felling of a tree, the removal of suitable habitat during periods of occupation will result in disturbance to roosting bats and additional energy expenditures seeking new roosting sites. During a period when weight gain is critical to survival, additional energy spent searching for new roost trees also results in less time for foraging, both of which could result in reduced weight gain. Lower weight gains during fall swarming could result in reduced survival and/or reproductive success.

Stress associated with the removal of swarming habitat is compounded when bats are entering a WNS-infected hibernaculum. WNS is wide-spread across the Action Area and currently uninfected sites will likely to become infected during the active period of this BO. Bats emerging from WNS-infected hibernacula likely have lower body weights and damaged tissues compared with bats emerging from uninfected sites.

The Strategy requires individual review of projects with impacts within that are less than 0.5-mile from a northern long-eared bat hibernaculum. During the spring staging period (generally mid-March or early- to mid-April), northern long-eared bats are still concentrated around the hibernacula. The bats have just emerged from hibernation, have depleted fat reserves, and are preparing to migrate to their summer habitats. Staging is not expected to occur beyond the 0.5-mile buffer. Additional review of projects proposed within these buffers will determine the appropriateness of the proposed mitigation measures and whether additional measures are warranted.

As discussed in sections 3.1 and 3.2, northern long-eared bats are difficult to detect during winter surveys, and the Service expects that many hibernacula are unknown; therefore, the Service conservatively assumes that all projects implemented under CMOUs will affect northern long-eared bat swarming populations. To estimate potential effects, we further assume that each 5-mile swarming buffer contains 100 northern long-eared bats. This is likely an overestimate, because most winter censuses within the Action Area result in detection of fewer than 10 northern long-eared bats per hibernaculum, but helps ensure that we account for impacts to currently undocumented swarming populations. Using these assumptions to calculate a bat density for swarming habitat, and applying that density to the 10,000 forested acres impacted by the Action, the Service anticipates that the Action will affect up to 20 northern long-eared bats:

- 5-mile radius around a hibernaculum encompasses 50,266 acres;
  - Area=$\pi \times \text{radius}^2 = 3.14159 \times (5 \text{ miles})^2 = 78.54 \text{ miles}^2$
  - $78.54 \text{ miles}^2 \times 640 \text{ acres/mile}^2 = 50{,}266 \text{ acres}$
- 100 bats ÷ 50,266 acres = 0.002 bats per acre; and
- 10,000 acres × 0.002 bats per acre = 20 bats.

3.3.3 Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The description of the Action specifically states that activities beyond the scope of the effects analysis on the removal of forested habitat are not part of the Action and must be addressed under a separate process for ESA compliance. Further, the Action is a voluntary process available to projects that would occur without the Action, relying on other ESA compliance processes as applicable (i.e., section 7 consultations, section 10(a)(1)(B) permits). Based on this information and the Service's review of the BA, there are no foreseeable interrelated or interdependent actions associated with this project.

3.4 Cumulative Effects

In the context of a consultation, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under section 7 of the Act.

Land uses that may affect northern long-eared bats and are likely occur within the Action Area include: timber harvest, all-terrain-vehicle recreation, recreational use of caves, and construction/land-clearing activity associated with roads, housing, industry, and agriculture. These non-federal actions are likely to occur within the Action Area, but the TFO is unaware of any quantifiable information about the extent of private timber harvests within the Action Area, the amount of use of off-highway vehicles within the Action Area, or the amount of recreational use of caves within the Action Area. Similarly, the TFO does not have any information on the amount or types of residential, industrial, or agricultural development that is reasonably certain to occur within the Action Area. It is possible that these activities will have cumulative effects on northern long-eared bats and their habitat in certain situations (e.g., a private timber harvest during summer months within an unknown maternity colony may cause adverse effects to that maternity colony).

3.5 Conclusion

After reviewing the current status of the northern long-eared bat, the environmental baseline for the Action Area, the effects of the proposed Action and cumulative effects, it is the RO's biological opinion that the Action is not likely to jeopardize the continued existence of the northern long-eared bat. No critical habitat has been proposed for this species; therefore, none is affected.

The northern long-eared bat is declining throughout its range as a result of WNS. Although the beneficial effects of the Action are not expected to reverse this decline, we have determined that its combined beneficial and adverse effects will not appreciably reduce the species' reproduction,

numbers, and distribution. We support this determination with the following rationale from our Analysis for the Effects of the Action (section 3.3.2):

- Impacts to the species reproduction and numbers are limited by the avoidance and minimization measures required under the Strategy (e.g., exclusion of hibernacula, restrictions on tree removal during the non-volant and spring staging periods, and within close proximity to hibernacula).
- Direct adverse effects that meet the definition of take are primarily in the form of harassment, i.e., fleeing disturbance associated habitat modification, causing additional energy expenditure and reduced fitness. To a lesser degree, we expect similar indirect effects (reduced fitness) resulting from habitat modification while bats are not present due to the additional energy expenditure associated with relocating to alternative habitats. In both cases, we anticipate that bats will recover within 1–2 years.
- Due to the relative abundance of forested habitats in the Action Area, impacts to maternity colonies and their reproductive success are likely short- term (2–3 years), and would only affect a small portion of the range-wide population.
- No reduction in the distribution of the species is expected, as impacts are dispersed across a large Action Area and limited at the project and programmatic scales.
- The conservation benefits provided by the Action are expected to promote the survival and recovery of the species through activities that include, but are not limited to:
  - protecting and managing known priority hibernacula;
  - protecting and managing existing forested habitat that support known maternity and swarming northern long-eared bat populations, particularly those that would expand existing conservation ownerships;
  - protecting and managing additional conservation lands that contain potential habitat for the species, particularly those that would expand existing conservation ownerships; and
  - funding priority research and monitoring activities that support the conservation and recovery of the species.

3.6 Incidental Take Statement

Section 9 of the ESA and Federal regulations under section 4(d) of the Act 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 mortality or injury of wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harassment is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by disturbing it to such an extent as to significantly disrupt normal behavioral patterns which 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 prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the TFO so that they become binding conditions of any grant, contract, or permit issued to an applicant, contractor, or

permittee for the exemption in section 7(o)(2) to apply. The TFO has the continuing duty to regulate the activity covered by this Incidental Take Statement. If the TFO: (a) fails to assume and implement the terms and conditions; or (b) fails to require an applicant, contractor, or permittee to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the grant, contract, or permit document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the TFO must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement.

3.6.1 Amount or Extent of Take Anticipated

The level of incidental taking anticipated in this BO resulting from projects implemented under CMOUs between the TFO and the respective project proponent(s) is not more than 830 northern long-eared bats: 810 in summer habitats (see section 3.3.2.1); and 20 in spring/fall habitats (see section 3.3.2.2). This taking is expected in the form of harm and/or harassment. The mechanisms of this taking and the basis for our estimation of its extent are described in section 3.3 (Effects of the Action) of this BO. In summary, harm will occur when removing or altering roosting habitat directly kills or injures a bat, or impairs breeding, feeding or sheltering behavior to the extent that a bat does not survive or reproduce. Harassment will occur when removing or altering habitat and other project-related disturbances significantly disrupts breeding, feeding, or sheltering behavior creating the likelihood of injury (e.g., reduced fitness or reproductive success). Other than the rare circumstance of felling trees while individuals, especially non-volant pups, are roosting in those trees, most of the taking of northern long-eared bats is anticipated as sub-lethal harassment.

SPECIES	INDIVIDUALS	TAKE TYPE
Myotis septentrionalis	830	Harm and Harass; some small indeterminable portion as harm, but most as harassment.

The Service anticipates the incidental taking of northern long-eared bats associated with CMOU projects will be difficult to detect for the following reasons:

- the individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to observe;
- the species forms small (i.e., 30 to 60 individuals) maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- finding dead or injured specimens during or following project implementation is unlikely; and
- most incidental take is in the form of non-lethal harassment and not directly observable.

Due to the difficulty of detecting take of northern long-eared bats caused by the proposed Action, the Service will monitor the extent of taking using the acreage of suitable habitat that CMOU projects remove or alter, which is up to 10,000 acres over a 5-year period, with no more than 2,000 acres occurring in any calendar year. This surrogate measure is appropriate because all anticipated taking will result from habitat removal/alteration and activities associated with that alteration, and because it sets a clear standard for determining when the extent of taking is exceeded.

3.6.2 Effect of the Take

In this BO, the RO has determined that the anticipated level of incidental take is not likely to jeopardize the continued existence of the northern long-eared bat.

3.6.3 Reasonable and Prudent Measures

The RO believes that the conservation measures included in the proposed Action (described in section 1.2.3 of this BO) are sufficient to minimize take of the northern long-eared bat. Therefore, the only reasonable and prudent measure that is necessary or appropriate at this time pertains to take monitoring as required under 50 CFR §402.14(i)(3):

> The TFO will ensure that the extent of incidental take, as measured by the surrogate acres of suitable forested northern long-eared bat habitat, caused by projects undertaken by Federal and non-federal entities who participate in voluntary CMOUs for those projects with the TFO does not exceed 2,000 acres annually and 10,000 acres cumulatively during the 5 years following the signature date of this BO.

3.6.4 Terms and Conditions

In order to be exempt from the prohibitions under 50 CFR §17.31 and §17.32 applicable to the northern long-eared bat, the TFO must comply with the following Terms and Conditions, which facilitate the Reasonable and Prudent Measure described above by describing monitoring and reporting requirements. These Terms and Conditions are non-discretionary.

1. The TFO shall keep records of the levels of incidental take exempted under this BO that are applied to CMOUs. These records shall track the acres of habitat affected under each agreement and specify whether the affected habitat is known summer habitat, presumed summer habitat, or swarming habitat. The TFO shall periodically audit projects implemented by CMOU cooperators to verify compliance with the Conservation Strategy for Forest-dwelling Bats in Tennessee and the CMOUs. The selection of projects for these audits is at the TFO's discretion, but shall occur at least once each year of the duration of this BO.

2. The TFO, its cooperators, and any of their contractors (CMOU parties) must use diligence when handling dead or injured northern long-eared bats or any other federally listed species that are found at CMOU project sites in order to preserve biological material in the best possible state and to protect the handler from exposure to diseases, such as rabies. CMOU parties are responsible for ensuring that evidence for determining the cause of death or injury is not unnecessarily disturbed. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this BO is exceeded and to ensure that the terms and conditions are appropriate and effective. Parties finding a dead, injured, or sick specimen of any endangered or threatened species, must promptly notify the Service's Division of Law Enforcement at 1875 Century Blvd., Suite 380, Atlanta, Georgia 30345 (Telephone: 404/679-7057) and the TFO at 446 Neal Street, Cookeville, Tennessee 38501 (Telephone: 931/528-6481). The TFO is then responsible for notifying the RO Ecological Services program office at 1875 Century Boulevard, Suite 200, Atlanta, Georgia 30345 (Telephone 404/679-7085).

The Reasonable and Prudent Measures and implementing Terms and Conditions are designed to minimize the impact of incidental taking. The Service believes that no more than 830 northern long-eared bats will be incidentally taken, mostly by harassment, as a result of habitat alteration associated with the Action on no more than 10,000 acres of potential and known forest habitat within the Action Area over the next 5 years, and on no more than 2,000 acres during any calendar year. Exceeding this level of habitat alteration during the course of the action would represent new information requiring a re-initiation of consultation and review of the Reasonable and Prudent Measures provided (see Section 5, Reinitiation Notice).

4 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the Act by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to minimize or avoid the adverse effects of a proposed action, implement recovery plans, or develop information useful for the conservation of listed species. The RO offers the following conservation recommendations:

1. The TFO should keep records of the amount of habitat purchased, managed, and protected and the amount of funding contributed to Tennessee's Imperiled Bat Conservation Fund. The TFO should use these records, and other information about conservation benefits to bats resulting from the CMOU program, to inform an analysis of its overall effect in determining whether to renew and modify the program as the duration of the current program draws to a close.
2. The TFO should create a geographic data base and query tool that allows CMOU cooperators to identify when proposed projects are located within known Indiana and/or northern long-eared bat habitat. The TFO should update this data base at least annually.

5 Reinitiation Notice

This concludes formal consultation on the TFO's participation in and approval of voluntary CMOUs and their effects on Indiana and/or northern long-eared bats. Reinitiation of formal consultation is required when discretionary TFO involvement or control over the action is retained (or is authorized by law) and:

(a) the amount or extent of incidental take is exceeded;
(b) new information reveals effects of the TFO's action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation;
(c) the TFO's action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this consultation; or
(d) a new species is listed or critical habitat is 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.

For this BO, the exempted incidental take is exceeded when the amount of Indiana bat or northern long-eared bat habitat removal associated with CMOUs surpasses 2,000 acres in any year for the next 5 years, ending in calendar year 2020. The total amount of incidental take, as measured by the habitat surrogate, covered for this period is 10,000 acres for each species. These are the amounts of

habitat removal that are exempted from the prohibitions under section 9 of the Act (Indiana bat) and from the applicable prohibitions under 50 CFR 17.31 and 17.32 (northern long-eared bat) by this BO.

This consultation was assigned FWS Log # 04E00000-2016-F-0001. Please refer to this number in any correspondence concerning this consultation.

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Appendix A: Summary of Past Incidental Take (Indiana bat)

PROJECTS	SERVICE OFFICE AND DATE BO ISSUED	INCIDENTAL TAKE (IT) FORM	TAKE EXEMPTED or SURROGATE MEASURE TO MONITOR
Installation of Cave Gates at Mammoth Cave National Park, Kentucky	Ashville FO October 1980	N/A	None
Construction of Solvent Refined Coal Demo Project in Daviess County, Kentucky	Ashville FO March 1981	N/A	None
Installation of Cave Gates at New Mammoth Cave, Tennessee	Ashville FO August 1982	N/A	None
Three Miles of New Transmission Line, Big Rivers Wescor. Kentucky	Ashville FO June 1983	N/A	None
Short Creek Stream Channelization Project, Kentucky	Ashville FO July 1983	N/A	None
Construction of a New Navigation Lock, Kentucky River	Tennessee FO March 1991	N/A	None
State Route 32 Improvement Project, Claiborne and Grainger Counties,Tennessee	Tennessee FO May 1993	N/A	None
Construction of Potable Water Distribution System, Jackson County, Kentucky	Tennessee FO May 1994	N/A	None
1996 Programmatic Biological Opinion for Surface Coal Mining Regulatory Programs Under the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87)	Washington DC September 1996	IT by harm, harassment, and killing of all current and future listed species	Unquantifiable

Cherokee National Forest LRMP; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect.	Tennessee FO January 1997	IT by killing harming or harassing	1,300 acres annually
Spillway Rehabilitation at Tippy Dam, MI	East Lansing FO January 1997	IT by harming, harassing, or killing	3-65 individuals
Relocation of US Army Chemical School & US Military Police School to Fort Leonard Wood, Missouri	Missouri FO	IT by harming, harassing, or killing	56 hibernating bats from fog oil and TPA smoke pots; summer bats difficult to determine sublethal take
Daniel Boone National Forest LRMP; Note: This BO has been superseded by a March 2004 BO.	Tennessee FO April 1997	IT by killing, harming, or harassing	4,500 acres annually
Ozark-St. Francis National Forest LRMP;	Arkansas FO June 25, 1998	IT by killing, harming or harassing	Annually 8,000 acres of timber harvest in hardwoods, 11,000 acres harvest of pine and pine/hardwoods; 30,000 acres of prescribed burning
Construction of New Training Facilities at Fort Knox, KY	Tennessee FO October 1998	IT by killing, harming or harassing	2,000 acres
Construction of a Qualification Training Range at Fort Knox, KY	Tennessee FO October 1998	IT by killing, harming or harassing	80 acres
Construction & operation of the Multi-purpose training Range at the Camp Atterbury Army National Guard Training Site- Edinburgh Indiana NOTE: Superseded by November 2000 Amendment	Indiana FO December 4, 1998	IT by harm through habitat loss and exposure to toxic agents	1 maternity colony (200 bats total) and 99.7 ha of forest

Disposition of Lands Acquired by the Tennessee Valley Authority for the Columbia Dam Project, Maury County, Tennessee	Tennessee FO March 1999	No take provided	No take provided
Proposed stream bank stabilization at Yano Range and upgrade of the Wilcox Tank Range at Fort Knox, KY	Tennessee FO April 1999	IT by loss of summer roosting, foraging, and maternity habitat	1800 acres; 2 maternity colonies
Agricultural Pesticide Application Practices at Newport Chemical Depot, Newport IN	Indiana FO April 13, 1999	IT by harm through exposure to pesticides	2 maternity colonies with 74 bats total
Ouachita National Forest LRMP; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect	Arkansas FO April 26, 1999	IT by killing, harming or harassing	Annually up to: 40,000 acres commercial harvest; 3,000 acres wildlife management & road construction/ reconstruction; 24,000 acres thinning; 200,000 acres prescribed burning
Mark Twain National Forest LRMP; Note: This BO has been superseded by the September 2005 BO	Missouri FO June 23, 1999	IT by killing, harming, or harassing	Timber harvest – 20,000 acres per year; Prescribed fire - 12,000 acres/yr; Wildlife habitat improvement -2000 acres/yr; Timber stand improvement – 4000 acres/yr; Soil & water improvement – 150 acres/yr; Range management – 50 acres/yr; Mineral exploration & development – 50 acres/yr; Wildfire fire lines – 50 acres/yr; Special use – 50 acres/yr; Road construction – 25 acres/yr

Impacts of Forest Management and Other Activities to the Bald Eagle, Indiana Bat, Clubshell and Northern Riffleshell on the Allegheny National Forest, Pennsylvania; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect.	Pennsylvania FO June 1999	IT by killing, harming, or harassing	Within a 5-year period (1999 to 2003), the disturbance of 45,594 acres
ational Forests in Alabama; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect.	Alabama FO December 10, 1999	IT by killing, harming or harassing	No more than 100 trees
Supplement for Proposed Bridges & Alignments Modifications to Kentucky Lock Addition Project	Tennessee FO January 2000	IT by killing, harming or harassing	No more than 20% of available suitable habitat
Green Mountain National Forest LRMP; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect.	New England FO 2000	IT by harming or harassing	300 acres annually
White Mountain National Forest LRMP; Note: As a result of new information, this Forest is now operating under a "not likely to adversely affect" determination, and this BO is no longer in effect.	New England FO 2000	IT by harming or harassing	1,500 acres

Nantahala and Pisgah National Forests LRMP Amendment #5 Superseded by February 2009 Amendment	Asheville (NC) FO April 2000	IT by killing, harming, or harassing	4,574 acres per year
Daniel Boone National Forest LRMP and the Proposed Special Habitat Needs and Silviculture Amendment	Tennessee FO May 2000	No take provided	No take provided
Hazard Tree Removal and Vegetation Management Program at Mammoth Cave National Park	Tennessee FO June 2000	IT by loss of roosting habitat, direct mortality or by forcing bats to abandon tree	No take provided
Salvage Harvest Necessitated by 1998 Storm Damage on the Daniel Boone National Forest	Tennessee FO July 2000	IT by killing, harming, or harassing	3,100 acres
Revised: Construction & operation of the Multi-purpose training Range at the Camp Atterbury Army National Guard Training Site-Edinburgh Indiana	Indiana FO November 2000	IT by harm through habitat loss and exposure to toxic agents	121 ha of forest
North East research Station – Fernow Experimental Forest – Five year plan NOTE: Superseded by the December 2005 BO	West Virginia FO November 2000	IT by potential harm or mortality of roosting bats	42 acres timber harvest and 95 acres prescribed burn
Bankhead National Forest; Modification of 1999 BO for National Forests in Alabama	Alabama FO January 23, 2001	IT by killing, harming or harassing	Level of take changed for southern pine beetle suppression areas – upper limit of 65 suitable roost trees

Hoosier National Forest LRMP; Note: This BO has been superseded by a January 2006 BO.	Indiana FO June 13, 2001	IT by harm	Pine clear cuts – 578 acres; Pine shelterwood cuts – 391 acres; Pine thinning – 408 acres; Hardwood group selection cuts – 777 acres; HW single tree selection cuts – 100 acres; HW even aged salvage cuts – 518 acres; Prescribed fire treatment – 7000 acres; Forest openings maintenance – 3311 acres; Timber stand improvement – 2264 acres; Special use permits – 286 acres; Wildfire management – 250 acres; road construction – 16 acres; hazard tree removal – 100 trees; trail construction – 15 miles
Wayne National Forest LRMP; Note: BO has been superseded by a November 2005 BO.	Ohio FO September 20, 2001	IT by harm	Permanent loss of habitat – 2,504 acres; Habitat alteration – 8,102 acres plus 125 trees
Ozark-St. Francis National Forest Prescribed Fire Plan (an amendment to June 1998 LRMP BO).	Arkansas FO March 21, 2002	IT by loss of roost trees and potential roost trees	Prescribed fire - 153,000 acres/yr
1986 (as amended) Monongahela National Forest Land and Resource Management Plan (Forest Plan); Note – This BO has been superseded by a July 2006 BO.	West Virginia FO March 2002	IT by killing, harming, or harassing	A maximum of 6,125 acres annually and prescribed burning on a maximum of 300 acres annually.
BO for the Six Points Road interchange and Associated Development	Indiana FO March 2002	IT by killing, harming, or harassing	139 ha of roosting and foraging habitat (includes: 149 reproductive females & young; unquantifiable number of adult males and un- reproductive females)

Huron-Manistee National Forest LRMP; Note: This BO has been superseded by a March 2006 BO.	Michigan FO June 13, 2003	IT by killing, harming, or harassing	0-65 bats; 3,150 ac (1,275 ha) of potential Indiana bat habitat may be harvested and 2,648 ac (1,071 ha) of habitat may be burned for fire management or wildlife habitat management activities for the duration of this proposed action
Great Smoky Mountains National Park Prescribed Burning	Tennessee FO August 12, 2003	IT by loss of suitable roosting or foraging habitat	One maternity colony
Big Monon Ditch Reconstruction Project	Indiana FO August 5, 2003	IT by harming and harassing	Permanent loss of 75 acres of occupied summer habitat
Proposed Construction, Operation, and Maintenance of Alternative 3C of Interstate 69 from Indianapolis to Evansville NOE: This has been replaced by a 2006 revised BO	Indiana FO December 3, 2003	IT by harming, killing	Summer Action Area: permanent direct & indirect loss of up to 1527 acres of forested habitat and 40 acres of non-forested wetlands. Winter Action Area: permanent loss of up to 947 acres of forest habitat around 10 known hibernacula. Death by vehicle collisions: 10 Indiana bats per year.
2003 Revised Jefferson National Forest Land and Resource Management Plan, Virginia, West Virginia, Kentucky	Virginia FO January 2004	IT by killing, harming, or harassing	16,800 acres total (15,000 fire; 1,800 other habitat manipulations) per year
Reinitiation: Wayne National Forest LRMP NOTE: Superseded by November 2005 BO	Ohio FO March 8, 2004	IT by harm	Additional 11,892 acres of habitat alteration
2004 Daniel Boone National Forest Revised LRMP Note: BO has been superseded by an April 2007 BO.	Kentucky FO March 20, 2004	IT by killing, harming, or harassing	Green tree harvest – 4000 acres; Salvage/sanitation – 350 acres; Prescribed burning during summer – 50,000 acres
Upper Mississippi River – Illinois Waterway System Navigation Feasibility Study	Rock Island (IL) FO August 2004	IT by injury, death, harming or harassing	511 acres of forested habitat annually for 50 years. Less than 20 bats per year.

Impacts of the Laxare East and Black Castle Contour Coal Mine Projects on the Indiana bat NOTE: BO has been superseded by the 2006 revised BO	West Virginia FO February 2005	IT by killing, harm and harassment	No more than 40 adult females & their pups; permanent loss of 2199 acres forested habitat; 917 acres of habitat fragmentation and degradation; 11.95 miles of stream loss
Department of the Army 88th Regional Readiness Command, US Army Reserve Center	Ohio FO April 14, 2005	IT by harming or harassing	18 acres of high quality roosting and foraging habitat
Construction, Operation, and Maintenance of the U.S. 33 Nelsonville Bypass	Ohio FO April 15, 2005	IT by harming, death, injury	No more than 10 Indiana bats
Mark Twain National Forest 2005 Forest Plan, Missouri; Note: Replaces June 1999 BO.	Missouri FO September 2005	IT through removal of roost trees	10 occupied roost trees , 19,400 acres and 240 miles of fire line over 10 years;
Construction .Operation, and Maintenance of the US 24 New Haven, Indiana to Defiance, OH Project	Ohio FO September 30, 2005	IT by harming, harassing, and killing	Not to exceed 10 individuals
BO on the Interstate 69 (I-69) preferred alternative #2 from Henderson, Kentucky to Evansville, Indiana, and its effects on the Indiana bat; Henderson County, Kentucky and Vanderburgh County, Indiana	Kentucky FO October 2005	IT through harm, harassment, and/or mortality	The level of take authorized is for those wooded areas of occupied and/or potentially occupied Indiana bat habitat within the construction limits of the proposed project that lie within the Indiana bat focus area identified in the BA, which was determined to be about 28 acres of wooded habitat and all of the potential Indiana bat roost trees contained within those 28 acres.

Wayne National Forest Land and Resource Management Plan; Note: Replaces March 2004 BO.	Ohio FO November 2005	IT through removal of roost trees	No more than 4 occupied roost trees will be incidentally taken over the next ten years; Permanent Road Construction & Reconstruction -392 acres; Temporary Road Construction -146 acres; Skid Trails and Log Landings - 740 acres; Utility Development - 50 acres; Fire Lines - 750 miles
Shawnee National Forest LRMP	Illinois FO December 3, 2005	IT through harming, harassing, and killing	First 10 Years of plan: -- 11,565 acres of timber harvest/mgt. and minerals mgt. -- 5,630 acres of timber stand improvement and wetlands mgt. Second 10 Years of plan: -- 21,255 acres of timber harvest/mgt. and minerals mgt. -- 13,289 acres of timber stand improvement and wetlands mgt. Mortality of up to 2 individuals during research and monitoring.
North East Research Station – Fernow Experimental Forest – Five year plan; Note: Replaced November 2000 5-year BO.	West Virginia FO December 2005	IT by potential harm or mortality of roosting bats	124 acres timber harvest and 466 acres of prescribed burns (previous 42 acres timber harvest and 54 acres prescribed burn) over 5 years
Final Biological Opinion on implementation of the 2003 Ice Storm Recovery Project and it effects on the Indiana bat, Morehead Ranger District, Daniel Boone National Forest, Rowan County, Kentucky	Kentucky FO December 2005	IT through harm, harassment, and/or mortality	The level of incidental take authorized is 4,704 acres of commercial removal of damaged trees and restoration and creation of bat habitat when accomplished during the summer roosting period of the Indiana bat (April 1 to September 15).
Hoosier National Forest LRMP; Note: This BO replaced the June 2001 BO.	Indiana FO January 2006	IT by injury or death or harassing	No more than four (4) occupied roost trees/year and between four (4) and twelve (12) individuals injured or killed each year. 2956-acres; 60 hazard trees; 100 "accident" trees per year

Huron-Manistee National Forest LRMP NOTE: Replaces 2003 BO	Michigan FO March 2006	IT through harming, harassing, and killing	For first 10 years of revised Forest Plan: Thinning = 59,497 Clearcut = 45,144 Shelterwood = 8,261 Selection = 0
Biological Opinion – Impacts of the Laxare East and Black Castle Contour Coal Mining Projects on the Indiana bat; Note: Reinitiation of February 2005 BO.	West Virginia FO March 2006	IT in the form of harm due to habitat loss, degradation and fragmentation, Harassment during active mining, Permanent loss of foraging loss and roosting habitat, habitat fragmentation and degradation, permanent loss of streams and their associated watering and prey base for Indiana bats, long term alteration of streams	No more than 17 adult females and their pups; 912 acres of forested habitat and 5.0 miles of stream
Allegheny National Forest, West Branch Tionesta Site	Pennsylvania FO April 2006	IT through harming, harassing, and killing	574 acres of forested habitat loss or alternation from prescribed burning
Hoosier National Forest's Proposed Tell City Windthrow 2004 Salvage Timber Harvest	Indiana FO April 2006	Death and injury from direct felling of occupied trees; Harassment of roosting bats from noises/ vibrations/ disturbance levels causing roost-site abandonment and atypical exposure to day time predators while fleeing and seeking new shelter during the day- time; and Harm through the loss of primary and/or alternate roost trees	Project-wide Combined Total: 8,525 acres

Final Programmatic BO On Minor Road Construction Projects In Kentucky And Their Effects On The Indiana Bat	Kentucky FO June 2006	IT through harming, harassment, mortality	The level of take authorized is for those wooded areas of Indiana bat habitat within the construction limits of a proposed project covered by Tier 2 during KYTC FY 2006 through KYTC FY 2010, which was determined to be 500 acres of Indiana bat habitat as described in the HAM in KYTC FY06, 600 acres in KYTC FY07, 720 acres in KYTC FY08, 864 acres in KYTC FY09, 1,037 acres in KYTC FY10.
Programmatic Biological Opinion for the Monongahela National Forest 2006 Forest Plan Revision	West Virginia FO July 2006	IT through harming, harassment, and/or mortality	10,052 acres of suitable Indiana bat habitat annually
Revised BO on the Proposed Construction, Operation, and Maintenance of Alt. 3C of Interstate 69 from Evansville to Indianapolis NOTE: BO has been superseded by the 2013 Amendment 2	Indiana FO August 2006	Death/kill and/or injury/wound from direct felling of occupied trees, direct collision with vehicles, and other sources.	2,148 acres of forested habitat and 20 acres of non-forested wetlands within summer Action Area; 1,097 acres of forested habitat within winter Action Area; 11 individuals per year from collision with vehicles
Programmatic BO for the Crab Orchard National Wildlife Refuge	Illinois FO August 8, 2006	IT by harm, harass and kill	Loss of no more than 15 occupied roost trees plus up to 2 individual from research/monitoring
Meads Mill Project, Allegheny National Forest; USFWS Project #2006- 1408	Pennsylvania FO September 2006	IT through harm, harassment, and/or death	549 acres of forested habitat by prescribed fire
BO on the Ohio DOT's Statewide Transportation Program for the Indiana bat	Ohio FO January 2007	IT through harm, harassment, and/or death	22,118 acres of suitable Indiana bat habitat over 5 years
2007 Daniel Boone National Forest Revised BO on implementation of the revised LRMP and its effects on the Indiana bat Note: Replaced March 20, 2004 BO.	Kentucky FO April 2007	IT by killing, harming, or harassing	Annually: Green tree harvest – 4000 acres; Salvage/sanitation – 350 acres; Prescribed burning during summer – 50,000 acres

BO and ITS for Indiana bat (*Myotis sodalis*) at the Herrington Place Subdivision, Reminderville, Summit County, Ohio	Ohio FO April 2007	IT through harm, harassment, and/or death	Permanent loss of 61.7 acres high quality roosting & foraging habitat and fragmentation of suitable habitat on the 125 acre site. Mortality of 1 adult male and1 adult female
The Effects of the U.S. 6219, Section 019, Transportation Improvement Project (Meyersdale, Somerset County, Pennsylvania to I- 68 in Garrett County, Maryland) on the Indiana bat	Pennsylvania FO October 2007	IT through harm, and/or harassment	All Indiana bats dependent on 375 acres of potential foraging and roosting habitat and near blasting/construction
Final Biological Opinion on the Reconstruction of US 119 from Partridge to Oven Fork in Letcher County	Kentucky FO November 2007	IT through harm, harass and/or death	456 wooded acres of occupied and/or potentially occupied Indiana bat habitat within the construction limits of the proposed project
Biological Opinion On The USDA Forest Service Application Of Fire Retardants On National Forest System Lands	Washington DC February 2008	No take provided	No take provided
Biological Opinion on the Fort Drum Connector Project, FHWA in Jefferson County, NY	New York FO June 2008	IT through harm and mortality	Harm to a small percentage of Indiana bats within 36 acres of forest, 4,181 linear feet of hedgerow and degradation of 102 acres of forest. Mortality from road operation of less than 10 Indiana bats
Intra-Service Programmatic Biological Opinion on the Proposed Participation In and Approval of Conservation Memoranda of Agreement for the Indiana bat, Commonwealth of KY replaced by the January 2011 BO	Kentucky FO June 2008	IT through harm, harassment and mortality	Up to 40,000 acres of suitable roosting and foraging habitat or travel corridors with no more than 8,000 acres in any one calendar year.

Biological Opinion on the Whitebreast Creek Lake and Housing Project, Osceola, Iowa	Rock Island, IL FO August 2008	IT in the form of injury, death, harm and harassment	Removal and modification of 651 acres of suitable maternity habitat and less than 10 adult male bats per year for five years.
Amendment to the Terms and Conditions of the USFWS's Biological Opinion on the Potential Impacts of the Nantahala and Pisgah National Forests Land and Natural Resource Management Plan on the Indiana bat Replaces the April 2000 T&C	Ashville, NC FO February 2009	IT by killing, harming, or harassing	5,855 acres of habitat
Biological Opinion on the Operation of Fort Drum Military Installation, Jefferson and Lewis counties, NY	New York FO June 2009	IT in the form of harm, injury and mortality	Permanent disturbance of up to: 3,781 acres of forest (potential roosting/foraging habitat) and an additional 2,183 acres of potential foraging habitat, forest management on up to 4,900 acres of forest (potential roosting/foraging habitat). Mortality of less than 20 Indiana bats.
Biological Opinion on the Adams Fairacre Farms Store, Dutchess County, NY	New York FO November 2009	IT in the form of harm	Removal of approximately 9.33 acres of forest and degradation of 3.48 acres of forest.
Biological Opinion for the Land Between the Lakes National Recreational Area's Wildfire and Forest Vegetation Management Program, Lyon and Trigg counties, KY	Kentucky FO January 2010	IT in the form of mortality, harm and/or harassment	Up to 9,000 acres of wildland fire during summer roosting; 5,000 acres of wildlife fire during fall swarming, and 2,200 acres of forest management at any time of year.
Programmatic Biological Opinion on the Effects of Ongoing and Future Military and Land Management Activities at Camp Atterbury Joint Maneuver Training Center in Bartholomew, Brown and Johnson counties, IN	Bloomington, IN FO October 2010	IT in the form of mortality, harm and/or harassment	The permanent loss of 209 acres of mature forested habitat, 132 acres of immature forested habitat and up to 10 exceptionally hazardous/potential roost trees per year removed between April1 and September 30.

Final Biological Opinion for Section 10(a)(1)(A) Activities Conducted for Federally Listed Bats in the Southeast Region	Kentucky FO December 2010	IT in the form of mortality, harm and/or harassment	Up to 5 individuals per year injured or killed by traditional bat research activities. Up to 10 individual per year killed by selective euthanasia associated with WNS
Final Revised Intra-Service Programmatic Biological Opinion on the Proposed Participation In and Approval of Conservation Memoranda of Agreement for the Indiana bat, Commonwealth of KY Replaces the June 2008 BO	Kentucky FO January 2011	IT through harm, harassment and mortality	All the Indiana bats on up to 12,500 acres of suitable roosting and foraging habitat or travel corridors with no more than 2,500 acres in any one year.
Biological Opinion on the Effects of the Shaffer Mountain Wind Farm on the Indiana Bat. Somerset and Bedford Counties, PA	Pennsylvania FO September 2011	IT through harm, harassment and mortality	Up to 2% of the maternity colony or $\leq$ 0.3 volant Indiana bats per year; and up to two adult males over the life of the project.
Biological Opinion on the Effect of Proposed Activities on the Fort Drum Military Installation (2012- 2014). Jefferson and Lewis Counties, NY	New York FO February 2012	IT through harm, harassment and mortality	One dead or injured Indiana bat from the wind turbine operation and harassment or mortality of a small number from smoke and obscurant operations.
Biological Opinion on the Application for an Incidental Take Permit for the Federally Endangered Indiana bat for the Buckeye Wind Power Project. Champaign County, OH	Ohio FO July 2012	IT through death	130 Indiana bats with no more than 26 per 5 year period and no more than 14.2 in any given year.
Biological Opinion on the Effects of Golden-Winged Warbler Habitat Creation by the Natural Resources Conservation Service on the Indiana Bat. Somerset County, PA	Pennsylvania FO December 2012	IT through harassment	Up to 2 Indiana bats.

Biological Opinion on the Effects of the Programmatic Forest Management Plan for Potential Indiana bat Habitat Areas on Wildlife Management Areas for which the WV Division of Natural Resources, Wildlife Resource Section Has Forest Management Authority.	West Virginia FO February 2013	IT through harm, harassment and mortality	Unquantifiable number of Indiana bats
Biological Opinion for Section 10(a)(1)(A) Permitted Activities Associated with Acoustic Deterrent and Curtailment Speed Research at the California Ridge Wind Energy Project. Champaign and Vermillion Counties, IL	Rock Island FO July 2013	IT through harm, harassment and mortality	Up to two bats per year for three years.
Biological Opinion on Enbridge Pipelines (FSP) L.L.C.'s Flanagan South Pipeline Project. IL, MO, KS, OK	Midwest RO July 2013	IT through harm, harassment and mortality	Up to 19 Indiana bats (death, harm, harass); and , up to 120 reproductive females (harm and/or harass)
Amendment 2 to the Tier 1 Revised Programmatic Biological Opinion for the I-69, Evansville to Indianapolis, Indiana highway	Bloomington FO July 2013	IT through harm, harassment and mortality	1,973 acres of forest loss resulting in the take of up to 1,068 Indiana bats. 21 Indiana bat from vehicle collision through 2030
Consultation Document for the NiSource Multi-Species Habitat Conservation Plan.	USFWS Regions, 3,4,5 September 2013	IT through harm, harassment and mortality	Up to 2,584 Indiana bat individuals estimated to be present in no more than 69,900 acres of summer and/or spring staging and/or swarming habitat.

Appendix B: Summary of Past Incidental Take (Northern long-eared bat)

PROJECTS	SERVICE OFFICE AND DATE BO ISSUED	INCIDENTAL TAKE (IT) FORM	TAKE EXEMPTED or SURROGATE MEASURE TO MONITOR
Ouachita NF Wolf Pen Gap Trail Complex	Arkansas FO December 2013		6 acres
Illiana Corridor Project Will Co. Illinois and Lake Co. Indiana	Illinois FO November 2014	34 individual bats over a 23 year operation period	222 acres (113 acres in IL and 109 aces in IN)
Monongahela NF West Virginia Ongoing Activities on the Forest	West Virginia FO January 2015		19,241 acres over the life of the project
Federal Highways Administration North Carolina Division activities in eastern North Carolina (Divisions 1-8)	Raleigh, North Carolina FO March 2015		10,223 acres over the next 5 years
Kentucky FO Participation in Conservation Memoranda of Agreement for the Indiana Bat and/or NLEB	Kentucky FO April 2015	803 individuals Harm and Harass; some small indeterminable portion will be harm but most take will be from harassment.	Surrogate of acreage of suitable habitat up to 10,000 acres over a 5 year period with no more than 2,000 acres per year.
SR 641 – Terre Haute Bypass	Bloomington, Indiana FO April 2015	No more than 1 individual NLEB every 2 years as a result of traffic collision	No additional habitat loss is expected at this stage of the project
Fort Drum Military Installation 2015-2017	New York FO April 2015	0-3 pups per year associated with smoke and obscurant operations conducted in June or July	
Mark Twain NF Forested Land and Resource Management Plan	Missouri FO April 2015		166,947 acres (of which 165,924 acres are exempt by the 4d rule) resulting in 338 acres
I-69, Evansville to Indianapolis, Indiana highway Conference Opinion	Bloomington, Indiana FO April 2015	90 individual female/juveniles over the next 16 years	486 forested acres

Hiawatha NF Forested Land and Resource Management Plan	East Lansing, Michigan FO May 2015		78,515 acres (of which78,021 are exempt by the 4d rule) Resulting in 494 Acres 435 Structures (410 general maintenance) 25 potential demolitions
Huron-Manistee NF Forested Land and Resource Management Plan	East Lansing, Michigan FO May 2015		135,999 acres (of which 131,401 are exempt by the 4d rule) resulting in 4,598 acres 2 structures per year for a max of 20 structures in 10 years demolished (155 structures general maintenance)
Ottawa NF Forested Land and Resource Management Plan	East Lansing, Michigan FO May 2015		92,608 acres and 600 additional trees (of which 92,510 acres and 600 trees are exempt by the 4d rule) resulting in 100 acres
General Services Administration's Construction and Operation of the Proposed U.S. Department of State, Bureau of Diplomatic Security Foreign Affairs Security Training Center	Virginia FO May 2015	14 total individuals in the form of harm or harassment (5 individuals during the late summer and fall of 2015 during construction 8 individuals during winter season vegetation clearing 1 individual could be taken as a result of noise levels from proposed operations)	
Shawnee NF Harris Branch Project	Marion Illinois Sub-Office June 2015		225 acres
Savannah District, Corps of Engineers Nationwide Permit Program in Georgia	Georgia FO June 2015		1,000 acres of forested land annually
New York State Department of Transportation	New York FO June 2015	Small number of pups	Associated with no more than 4.66 acres of potential NLEB habitat All other anticipated incidental take is exempt by the 4d rule
USFS Southern Region	Region 4	25,735 Harass adults	486,498 acres annually of

Forest Land and Resource Management Plans	July 2015	and volant juveniles 5,666 Harm non-volant juveniles	harassment between April and October 318,771 acres annually for harm (overlaps with harassment acres) occurring between May1 – July 15
Savannah District, Corps of Engineers; Russell Creek Reservoir	Georgia FO July 2015		180 acres of forested habitat
Georgia Farm Services Agency Programs	Georgia FO July 2015		1,000 acres over the next 5 years
Middle Tennessee Natural Gas Utility District	Tennessee FO September 2015	1 NLEB per year	32.5 acres of suitable roosting and or foraging habitat (25.4 acres of this being swarming habitat)