FINAL

BIOLOGICAL OPINION

On the Effects of the

Programmatic Forest Management Plan for Potential Indiana Bat Habitat Areas on Wildlife Management Areas for which the West Virginia Division of Natural Resources, Wildlife Resource Section Has Forest Management Authority

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INTRODUCTION

The U.S. Fish and Wildlife Service (Service) West Virginia Field Office (WVFO) is providing this final Endangered Species Act intra-Service section 7 Biological Opinion (BO) to the Service Wildlife and Sport Fish Restoration Program (WSFRP) and the West Virginia Division of Natural Resources, Wildlife Resource Section (WVDNR WRS) pertaining to the Programmatic Forest Management Plan for Potential Indiana Bat Habitat on Wildlife Management Areas for which the West Virginia Division of Natural Resources, Wildlife Resources Section has Forest Management Authority (Programmatic Forest Management Plan). The WVDNR WRS is the recipient of Federal Aid grant monies under the Pittman-Robertson Wildlife Restoration Act (50 Stat. 917; 16 U.S.C. 669-669i) administered by the WSFRP. The WVDNR WRS will implement, monitor and report annually on the proposed actions contained in the Programmatic Forest Management Plan over a 10-year period on 62 wildlife management areas (WMA) located throughout West Virginia. In the associated Memorandum, WSFRP, with WVDNR WRS's agreement, requested the draft Endangered Species Act intra-Service section 7 BO be finalized on the Programmatic Forest Management Plan prior to implementation of any forest management practices. If any modifications are made to the proposed Programmatic Forest Management Plan, or if new species become listed or critical habitat is designated, or if additional information on federally listed and proposed species becomes available, the determination in the BO may be reconsidered.

CONSULTATION HISTORY

This formal intra-Service section 7 consultation is being conducted with the WSFRP pertaining to their Federal Aid in Wildlife Restoration Act grant funding awarded to WVDNR WRS. Prior to submission of the document, the WVFO and the WVDNR WRS worked closely together numerous times in person and by telephone during the development of the Biological Assessment (BA) pertaining to the proposed Programmatic Forest Management Plan.

Subsequently, on June 1, 2011, the WVDNR WRS provided a BA to the WVFO and requested the Service's review and evaluation of the potential effects implementation of the proposed actions contained in the Programmatic Forest Management Plan may have on the federally endangered Indiana bat (*Myotis sodalis)* and designated critical habitat. The WVDNR WRS is proposing to conduct a variety of forest management practices that include a) non-commercial and commercial timber management practices (i.e., even-aged, two-aged, uneven-aged, and combination timber harvests, b) prescribed fire, and c) herbicide applications in multiple WMAs each year. The WVDNR WRS determined that some proposed actions "may affect", and are "likely to adversely affect" the Indiana bat, and other proposed actions "may affect" and are "likely to benefit" the Indiana bat, and requested initiation of formal Endangered Species Act section 7 consultation.

On August 23, 2011, the WVFO coordinated with Dr. John McDonald, WSFRP Wildlife Research Specialist, regarding the WVDNR WRS request for funding through the Federal Aid in Wildlife Restoration Act and the potential to conduct an Endangered Species Act intra-Service section 7 consultation on the WVDNR WRS proposed forest management practices. On

November 10, 2011, WVFO received an email from Dr. McDonald confirming that these WMA forest management practices were eligible to receive Federal Aid funding for implementation under the Federal Aid in Wildlife Restoration Act (50 Stat. 917; 16 U. S. C. 669-669i).

Following the November notification of eligibility, the WVFO had additional numerous discussions with the WVDNR WRS to clarify the scope and extent of the proposed actions and to finalize the descriptions of the activities in the proposed Programmatic Forest Management Plan.

On October 4, 2012, the WVDNR WRS met with representatives from the WVFO to discuss their request for an increase in the total amount of acreage for a variety of forest management practices over a 10-year period. The WVDNR WRS submitted an updated BA in December 2012. The WVFO has evaluated this increase request and the potential impacts to the Indiana bat.

The WVFO has reviewed and assessed the potential impacts to the Indiana bat from implementation of the proposed forest management practices, and is providing the following final BO pertaining to these proposed actions contained in the WVDNR WRS Programmatic Forest Management Plan. The WVFO has provided a copy of this final BO the WVDNR WRS.

FINAL BIOLOGICAL OPINION

Pursuant to section 7 of the Endangered Species Act (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) the WVFO is formally consulting on the proposed Programmatic Forest Management Plan. The Programmatic Forest Management Plan contains a variety of forest management practices to include a) non-commercial and commercial forest management practices (i.e., even-aged, two-aged, uneven-aged, and combination timber harvests), b) prescribed fire, and c) herbicide applications that will be implemented in multiple West Virginia WMAs each year over a 10-year period by the WVDNR WRS.

All forested WVDNR WRS-managed lands are potential summer habitat for the Indiana bat. The WVDNR WRS has been unable to avoid potential adverse effects to the Indiana bat by implementing large scale forest management practices during the period when Indiana bats are hibernating due to inclement weather conditions and the associated environmental issues such as soil erosion and stream sedimentation.

The endangered Indiana bat may be adversely impacted from implementation of these practices. In this final Biological Opinion (BO) the Service has assessed potential impacts to the Indiana bat and designated critical habitat from implementation of the proposed actions over a 10-year period as described in the Programmatic Forest Management Plan.

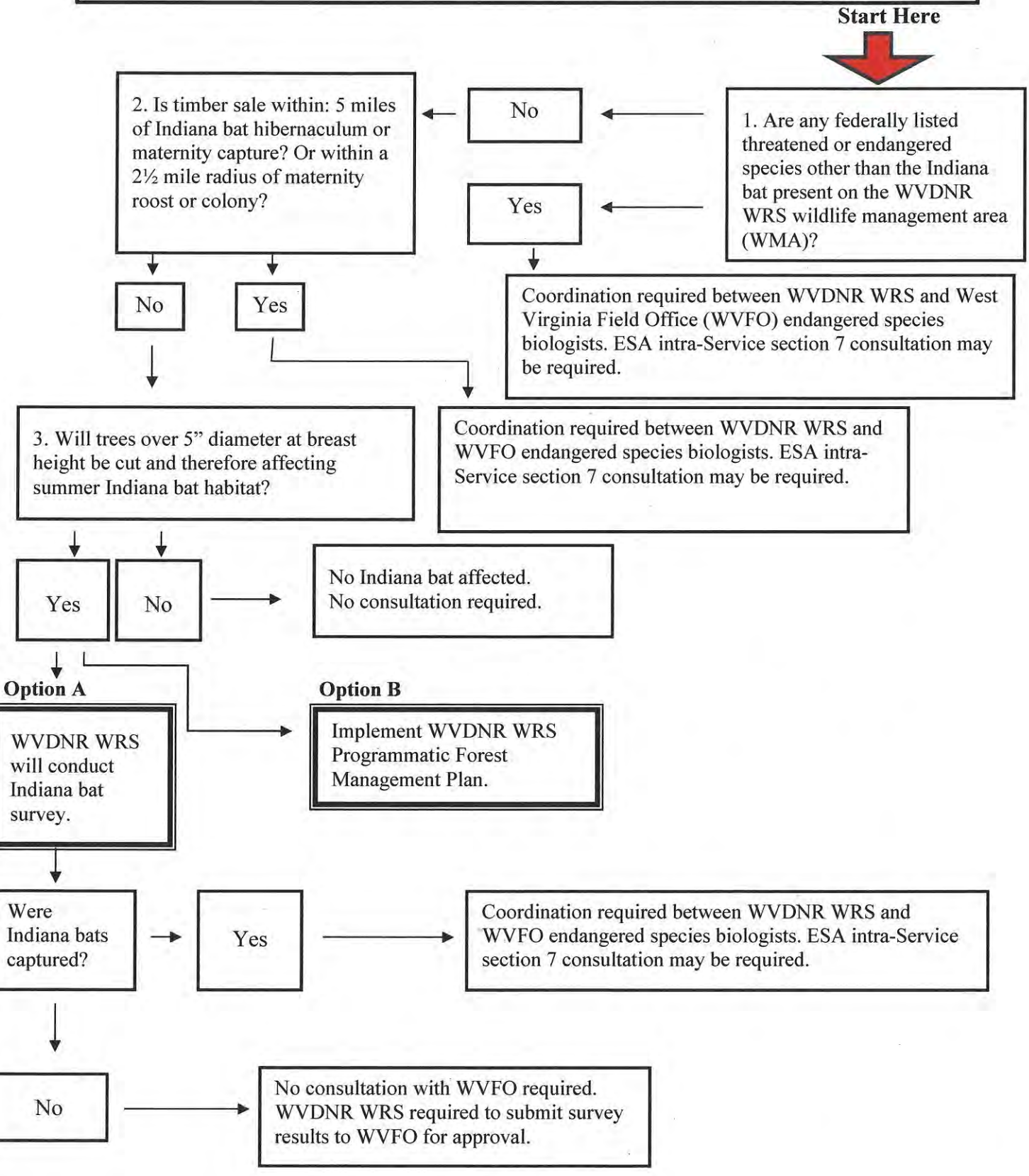
The WVDNR WRS and WVFO developed a flow chart (Figure 1) to guide decision making and coordination between WVDNR WRS and WVFO pertaining to proposed implementation of activities in the Programmatic Forest Management Plan.

Proposed actions that may affect any other federally listed endangered or threatened species that may occur on West Virginia's WMAs are not addressed in this intra-Service section 7 consultation with the WSFRP, and separate consultations may be required (Step 1-Yes).

In addition, proposed actions that will be implemented within areas known to support the Indiana bat, including known maternity, hibernacula, and/or swarming areas, are not addressed in this consultation, and separate consultations may be required (Step 2-Yes).

If projects that will not affect other species are outside these known occupied areas, and if these same projects will be affecting potential Indiana bat summer habitat by cutting trees greater than 5" diameter at breast height (DBH), then the WVDNR WRS has the option of either doing project specific surveys to determine whether Indiana bats are present, or assuming presence and implementing the Programmatic Forest Management Plan (Step 3-Yes: Option A or Option B). If bat surveys are conducted, no Indiana bats are detected and take is not anticipated, then associated timber sale acreages will not apply to the annual or 10-year harvest acreage limitations associated with the incidental take statement of this BO.

Figure 1. This key summarizes West Virginia Division of Natural Resources Wildlife Resources Section (WVDNR WRS) steps for including proposed forest management practices in the Programmatic Forest Management Plan.



Overview

The WVDNR WRS is responsible for, among other duties, the conservation, protection, and use of West Virginia's natural resources. West Virginia has 62 WMAs located throughout the State in which the WVDNR WRS has forest management authority. These total approximately 280,823 acres (113,648 hectares [ha]) and are either owned by the WVDNR WRS or are under license agreement with the U.S. Army Corps of Engineers (Corps), so that WVDNR WRS personnel may conduct forest management practices, including non-commercial and commercial forest management practices, prescribed fire, and herbicide applications.

Approximately 91 percent (256,007 acres [103,605 ha]) of the lands on these State-owned and leased WMAs is forested, with some areas being upwards of 98 percent forested. WVDNR WRS personnel manage these forest resources to: 1) create and/or enhance a diversity of wildlife habitat using a variety of forest and wildlife management techniques; and 2) harvest and market the timber resources utilizing sound silvicultural methods according to State guidelines. WVDNR WRS timber harvests and sales are intended to maintain or regenerate forest mast-producing species, improve habitat diversity, create openings for food plots and/or brood range, develop hunter access roads and trails, and improve wildlife food and cover through a broad application of management techniques and silvicultural treatments.

DESCRIPTION OF PROPOSED ACTION

The WVDNR WRS is proposing to conduct forest management practices during a 10-year period on 62 WMAs to include non-commercial and commercial forest management practices on approximately 7,000 to 20,000 acres (2,832 to 8,093 ha) with a maximum of 2,000 acres (809 ha) annually, and up to 12,000 acres (4,856 ha) of prescribed fire with a maximum of 1,200 acres (485 ha) annually. In addition, the WVDNR WRS proposes to conduct herbicide applications associated with forest management activities on up to 30 acres (12 ha) per WMA treatment unit annually. Annual acreage limitations are based on the WVDNR WRS's fiscal year (July 1 to June 30). The number of acres that will be affected by these actions annually will be dependent on factors such as agency and inter-agency approvals, management needs on the WMAs, weather conditions, and wood industry markets.

The WVDNR WRS proposes to conduct these commercial timber sales on an average of 15 WMAs and a maximum of 25 WMAs annually. The WVDNR WRS may combine non-commercial forest management practices to create projects that annually affect up to 300 acres (0.4 and 121 ha) per WMA. Table 1 summarizes the type of forest management practices and associated annual acreage the WVDNR WRS proposes to implement on the WMAs.

Table 1. These potential WVDNR WRS forest management practices may be implemented on West Virginia wildlife management areas.

Forest Management Practice	Expected Size Per Treatment Unit Within a WMA*
Non-Commercial Forest Management Practice	
Early Successional Habitat Creation	1 to 25 acres (0.40 to 10 ha)
Savannah Development	2 to 15 acres (1 to 6 ha)
Wildlife Clearing Development	1/10 to 4 acres (0.04 to 2 ha)
Crop Tree Release	1 to 30 acres (0.40 to 12 ha)
Timber Stand Improvement	1 to 20 acres (0.40 to 8 ha)
Cut-back Border or Edge Cut	≤10-100 feet (3 to 31 meters [m]) to 10 acres (4 ha)
Commercial Timber Sales	
Clear-cut	3 to 25 acres (1 to 10 ha)
Shelterwood**	5 to 100 acres (2 to 41 ha)
Seed Tree Cut**	5 to 25 acres (2 to 10 ha)
Clear-cut with Reserves	5 to 25 acres (2 to 10 ha)
Variable Retention Harvest	5 to 25 acres (2 to 10 ha)
Group Selection	1 to 25 acres (0.40 to 10 ha)
Single Tree Selection	1 to 50 acres (0.5 to 20 ha)
Total Annual Timber Management Per WMA	Up to 300 acres (121 ha)***
Total Prescribed Fire Per WMA	Up to 200 acres (81 ha)
Total Herbicide Application Per WMA Treatment Unit	Up to 30 acres (12 ha)

*There could be multiple treatment units within a single WMA.
**Shelterwood and seed tree harvest methods may by conducted in multiple phases (i.e. 2-3 canopy removals) during the 10 year plan period. These timber sales will only be counted toward the acreage limitations at the time of the initial harvest.
***Timber sale acreages will be determined and applied toward the cap limitations at the time of completion of timber sale boundary delineation and timber cruising and tree marking efforts. Due to various factors (i.e. weather, extended harvest windows) it is impractical to apply acreage levels to the cap limitations at the time of harvest.

Proposed WVDNR WRS Conservation Measures for Indiana Bat

The WVDNR WRS has included conservation measures in their proposed action for non-commercial forest management practices and commercial timber sales. These measures are designed to avoid or minimize impacts to the Indiana bat, to monitor the effects of the project on the species, and to contribute to the recovery of the species through the development of protection and enhancement measures for the species. These measures are more fully described in the Biological Assessment on pages 12 through 21 (WVDNR WRS 2012).

- Application of no-cut policy for shagbark hickory.
- Application of no-cut policy on snags greater than 5 inches (13 centimeters [cm]) diameter at breast height (DBH), unless snag poses a safety hazard or conflicts with OSHA regulations.
- Application of seasonal cutting restriction. No cutting from April 1 to August 15[1] for some harvest methods dependent on size of cutting unit, predominant forest type and other factors as described in the BA.
- Maintenance of uncut forested travel corridors between cutting units within project area, where applicable terrain or project design permits (e.g. right-of-ways, adjacent land ownership, wetlands, etc.).
- Construction of waterholes with a minimum of 1 per 50 acres (20 ha) of commercial timber harvest area.
- Creation of bat forage corridors on haul and skid roads in reclaimed herbaceous vegetation.
- Buffering of riparian areas with a 100-foot (31 meters [m]) streamside management zone where WVDNR WRS practices and equipment usage will be limited.

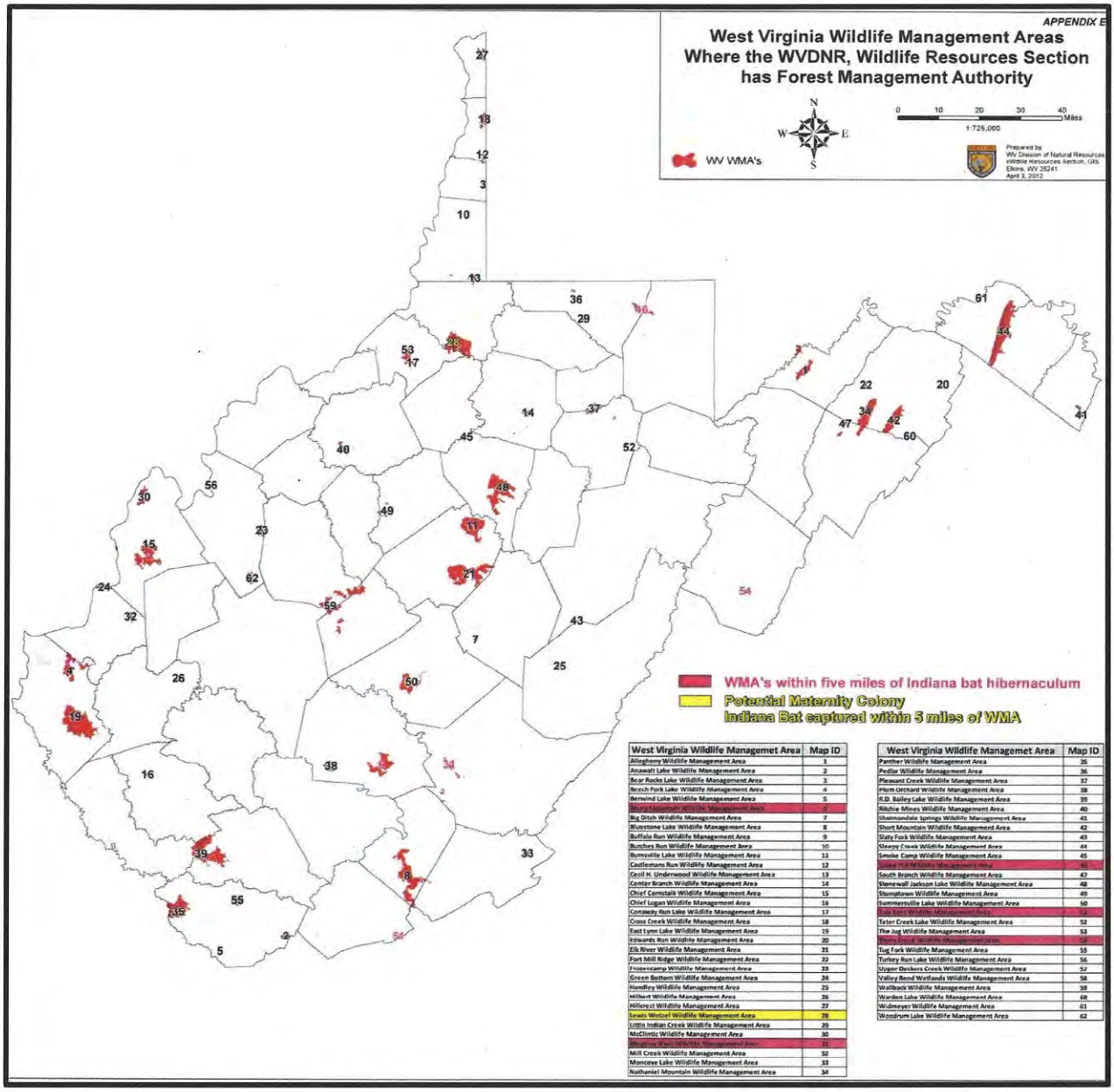
[1] Since the time of the draft BA, the cutting restriction date has been changed from August 1 to August 15.

Action Area

As defined in 50 CFR 402.02, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States. The "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 direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present Federal, State, or private activities within the action area, as well as cumulative effects of future Federal, State or private activities that are reasonably certain to occur within the action area.

For the purposes of this BO, the action area includes 62 WMAs in the State for which the WVDNR WRS has forest management authority. Figure 2 shows the map of the action area, i.e., the 62 WMAs in West Virginia.

Figure 2. The action area includes these West Virginia wildlife management areas.



West Virginia Wildlife Managemet Area	Map ID
Allegheny Wildlife Management Area	1
Anawalt Lake Wildlife Management Area	2
Bear Rocks Lake Wildlife Management Area	3
Beech Fork Lake Wildlife Management Area	4
Berwind Lake Wildlife Management Area	5
Big Ditch Wildlife Management Area	7
Bluestone Lake Wildlife Management Area	8
Buffalo Run Wildlife Management Area	9
Bunches Run Wildlife Management Area	10
Burnsville Lake Wildlife Management Area	11
Castlemans Run Wildlife Management Area	12
Cecil H. Underwood Wildlife Management Area	13
Center Branch Wildlife Management Area	14
Chief Cornstalk Wildlife Management Area	15
Chief Logan Wildlife Management Area	16
Conaway Run Lake Wildlife Management Area	17
Cross Creek Wildlife Management Area	18
East Lynn Lake Wildlife Management Area	19
Edwards Run Wildlife Management Area	20
Elk River Wildlife Management Area	21
Fort Mill Ridge Wildlife Management Area	22
Frosty Camp Wildlife Management Area	23
Green Bethen Wildlife Management Area	24
Handley Wildlife Management Area	25
Hilbert Wildlife Management Area	26
Hillcrest Wildlife Management Area	27
Lewis Wetzel Wildlife Management Area	28
Little Indian Creek Wildlife Management Area	29
McClintic Wildlife Management Area	30
Mill Creek Wildlife Management Area	32
Moncove Lake Wildlife Management Area	33
Nathaniel Mountain Wildlife Management Area	34

West Virginia Wildlife Managemet Area	Map ID
Panther Wildlife Management Area	35
Pedlar Wildlife Management Area	36
Pleasant Creek Wildlife Management Area	37
Plum Orchard Wildlife Management Area	38
R.D. Bailey Lake Wildlife Management Area	39
Ritchie Mines Wildlife Management Area	40
Shannondale Springs Wildlife Management Area	41
Short Mountain Wildlife Management Area	42
Slaty Fork Wildlife Management Area	43
Sleepy Creek Wildlife Management Area	44
Smoke Camp Wildlife Management Area	45
South Branch Wildlife Management Area	47
Stonewall Jackson Lake Wildlife Management Area	48
Stumptown Wildlife Management Area	49
Summersville Lake Wildlife Management Area	50
Teter Creek Lake Wildlife Management Area	52
The Jug Wildlife Management Area	53
Tug Fork Wildlife Management Area	55
Turkey Run Lake Wildlife Management Area	56
Upper Deckers Creek Wildlife Management Area	57
Valley Bend Wetlands Wildlife Management Area	58
Wallback Wildlife Management Area	59
Warden Lake Wildlife Management Area	60
Widmeyer Wildlife Management Area	61
Woodrum Lake Wildlife Management Area	62

STATUS OF THE SPECIES

Life History

The Indiana bat is a medium-sized brownish bat in the genus *Myotis.* Its forearm length is 1 3/8 to 1 5/8 inches (35 to 41 millimeters [mm]), and the head and body length ranges from 1 5/8 to 1 7/8 inches (41 to 48 mm). This species closely resembles the little brown bat (*M. lucifugus*) and the northern long-eared bat (*M. septentrionalis*).

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

The Indiana bat is a migratory bat, hibernating in caves and mines in the winter and spending the summer in forested habitats. In the next section we provide summaries of habitat requirements for Indiana bats. The Indiana Bat Recovery Plan (Service 2007) provides a more comprehensive summary and is incorporated by reference.

Winter Hibernation

During winter, Indiana bats are restricted to suitable underground habitats known as hibernacula. The majority of hibernacula consist of limestone caves, especially in karst areas of the east central United States, but abandoned underground mines, railroad tunnels, and even hydroelectric dams can provide winter habitat throughout the species' range (Service 2007). In New York, the largest populations of Indiana bats occur in abandoned underground mines (Hicks and Novak 2002). Caves or mines must possess certain characteristics to be suitable as Indiana bat hibernacula. Raesly and Gates (1986) compared microhabitat and microclimate variables between occupied and unoccupied caves and mines. They found that Indiana bat hibernacula tended to have larger openings, more cave passage length, and higher ceilings compared to unoccupied sites. In addition, occupied hibernacula have noticeable airflow (Henshaw 1965). Once Indiana bats enter hibernation, they require specific roost sites in caves or mines that reach appropriate temperatures (Tuttle and Taylor 1994). Indiana bats choose roosts with a low risk of freezing. Stable, low temperatures allow the bats to maintain a low metabolic rate and conserve fat reserves until they are ready to emerge in spring; thus, Indiana bats select roosts within hibernacula that best meet their needs for cool temperatures. Indiana bat hibernacula usually host other species of bats. Indiana bats are occasionally observed clustered with or adjacent to other species, including gray bats (*M. grisecens*), Virginia big-eared bats (*Corynorhinus townsendii virginianus),* little brown bats, and northern long-eared bats (Myers 1964, LaVal, 1980).

Indiana bats cluster and hibernate on cave ceilings in densities of approximately 300 to 484 bats per square foot, from approximately mid-November through late March. The season of hibernation may vary by latitude and annual weather conditions. Clusters may protect central individuals from temperature change and reduce sensitivity to disturbance. Like other cave bats, the Indiana bat naturally arouses at intervals of 7 to 14 days during hibernation (Sealander and Heidt 1990). Arousals are more frequent and longer at the beginning and end of the hibernation period (Sealander and Heidt 1990).

Spring Emergence and Migration

Female Indiana bats emerge first from hibernation in late March or early April, followed by the males (Hall 1962). 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 (Service 2007). The timing of annual emergence may vary across their range, depending on latitude and annual weather conditions. However, most Indiana bats have left their hibernacula by late April (Hall 1962). Exit counts from several hibernacula in southern Pennsylvania and Big Springs Cave in Tucker County, West Virginia, suggest that peak emergence from hibernation is mid-April for these two areas (Butchkoski and Hassinger 2002; Rodrigue 2004). Spring surveys of the interior of Barton Hill Mine in New York documented substantial numbers of Indiana bats through April and into mid-May, then, by the end of May only one-tenth of the population remained (Hicks 2004).

In spring when fat reserves and food supplies are low, migration is probably hazardous (Humphrey *et al.* 1977, Tuttle and Stevenson 1977, Britzke *et al.* 2006). Consequently, mortality may be high in early spring, following emergence. Perhaps this is one reason why many males do not migrate far from the hibernacula (Gardner and Cook 2002, Whitaker and Brack 2002). Some males remain within the vicinity of their hibernacula, where they roost and forage in open forests and agricultural lands and other openings (Brack 2006). Movements of 3 to 10 miles (4 to 17 kilometers [km]) by male Indiana bats were reported in Kentucky, Missouri, and West Virginia (Hobson and Holland 1995, Rommé *et al.* 2002). However, other males leave the area entirely upon emergence in the spring and have been captured throughout various summer habitats.

Indiana bat females can migrate hundreds of miles from their hibernacula. Kurta and Murray (2002) documented female Indiana bats migrating over 200 miles (321 km) from their hibernacula to their maternity area and Gardner and Cook (2002) documented migratory distances in excess of 300 miles (482 km) for females traveling from hibernacula to maternity areas. Conversely, recent radio-telemetry studies of spring emerging Indiana bats (primarily females) from three New York hibernacula found that these bats migrated less than 40 miles (64 km) to their summer habitat (Service 2007), indicating that migratory distance may not be consistent across the species range.

Female Indiana bats may leave immediately for summer habitat or linger for a few days near the hibernaculum. Once enroute to their summer destination, females have been documented to move quickly across the landscape. One female released in southeastern New York was documented to move 35 miles (56 km) in approximately 85 minutes (Sanders *et al.* 2001).

Radio-telemetry studies in New York documented females flying between 10 to 30 miles (17 to 48 km) after release from their hibernaculum, arriving at their maternity sites within one night (Sanders *et al.* 2001, Hicks 2004) and in some cases reaching their summer destination within hours of the release (Service 2007). One radio-tagged bat released from Canoe Creek Mine in Pennsylvania, traveled approximately 60 miles (97 km) in one evening (Service 2007).

Little information is available to determine habitat use and needs for Indiana bats during migration, although recent spring emergence telemetry studies in New York and Pennsylvania are beginning to document migratory routes in the Northeast (Service 2007). In the core of their range, most pregnant females migrate north for the summer (Gardner and Cook 2002). In the northeastern part of their range, Indiana bats migrate in all directions to summer habitat. In Watertown, New York, Indiana bats migrated short distances of (less than 11 miles [18 km]) north, west and south of their hibernaculum (Service 2007). In the Lake Champlain Valley of New York and Vermont, female Indiana bats migrated east and southeast of their hibernaculum (Hicks 2004). Roost trees used by adult females during this mid-spring period are similar to those used during the summer in terms of species, size, and structure (Britzke *et al.* 2006). While Indiana bats primarily roost in trees, some colonies have been found in artificial roost sites (USFWS 2007).

Summer

Upon arriving at their summer habitat, female Indiana bats form colonies with primary and alternate roosts trees, give birth to young, raise pups until they fly (volant) and are independent, forage intensively to restore depleted fat reserves, and depart in late summer and fall to migrate to their hibernacula to mate and eventually hibernate. Less is known about the male activity patterns; males may summer near the hibernacula (Whitaker and Brack 2002) or disperse throughout the range. Males roost individually or in small numbers in the same types of trees and in the same areas as females. Non-reproductive females may also roost individually or in small numbers and occasionally are found roosting with reproductive females. Far less is known about the summer habits of males and non-reproductive females; therefore, the following section is primarily focused on summer life history aspects of reproductive females.

Reproductive females arrive at their summer habitats as early as mid-April in Illinois, New York and Vermont (Gardner *et al.* 1991a, Britzke 2003, Hicks 2004). During this early spring period, a number of roosts, including small cavities, may be used temporarily. Traditional summer sites that maintain a variety of suitable roosts are essential to the reproductive success of local populations. It is not known how long or how far female Indiana bats will search to find new roosting habitat if their traditional roost habitat is lost or degraded during the winter. If Indiana bats are required to search for new roosting habitat in the spring, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration and pregnancy.

As the summer progresses, female Indiana bats begin to congregate and form colonies. A single Indiana bat maternity colony can vary greatly in size and colony members may be dispersed among various roosts at any given time (Kurta 2004). While most documented maternity colonies contained 100 or fewer adult bats (Harvey 2002), as many as 384 bats have been

reported emerging from one maternity roost tree in Indiana (Service 2007). Recent counts at well-studied colonies (with at least 3 years of data) in Indiana and Vermont resulted in maximum emergence counts of 104 and 270 adult females, respectively (Indianapolis Airport Authority 2003, Watrous *et al.* 2006). Whitaker and Brack (2002) indicated that average maternity colony size in Indiana was approximately 80 adult bats. The mean maximum emergence count after young become volant at 12 study areas was approximately 119 bats, indicating 60 to 70 adults in a primary roost at any given time (Kurta 2004).

This colonial roosting behavior is well documented for Indiana bat females at maternity colonies. Barclay and Kurta (2004) suggested four potential explanations for female aggregation (establishment of maternity colonies) in the summer: 1) roosts are limited; 2) foraging efficiency; members of a colony communicate regarding good foraging areas; 3) anti-predator mechanism; and 4) thermoregulation. Although there are probably many advantages to colonial roosting, the most important factor for Indiana bats is probably its thermoregulatory benefits (Humphrey *et al.* 1977; Kurta *et al.* 1996). Pups and adults in late pregnancy are poor thermoregulators (Speakman and Thomas 1983), and pre- and post-natal growth is controlled by metabolism and body temperature (Racey 1982). In the absence of clustering, the strict thermal conditions needed to support pre-natal and post-natal growth would not exist. Thus, colonial roosting is a life history strategy adopted by Indiana bats (like many other temperate zone bats) to improve their reproductive success (Barclay and Harder 2003). While there may be a loss of these communal benefits below a threshold colony size, it remains an important component of Indiana bat behavior (Racey and Entwistle 2003; Callahan 1993; Gardner *et al.* 1991b).

Indiana bat maternity roosts can be described as "primary" or "alternate" based upon the proportion of bats in a colony consistently occupying the roost site (Kurta *et al.* 1996, Kurta *et al.* 2002, Callahan *et al.* 1997). Primary roost trees are almost always located in either open canopy sites or in the portion of a tree that is above the canopy cover of the adjacent trees (Callahan *et al.* 1997, Kurta *et al.* 2002). Alternate roost trees can occur in either open or closed canopy habitats, and may be used when temperatures are above normal or during precipitation. Shagbark hickories are good alternate roosts because they are cooler during periods of high heat and tight bark shields the bats from rain (Service 1999).

Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by the majority of bats for some or all of the summer (Callahan 1993, Callahan *et al.* 1997). Before the young are volant, the composition of a colony at a primary roost fluctuates, as individual bats leave and return (Service 2007). Kurta *et al.* (2002) observed that certain maternity roost trees were occupied by a "quasi-stable number of Indiana bats for days or weeks" at a time. During their observations of these roost trees, individuals (based on radio-telemetry data) were found to move consistently into and out of the trees.

Alternate roosts are used by individuals or a small number of bats and may be used intermittently throughout the summer or used on only one or a few days. Most roost trees (except live trees) eventually become unusable by losing bark, falling over, or through competition with other animals. Typically these events occur suddenly and without warning (Gardner *et al.* 1991a, Kurta and Foster 1995, Belwood 2002). The use of alternate roosts may be a way of discovering new

primary roosts since Indiana bats must maintain an awareness of suitable replacements in case of an emergency (Kurta *et al.* 1996, Kurta *et al.* 2002). Numerous studies documenting roost trees used by individuals in a colony identified a range of alternate roosts. For example, based on Callahan's (1993) primary roost definition, Watrous *et al.* (2006) documented 9, 12, and 14 alternate roost trees for three different colonies in the Lake Champlain Valley of Vermont and New York.

On average, Indiana bats switch roosts every two to three days although the reproductive condition of the female, the roost type, and time of year, will affect switching behavior (Kurta *et al.* 2002, Kurta 2004). Lactating females may change roosts less often than pregnant or post-lactating females. Bats roosting under exfoliating bark may change more often than bats roosting in crevices (Kurta *et al.* 1996, Gumbert *et al.* 2002, Carter 2003, Kurta 2004). Roost switching occurs less often in the spring, most likely due to colder night temperatures that may induce extended torpor (Gumbert *et al.* 2002, Britzke *et al.* 2006).

A variety of tree species is used for roosts including, but not limited to, silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), eastern cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), shingle oak (*Quercus imbricaria*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), and sassafras (*Sassafras albidum*) (Rommé *et al.* 1995). Structure is probably more important than the species in determining if a tree is a suitable roost site.

Tree structure, specifically the availability of exfoliating bark with roost space underneath, is a critical characteristic for roost trees. A majority of bat roosts have been located in dead or dying trees, although some roost sites have been in living trees. Indiana bat use of snags appears to be influenced by bark characteristics. The ability of a tree species to produce exfoliating bark probably influences Indiana bat use of that tree (Britzke *et al.* 2003, Callahan *et al.* 1997).

Maternity colonies are rarely found in tree cavities, and most primary maternity roosts have been located under exfoliating bark. However, studies from Michigan and Missouri that compared the amount of exfoliating bark and Indiana bat use, found snags with more exfoliating bark may not be used more than snags with little exfoliating bark (Kurta *et al.* 1996, Callahan *et al.* 1997). Indiana bats may pick maternity roosts with high solar exposure to increase the roost temperature, which may decrease the fetal development time and speed juvenile growth (Callahan *et al.* 1997). However, because males do not need these high roosting temperatures to support reproduction (Callahan *et al.* 1997), they may seek cooler roosts to reduce their physiological expenditures. Callahan *et al.* (1997) considered roosts to be either open (exposed to solar radiation) or interior (greater than 50 percent canopy cover) and found that all primary roosts were in open snags. Roost height may vary with canopy cover in order to maintain a relatively constant level of solar exposure (Gardner *et al.* 1991b). Most primary roosts are found in large, dead trees, generally ranging in size from 12 to 30 inches (31 to76 cm) DBH (Romme *et*

al. 1995). In Vermont, maternity roosts ranged from 19 to 30 inches (48 to76 cm) DBH (Britzke *et al.* 2004). Alternate roost trees also tend to be large, mature trees, but tend to be somewhat smaller than primary roosts (7 to 33 inches) (18 to 83 cm) DBH (Romme *et al.* 1995).

Reproduction

Females give birth to a single young in June or early July (Easterla and Watkins 1969, Humphrey *et al.* 1977) while in their maternity colonies. As previously discussed, forming maternity colonies reduces thermoregulatory costs, which, in turn increases the amount of energy available for birthing and raising young (Barclay and Harder 2003). There are no documented occurrences in which a female Indiana bat has successfully given birth and raised a pup alone without the communal benefits offered by establishment of a maternity colony. Studies by Belwood (2002) show asynchronous births extending over a period of two weeks within one colony. This results in great variation in size of juveniles (newborn to almost adult size young) in the same colony. In Indiana, lactating females have been recorded from June 10 to July 29 (Whitaker and Brack 2002). Young Indiana bats are capable of flight (volant) within 3 to 5 weeks of birth (Mumford and Cope 1958, Easterla and Watkins 1969, Cope *et al.* 1974, Humphrey *et al.* 1977, Clark *et al.* 1987, Gardner *et al.* 1991a, Kurta and Rice 2002, Whitaker and Brack 2002). Young born in early June may be flying as early as the first week of July (Clark *et al.* 1987), others from mid to late July. Once young Indiana bats are volant, the maternity colony begins to disperse. The use of primary maternity roosts diminishes, although the bats stay in the maternity area prior to migrating back to their respective hibernacula. Bats become less gregarious and the colony utilizes more alternate roosts, possibly because there is no longer the need for the adult females to cluster for thermoregulation and to nurture their young (Indianapolis Airport Authority 2003 and 2004).

Traditional summer sites that maintain a variety of suitable roosts are essential to the reproductive success of local populations. It is not known how long or how far female Indiana bats will search to find new roosting habitat if their traditional roost habitat is lost or degraded during the winter. If they are required to search for new roosting habitat in the spring, this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration and pregnancy.

Although the preceding discussion provides a seasonal framework for Indiana bat reproduction, the timing of reproductive events is somewhat weather-dependent (Grindal *et al.* 1992, Lewis 1993, Racey and Entwistle 2003). Adverse weather, such as cold spells, increases energetic costs for thermoregulation and decreases availability of insect prey and hence, decreases energy gain. Bats respond to a negative energy balance by entering torpor; the resulting low body temperature slows biochemical reactions associated with fetal and juvenile growth and adult milk production, and may cause annual variation when young are born and fly.

Males

Many male Indiana bats appear to remain at or near the hibernacula in summer with some fanning out in a broad band around the hibernacula (Whitaker and Brack 2002). Males may roost individually or in groups in roost trees similar to those used by females. Males may occasionally roost in caves. Suitable roost trees typically have a large diameter, exfoliating bark, and

prolonged solar exposure with no apparent importance in regard to the tree species or whether it is upland or bottomland (Whitaker and Brack 2002). Because males may roost individually or in small groups, the average size of their roost trees tends to be smaller than roost trees used by female maternity colonies, and in one instance a roost tree only 3 inches (6 cm) in diameter was used (Gumbert *et al.* 2002). Male bats have also been observed using trees as small as 3 inches (8 cm) DBH (Service 2002). Also, males are more likely than females to be found in disturbed areas; possibly because the roost trees in those areas are likely to be too small for colony use, but still suitable for an individual roost (Brack 2006). One individual was found roosting on the Hoosier National Forest within the easement of I-64 (HNF 2000). Males have shown summer site fidelity and have been recaptured in foraging areas from prior years (Service 2007). In Pendleton County, West Virginia, a male Indiana bat was tracked to a roost tree at the edge of a field. Up to 40 bats were seen emerging from this tree. All bats captured were male Indiana bats. This tree was used by bats for at least 4 years before it fell down (Douglas, personal communication). At Camp Atterbury in Indiana, male bats were observed using the same bridges as females for night roosts, but they roosted individually (Kiser *et al.* 2002). In West Virginia, 88 Indiana bats were found roosting under a bridge with over 100 little brown bats. All Indiana bats that were examined were males (Stihler 2011).

Site Fidelity

Recent research indicates that Indiana bats exhibit site fidelity to their traditional summer maternity and foraging area. A number of studies documented female Indiana bats annually returning to the same general area to establish maternity colonies (Humphrey *et al.* 1977, Gardner *et al.* 1991a, Gardner *et al.* 1991b, Gardner *et al.* 1996, Callahan *et al.* 1997, Butchkoski and Hassinger 2002, Kurta and Murray 2002, Indianapolis Airport Authority 2003 and 2004). Gumbert *et al.* (2002) differentiated between roost tree and roost area fidelity in Indiana bats, and found that bats are faithful to both areas and particular trees within those areas. Roost trees, although ephemeral in nature, may be reoccupied by a colony for a number of years until the trees are no longer available or suitable. Roost tree reoccupation of between 2 to 6 years has been documented in a number of studies (Gardner *et al.* 1991b, Gumbert *et al.* 2002, Watrous 2006, Barclay and Kurta 2007).

Individual Indiana bats appear to be faithful to their foraging areas between years. Gardner *et al.* (1991a; 1991b) observed that females returned to the same foraging areas between years, irrespective of whether they were captured as juveniles and tracked as adults, or if they were captured as adults and then followed. A long-term study of Indiana bats at the Indianapolis Airport followed more than 40 bats between 1997 and 2004; all these bats foraged in the same general areas, although home ranges were distinct (Sparks *et al.* 2004). Bats were found to move through their foraging habitat so predictably that researchers with receivers were able to move into an area prior to the bat arriving (Sparks *et al.* 2004). On one occasion, data was collected for the same bat in two different years. Roosting and foraging habitat were remarkably consistent between years, including occasional nocturnal visits to a day roost on the opposite end of the colony's foraging range, despite the fact that the bat was pregnant when tracked in 2003 and lactating in 2004 (Sparks *et al.* 2004). In Michigan, Kurta and Murray (2002) recaptured 41

percent of females when mist netting at the same area in subsequent years. Further studies of this colony reported a wooded fence line was used as a commuting corridor for at least 9 years (Winhold *et al.* 2005; Kurta 2004).

Diet and Foraging Behavior

The Indiana bat feeds primarily on aquatic and terrestrial insects. Diet varies seasonally and variations exist among different ages, sexes, and reproductive status (Service 2007). Indiana bats begin emerging from the roost to forage shortly after sunset; although there is considerable variation in timing within a colony that is not related to light level, ambient temperature, or number of bats inside (Gardner *et al.*, 1991a, Viele *et al.* 2002). Observations of light-tagged animals and bats marked with reflective bands indicate that Indiana bats typically forage in closed to semi-open forested habitats and forests edges (Humphrey *et al.* 1977, LaVal *et al.* 1977, Brack 1983). Radio tracking studies also indicate that foraging usually occurs in various types of forest, including floodplain, riparian, lowland, and upland forest (Garner and Gardner 1992, Murray 1999, Butchkoski and Hassinger 2002, Murray and Kurta 2002b, Watrous 2006). Indiana bats hunt primarily around, not within, the canopy of trees, but they come down to sub-canopy and shrub layers on occasion. In riparian areas, Indiana bats primarily forage around and near riparian and floodplain trees, solitary trees, and the forest edge on the flood plain (Belwood 1979, Cope *et al.* 1974, Humphrey *et al.* 1977, Clark *et al.* 1987). Optimum canopy closures are 50 to 70 percent with relatively open understory (less than 40 percent of trees are 2 to 5 inches (5 to 12 cm) DBH (HNF 2000). Woody vegetation with a width of at least 98 feet (30 m) on both sides of a stream has been characterized as excellent foraging habitat.

Although forested habitats are very important for foraging bats, old fields and agricultural areas seem to also be somewhat important habitats in studies completed in Indiana (Service 2007). A study site near the Indianapolis International Airport, Sparks *et al.* (2005b) found Indiana bats spending nearly 51 percent of their time foraging over agricultural fields, with movements focused on a riparian corridor. Indiana bats, using open habitats for foraging at other sites, are probably utilizing forest-field edges and crowns of large scattered trees within the open canopy habitats. Foraging or commuting over open areas is uncommon (Brack 1983, Menzel *et al.* 2001).

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

Fall Swarming

Maternity colonies begin disbanding during the first two weeks in August, although large colonies in southern areas may contain a steadily declining number of bats into mid-September (Humphrey *et al.* 1977, Kurta *et al.* 1993). Even in northern areas, such as Michigan, a few Indiana bats may remain into late September and early October; these late migrants may be young-of-the-year (Kurta and Rice 2002). When arriving at their traditional hibernacula in

August through September, Indiana bats "swarm." Some male bats may begin to arrive at hibernacula as early as July. Females typically arrive later, and by September, numbers of males and females are almost equal.

Swarming is a critical part of the life cycle when Indiana bats converge at hibernacula, mate, and forage until sufficient fat reserves have been deposited to sustain them through the winter (Cope et al. 1977, Service 2007). Swarming behavior typically involves large numbers of bats flying in and out of cave entrances throughout the night, while most of the bats continue to roost in trees during the day. Body weight may increase by 0.07 ounces (oz.) (2 grams) within a short time, mostly in the form of fat. Swarming continues for several weeks and copulation occurs on cave ceilings near the cave entrance during the latter part of the period (Service 2007b). The time of highest swarming activity in Indiana and Kentucky has been documented as early September (Cope et al. 1977). By late September many females have entered hibernation, but males may continue swarming well in to October in what is believed to be an attempt to breed with late arriving females.

Indiana bats use roosts in spring and fall that are similar to those used in summer (Service 2007). However, because habitat is used by individuals rather than colonies, sites may be much smaller (Brack 2006). Females use smaller, more disturbed areas during swarming and staging than in summer in maternity colonies (Brack 2006). During fall, when bats swarm and mate at their hibernacula, male bats roost in trees nearby during the day and fly to the cave during the night. Studies have found males roosting in dead trees on upper slopes and ridge tops within a few miles of the hibernacula (Service 2007). In Jackson County, Kentucky, research showed fall roost trees tend to be located in canopy gaps created by disturbance (logging, wind throw, prescribed fire) and along edges (Gumbert et al. 2002). Fall roost trees are often exposed to sunshine (Service 2007). Within-year fidelity to fall roosts has been observed, where an individual bat uses an individual roost for an average of two to three days before moving to a new tree (Gumbert et al. 2002). Bats have been observed moving among multiple roosts in an area, using particular roosts alternatively (Gumbert et al. 2002).

Research is needed to determine how far bats will forage in the fall. Most bats tracked have stayed within 2 to 3 miles (3 to 5 km) of the hibernacula, but some have been found up to 11.1 miles (18 km) away from hibernacula in Pennsylvania (Chenger and Sanders 2007). Studies suggest that the majority of foraging habitat in spring and autumn is within 2 miles (3 km) of the hibernacula, but extends to 5 miles (8 km) or more. Therefore, it is not only important to protect the caves that the bats hibernate in, but also to maintain and protect the quality of roosting and foraging habitat within 5 miles (8 km) of each Indiana bat hibernaculum. Additional studies of fall swarming behavior are warranted to gain a better understanding of the bats' behavior and habitat needs during this part of its annual life cycle (Romme et al. 2002).

Review of Endangered Species Information

The Indiana bat was officially listed as an endangered species on March 11, 1967 (32 FR 4001), under the Endangered Species Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The Endangered Species Act of 1973 extended full protection to the species. Listing was warranted based primarily on large-scale habitat loss and degradation, especially at winter hibernation sites,

and significant population declines. The Service published a recovery plan in 1983. In April 2007, the Service released the *Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision* (Service 2007), which contains a detailed summary of the current status of the Indiana bat. In addition, the Service recently completed a Five-Year Review of the Indiana bat (Service 2009), which summarizes the current status of the species, progress towards recovery, and remaining threats to the bat. Both the draft Recovery Plan and Five-Year Review are available on the Service's Indiana bat Web site at *http://www.fws.gov/midwest/Endangered/mammals/inba/index.html* and are hereby incorporated by reference. The Five-Year Review found that all of the required recovery criteria for the Indiana bat had not been achieved and thus it should remain at its current 'endangered' status.

Critical Habitat and Priority Hibernacula

Critical habitat was designated for the species on September 24, 1976 (41 FR 14914). The following eleven caves and two mines in six states were listed as critical habitat:

- Illinois - Blackball Mine (LaSalle County)
- Indiana - Big Wyandotte Cave (Crawford County), Ray's Cave (Green County)
- Kentucky - Bat Cave (Carter County), Coach Cave (Edmonson County)
- Missouri - Cave 021 (Crawford County), Caves 009 and 017 (Franklin County), Pilot Knob Mine (Iron County), Bat Cave (Shannon County), Cave 029 (Washington County)
- Tennessee - White Oak Blowhole Cave (Blount County)
- West Virginia – Hellhole (Pendleton County).

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

Priority 1 (P1) – Essential to recovery and long-term conservation of the Indiana bat, Priority 1 hibernacula typically have: (1) a current and/or historically observed winter population greater than or equal to 10,000 Indiana bats, and (2) currently have suitable and stable microclimates. Priority 1 hibernacula are further divided into one of two subcategories, "A" or "B," depending on their recent population sizes. Priority 1A (P1A) hibernacula are those that have held 5,000 or more Indiana bats during one or more winter surveys conducted during the past 10 years. In contrast, Priority 1B (P1B) hibernacula are those that have sheltered greater than or equal to10,000 Indiana bats at some point in their past, but have consistently contained fewer than 5,000 bats over the past 10 years.

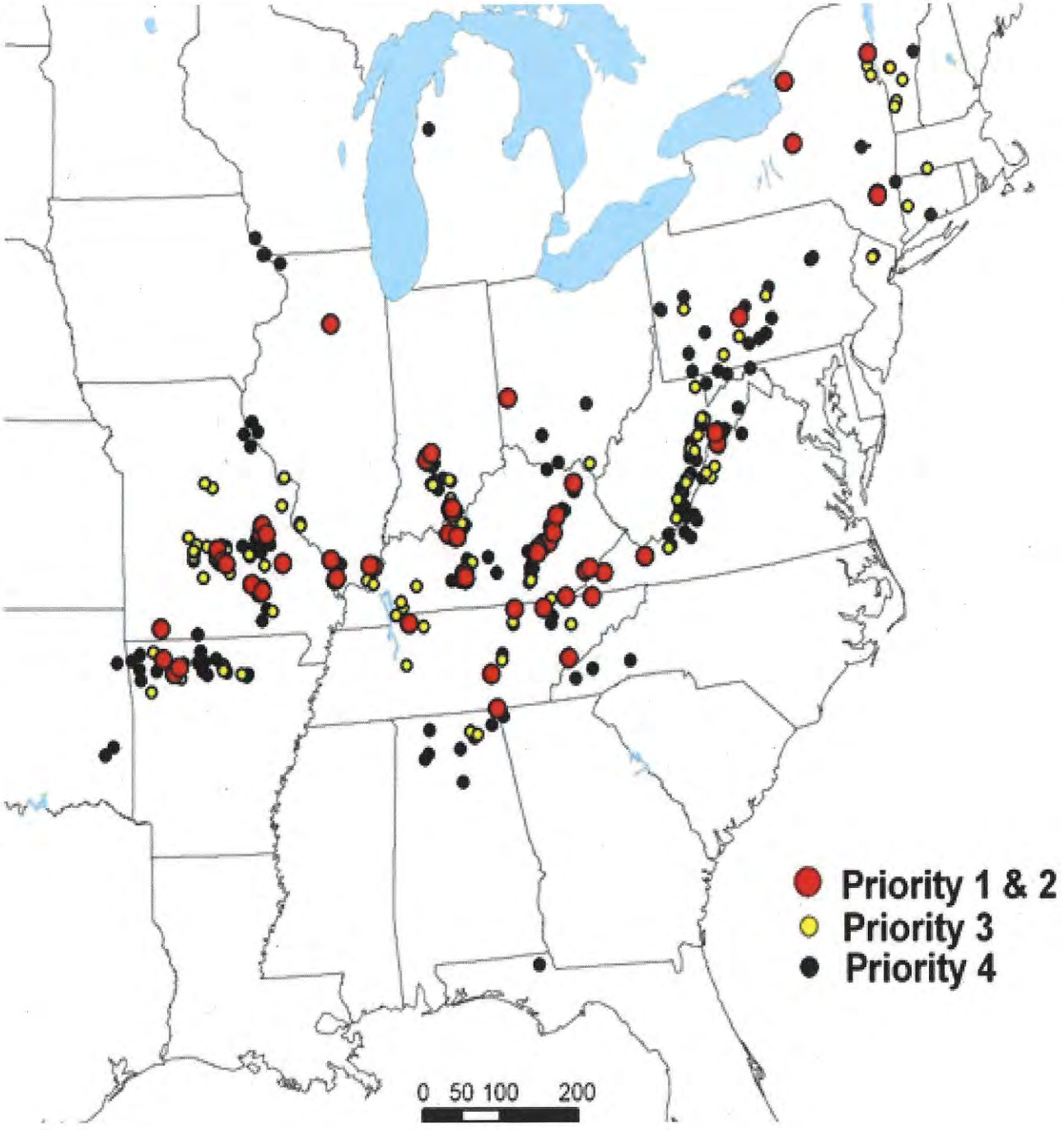
Priority 2 (P2) – Contributes to recovery and long-term conservation of the Indiana bat. Priority 2 hibernacula have a current or observed historic population of 1,000 or greater, but fewer than 10,000 Indiana bats, and an appropriate microclimate.

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

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

More than 85 percent of the range wide population occupies 23 P1 hibernacula in Illinois, Indiana, Kentucky, New York, Tennessee, Missouri, and West Virginia. P2 hibernacula are known in the aforementioned states, in addition to Alabama, Arkansas, Ohio, Pennsylvania, and Virginia. P3 hibernacula are known in 16 states. Hellhole in Pendleton County, West Virginia, is a P1 and Trout Cave, also located in Pendleton County, is a P2 hibernacula. The limestone region of West Virginia in Preston, Tucker, Randolph, Pendleton, Pocahontas, Greenbrier, Monroe and Mercer Counties contains approximately 28 other P3 hibernacula. Figure 3 displays the distribution of known Indiana bat hibernacula and their priority status.

Figure 3. This map indicates the distribution of known Indiana bat hibernacula and their current priority status (Service 2007).



Recovery Units

The Indiana Bat Draft Recovery Plan proposes four Recovery Units (RU) for the Indiana bat: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Service 2007). The Service's proposed delineation of RUs relied on a combination of preliminary evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in microhabitats and land use (Service 2000b).

In 2011, the Midwest RU contained 71.9 percent of the range-wide Indiana bat population followed by the Ozark-Central (16.7 percent), Appalachian (7.7 percent) and Northeast (3.8 percent) RUs (Service 2011). Between 2009 and 2011, the Indiana bat population increased in the Appalachian RU (+6.4 percent), Ozark-Central RU (+3.4 percent), Midwest RU (+8.3 percent) and the Northeast RU declined (-2.2 percent) (Service 2011). West Virginia falls within the Appalachian RU. Figure 4 identifies Indiana bat population estimates by RU from 2001-2011 (Service 2012) and Table 2 identifies Indiana bat rangewide population estimate for 2011 by Recovery Unit.

Figure 4. This figure summarizes the Indiana bat population estimates by Recovery Unit from 2001-2011 (Service 2011).

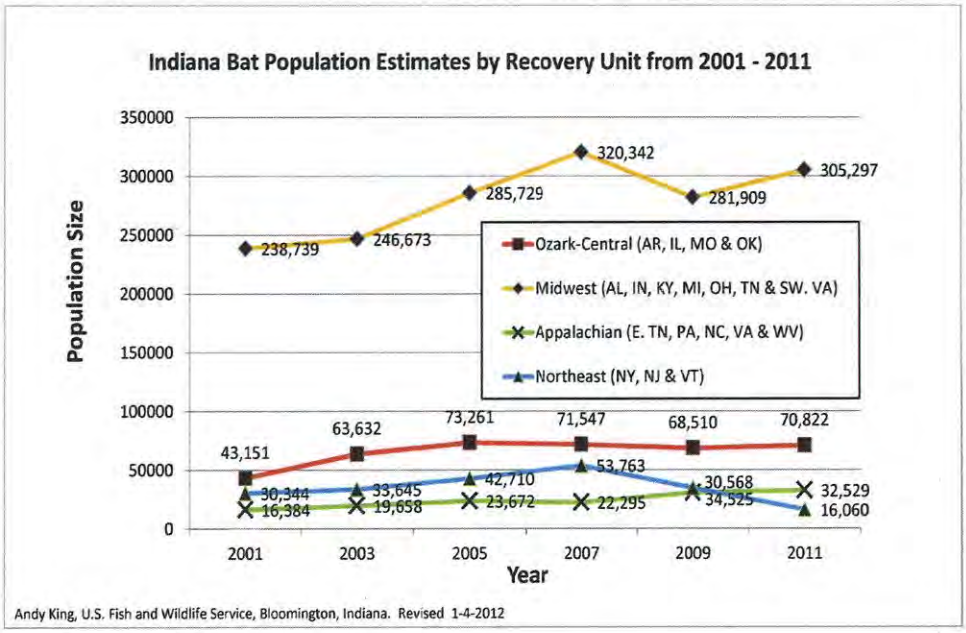


Table 2. This table provides the 2011 rangewide population estimate for the Indiana bat by Recovery Unit (Service 2011).

IBat Recovery Unit	State	2003	2005	2007	2009	2011	% Change from 2009	% of 2011 Total
Ozark-Central	Illinois	43,647	55,090	53,823	53,342	55,956	4.9%	13.2%
	Missouri	17,752	16,102	15,895	13,688	13,647	-0.3%	3.2%
	Arkansas	2,228	2,067	1,829	1,480	1,206	-18.5%	0.3%
	Oklahoma	5	2	0	0	13	0.0%	0.0%
	Total	**63,632**	**73,261**	**71,547**	**68,510**	**70,822**	**3.4%**	**16.7%**
Midwest	Indiana	183,337	206,610	238,068	213,170	222,820	4.5%	52.5%
	Kentucky	49,544	65,611	71,250	57,325	70,329	22.7%	16.6%
	Ohio	9,831	9,769	7,629	9,261	9,870	6.6%	2.3%
	Tennessee	3,246	3,221	2,929	1,663	1,690	1.6%	0.4%
	Alabama	265	296	258	253	261	3.2%	0.1%
	SW Virginia	430	202	188	217	307	41.5%	0.1%
	Michigan	20	20	20	20	20	0.0%	0.0%
	Total	**246,673**	**285,729**	**320,342**	**281,909**	**305,297**	**8.3%**	**71.9%**
Appalachian	West Virginia	11,443	13,417	14,745	17,965	20,358	13.3%	4.8%
	E. Tennessee	6,556	8,853	5,977	11,058	11,096	0.3%	2.6%
	Pennsylvania	931	835	1,038	1,031	518	-49.8%	0.1%
	Virginia	728	567	535	513	556	8.4%	0.1%
	North Carolina	0	0	0	1	1	0.0%	0.0%
	Total	**19,658**	**23,672**	**22,295**	**30,568**	**32,529**	**6.4%**	**7.7%**
Northeast	New York	32,529	41,745	52,779	34,045	16,052	-52.9%	3.8%
	New Jersey	644	652	659	416	5	-98.8%	0.0%
	Vermont	472	313	325	64	3	-95.3%	0.0%
	Total	**33,645**	**42,710**	**53,763**	**34,525**	**16,060**	**-53.5%**	**3.8%**
Rangewide Total:		**363,608**	**425,372**	**467,947**	**415,512**	**424,708**	**2.2%**	**100.0%**
	2-yr. Net Change:	**61,764**	**42,575**	**-52,435**	**9,196**			
	2-yr. % Change:	17.0%	10.0%	-11.2%	2.2%			

Threats to Species Recovery

Many of the previous declines in Indiana bat populations have been linked to habitat modifications at some of the most important hibernacula (Service 2007). Most of these modifications were human-induced via either commercialization of the cave, control of cave access, or mining. Improper gating and other structures have rendered many historical hibernacula unavailable to Indiana bats. Other documented threats involving hibernacula include human disturbance, vandalism, indiscriminate collecting, handling, and/or banding of hibernating bats, flooding of caves for reservoirs, and destruction by limestone quarries. Natural alterations of hibernacula can alter the temperature regime within the cave and even prevent entry by bats. Natural and human-induced changes to hibernacula can alter the climate required by Indiana bats, which adversely affects the population.

Land use practices have also been identified as a suspected cause in the decline of the Indiana bat, particularly because habitat in the bat's maternity range has changed dramatically from pre-settlement conditions. Indiana bats exhibit site fidelity to their traditional summer maternity and foraging areas, and are known to return to the same general area to establish maternity colonies from year-to-year (Humphry *et al.* 1977, Gardner *et al.* 1991a, Gardner *et al.* 1991b, Callahan *et al.* 1997, Indianapolis Airport Authority 2003 and 2004, Kurta and Murray 2002, Butchkoski and Hassinger 2002; Gardner *et al.* 1996). Roosting/foraging area fidelity may serve to increase the probability of successful reproduction, and to maintain social interactions between members of the population. Using familiar foraging and roosting areas, bats may have a decreased susceptibility to predators, an increase in foraging efficiency, and an improved ability to switch roosts if impacts occur to the original roost (Gumbert *et al.* 2002). In turn, site fidelity may also inhibit the ability of Indiana bats to explore and find new areas (Sparks *in* Service 2004). Due to the ephemeral nature of roosting sites, bats are probably not dependent on the continued suitability of an individual tree. However, landscape level alterations in traditional maternity habitats may adversely affect Indiana bat survival and reproductive success.

In addition to an increased focus on Indiana bat summer habitat, attention has also been directed to investigate pesticide exposure (Clark *et al.* 1987, Garner and Gardner 1992, Callahan *et al.* 1997, Romme *et al.* 1995, O'Shea and Clark 2002, Kurta and Murray 2002). Insecticides have been known or suspected as the cause of a number of bat die-offs in North America, including endangered gray bats in Missouri (Reidinger 1972, Clark and Prouty 1976, Clark *et al.* 1978). The insect diet and longevity of bats also exposes them to environmentally persistent organochlorine chemicals that may cause a bioaccumulation in body tissue and cause sub-lethal effects such as impaired reproduction (O'Shea and Clark 2002).

Collisions of bats with man-made objects have not been fully evaluated, but concern for bat mortality related to such collisions is growing, specifically with reference to collisions with turbines at wind-energy plants. Johnson (2005) reviewed bat mortality due to collisions with turbines at wind-energy developments in the United States. Eleven species of North American bats have been recorded among the mortalities with species from the genus *Lasiurs* forming a large proportion of the bats killed. There have been three documented mortalities of Indiana bats from wind-energy plants, two at the Fowler Ridge Wind Farm, LLC located in Indiana, and the third located in Pennsylvania at the North Allegheny Wind Facility (Service 2011). There is

growing concern regarding the potential for bat kills given the rapid proliferation of wind farming and the large-scale of unlisted mortality that has occurred at some facilities. Limited knowledge of the migratory behavior of bats limits our ability to understand and evaluate why bats are susceptible to striking wind turbines (Larkin 2006).

Bat collision mortalities have also been associated with communication towers and other man-made structures (Johnson 2005). For example, Martin *et al.* (2005) reported that since 1997 remains from more than 126 bats that collided with military aircraft have been processed. This figure probably largely underestimates total strikes as most of these incidents do not result in serious, if any, damage to the aircraft, and therefore are not consistently reported. Like collisions with wind turbines and communication towers, strikes with aircraft occur most often during the fall migration. Russell *et al.* (2002) verified that an Indiana bat was killed by collision with a vehicle on a Pennsylvania road. There is no implication to date that Indiana bats are particularly susceptible to such collisions. Proposals to erect wind turbines, communication towers, or roads should be closely evaluated, particularly near hibernacula or along potential migration routes where large numbers of Indiana bats could be impacted.

Recently, a new threat has emerged that has serious implications for the well-being of North American bats, including the Indiana bat. White-nose Syndrome (WNS) has been characterized as a condition primarily affecting hibernating bats. Affected bats usually exhibit a white fungus on their muzzles and often on their wings and ears as well (Blehert *et al.* 2009). Recently, the fungus associated with WNS has been identified as a previously undescribed species of the genus *Geomyces* (named *G. destructans*) (Gargas *et al.* 2009). The fungus thrives in the cold and humid conditions of bat hibernacula. *G. destructans* has been documented growing on hibernating bats in several European countries, but the fungus does not appear to be causing widespread mortality there (Puechmaille *et al.* 2010). The mode of transmission is primarily by bat-to-bat contact. In addition, people may unknowingly contribute to the spread of WNS by visiting affected caves and subsequently transporting fungal spores to unaffected caves. It is unclear how long symptoms take to manifest after exposure to the fungus. It is also unclear what the long-term effects to the Indiana bat will be (e.g., geographic spread, mortality within affected sites).

Bats affected with WNS do not always have a grossly visible fungus, but may display abnormal behaviors. These behaviors include bats roosting towards the entrances of caves/mines where the temperatures and humidity are far less stable than traditional roosting sites. Bats are also leaving their hibernacula and flying around during the day in cold temperatures far too early in the winter/spring before any insects are available for foraging. Many WNS-affected bats still inside hibernacula have not responded to human presence during surveys as healthy, unaffected bats do. Affected bats appear to be using up their essential fat reserves well before spring emergence.

WNS was first documented in a photograph taken in a New York cave in February 2006. As of October 2011, evidence of the syndrome has been documented in 18 states (New York, Massachusetts, Maryland, Delaware, Vermont, New Hampshire, Connecticut, Virginia, West Virginia, Pennsylvania, New Jersey, Oklahoma, Missouri, Ohio, Kentucky, Indiana, North Carolina, and Tennessee) and two Canadian Provinces, including known Indiana bat hibernacula. In some affected hibernacula in New York and New England, 90 to 100 percent of the bats have

died. U.S. Fish and Wildlife Service biologists and partners estimate that at least 5.7 million to 6.7 million bats have now died from WNS (Service 2011a). The range-wide population of the Indiana bat has declined approximately 10 percent from 2007 to 2011 (Service 2011 b). The Northeast regional population of Indiana bats and five other states known to be affected by WNS has declined 54 percent from 2007 to 2011 (Service 2011b).

Currently, most WNS-associated mortality has occurred at sites within the proposed Northeast and Appalachian Mountain RUs, but evidence of the fungus has been found at sites within the Midwest and Ozark Central RUs as well. Future monitoring should reveal the extent to which WNS will affect bats within these later two RUs. Although populations in some states within the Appalachian Mountain RU have declined almost 50 percent since 2009, overall populations within this RU have increased by 6.4 percent (Service 2011 b). However, the full effects of WNS may not manifest until after the winter of 2012, the third year after WNS was discovered in some caves.

WNS was first documented in West Virginia in 2009 at Trout Cave, Pendleton County. This is a Priority 2 Indiana bat hibernaculum. By October 2011 WNS had been confirmed in caves in Greenbrier, Hardy, Mercer, Monroe, Pendleton, Tucker, Fayette, Randolph, Grant and Pocahontas Counties (WVDNR 2011). In addition, a WNS positive bat was found in Jefferson County, although no caves in that county have been confirmed positive. While winter hibernacula monitoring shows Indiana bat populations were decreasing in other portions of their range in recent decades, estimated winter populations in West Virginia have been increasing since the early 1980s (WVDNR 2011). Hibernating populations in West Virginia have increased from an estimated 6,500 since 1990 to 20,358 in 2011 which is the most recent year that full data is available (Service 2011 b). However, based on data from three WNS-affected sites in West Virginia, 43 percent mortality of Indiana bats has already been observed in these affected caves. In addition, February 2011 entrance surveys at Hellhole, which supports the largest population of both Indiana and little brown bats in the State, documented over 400 bats flying out of the entrance in a one hour period of the afternoon (WVDNR 2011). This indicates that significant mortality of the Indiana bat population can be expected in this cave as well. Continued monitoring in future years should provide more information on the extent of WNS-related impacts to populations in West Virginia and the Appalachian Mountain RU.

Rangewide Status and Distribution

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

For several reasons, interpretation of the census data must be made with some caution. First, winter survey data have traditionally been subdivided by State due to the nature of the data collection. As described below, each State does not represent a discrete population center. Nevertheless, the range-wide population status of the Indiana bat has been organized by State

thus far. Second, available information specific to the "reproductive unit" (i.e., maternity colony) of the Indiana bat is limited. While winter distribution of the Indiana bat is well documented, little is known as to the size, location, and number of maternity colonies for the Indiana bat. It is estimated that the locations of more than 90 percent of the estimated maternity colonies remain unknown. Additionally, the relationship between wintering populations and summering populations is not clearly understood. For example, while it is known that individuals of a particular maternity colony come from one to many different hibernacula, the source hibernacula of most, if any, of the individuals in most maternity colonies is unknown.

Winter

When the Indiana bat was originally listed as endangered in 1967, there were approximately 883,300 bats and most of these hibernated in a small number of hibernacula (Clawson 2002). Since it was listed, the species' overall population numbers have continued to decline through approximately 2001. Although some winter bat surveys began as early as the late 1950s, systematic surveys were not conducted across the range until the mid 1980s when there were an estimated 678,750 Indiana bats (Clawson 2002). Since being listed, large population declines have been observed, especially at hibernacula in Kentucky and Missouri. Caves in Kentucky suffered dramatic losses because of changes in microclimate due to poor cave gate design in two of the three most important hibernacula (Humphrey 1978), and Indiana bat numbers in Kentucky hibernacula continued to decline until 2005 when an increase was first observed (Service 2009). Despite recovery efforts, Indiana bats in Missouri caves have continuously declined with a loss of more than 80 percent of the previous population size (Clawson 2002). From the 1960s/1970s to the most recent population survey in 2011, the range-wide population of the Indiana bat has declined from approximately 883,300 Indiana bats for 1960/1970 to 390,000 in 2011, or approximately 56 percent. The 40-year population trend from 1960 to 2000 of the Indiana bat has shown a steady decline.

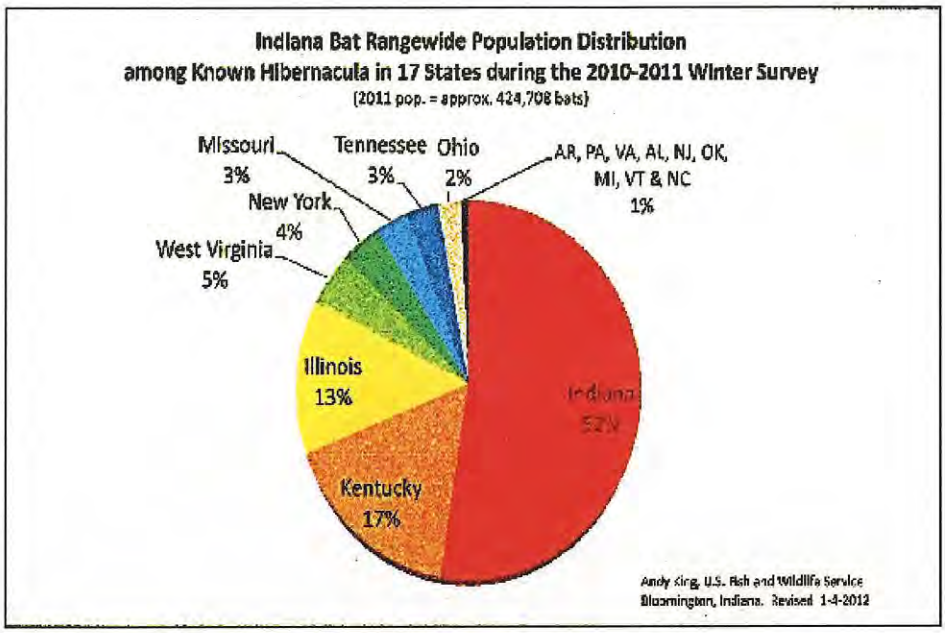
A notable increase (10.8 percent) over the previous biennial range-wide population estimate first occurred in 2003. In 2005, there was almost a 17 percent increase over the 2003 estimate and another 10 percent increase between 2005 and 2007. Unfortunately, the rangewide population experienced an apparent 16.6 percent decline in 2009 (Service 2010). A winter survey conducted in 2010 to 2011 among known Indiana bat hibernacula in 17 states estimates the range-wide population distribution approximately 424,708 Indiana bats. Figure 5 shows the Indiana bat rangewide population distribution for 2010-2011 winter survey.

Summer

Summer distribution of the Indiana bat occurs throughout 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. Recently, many summer maternity colonies have been found in the northeastern states of Pennsylvania, Vermont, New Jersey, New York, West Virginia, and Maryland. Maternity colonies extend south as far as northern Arkansas, southeastern Tennessee, and southwestern North Carolina (Britzke et al. 2003, Service 2007). 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). Non-reproductive summer records for the Indiana bat have also been documented in eastern Oklahoma, northern Mississippi, Alabama, and Georgia.

Figure 5. This graph illustrates the rangewide population distribution in 17 States from a 2010–2011 winter survey (Service 2011).



Status and Distribution in West Virginia

Summer

As of March 2012, summer maternity activity has been documented at a total of six sites in West Virginia. Prior to 2003, there were no documented areas of Indiana bat maternity activity in the State. However, in the summer of 2003, two post-lactating female Indiana bats were captured and tracked to roost trees in Boone County, West Virginia. These captures represented the first documented Indiana bat maternity activity in West Virginia. Surveys at this site during 2005 located two primary roost trees and resulted in a maximum emergence count of 73 bats. Maternity activity at this site has consistently been confirmed since then through annual surveys. In the summer of 2004, a second maternity colony of approximately 25 bats was confirmed through the capture and tracking of a lactating female Indiana bat. This colony was located adjacent to the Monongahela National Forest (MNF) in Tucker County and is located within 2 miles (3.2 km) of a known Indiana bat hibernaculum. The roost tree that the bats were eventually tracked to fell down the following summer. Subsequent surveys in the area have not been successful in capturing any reproductively-active females, although a number of male Indiana bats have been caught. The status of this maternity colony is unknown. A third maternity colony

was documented as a result of surveys conducted in 2005 near Kanawha State Forest in Boone County. Emergence counts at the two identified primary roost trees documented a maximum count of 49 bats. In the spring of 2010, female bats tracked emerging from a hibernaculum in Pennsylvania were found to have established a roosting area just over the State border in Ohio County, West Virginia. A maximum of 58 bats were found to emerge from a roost tree in this area. Finally, in the summer of 2010, a pregnant female was captured in Wetzel County and a juvenile male was captured in Fayette County. Radio telemetry was not conducted on these bats, so no additional information on these maternity areas is available.

In addition to these captures near potential or confirmed maternity colonies, individual male Indiana bats have been captured in numerous locations throughout the State in the following counties: Clay, Fayette, Nicholas, Pendleton, Preston, Pocahontas, Randolph, Raleigh, and Tucker. Three male Indiana bats were captured on another site on the MNF in Pendleton County in 2004. These bats were tracked to a roost tree and subsequent emergence counts on that tree revealed 23 bats. Surveys conducted since that time confirmed this area supports a bachelor male colony roost. These captures of both male and female bats confirm that the Indiana bat uses forested habitats throughout the State for summer foraging and roosting. The increase in recent captures may not reflect an actual increase in densities of Indiana bats summering within the State; rather these results may reflect the fact that survey efforts in relation to project review and monitoring have increased in recent years.

Winter

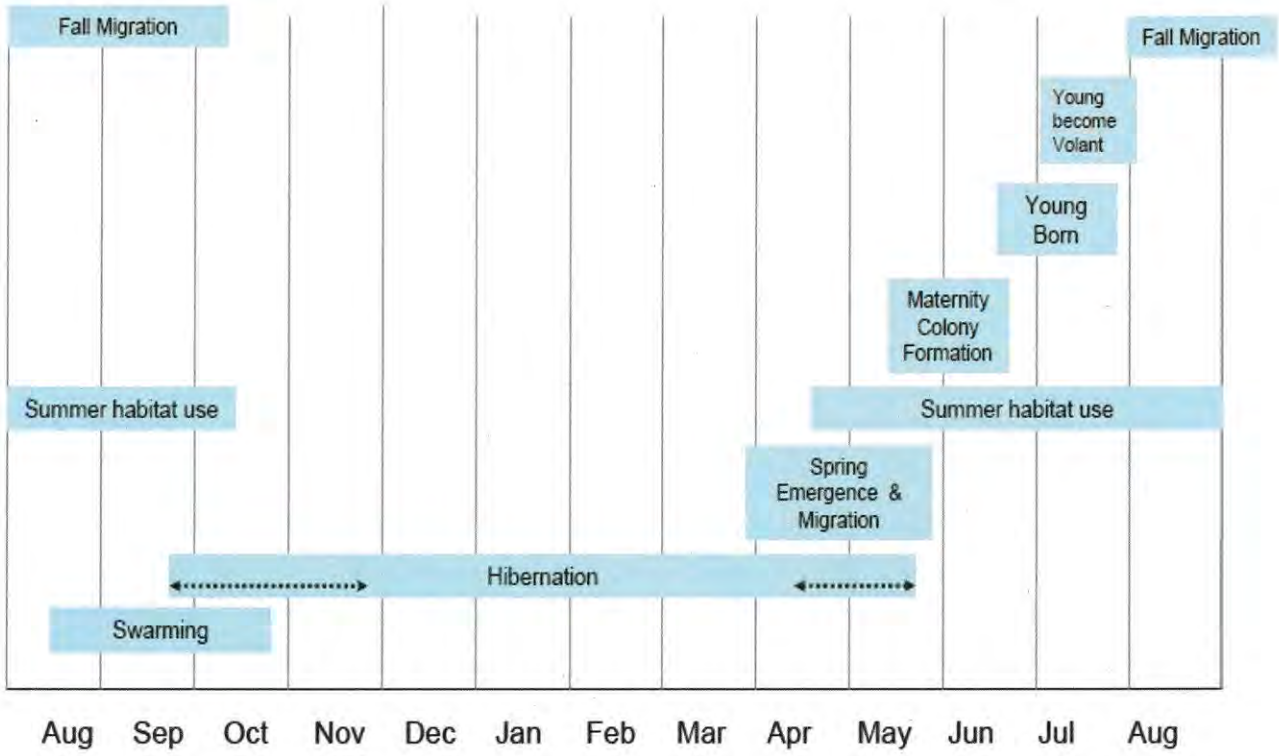
While winter hibernacula monitoring shows Indiana bat populations were decreasing in other portions of their range in recent decades, estimated winter populations in West Virginia have been increasing since the early 1980s (WVDNR 2004). Hibernating populations in West Virginia have more than tripled from an estimated 6,500 since 1990 to 14,855 in 2009 and 20,358 in 2011, which is the most recent year full data is available (Service 2011b). Increases in the number of bats hibernating in Hellhole have accounted for most of this growth. Protection measures that limited access to the cave occurred when the entrance to Hellhole was fenced in 1985. Although counts of most Indiana bat hibernacula were not conducted in 2010, surveys in Hellhole completed in February 2010 documented 18,557 Indiana bats. This is the highest count ever recorded for this site and is an increase of nearly 5,700 from the 2007 survey. This could indicate a total population of approximately 20,000 Indiana bats hibernating in the State. However, the survey also confirmed the presence of WNS in the cave. Approximately 2 percent of the visible Indiana bats in Hellhole showed signs of WNS, and the number of little brown bats in surveyed areas was 53 percent less than the 2007 count, indicating the potential level of WNS-associated mortality in that species. WNS has now been documented to occur in most Indiana bat hibernacula in the State. Monitoring in subsequent years should help quantify the potential severity of effects on WNS in the State.

Rangewide Conservation Needs of the Species

The most pressing conservation need of the species is to slow the spread of WNS and reduce the rate of WNS-associated mortality. In order for the Indiana bat to have a reasonable chance for survival and recovery, the current population must be stabilized and increased. The only options available for stabilizing and increasing the population are to increase its recruitment (birth and

survival of young to breeding age) or reduce its mortality rate. The annual cycle (for females) of hibernation, spring migration, parturition, lactation, fall migration, mating, and hibernation can be broken at any point, resulting in the loss of that individual from the population, and her remaining reproductive potential in the population. The vulnerable point(s) in this cycle may very well differ by geographic area, and even within the same area. Therefore, efforts to protect hibernacula from disturbances need to continue. This should include implementing closure plans, constructing and maintaining appropriately designed gates, and restoring microhabitat conditions in hibernacula that have been altered. Efforts should also be made to protect and restore adequate fall swarming habitat around hibernacula. Occupied maternity habitat should be identified and maintained. Research to further delineate the migratory relationship between summering and wintering populations should be pursued, and measures to avoid and reduce the potential of wind farm-related mortality during migration should be implemented. Figure 6 describes the annual life cycle of the Indiana bat.

Figure 6. Illustrated below is the Indiana bat's annual life cycle (USFWS 2006).



Previous Incidental Take Authorizations

All previously issued Service BOs involving the Indiana bat have been non-jeopardy. These formal consultations have involved a variety of action agencies including: (a) the U. S. Forest Service (USFS) for activities implemented under various Land and Resource Management Plans on National Forests in the eastern United States, (b) the Federal Highway Administration for various transportation projects, (c) the U.S. Army Corps of Engineers for various water-related projects, and (d) the Department of Defense for operations at several different military installations. Additionally, an incidental take permit has been issued under section 10 of the ESA to an Interagency Taskforce for expansion and related development at the Indianapolis Airport in conjunction with the implementation of a Habitat Conservation Plan (HCP). Additional HCPs are being developed for a privately-owned natural gas pipeline/storage field system, State-operated forestry program, and several private wind power developments. Links to previously issued BOs and a summary of previous incidental take can be found at: *http://www.fws.gov/midwest/endangered/mammals/inba/inbabos.html*

In conducting many of these consultations, Indiana bat presence/absence survey information was unavailable; therefore, the action agency and Service often assumed that Indiana bats were

present in the action area and could be subject to incidental take. This type of conservative approach is generally protective of Indiana bats because it tends to over-estimate the incidental take that may occur.

Previous consultations have addressed impacts to hibernating or swarming bats, known maternity areas, and/or summer habitat that were assumed occupied. Due to the various life stages affected, the types of conservative assumptions made (as mentioned above), and the difficulty in documenting actual take to Indiana bats (as more fully described in each BO provided at the link above, and in the Incidental Take Statement section of this BO), different methods have been used to estimate the amount of potential take. Depending on the consultation, take has been measured either by estimating numbers of affected roost trees, individual bats or maternity colonies, or acres of potentially suitable and/or occupied habitat. However, the Service typically has determined the incidental take measure that was used based on the most accurate and reasonable means available for each site-specific analysis. There are multiple BOs that, based on new information, resulted in reinitiation of consultation and subsequent "not likely to adversely affect" determinations.

National Forests

Within the past several years, nearly all National Forests within the range of the Indiana bat have requested formal consultation at the programmatic level. These consultations have led to non-jeopardy biological opinions with associated incidental take statements. Although some of these incidental take statements anticipated the take of reproductive females, we have not yet confirmed a loss of a maternity colony on National Forest lands. The reasons for this are likely two-fold. First, the programmatic conservation measures (i.e., standards and guidelines) and second, the project-specific reasonable and prudent measures were designed to minimize maternity colony exposure to the environmental impacts of Forest Plan actions. Specifically, these measures ensured an abundance of suitable Indiana bat habitat on the National Forests, and protected all known or newly discovered maternity colonies.

Approximately 95 percent of previously authorized habitat loss on National Forests has not been a permanent loss. Rather, it has been varying degrees of temporary loss (short-term and long-term) as a result of timber management practices. Although this analysis does not include all National Forests that, to date, have received an incidental take statement, the concepts of the analysis are consistent, regardless of the location. Conservation measures provided by the National Forests as part of the proposed actions, as well as reasonable and prudent measures provided by the Service to minimize the impact of the annual allowable take for each of the National Forests, have been designed to: (1) ensure an abundance of available remaining Indiana bat roosting and foraging habitat on all National Forests; and (2) ensure persistence of any known or newly discovered maternity colonies to the maximum extent practicable.

Although Indiana bat presence has been verified on most, if not all National Forests within the range of the species, confirmation of maternity activity on these lands is relatively scant. There have been less than seven maternity colonies documented on National Forests (MNF in West Virginia and Hoosier National Forest in Indiana) as recently as 2004.

Incidental take primarily has been exempted in the form of habitat loss because of the great difficulty in detecting and quantifying take of the individual Indiana bats because of their small body size, wide and cryptic summer distribution while roosting under loose bark of trees, and unknown spatial extent and density of their summer roosting population range within the respective National Forests. For some incidental take statements, take has also been extrapolated to include an estimated number of individual Indiana bats. The estimate of the number of individual Indiana bats likely to be taken has been wide-ranging and based on various assumptions. Legal coverage has included the take, by kill, of individual bats; or take by harm through habitat loss; or harassment.

Other Federal Agencies or Non-Federal Entities
Several incidental take statements have been issued to other Federal agencies. Unlike those issued for the National Forest Land and Resource Management Plans, some of these projects were certain to impact known occupied habitat. To minimize the effect of these projects, the action agencies agreed to implement various conservation measures. These included seasonal clearing restrictions to avoid disturbing female Indiana bats and young; protection of all known primary and secondary roost trees with appropriate buffers; retention of adequate roosting and foraging habitat to sustain the maternity colony into the future; and permanent protection of areas and habitat enhancement or creation measures to provide future roosting and foraging habitat opportunities.

With the exception of three, (Fort Knox, Great Smoky Mountains National Park, and Laxare East and Black Castle Contour Coal Mining projects), none of the BOs and associated incidental take statements issued for non-Forest Plan activities anticipated the loss of a maternity colony. Subsequent information has shown that maternity colonies have persisted in areas addressed in these BOs. For example, 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. Reinitiation of that consultation in 2006 concluded that while the colony would experience adverse effects, the colony should be able to persist through the life of the project. This was largely because subsequent surveys determined that the colony's primary roosts and many of their foraging areas were located outside the area of direct habitat destruction.

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. Given the philopatric nature of Indiana bats and long lifespan, the full extent of the anticipated impacts may not yet have occurred. Nonetheless, these monitoring results, and the lack of data to suggest otherwise, indicate that the conservation measures to avoid and minimize the impacts of Federal projects appear to be effective.

Summary
The take exempted to date via section 7 consultation has resulted in short-term effects to Indiana bat habitat and, in limited circumstances, on Indiana bat maternity colonies. As many of these consultations necessarily made assumptions about Indiana bat presence, we are uncertain of the

actual number of maternity colonies exposed to environmental impacts of Federal actions throughout the species' range, but we believe the actual number is likely less than what we have assumed to be present. Furthermore, although not definitive, monitoring of maternity colonies pre-and post-project implementation preliminarily suggests that our standard conservation measures, when employed in concert, appear to be effective in minimizing adverse effects on the affected maternity colonies. For reasons stated above, the Service concludes that the aggregate effects of the activities and incidental take covered in previous BOs on the Indiana bat have not degraded the overall conservation status (i.e., environmental baseline) of the Indiana bat.

ENVIRONMENTAL BASELINE

Under section 7(a) (2) of the ESA, when considering the "effects of the action" on federally listed species, the Service is required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all Federal, State, or private actions and other activities in the action area (50 CFR 402.02), including Federal actions in the area that have already undergone section 7 consultation, and the impacts of State or private actions that are contemporaneous with the consultation in process. As such, the environmental baseline is "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including critical habitat), and ecosystem, within the action area (Service and National Marine Fisheries Service [NMFS] 1998)". The environmental baseline is, therefore, a "snapshot" of the species' health at a given point in time, but it does not include the effects of the proposed action.

Winter Populations

Indiana bats hibernate in caves during the winter, but roost in trees, usually under exfoliating bark, during other times of the year. Winter records are mostly restricted to karst areas (hibernation caves known in Grant, Greenbrier, Hardy, Mercer, Monroe, Pendleton, Pocahontas, Preston Randolph, and Tucker Counties), but Indiana bats have been netted at abandoned mine portals in Fayette County and, most likely, hibernate in these mines. While winter hibernacula monitoring shows Indiana bat populations were decreasing in other portions of their range in recent decades, estimated winter populations in West Virginia have been increasing since the early 1980s (WVDNR 2011). Hibernating populations in West Virginia have increased from an estimated 6,500 since 1990 to 20,358 in 2011, which is the most recent year that full data is available (Service 2011b). As described in the "Status of the Species" section of this BO, most Indiana bat hibernacula in the State have been affected by WNS. Given the information currently available, it is uncertain how the overall population status of the Indiana bat will be affected over the long term.

Some male and non-reproductive female Indiana bats are known to remain in the vicinity of the hibernacula all year, and areas within five miles (8 km) of entrances of the hibernacula are considered occupied during the times bats are not in hibernation. Seven WMAs contain lands within five miles (8 km) of an Indiana bat hibernaculum: Beckys Creek, Beury Mountain, Huttonsville State Farm, Meadow River, Snake Hill, Tate Lohr, and Thorn Creek WMAs.

Summer Populations

Summer records for the Indiana bat occur across the State. During a five-year period (2005 to 2009), for which summary statistics are available, 17,444 bats were captured, of which 59 were Indiana bats. Indiana bats were captured in Boone, Fayette, Nicholas, Pendleton, and Tucker Counties. A summary of mist net survey results can be found in Appendix B of the WVDNR BA. Mist net surveys conducted on 14 WMAs between 1998 and 2006, resulted in no Indiana bat captures (WVDNR WRS 2011). However, eight different species of bats were captured and a summary of surveys conducted on those 14 WMAs can be found in Appendix C of the WVDNR BA (WVDNR WRS 2012).

In 2010, a pregnant Indiana bat was captured in Wetzel County, but no roost trees were located due to restrictions on radio tagging pregnant bats. This bat was captured approximately two miles (3 km) from the Lewis Wetzel WMA. Male Indiana bats are assumed to be more dispersed on the landscape during the summer, although a "bachelor" colony of approximately 30 Indiana bats was found in Pendleton County. Forested areas of the state where suitable roost trees exist (generally trees over five inches DBH with exfoliating bark) are considered potential summer habitat for the Indiana bat. Even though no Indiana bat maternity colonies have been documented using WMAs during the summer, these areas do provide suitable summer foraging and roosting habitat. Habitat conditions for the Indiana bat on WMAs are considered 91 percent forested, with some areas being upwards of 98 percent forested.

EFFECTS OF THE ACTION

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

The WVDNR WRS proposes to implement non-commercial and commercial forest management practices on approximately 7,000 to 20,000 acres (2,833 to 8,091 ha) and up to 12,000 acres (4,856 ha) of prescribed fire over a 10-year period that could impact Indiana bat habitat that may be used by roosting or foraging Indiana bats. Proposed commercial timber sales will be conducted on an average of 15 WMAs and a maximum of 25 WMAs annually, with the goal of optimizing wildlife habitat and recreational opportunities. Annual forest management objectives involve conducting timber sales and non-commercial forest management practices on a minimum of 700 acres (283 ha) with a maximum 2,000 acres (809 ha) annually and conduct up to 1,200 acres (486 ha) of prescribed fire annually. These practices could potentially result in take of Indiana bats through direct mortality or injury, or indirectly through harm or harassment. Harm is defined as an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing normal behavioral patterns such as feeding, breeding, or sheltering. Harassment is defined as actions that create the likelihood of injury to listed species to such and

extent as to significantly disrupt normal behavioral patterns such as feeding, breeding, or sheltering. However, the likelihood and severity of this potential take depends on site-specific conditions including Indiana bat activity in the action area, the timing of the action, the type of habitat modification proposed, and characteristics and amount of habitat remaining available after the proposed activity is conducted. The proposed activities can be grouped into three general categories based on the type of effects that may have on the Indiana bat: tree removal, prescribed fire, and herbicide use.

Tree Removal Activities-Direct Effects

If trees are cut during the hibernation period (November 15 through March 31), the potential for direct effects (mortality) to Indiana bats can usually be avoided. However, tree removal during the non-hibernation period (April 1 through November 14) may result in mortality (take) of roosting Indiana bats if a tree that contains a roosting bat is removed. If a bat using a roost tree that is removed is not killed during the removal, the roosting bat would be forced to find an alternative roosting site, causing a significant loss of energy that could result in harm or harassment of the individual. If the affected roost tree is a primary roost tree used by an Indiana bat maternity colony, adverse effects could include reduced colony cohesion; increased energy demands from searching for new roost areas; and decreased thermoregulatory efficiency. These impacts can lead to reduced reproductive success (Kurta *et al.* 2002; Kurta and Murray 2002; Gumbert *et al.* 2002; Kunz and Lumsden 2003; Indianapolis Airport Authority 2003; Garner and Gardner 1991; Racey and Entwistle 2003; Humphrey *et al.* 1977; Pierson 1998).

Loss of an inhabited primary roost tree is most likely to occur during the maternity period (May 15 through August 15). Clearing trees during early spring (April 1 to June 1) can affect bats when they are already stressed from migration and pregnancy, and can disrupt colony cohesion as bats are beginning to arrive at their maternity habitat and form a colony. Clearing during the lactation portion of the maternity period when young are not volant (June through early July), has the potential to cause the most severe direct effects because young would likely be injured or killed during the tree felling. At approximately July 15 to August 15, female and juvenile bats are still present in their maternity areas but the young are volant and the colony is starting to disperse into more individual roosts. Because Indiana bats tend to roost individually during swarming (August 16 through November 14), any mortality or harm that occurred under these circumstances would likely be limited to individual bats and would not adversely affect colony cohesion or reproductive success.

The WVDNR WRS has committed to not conduct most tree removal activities from April 1 through August 15, avoiding effects during critical time periods of spring emergence, colony formation, pregnancy, and when young are not volant.

In addition, the WVDNR WRS has committed to retaining trees that have the highest likelihood of serving as roost trees, including snags and exfoliating bark species like shagbark hickory, thus further reducing the potential of removing an occupied roost.

Despite mist net surveys conducted over eight years, no Indiana bats have been found on any WMA covered by this BO. WMAs that are within known or suspected summer maternity areas

or fall swarming zones are excluded from this BO and thus no known areas will be affected. Thus the potential to impact a large, established maternity colony is reduced. While the potential to cut an occupied roost tree does exist, given the large amount of forested habitat within the WMAs, and the localized and relatively small scale of tree clearing activities that will occur during the late summer, winter, and fall periods, and the implementation of the WVDNR WRS proposed conservation measures, the Service concludes that the likelihood of direct take has been minimized to the maximum extent practicable and that the potential direct mortality of Indiana bats is limited. The WVDNR WRS will continue to monitor both Indiana bat hibernacula and summer usage patterns within the project area and will provide further information on the scope and type of effects that WNS has on bats both within the action area and throughout the range of the species.

Tree Removal Activities-Indirect Effects

Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Removal of living trees or snags that have the potential to serve as roosts for maternity colonies or individual bats, or reduction of density of mature trees and overstory canopy could result in the loss or reduction in suitability of the summer (roosting and foraging) and pre-hibernation (fall foraging) habitat. Overall, the proposed tree removal activities within the WMAs fall into two general categories that can be related to severity of impacts to the Indiana bat: non-commercial timber harvest or light thinning, and commercial timber harvest or extensive thinning to include patch clear-cut harvests. A maximum total of 20,000 acres (8,091 ha) of non-commercial forest management practices and commercial timber sales are proposed to undergo at least one of these silvicultural treatments (tree removal activities) over the next 10 years.

Light thinning, utilizing crop tree release (1 to 30 acres [0.4 to 12 ha] per treatment unit) and timber stand improvement (1 to 20 acres [0.4 to 8 ha] per treatment unit) or non-commercial practices are being proposed for individual WMAs. The conditions created by the proposed light thinning are not expected to decrease the long-term suitability of these areas as Indiana bat roosting habitat. Conversely, light thinning will create openings in the forest canopy that could improve foraging as well as roosting conditions. Indiana bat primary roosts are usually not surrounded by closed canopy and are often warmed by solar radiation, which provides a favorable microclimate for growth and development of young during normal weather. Humphrey *et al.* (1977) hypothesized that roost trees were usually located in openings within the forest because they provide the necessary thermoregulatory characteristics. This is supported by the analysis conducted at several maternity sites by Romme *et al.* (1995) who found that most roosts were located in areas that had a canopy closure of 60 to 80 percent. The proposed thinning will also increase the solar exposure of the remaining trees within the harvest area, thus potentially making them more suitable for Indiana bat roosting habitat.

Since it appears that Indiana bats utilize many different types of habitat when foraging, the opening of the overstory as a result of these treatments would not change the abundance of foraging habitat on the landscape. Owen *et al.* (2004) found that areas subject to these types of treatments still approximate usable foraging habitat for *Myotis* species. Areas affected by these types of activities should remain suitable for Indiana bat foraging and roosting habitat.

Commercial timber harvests including extensive thinning (e.g. shelterwood harvests), are proposed for individual WMAs in treatment units that would range in size up to 100 acres (40 ha). Because greater numbers of trees are removed and canopy closure is significantly reduced when compared to light thinning, these areas may have sub-optimal characteristics when compared to existing Indiana bat habitat suitability indexes. Areas affected by extensive thinning activities will have reduced suitability for Indiana bat foraging and roosting habitat.

Patch clear-cut harvests will be conducted on individual WMAs in treatment units that would range in size from approximately 6 to 50 acres (3 to 20 ha). These types of harvests could affect potential foraging and roosting habitat and travel corridors by reducing canopy below suitable levels. According to Romme et al. (1995), almost all potential roost trees would be removed and future roost tree availability would be reduced, making these areas unsuitable for Indiana bat roosting. The effect of potential roost tree loss would last several decades until trees in the regenerated areas reach roost tree size. Therefore, the effects of clear-cut harvesting are more severe and last for a greater duration than the other proposed silvicultural activities (Romme et al. 1995). Additionally, Callahan et al. (1997) stated that even-aged and uneven-aged management could be used in conjunction with Indiana bat management when snags and shagbark hickories are retained, and management favors oak species. However, the WVDNR WRS proposed clear-cut harvests are relatively small in size and one of the WVDNR WRS's proposed conservation measures is the retention of all shagbark hickory. A study, conducted on the U.S. Department of Agriculture's Fernow Experimental Forest (FEF), over a five-year research period documented an Indiana bat roosting on the FEF in a shagbark hickory that was a residual tree in a six-year-old patch clear-cut. This seems to indicate that Indiana bats could continue to use suitable roost trees within the types of harvest units proposed by the WVDNR WRS and the proposed conservation measures will reduce the potential level of effects to the Indiana bat.

Between 2.5 and 7.1 percent of eligible WMA lands will be affected by silvicultural practices that have the potential to reduce their suitability for Indiana bat foraging and roosting habitat. When project impacts are considered in conjunction with baseline conditions, a minimum total of 236,007 acres (95,106 ha) would consist of suitable forested habitat with a mixed composition of age classes. Implementation of the WVDNR WRS's conservation measures should help to ensure that Indiana bats will continue to have adequate roosting habitat within the action area.

Given that more than 84.0 percent of the project area will be maintained as potentially suitable Indiana bat foraging and/or roosting habitat, that preferred foraging habitat will be protected, and the majority of practices will not be conducted during the most sensitive times of year, the Service concludes that the action area will remain able to support Indiana bats after completion of the proposed action, and that the potential direct and indirect adverse effects caused by proposed commercial and non-commercial forest management practices have been appropriately minimized.

Prescribed Fire-Direct Effects

Prescribed fire would be used on up to 1,200 acres (486 ha) annually. Treatments on individual WMAs could range from 1 to 200 acres (0.40 to 81 ha) in size. Fire management techniques would be conducted according to West Virginia Division of Forestry regulations, and would ensure fuel consumption at 1 to 5 feet per minute (0.30 to 2 m/min). Conducting prescribed fires outside the hibernation period could cause indirect mortality or injury to the Indiana bat from burning or smoke inhalation, especially death to young bats that are not able to fly. The likelihood of this happening, however, is reduced due to the proposed method and timing of the burning. Prescribed fire would only be conducted from October 1 through March 31, which is after all young are volant. While little to no research is available to document the potential direct effects of fire on Indiana bats, anecdotal information suggests that, Indiana bats might be capable of escaping burning roost trees when necessary and if volant. In Tucker County, West Virginia, on Monongahela National Forest land, a *Myotis* bat flew out of a burning snag during a prescribed fire and into an unburned forested area during the spring 2001 (Rodrigue et al. 2001). Because the proposed fires will be slow moving, most bats should have time to move out of the affected area. As a result, the Service anticipates that the likelihood of direct mortality from prescribed fires is minimized.

Prescribed Fire-Indirect Effects

Indirect effects in the form of harm or harassment of Indiana bats may result from loss of potential roost trees, or by forcing the bats to abandon active roost trees. However, the WVDNR WRS has incorporated measures that should minimize these impacts. The proposed method of burning should ensure that the proposed fires are relatively cool and it is not anticipated that whole large trees or snags that are suitable for Indiana bat roosts will be consumed/combusted. In addition, the WVDNR WRS is enhancing or maintaining most of the action area as forested habitat. Female Indiana bats in the non-maternity season, and/or males, typically have numerous suitable day-roosts available and they frequently roost switch. Therefore, in the event that a bat is forced to flee from a burn area where it is roosting, other day-roosts are likely present in adjacent compartments that are not being burned, and available for Indiana bats to use. Based on these factors, the Service anticipates that while the potential for take in the form of harm and harassment of individual Indiana bats as a result of prescribed fires does exist, the potential for and the severity of these impacts has been minimized.

While prescribed fires could have some negative effects on the Indiana bat, as described above, overall prescribed fire will likely improve Indiana bat foraging and roosting habitat. Prescribed fires most often result in some degree of midstory mortality to small diameter trees and shrubs, producing more open understory conditions. Opening of the midstory may improve foraging and roosting habitat conditions. Individual mortality to trees would increase the number of snags and create scattered canopy gaps, which could improve roosting. Increased insect populations produced for foraging in burned areas is also likely to occur in successional years. Carter et al. (2000) state that additional potential roost cavities and snags can be created in forested stands by utilizing prescribed fire, and depending on fire intensity, can increase the availability of snags. Snags could be created either directly by fire mortality or indirectly by making the trees more susceptible to insect attacks or pathogens (Bull et al. 1997). Depending on the tree species, live

trees subsequently killed by fire activity would remain as suitable potential roost trees until such time that peeling/lost bark renders them unsuitable as summer roost sites.

The Indiana bat maternity colony discovered in the summer of 2004 in Lower Glady, Tucker County, West Virginia was located in an area subjected to wildfire during the spring of 2002 (D. Arling, USFS, pers. comm.). This site is located in close proximity to an Indiana bat hibernacula. It is likely that Indiana bats are using this area as a maternity site as a result of its close proximity to the hibernacula and the abundance of roost trees that were created as a result of forest fires. A study conducted over a five-year period on the FEF specifically on Indiana bat roost tree use following forest fires, found that Indiana bats roosted in both unburned stands and stands that had been burned one to three years prior to the study. Roost switching frequency and distance moved between roost trees were similar between burned and unburned stands. This study suggested that prescribed fire might provide additional roosting resources for Indiana bats already known to use the area.

In summary, there is a minimal potential that proposed prescribed fire activities on the WMAs included in this BO may take Indiana bats through direct mortality or harm and harassment. Due to the lack of evidence of maternity colonies in the area, the timing of the proposed activities, and the research indicating that the most likely Indiana bats in the area are individually-roosting males, these impacts are likely restricted to individual adult male Indiana bats. The potential for these effects has been minimized through the use of conservation measures. Over the long-term, the indirect effects of the prescribed fires may be beneficial to the Indiana bat through an increase in the number and quality of potential roosting areas on these WMAs.

Herbicide Use-Direct Effects

The WVDNR WRS proposes to use herbicides during a number of proposed activities including non-commercial forest practices and pre-timber harvest, for deadening of undesirable competing herbaceous and woody vegetation, and non-native invasive species (NNIS) control. Treatments on individual WMAs would range up to 30 acres (12 ha) per treatment unit. Herbicide treatments will be conducted for the purpose of controlling undesirable herbaceous (i.e., Japanese stiltgrass) and woody (i.e., tree of heaven, striped maple) vegetation during the months of June through December. Herbicide applications will often be "spot treatments" with minimal and dispersed application of herbicides conducted on a per acre basis. Methods of herbicide application proposed include tree injection, foliar and basal spray. One potential risk to Indiana bats could be that spraying negatively impacts insects, thereby reducing forage. However, impacts are expected to be minimal due to the small proportion of the project area being treated at any one particular time, and because the herbicides proposed for use degrade rapidly and do not bio-accumulate. Appendix F of the WVDNR BA, lists the schedule of herbicide treatments in conjunction with forest management practices (WVDNR WRS 2012).

Effects of the Proposed Conservation Measures

The implementation of project-specific protection and conservation measures will minimize adverse direct and indirect effects of the project and will ensure that these action areas will remain suitable to support Indiana bats in the future by: 1) avoiding known Indiana bat hibernacula and maternity areas; 2) retaining Indiana bat travel corridors and foraging habitat by

protecting riparian corridors; 3) maintaining and providing adequate Indiana bat roosting habitat; and 4) creating and/or enhancing potential Indiana bat foraging and roosting summer habitat within the WMAs through the creation of watering holes and forest structures that are suitable for the species.

In addition, the WVDNR has agreed to implement a research and monitoring plan (Appendix A) that will evaluate Indiana bat and other bat usage on WMAs. If future monitoring or research conducted on the WMAs identifies evidence of Indiana bats utilizing the project area for summer maternity habitat, WVDNR WRS will consult with the Service to develop, as appropriate, additional protective measures in accordance with the terms and conditions outlined below.

White-nose Syndrome

Although there are no caves located within the project action area, there are seven WMAs within five miles (8 km) of known Indiana bat hibernacula. Given the rate and distance of the spread of WNS, it is reasonable to expect that WNS will affect bats within the action area over the ten-year period covered by this BO. Surveys conducted in the winter of 2010-2011, confirmed WNS in four additional counties in West Virginia. A list of affected sites can be found in Appendix D of the WVDNR BA (WVDNR WRS 2012).

Bats affected by WNS that do not die during hibernation may be weakened by the effects of the disease and may have extremely reduced fat reserves and damage to wing membranes. This may make it difficult for them to fly or to survive long-distance migrations to summer roosting or maternity areas. They may also emerge from hibernation sites earlier and may be more likely to stay closer to the hibernation site for a longer time period following spring emergence. In order to reduce the potential that tree removal activities will directly impact Indiana bats that survived WNS, but may be debilitated from the effects of the syndrome, WVDNR WRS has committed to avoid most tree clearing activities from April 1 through August 15, thus avoiding activities during early spring emergence and migration. This will allow bats some time to emerge, forage in the area, and potentially regain fat reserves and begin healing from wing membrane damage, before potentially being disturbed or killed by the felling of occupied roost trees.

Furthermore, although it is not possible to quantify the potential future effects that WNS may have on bats that inhabit areas in close proximity to the action area, the WRS has anticipated potential effects and developed measures, such as timing of tree clearing, to avoid contributing to future WNS-related mortality. Because many of the activities proposed are small in size and scope, the Service anticipates that the WVDNR WRS proposed activities, when evaluated in conjunction with their proposed conservation measures, will not adversely affect the ability of the action area to support Indiana bats. WMAs within swarming zones are not included in this consultation and those proposed actions and their potential impacts to listed species will be assessed separately.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. The Service is not aware of any additional future State, Tribal, local, or private actions that are reasonably certain to occur within the action area. After implementation of the proposed action, it is anticipated that at least 84.0 percent of the action area, including the majority of the area affected by WVDNR WRS activities, will remain in a primarily forested condition. Therefore, we do not anticipate cumulative effects, as defined in the ESA, to be significant within the action area.

The Service has determined that a significant cumulative reduction in population numbers of the Indiana bat will not occur in the project area for the following reasons: 1) Suitable Indiana bat habitat will continue to occur on a large percentage of the project area and action area. 2) The WVDNR WRS will implement the conservation measures outlined in this BO and existing BA. Therefore, we conclude that cumulative effects to the Indiana bat should be substantially avoided and minimized.

CONCLUSION

After reviewing the current status of Indiana bat, the environmental baseline for the action area, the effects of the proposed actions contained in the Programmatic Forest Management Plan, and the cumulative effects, it is the Service's biological opinion that implementing the WVDNR WRS proposed activities in the Programmatic Forest Management Plan over the next 10 years, as proposed, is not likely to jeopardize the continued existence of the Indiana bat. Critical habitat has been designated for this species; however, none will be affected by implementation of these proposed actions.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA, and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns 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 to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the WVDNR WRS for the exemption of section 7(o)(2) to apply. In order to monitor the impact of incidental take, the WVDNR WRS must report the progress of the action and its impact on the species to the WVFO as specified in the incidental take statement. The WSFRP will include a grant condition statement on the grant approval letter requiring the WVDNR WRS to adhere to the terms and conditions of the incidental take statement. The protective coverage of section 7(o)(2) may lapse if WVDNR WRS or their contractor fails to assume and implement the terms and conditions of this incidental take statement.

Level of Take

The Service anticipates that incidental take of Indiana bats as a result of the WVDNR WRS's activities implemented on the WMAs under the Federal Aid in Wildlife Restoration Act will be difficult to quantify and detect due to the bat's small body size, widely dispersed individuals under loose bark or in cavities of trees, and unknown areal extent and density of their roosting populations within the WMAs. However, any incidental take of Indiana bats is expected to be in the form of killing, harming, or harassing. Tree removal during the non-hibernation season period may result in harm or mortality to roosting Indiana bats. Smoke and fire generated during prescribed fires that occur during the non-hibernation period could also cause roosting bats distress or death. Burning may cause an individual roosting bat to abandon a traditionally used roost tree.

Monitoring to determine take of individual bats within an expansive area of forested habitat is a complex and arduous task. Unless every individual tree that contains suitable roosting habitat is inspected by a knowledgeable biologist before management practices begin, it would be impossible to know if a roosting Indiana bat is present in an area proposed for harvest or burning. It would also be impossible to evaluate the amount of incidental take of Indiana bats unless a post-harvest inspection is immediately made of every tree that has been removed or disturbed. Inspecting individual trees is not considered by the Service to be a practical survey method and is not recommended as means to determine incidental take. However, the areal extent of potential roosting habitat affected can be used as a surrogate to monitor the level of take. Although, to the best of our knowledge, no individually-roosting Indiana bats have been incidentally taken during tree removal or other habitat-modifying activities on the WMAs, the possible removal of undiscovered occupied roost tree(s) may result in incidental take of this species. If roosting individuals are present in an area proposed for timber harvest or other disturbance, incidental take of Indiana bats could occur. However, implementation of the terms and conditions associated with the reasonable and prudent measures provided below by the Service will significantly reduce the potential for incidental take.

This incidental take statement anticipates the taking of a presently unquantifiable number of Indiana bats from timber harvest and prescribed fires occurring during the non-hibernation season (April 1 to November 14). The WVDNR WRS proposes to conduct non-commercial and commercial timber management practices on a total of 20,000 acres (8,091 ha) over the next 10 years, not to exceed 2,000 acres (809 ha) annually for all WMAs, and with no more than 300 acres (121 ha) within an individual WMA in any one year.

In addition, the WVDNR WRS proposes to ignite up to12,000 acres (4,856 ha) of prescribed fire over the next 10 years, not to exceed 1,200 acres (486 ha) annually for all WMAs, and with no more than 200 acres (81 ha) of prescribed fire within an individual WMA in any one year.

Therefore, the incidental take statement is based on forest management practices occurring on a maximum of 20,000 acres (8,091 ha) over 10 years, not to exceed 2,000 acres (809 ha) annually or exceed 300 acres (121 ha) within a single WMA per year; and a maximum of prescribed fire on 12,000 acres (4,856 ha) over 10 years, not to exceed 1,200 acres (486 ha) annually or exceed 200 acres (81 ha) within a single WMA per year.

With regard to herbicide applications, no more than 30 acres of herbicide will be applied on any individual WMA treatment unit per year. No incidental take is anticipated from implementing herbicide applications; therefore, no incidental take is authorized for the application of herbicides.

Table 3 summarizes the authorized level of take associated with the proposed activities on WMAs.

Implementation of the terms and conditions associated with the reasonable and prudent measures are anticipated to minimize the impact of the potential for incidental take of Indiana bats. If, during the course of implementing the proposed actions, these levels of incidental take are exceeded, the WVDNR WRS will be required to reinitiate consultation. The WVDNR WRS must immediately provide an explanation for exceedance of the authorized incidental take, and review with the WVFO the need for possible modification of the reasonable and prudent measures and terms and conditions.

Table 3. This table summarizes the authorized incidental take due to the removal or disturbance of potential Indiana bat habitat on 62 wildlife management areas throughout West Virginia.

Forest Management Practice	**Maximum Annual Acreage per WMA**	**Maximum Annual Total Acreage for all WMAs**	**Maximum Total Acreage Over Ten (10) Years**
Non-Commercial and Commercial Timber Management	300 acres (121 ha)*	2,000 acres (809 ha)*	20,000 acres (8,091 ha)*
Prescribed fire	200 acres (81 ha)**	1,200 acres (486 ha)**	12,000 acres (4,856 ha)**
Herbicide applications	Incidental take not anticipated or authorized.		

*Forest management activities associated with emergency situations (i.e. storm damage, disease and insect damage) will not apply to timber sale annual and 10-year acreage limitations. These situations will require consultation between WVDNR WRS and the WVFO.

**acreage limitations only apply to prescribed burns conducted in forested settings.

REASONABLE AND PRUDENT MEASURES

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

1. The WVDNR WRS, the Federal Aid grant recipient, will plan, evaluate, and implement proposed forest management practices consistent with measures developed to protect the Indiana bat and minimize adverse impacts from commercial timber sales, prescribed fire, and herbicide applications in the wildlife management areas (WMAs) as described in the proposed Programmatic Forest Management Plan.

2. The WVDNR WRS will implement a monitoring plan in order to assess long-term effects of implementing the proposed actions on Indiana bat populations. WVDNR WRS can request WSFRP grant funds to implement the monitoring activities.

3. The WVDNR WRS will monitor the implemented commercial timber sales and non-commercial timber management practices, prescribed fire, and herbicide applications on the WMAs to determine whether minimization measures to protect Indiana bats and their critical habitat, as well as the terms and conditions of the BO, are being implemented appropriately.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the WVDNR WRS must comply with the following terms and conditions, which implement the RPMs described above and outline reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. A. The WVDNR WRS shall conduct all non-commercial timber management practices and commercial timber sales consistent with the conservation measures outlined in the BA on pages 7 through 21 (WVDNR WRS, 2012). These measures include but are not limited to:

    - retaining all snags and shagbark hickory trees on WMAs except where retention of such trees will present a safety hazard or conflicts with OSHA regulations;

    - conducting the majority of tree removal practices from August 16 through March 31, as stated in the BA on pages 7 through 21 (WVDNR WRS, 2012);

    - maintaining aquatic health and riparian zones as described in the BA on page 13 (WVDNR WRS, 2012).

   B. The WVDNR WRS shall conduct all prescribed fires from October 1 through March 31 pursuant to their permit from the West Virginia Division of Forestry, when applicable.

   C. The WVDNR WRS shall comply with the West Virginia Department of Agriculture's herbicide application procedures and protocol. The herbicide application personnel shall be trained and have a current permit in the correct application of herbicides.

2. A. The WVDNR WRS shall conduct annual monitoring the first year after finalization of the draft BO, as outlined in Table 1 of Appendix A (enclosed), and shall continue monitoring in subsequent years unless changes are coordinated with and approved by the Service's WVFO prior to the initiation of said monitoring.

   B. The WVDNR WRS shall submit an annual report containing the results of the monitoring conducted under Terms and Conditions 2. A. to the Service's WVFO by February 28 each year the BO is in effect, beginning with the first February following the year the proposed actions under this plan are implemented.

   C. Changes or additions to the monitoring parameters and schedule may occur in any year due to unforeseen complications resulting from white-nose syndrome, and/or other unanticipated events, or to improve the overall monitoring effort. The WVDNR WRS shall coordinate any change in monitoring parameters or schedule with the Service's WVFO, and receive approval for the changes prior to the initiation of the modified or additional monitoring.

D. If monitoring provides evidence that Indiana bats are present within new and/or additional areas within any of the WMAs, the WVDNR WRS shall coordinate with the Service's WVFO to determine if any changes to proposed actions are warranted prior to implementing any further activities in the Programmatic Forest Management Plan.

3. A. Prior to implementing any commercial timber management practice to include timber sales, and prescribed fire under this BO, the WVDNR WRS shall submit annually to the Service's WVFO a notification listing the WMA and associated activities to occur on each WMA in a given WVDNR WRS fiscal year, as well as the approximate project acreage. The notification which will be submitted to the WVFO by July 15 of each year shall include a statement confirming that the activities shall be conducted consistent with the terms outlined in the BO and associated BA. In addition, the notification shall include a statement confirming that the proposed activity(s) has been reviewed by WVDNR Wildlife Resources, Wildlife Diversity Unit staff and that the Wildlife Diversity Unit staff has determined that no federally listed, proposed or candidate species other than the Indiana bat are potentially present within the action area, or could be affected by implementation of any proposed forest management practice.

B. Non-commercial activities shall be reviewed for the presence of other listed species prior to implementation and will be implemented consistent with the BA, but will not require prior notification to the Service.

C. The WVDNR WRS shall monitor the number of acres of non-commercial and commercial forest management practices and prescribed fires implemented on an annual basis (WVDNR WRS fiscal year – July 1 to June 30) to ensure the total acreages do not exceed the authorized incidental take. Shelterwood and seed tree harvest methods which typically require multiple harvest phases (i.e., 2 to 3 canopy removals) during the 10-year plan period will only be counted toward the acreage limitations at the time of the initial harvest. The WVDNR WRS shall provide a summary of activities and acreages to the Service's WVFO no later than August 15 each year the BO is in effect, beginning with the issuance of the BO.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery actions, or to develop information. The Service recommends WVDNR WRS collaboration with the WVFO to develop forest management recommendations that would avoid impacts to, and potentially benefit, the Indiana bat. The recommendations would be designed towards use by Federal and State agencies, and private foresters, land managers, and the general public.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of this conservation recommendation.

REINITIATION NOTICE

This concludes formal consultation on the proposed actions outlined in the request and described above. As required by 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease, pending reinitiation. In particular, the Service notes that the potential future effects of WNS on the Indiana bat and other bats that may be present in the action area are currently unknown. Although the Service and the WVDNR WRS have worked cooperatively to anticipate and address the range of potential effects of this disease during consultation, effects beyond the scope analyzed and anticipated in this BO may constitute new information that would trigger reinitiation.

If new WMAs are acquired and/or additional acreage is added to existing WMAs by the WVDNR WRS, this BO may be amended to incorporate these new areas or WMA expansions. The WVDNR WRS should send a notification to the WVFO that includes the name, location, and acreage of the new WMA. The incorporation of additional WMAs shall not include an increase in the currently authorized level of incidental take. However, any expansion or increase in the requested or authorized level of incidental take shall trigger reinitiation of consultation.

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Appendix A: Long-term Indiana Bat Monitoring Plan (WVDNR WRS 2011).

Indiana Bat Monitoring Plan

To examine long-term population trends in bats, including Indiana bat, on the State's wildlife management areas (WMAs), the West Virginia Division of Natural Resources (WVDNR) will monitor bat populations on WMAs where the WVDNR has timber management authority. On-going long-term statewide monitoring efforts provide information on bat populations on some WMAs, and additional monitoring will be established on specific WMAs to provide data to fill gaps in the existing monitoring and data.

WVDNR personnel have monitored bat populations in caves for over 25 years and these monitoring activities will continue. Hibernacula surveys are conducted by entering the caves (usually in January or February) and counting all bats observed. In the past, caves with significant populations of hibernating endangered bats have been monitored biennially. However, with White-nose Syndrome (WNS) now affecting these populations, surveys may be conducted less frequently (i.e., every three years) in the future to minimize disturbance to surviving bats. Caves containing only smaller numbers of non-endangered bat species are typically monitored less frequently than caves containing endangered species. Summer maternity colonies of Virginia big-eared bats have been monitored annually each June using infra-red lights and night-vision equipment to enumerate bats as they exit the caves in the evening. Because these surveys are non-invasive, they will continue to be conducted annually. Bat populations in five caves on two WVDNR WMAs will continue to be monitored to provide long-term bat population data (Appendix A Table 1).

Beginning in 2009, acoustic bat routes were established across the State to provide data on bat distributions and densities. Additional routes were established in 2010 and 2011. These routes will be used to provide long-term data on changes in bat populations. Acoustic routes consist of segments of roads driven in a vehicle traveling at approximately 33 kilometers per hour (20 miles per hour) while recording ultrasonic bat echolocation calls. The routes are typically 20 to 30 miles long, and runs begin 30 minutes after sunset. Routes are run between May 15 and August 15. A full-spectrum ultra-sound detector is mounted on the roof of the vehicle using a magnetic mount. A USB cable connects the detector to a laptop computer in the vehicle. The software package SPECT'R is used to record the calls onto the computer's hard drive. Simultaneously, a GPS unit gathers location data and records them in another file on the computer's hard drive. Sonobat software will be used to analyze the bat echolocation call data. Eleven of the established acoustic routes are located on or near WMAs where the WVDNR has timber management authority (Appendix A Table 1). The WVDNR's plan is to run these routes annually for at least three years to obtain baseline data, and after this time, they may be run less frequently (i.e., every three) to provide long-term data.

Stationary acoustic monitoring sites will be established on a minimum of 10 WMAs to provide additional data on bat populations. Sites will be resurveyed every three years, and up to four of the WMAs will be surveyed each summer. Sites will be selected based on the presence of suitable bat habitat and the need to fill data gaps in the other long-term monitoring efforts.

Surveys will be conducted between May 15 and August 15. Each survey will record bat echolocation calls at a specific site from sunset to sunrise for at least two consecutive nights.

The WVDNR will report its monitoring activities to the U.S. Fish and Wildlife Service's West Virginia Field Office annually.

Appendix A Table 1. This table lists the systematic long-term bat routes and caves monitored by the WVDNR which provide information on bat populations on/near WVNDR Wildlife Management Areas.

Long-term Bat Acoustic Routes That Provide Information on Bat Populations on/near WVDNR's Wildlife Management Areas			
Route	**WMA**	**Counties**	**Comments**
BackCreek	Sleepy Creek	Berkeley and Morgan	Runs through WMA
Trough	South Branch	Hardy and Hampshire	Runs along boundary of WMA
CacaponNorthRiver	Edwards Run	Hampshire	Adjacent to WMA
SummersNewR	Bluestone	Summers, Mercer, and Monroe	Runs through WMA
MercerElgood	Bluestone	Summers, Mercer, and Monroe	Runs through WMA
ThornCreek	Thorn Creek	Pendleton	Runs through WMA
CornstalkMilton	Chief Cornstalk	Mason	Begins on WMA
NewMiltonJacksonMill	Smoke Camp	Lewis	Near WMA
Vandalia	Stonewall Jackson Lake	Lewis and Upshur	Runs through WMA
Midway	Teter Creek	Barbour	Runs through WMA
TylerJacksonburg	Lewis Wetzel	Tyler and Wetzel	Runs through WMA
Caves on WVDNR's Wildlife Management Areas with Bat Populations Monitored by the WVDNR Wildlife Diversity Unit			
Cave	**WMA**	**County**	**Comments**
Hoffman School	Thorn Creek	Pendleton	Virginia big-eared bat maternity colony. Hibernating Virginia big-eared bats. Significant hibernating concentrations of little brown bats and tricolored bats.
Minor Rexrode	Thorn Creek	Pendleton	Cave entrance is just off WMA, cave is under WMA. Summer bachelor colony of Virginia big-eared bats. Hibernating concentrations of Virginia big-eared bats, Indiana bats, and little brown bats.

Dreen	Slaty Fork	Pocahontas	Small number of Indiana bats in past. Good population of little brown bats in winter.
Just	Slaty Fork	Pocahontas	Small numbers of bats. No endangered species.
Justrite	Slaty Fork	Pocahontas	Small numbers of bats. No endangered species.