



United States Department of the Interior

FISH AND WILDLIFE SERVICE

3817 Luker Road
Cortland, NY 13045



November 23, 2009

Mr. Christopher S. Mallery
Chief, Western Permits Section
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Attn: Brian Orzel, Regulatory Branch, Western Permits Region

Dear Mr. Mallery:

This is in response to your letter dated September 21, 2009, regarding the proposed Adams Fairacre Farms located in the Town of Wappinger, Dutchess County, New York (NAN-2006-03278-WOR), and the potential effects that the project may have on the Federally-listed endangered Indiana bat (*Myotis sodalis*).

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), enclosed is the U.S. Fish and Wildlife Service's (Service) biological opinion produced in response to the biological assessment submitted with your September 2009 letter.

After reviewing the current status of the Indiana bat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Indiana bat. Critical habitat for the Indiana bat has been designated at a number of locations throughout its range; however, this action does not affect any of those designated critical habitat areas and no destruction or adverse modification of that critical habitat is expected.

We appreciate the cooperation that we have received from your staff, the applicant, and his consultants. Should you have any questions, please contact Ms. Robyn Niver of this office at (607) 753-9334.

Sincerely,



David A. Stilwell
Field Supervisor

Enclosure

cc: NYSDEC, New Paltz, NY (L. Masi)
NYSDEC, Albany, NY (P. Nye/A. Hicks)
COE, New York, NY (B. Orzel)
FWS, Hadley, MA (G. Smith)

BIOLOGICAL OPINION

For the

**PROPOSED ADAMS FAIRACRE FARMS STORE
TOWN OF WAPPINGER
DUTCHESS COUNTY, NEW YORK**

**FOR THE FEDERALLY-ENDANGERED INDIANA BAT
(*Myotis sodalis*)**

In the

**TOWN OF WAPPINGER
DUTCHESS COUNTY, NEW YORK**

**Submitted to the U.S. Army Corps of Engineers
New York District
November 23, 2009**

Prepared by:
Sandra Doran and Robyn Niver
U.S. Fish and Wildlife Service
New York Field Office
3817 Luker Road
Cortland, NY 13045
(607) 753-9334

TABLE OF CONTENTS

	<u>Page No.</u>
INTRODUCTION	1
BIOLOGICAL OPINION.....	2
DESCRIPTION OF THE PROPOSED ACTION	2
Project Description.....	3
Conservation Measures	5
Action Area.....	8
STATUS OF THE SPECIES/CRITICAL HABITAT	10
Species Description.....	10
Listing Status	10
Critical Habitat.....	11
Recovery Plan Status	11
Life History.....	11
Status and Distribution.....	14
Current Summer Distribution	20
Range-wide Trend.....	29
Analysis of the Species/Critical Habitat Likely to be Affected.....	30
ENVIRONMENTAL BASELINE.....	30
Status of the Species in New York	30
Status of the Species within the Action Area.....	30
Factors Affecting the Species' Environment within the Action Area	33
EFFECTS OF THE ACTION.....	34
Analyses of Effects of the Action	35
CUMULATIVE EFFECTS	40
CONCLUSION.....	40
INCIDENTAL TAKE STATEMENT	41
AMOUNT OR EXTENT OF TAKE ANTICIPATED.....	42
EFFECT OF THE TAKE.....	42
REASONABLE AND PRUDENT MEASURES.....	42
TERMS AND CONDITIONS	43
CONSERVATION RECOMMENDATIONS.....	44
REINITIATION NOTICE	45
LITERATURE CITED	45

APPENDIX A **Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision** 50

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the proposed construction of the Adams Fairacre Farms Store located in the Town of Wappinger, Dutchess County, New York, and the effects on the Indiana bat (*Myotis sodalis*) in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The U.S. Army Corps of Engineer's (Corps) September 21, 2009, request for formal consultation was received on September 23, 2009, along with the Biological Assessment of the Proposed Adams Fairacre Farms Store (Stearns & Wheeler, LLC 2009). The applicant, Mr. Pat Adams of Adams Fairacre Farms, contracted Stearns & Wheeler, LLC, to assist with the development of the Biological Assessment (BA).

This BO is based on information provided in the August 2009 BA, numerous meetings, telephone conversations, and electronic mail exchanges among the Service, Corps, applicant, and their consultants. A complete administrative record of this consultation is on file at the Service's Cortland, New York, Field Office.

CONSULTATION HISTORY

July 21, 2008 – The Service was contacted by a project consultant who provided a brief description of the proposed action. The consultant also provided a map of the project site and a listed species habitat report.

July 22-23, 2008 – The Service sent an electronic mail to the consultant recommending mist-netting.

August 7, 2008 – The Service was notified that seven Indiana bats had been captured at the project site.

October 7, 2008 – The Service requested project plans and a final copy of the mist-netting report.

November 4, 2008 – The Service received a link to the mist-netting report and other background materials.

December 4, 2008 – The Service was notified of the availability of revised project plans and requested a copy. The Service received draft conservation measures from the Corps.

January 8, 2009 – The Corps requested additional information from the applicant to process their wetland application.

January 23, 2009 – A conference call was held and attended by the applicant, Corps, Service, and the applicant's consultants.

February 12, 2009 – The Service was contacted by the applicant’s consultant to let us know that the applicant was hiring a consultant to prepare a biological assessment (BA) for the project. The Service offered assistance with the development of the BA.

April 1, 2009 – The Service and a project consultant met to review the current proposed project plans and discuss potential conservation measures for the Indiana bat.

May 28, 2009 – The Service received revised site plans that included revisions to minimize impacts to Indiana bat foraging and roosting habitat, as well as notes regarding additional proposed conservation measures

July 15, 2009 – The Service received a draft BA.

July 29, 2009 – The Service, Corps, and project consultants met in Cortland, New York, to discuss the draft BA and the formal consultation process/timeline.

August 3, 2009 – The Service provided written comments on the draft BA.

August 20, 2009 – The Service received a revised BA from the applicant’s consultant and was copied on a letter to the Corps with a request to expedite the formal consultation.

September 14, 2009 – The Service received additional information on conservation easements.

September 23, 2009 – The Service received a letter requesting expedited formal consultation from the Corps.

October 8, 2009 – The Service responded to the Corps in a letter acknowledging receipt of their complete initiation package.

November 13, 2009 – The Service sent draft terms and conditions to the Corps, applicant, and New York State Department of Environmental Conservation (NYSDEC).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

As defined in the ESA Section 7 regulations (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 or upon the high seas.” 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, as well as the cumulative effects of reasonably certain future State or private activities within the action area.

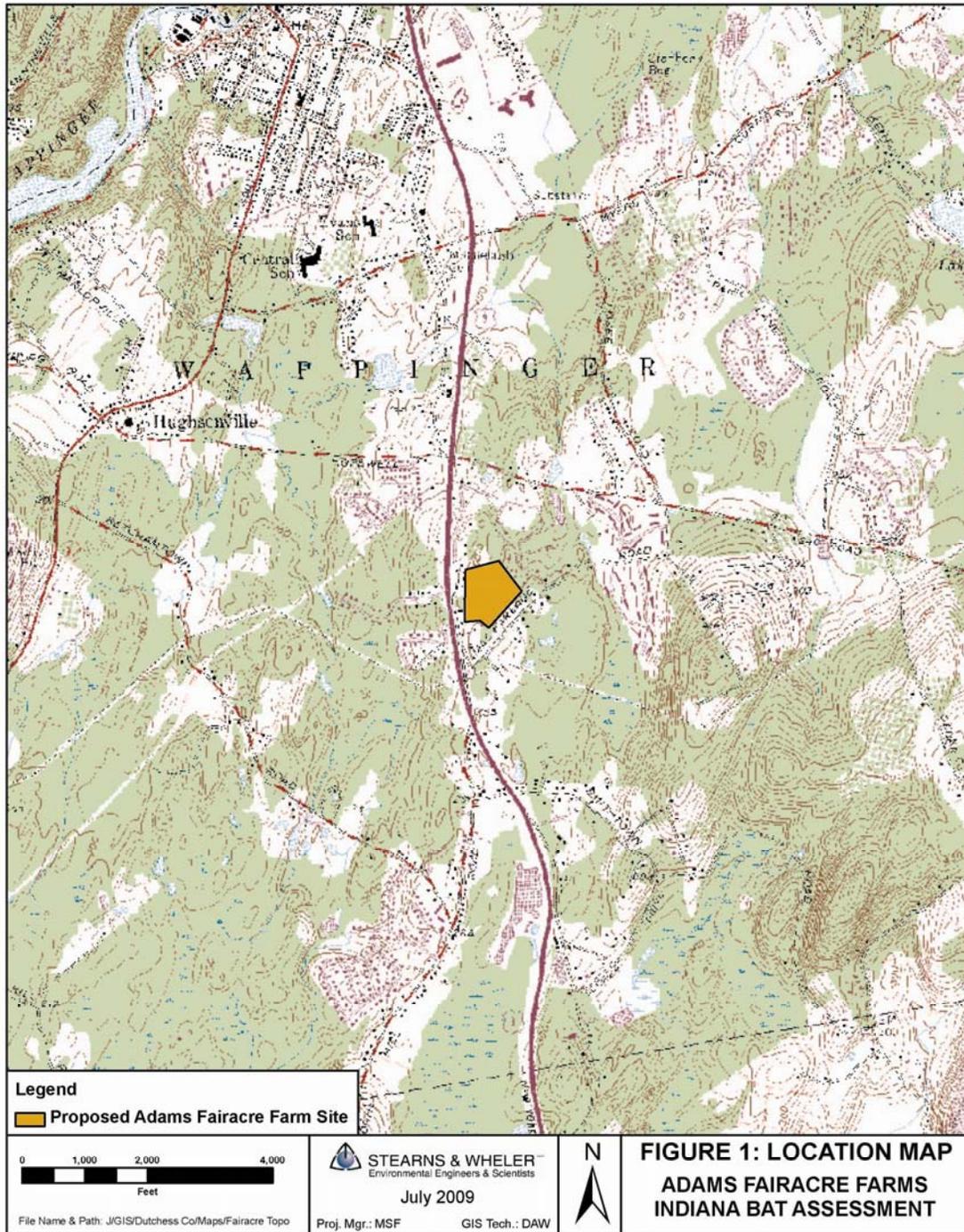


Figure 2. Project location topographic map.

Actions associated with the project include construction, operation, and maintenance of a grocery, farm and garden retail facility with associated nursery yard, parking, and landscaping.

The following is the timeline of activities associated with the project.

- Tree clearing (October 2009-March 2010);
- Construction of retaining walls (April 5, 2010 – June 11, 2010);
- Early part of grading and drainage installation (June 7, 2010 – October 22, 2010);
- Early construction of the main building exterior (August 9, 2010 – May 6, 2011);
- Early paving, and curb and site lighting installation (August 23, 2010 – November 19, 2010);
- Greenhouse construction (April 11, 2011 – May 27, 2011);
- Building interior finishing (April 11, 2011 – July 22, 2011); and
- Store stocking, testing, and staff training; begin operation (September 26, 2011 – October 28, 2011).

The total footprint of disturbance on the 12.82-acre parcel will be 9.33 acres. The remaining 3.48 acres of the site will remain undisturbed. The development area is generally concentrated in the northern 2/3 of the parcel to avoid impacts to local and Federal jurisdictional wetlands located in the south end of the property and to provide a naturally vegetated buffer, foraging area, and dispersal corridor for an Indiana bat roost tree located on an adjacent property near the southwest corner of the site.

The Corps is involved with the project through the authorization of activities in waters of the United States under Nationwide General Permit #39 under the authority of Section 404 of the Clean Water Act (33 U.S.C. 1344).

The project involves 25,793 square feet of permanent impacts to wetlands. The applicant proposes to mitigate for these impacts by creating 26,605 square feet of scrub-shrub wetlands around the perimeters of the remaining wetlands.

Conservation Measures

Conservation measures represent actions pledged in the project description that the action agency or the applicant will implement to further the species' recovery. Such measures may be tasks recommended in the species' recovery plan, should be closely related to the action, and should be achievable within the authority of the action agency or applicant. The beneficial effects of conservation measures are taken into consideration in the Service's conclusion of jeopardy or non-jeopardy to the listed species, and in the analysis of incidental take. Such measures, however, must minimize adverse effects to listed species within the action area in order to be factored into the Service's analyses.

The following conservation measures include both typical best management practices for commercial development and measures specifically designed to avoid, minimize, and compensate for impacts of the proposed project on the Indiana bat. The Service has analyzed the

effects of the proposed action considering that the project will be implemented as proposed (including all conservation measures).

A. **Seasonal Restriction on Vegetation Clearing.** The applicant proposes to clear trees from the proposed development envelope between October 31, 2009, and March 31, 2010, when Indiana bats will be in hibernation. This will avoid direct effects to Indiana bats from tree removal. Prior to clearing, the limits of proposed clearing will be clearly demarcated on the site with orange construction fencing (or similar) to prevent inadvertent over-clearing of the site.

B. **Project Limiting Fence.** A bright orange plastic mesh project-limiting fence will be erected at the proposed limit of clearing on the site prior to any vegetation being cleared from the site. This fence will provide a clear visual and physical barrier to prevent inadvertent clearing of naturally vegetated areas and existing bat habitat that are not intended to be cleared for this project. The project limiting fence will not be removed from the site until all site construction and stabilization activities have been completed.

C. **Decreased Project Footprint.** The project sponsor has substantially decreased the footprint of the proposed project since its initial proposal in 2007. As originally proposed, the project disturbed virtually the entire 12.82 acre parcel. The project sponsor has since decreased the footprints of the building, parking lot, nursery, receiving area, and jurisdictional wetland disturbance through extensive redesign and modifications of the proposed project. This has decreased the project footprint by about 25%, yielding about 3 acres of the property that will either remain undisturbed, or will provide habitat value for bats post-construction.

The project sponsor proposes to minimize development disturbance in the south end of the site to provide a natural and undisturbed forested habitat immediately surrounding a known Indiana bat roost tree located on an adjacent property near the southwest corner of the site, as well as to provide roost emergence foraging habitat and a protected dispersal corridor to allow bats to travel under forest canopy from that roost to adjacent wooded properties. The undisturbed forested corridor will range from 45 feet to up to 195 feet wide across the south end of the parcel.

The proposed stormwater management basin will be the only cleared area in the proposed buffer. It will be ± 230 feet long by ± 175 feet wide, and it will be vegetated with herbaceous vegetation in the basin, and surrounded by a mixture of herbaceous vegetation and shrubs to create a gradual transition between the herbaceous basin and the surrounding wooded area. This cleared area will mimic a natural clearing in the forest, and may still provide foraging habitat for Indiana bats, which are known to feed and travel along forest edges, and will also cross small clearings. There will be a 35 foot forested buffer between the proposed parking area and the roost tree, which is located at the edge of an asphalt parking area on the adjacent parcel to the south. In addition, the applicant is proposing to plant 60 shade trees in the site landscaping, including at least 6 shagbark hickory (*Carya ovata*), which, when mature, may be used as roost trees by Indiana bats.

D. **Avoidance of Known Roost Trees.** No known Indiana bat roost trees exist on the project site, though there is one that is located on an adjacent property to the southwest, just over the property line. The proposed project plan avoids removal of any known roost trees, and provides

for a minimum 35 foot undisturbed buffer of existing vegetation around the roost tree on the adjacent property. This buffer will minimize the effects of the proposed project on bats that use that roost tree, and balances the various Town requirements for stormwater management and parking, and conservation requirements of the Corps and Service.

E. **Lighting.** Lighting on the site will be minimized around the wooded perimeter to minimize light disturbance of the wooded buffer area. Light fixtures proposed for the parking lot and nursery will have tops that direct light down to minimize light pollution. Light fixtures proposed for the loading dock on the northeastern side of the building do not have tops or shields, but they will be angled down to cast their light toward the ground.

Lights will be set on timers to operate from dusk until 10:00 p.m. Only 8 of the 54 exterior light fixtures in the parking lot or on the building are designated for security purposes and shall remain illuminated all night. They will be fitted with photo cells that will turn them off at dawn. Lights around entrances to the building (front and side entrance, loading dock, and dumpster area) will be fitted with motion sensors, so that they will turn on if someone approaches the building entrances. Otherwise these fixtures will remain off after 10:00 p.m.

F. **Water Quality Protection.** The existing ponds on the site are proposed to be left in their natural state with wooded buffers, and they will not receive stormwater runoff from the impervious areas of the site. The proposed stormwater basin is proposed as a wet basin, meaning that it will retain water for as long as it takes for the water to percolate into the soil or evapotranspire. Thus, it is not anticipated to support algae or breeding insects. Therefore, the stormwater pond and the natural ponds are not proposed to be maintained with any chemicals that might adversely affect bats or insect populations on which they may feed.

Further, stormwater on the site will run through catch basins and the vegetated forebay of the stormwater basin prior to reaching the main bay of the basin. This will allow particulates and some dissolved nutrients to be trapped prior to percolating into the ground. This will also protect local water quality, avoiding adverse impacts to bats that drink water locally, or to water-breeding insects on which they may feed.

G. **Wetland Impact Minimization and Mitigation.** The original proposed site plan from 2007 included impacts to 27,225 square feet of wetland habitat for Indiana bats, including both Federal and town-regulated wetlands. The applicant, through negotiations with the Corps and multiple design modifications, reduced this impact area to 25,793 square feet. The applicant proposes to mitigate for these impacts by creating 26,605 square feet of scrub-shrub wetlands around the perimeters of the remaining wetlands to provide a soft transition zone between water in the ponds on site and the surrounding woods, yielding a 1:1 replacement ratio for the mitigation. In addition, the applicant proposes to connect the existing Federal wetlands on the south side of the site to the isolated wetlands on the northern end of the site via a culvert, rendering the currently isolated, town-regulated wetlands as Federally-regulated wetlands. This will add Federal protection to that currently isolated wetland area.

H. **Off-Site Habitat Protection.** The applicant proposes to purchase 12.66 acres of land offsite that contains suitable foraging and potential roosting habitat for Indiana bats, and place

that land in a conservation easement to be held by the Town of Wappinger to offset the anticipated habitat loss on the project site. The proposed land includes 5 parcels of land that are outparcels within existing conservation easements that lie along both sides of a power line right-of-way approximately 4,000 feet east-southeast of the project site.

The parcels are all forested in mature, oak-dominated southern hardwood forest cover type, and lie along the power line right-of-way. This provides both suitable foraging habitat along the edge of the cleared right-of-way, and roosting habitat in the mature forest. The 12.66 acres are not currently within the existing adjacent conservation easements, but when added to them, will result in a total of ± 77 acres of contiguous land committed to conservation easements that provides suitable habitat for Indiana bats, and will never be developed or cleared. The location of these parcels is within one mile of the project site, and while Bat Conservation and Management, Inc. (2008) did not radio track any bats to these properties, they are well within the nightly foraging distance traveled by Indiana bats from this site.

The conservation easement for the five parcels is proposed to be held by the Town of Wappinger, as is the existing easement on the adjacent lands. Proposed language for the conservation easement will be submitted to the Service and the Corps for approval prior to executing the easement.

Action Area

The “action area” is the entire area within which project-associated environmental effects are anticipated to occur (e.g., earth disturbance, noise, flight path disruption) and effects will extend beyond the project footprint. The Service generally agrees with the action area described in the BA.

Spring/Summer

The summer action area is defined as the project site and an area within 3 miles of the site to incorporate known and potential roosts and foraging areas (Figure 3).

The site is surrounded to the south and east by single family residences on $\pm 1/4$ to 1-acre parcels, to the north by a car dealership and commercial district, and to the west by single family residences and a four-lane highway. Forested habitat exists on adjacent properties and throughout the local area, but is highly fragmented by residential and commercial development, local two-lane roads, a four-lane highway, and a ± 200 -foot-wide power line right-of-way.

Development is relatively dense in the U.S. Route 9 corridor, but large blocks of undisturbed forested land remain just beyond this corridor to the east and west. Forested habitat makes up about 39% of the area within 3 miles of the site, which is a typical travel radius for a roosting Indiana bat during the summer months. Forested habitat represents 55% of the known area used by bats in this area (Bat Conservation and Management, Inc. 2008).

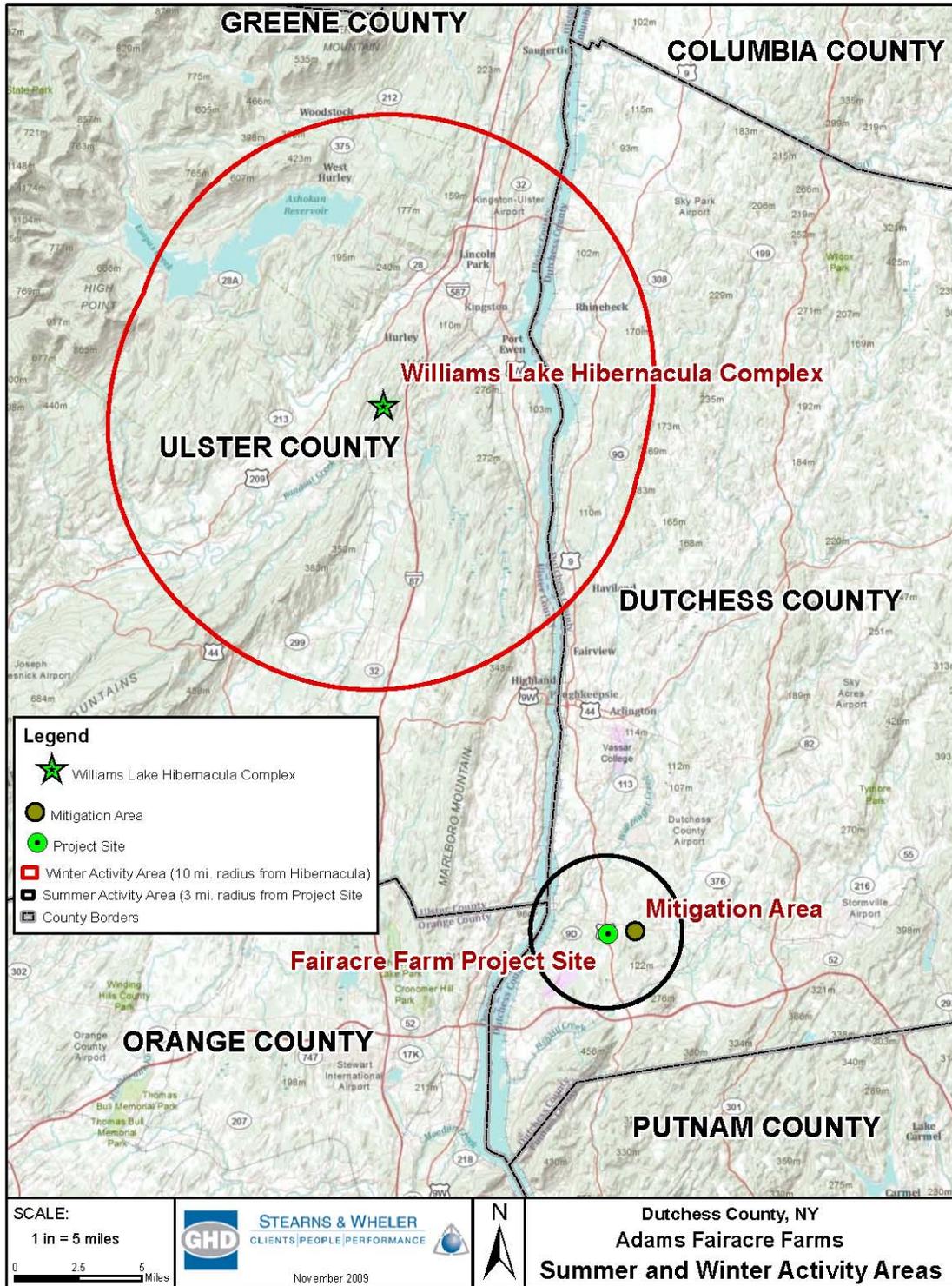


Figure 3. Summer and Winter Action Areas.

Fall/Winter

Indiana bats using the project area are presumed to be part of the wintering population that hibernates in the Williams Lake Complex of hibernacula in Rosendale, Ulster County, New York, which is 21 miles from the project site. Radio-telemetry studies conducted in 2004, 2005, and 2007 by the NYSDEC and Service indicated that the bats dispersed from the Williams Lake Complex and traveled up to approximately 45 miles to their summer range. Indiana bats were tracked to Dutchess County within 3.5 miles of the site.

The fall/winter action area is defined as the Williams Lake Hibernacula Complex with a 10-mile radius. This area should include the majority of fall swarming and spring dispersal stopover activities (Figure 3). There are no impacts anticipated to Indiana bats in their hibernacula. We believe there is a discountable probability of impacts to Indiana bats during fall swarming/foraging and no further review of this potential larger action area is warranted because the anticipated effects will occur to Indiana bats during the spring and summer in a smaller geographic area. In addition, some members of the identified maternity colonies could originate from hibernacula other than the Williams Lake Complex, however, we have no information to suggest that this is the case.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species Description

The Indiana bat is a medium-sized bat in the genus *Myotis*. Its forearm length is 1 3/8-1 5/8 in, and the head and body length ranges from 1 5/8-1 7/8 in. This species closely resembles the little brown bat and the northern long-eared bat (*M. septentrionalis*). The Indiana Bat Draft Recovery Plan (Service 2007) provides a comprehensive summary of the description of the species and is incorporated by reference.

Listing Status

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter and summers in wooded areas. The Indiana bat was officially listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001), under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The ESA extended full protection to the species. A 5-year review was published in September 2009 (Service 2009).

Critical Habitat

Critical habitat was designated for the species on September 24, 1976 (41 FR 14914). Thirteen hibernacula, including 11 caves and two mines in six states, were listed as critical habitat:

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

Recovery Plan Status

The Service has published a recovery plan (Service 1983) which outlines recovery actions. Briefly, the objectives of the plan are to: (1) protect hibernacula; (2) maintain, protect, and restore summer maternity habitat; and (3) monitor population trends through winter censuses. An agency draft of a revised plan was published in 1999, but this was never finalized. A revised draft recovery plan was published in 2007 (Service 2007) (Appendix A). The Recovery Priority of the Indiana Bat is 8, which means that the species has a moderate degree of threat and high recovery potential.

Life History

The average life span of the Indiana bat is 5 to 10 years, but banded individuals have been documented living as long as 14 and 15 years (Humphrey and Cope 1977). Female survivorship in an Indiana population was 76% for ages 1 to 6 years and 66% for ages 6 to 10 years. Male survivorship was 70% for ages 1 to 6 years and 36% for ages 6 to 10 years (Humphrey and Cope 1977).

The Indiana bat is a migratory bat, hibernating in caves and mines in the winter (typically October through April) and migrating to summer habitat. Although some Indiana bat bachelor colonies have been observed (Hall 1962, Carter et al. 2001), males and non-reproductive females typically do not roost in colonies and may stay close to their hibernaculum (Whitaker and Brack 2002) or migrate long distances to their summer habitat (Kurta and Rice 2002). Reproductive females may migrate up to 357 miles (Winhold and Kurta 2006) to form maternity colonies to bear and raise their young. However, much shorter movements have been observed in New York. Both males and females return to hibernacula in late summer or early fall to mate and enter hibernation. The Indiana Bat Draft Recovery Plan (Service 2007) provides a comprehensive summary of Indiana bat life history and is incorporated by reference.

Food Habits

The Indiana bat feeds primarily on aquatic and terrestrial insects. Diet varies seasonally and variations exist among different ages, sexes, and reproductive status (Service 1999). Numerous

foraging habitat studies have been completed for the Indiana bat. These studies found that Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands. Forested habitats are very important for foraging bats, but old fields and agricultural areas seem to also be somewhat important habitats in studies completed in Indiana (Service 2007). At a study site near the Indianapolis International Airport, Sparks et al. (2005a) found Indiana bats spending nearly 51% 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.

Habitat Requirements

In this section we provide summaries of habitat requirements for Indiana bats. The Indiana Bat Draft Recovery Plan (Service 2007) provides more comprehensive summaries and is incorporated by reference.

During winter, Indiana bats are restricted to suitable underground habitats known as hibernacula. The majority of hibernacula consist of limestone caves, especially in karst areas of east central United States, but abandoned underground mines, railroad tunnels, and even hydroelectric dams can provide winter habitat throughout the species' range (Service 2007). In New York, the largest and most rapidly growing populations of Indiana bats occurred in abandoned underground mines (Hicks and Novak 2002) (although see **Threats** section for new information). Hibernacula with stable and/or growing populations of Indiana bats have stable low temperatures that allow the bats to maintain a low metabolic rate and conserve fat reserves through the winter.

Spring emergence occurs when outside temperatures have increased and insects (forage) are more abundant (Richter et al. 1993). In New York, spring emergence studies have consistently shown that Indiana bats emerge once evening temperatures remain higher than 50°F after April 15. Some bats may remain in close proximity to the cave for a few days before migrating to summer habitats. This activity is known as spring staging. Others head directly to summer habitat. 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).

Indiana bats exhibit strong site fidelity to their traditional summer colony areas and foraging habitat, that is, they return to the same summer range annually to bear their young (Kurta et al. 2002, Service 1999). Traditional summer sites that maintain a variety of suitable roosts are essential to the reproductive success of local populations. It is not known how long or how far female Indiana bats will search to find new roosting habitat if their traditional roost habitat is lost or degraded during the winter. If they are required to search for new roosting habitat in the spring, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration and pregnancy.

Summering Indiana bats (males and females) roost in trees in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bat to roost between the bark and bole of the tree. Cavities and crevices in trees also may be used for roosting. A variety

of tree species are used for roosts including, but not limited to, silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), eastern cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), shingle oak (*Quercus imbricaria*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), and sassafras (*Sassafras albidum*) (Rommé et al. 1995). Structure is probably more important than the species in determining if a tree is a suitable roost site; tree species which develop loose, exfoliating bark as they age and die are likely to provide roost sites. Male bats disperse throughout the range and roost individually or in small groups. In contrast, reproductive females form larger groups, referred to as maternity colonies in which they raise their offspring. Non-reproductive females may roost individually or in small groups, but occasionally are found roosting with reproductive females. While Indiana bats primarily roost in trees, some colonies have been found in artificial roost sites. Only four maternity colonies have been found in buildings; in comparison, more than 400 roost trees have been documented for female Indiana bats (Service 2007).

Indiana bat roost trees have been described as either primary or alternate depending on the number of bats in a colony consistently occupying the roost site. In Missouri, Callahan (1993) defined primary roost trees as those with exit counts of more than 30 bats on more than one occasion; however, this number may not be applicable to small-to-moderate sized maternity colonies. Kurta (2005) summarized summer habitat information from 11 states and found most exit counts at primary roosts are at least 20-100 adults with a typical maximum of 60-70 adults in a primary roost at any given time. Primary roost trees are almost always located in either open canopy sites or in the portion of a tree used by bats that is above the canopy cover of the adjacent trees (Callahan et al. 1997, Kurta et al. 2002). Alternate roost trees can occur in either open or closed canopy habitats. Maternity colonies use a minimum of 8-25 trees per season (Callahan et al. 1997, Kurta et al. 2002). On the average, Indiana bats typically switch roosts every two to three days with reproductive condition of the female, roost type, weather conditions, and time of year affecting switching behavior (Kurta et al. 2002, Kurta 2005).

Exposure of trees to sunlight and location relative to other trees are important to suitability. Cool temperatures can delay development of fetal and juvenile young and selection of maternity roost sites may be critical to reproductive success. Dead trees with southeast and south-southwest exposures allow warming solar radiation. Some living trees may provide a thermal advantage during cold periods (Service 1999). Maternity colonies use multiple roosts in both dead and living trees that are grouped. Extent and configuration of a use area is probably determined by availability of suitable roost sites. Distances between roosts can be a few meters to a few kilometers. Reasons for frequent roost switching may be a response to weather changes, changing needs of females in different reproductive conditions, or an attempt by the bats to maintain social contacts or knowledge of alternate roost sites (Barclay and Kurta 2007). Primary roosts are often located in openings or at the edge of forest stands, while alternate roosts can be in either openings or the interior of the forest stand. Primary roosts are usually surrounded by open canopy and are warmed by solar radiation. Alternate roosts 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). Weather has been found to influence bat behavior and habitat use (Humphrey et al. 1977).

Very little research has focused on the use of travel corridors by Indiana bats. Most information pertaining to bat movements and travel corridors is incidental to other portions of a study and/or general observations. However, Murray and Kurta (2004) showed that Indiana bats increased commuting distance by 55% to follow tree-lined paths rather than flying over large agricultural fields, some of which were at least 0.6 mile (1 km) wide. In addition, data collected from a residential development in northern New York showed use of linear features (i.e. hedgerows and tree-lined fence rows) by Indiana bats (Environmental Solutions and Innovations, Inc. 2006). Apparently suitable, but distant forest patches may not be available to Indiana bats unless they are connected by a wooded corridor, however, we do not know the maximum size of an opening Indiana bats may cross.

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 (i.e. caves and mines) each winter, conducting standardized surveys of the hibernating bats is the most feasible and efficient means of estimating and tracking population and distribution trends across the species’ range. Collectively, winter hibernacula surveys provide the Service with the best representation of the overall population status and relative distribution that is available.

For several reasons, interpretation of the census data must be made with some caution. First, winter survey data have traditionally been subdivided by state due to the nature of the data collection. As described below, each state does not represent a discrete population center. Nevertheless, the range-wide population status of the Indiana bat has been organized by state thus far. Second, as will be further discussed, available information specific to the “reproductive unit” (i.e. maternity colony) of the Indiana bat is limited. While winter distribution of the Indiana bat is well documented, relatively little is known as to the size, location, and number of maternity colonies for the Indiana bat. As described below, it is estimated that the locations of more than 90% of the estimated maternity colonies remain unknown.

Additionally, the relationship between wintering populations and summering populations is not clearly understood. For example, while it is known that individuals of a particular maternity colony typically come from one to many different hibernacula, the source (hibernacula) of most, if any, of the individuals in a maternity colony is not known.

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

Current Abundance

The Service compiled winter hibernacula survey information from 2006 and 2007 to develop the most recent range-wide population estimate of 468,184 Indiana bats. Winter counts ranged from 509,708 in 1981 down to 328,410 in 2001 and back up to 468,184 in 2007 (Figure 5). Additional information on short- and long-term trends can be found in the Indiana Bat Draft Recovery Plan (Service 2007). Final results of the winter of 2008-2009 surveys are not yet available, however, the range-wide population estimate has declined since 2007, primarily due to white-nose syndrome (WNS) (see **New Threats** section).

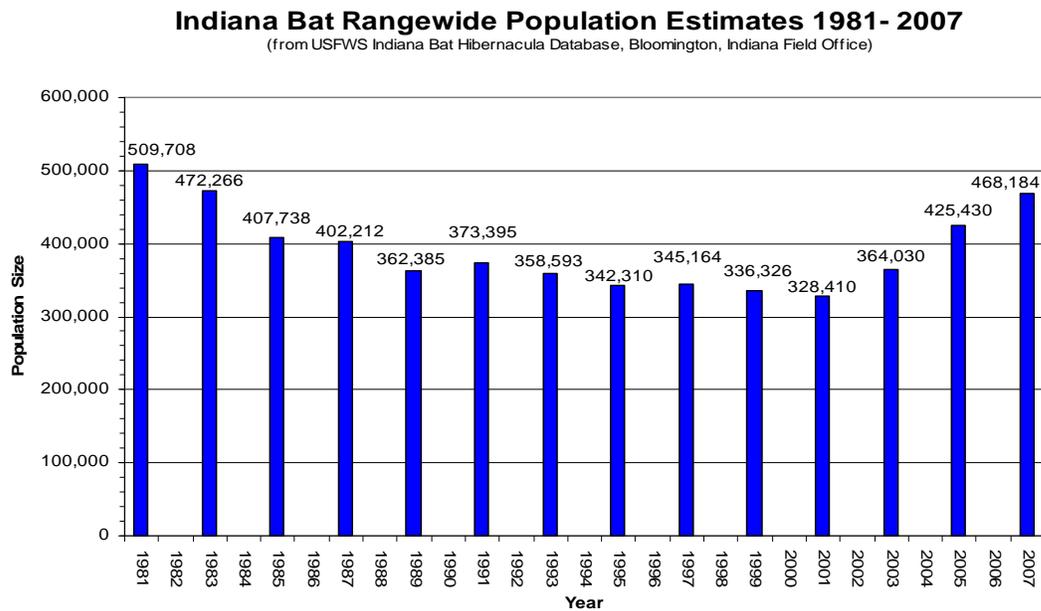


Figure 5. Indiana bat range-wide populations estimates 1981-2007 (Service 2009).

Categorization of Hibernacula

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

Priority 1 (P1): Essential to recovery and long-term conservation of Indiana bat, Priority 1 hibernacula typically have (1) a current and/or historically observed winter population $\geq 10,000$ Indiana bats and (2) currently have suitable and stable microclimates (e.g., they are not considered "ecological traps" as defined below). 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 $\geq 10,000$ Indiana bats at some point in their past, but have consistently contained fewer than 5,000 bats over the past 10 years.

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

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

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

High Potential (HP): A special designation given to P2, P3, or P4 hibernacula that are deemed capable of supporting 10,000 or more Indiana bats in the future if (1) an appropriate microclimate is restored (or created in the case of some mines) and/or (2) the site is protected from disturbance. These sites typically have no recorded direct observations of significant numbers of Indiana bat (i.e. at least none that can be readily confirmed; they differ from a P1B site in this respect). Instead most “high-potential” hibernacula have one or more forms of indirect evidence indicating previous use by large numbers of *Myotis* and/or Indiana bat (e.g., anecdotal historic accounts and/or paleontological evidence such as bones, mummified remains, ceiling staining, etc.). As of October 2006, two caves had been designated as having HP – Mammoth Cave in Kentucky and Rocky Hollow Cave in Virginia.

Ecological Trap (ET): A hibernaculum having a history of repeated flooding or severe freezing events that have resulted in the mortality of most hibernating Indiana bat. Hibernacula with other environmental conditions that pose a severe and/or imminent threat to the majority of hibernating bats may also be designated as “ecological traps” by the Service (e.g., threat of catastrophic collapse). As of October 2006, three caves had been preliminarily designated as ETs – Bat Cave (Shannon Co.) in Missouri (freezing), Hailes Cave in New York (flooding), and Clyfty Cave in Indiana (flooding). These preliminary designations were made based on the recommendations of Indiana bat experts familiar with these caves and on the history of Indiana bat mortality in these caves. The designations will be reevaluated when procedures for evaluation and designation of hibernacula as ETs are developed.

Current Winter Distribution

The following is a summary from the Indiana Bat Draft Recovery Plan and 5-year review (Service 2007, Service 2009); additional information from the Plan is incorporated by reference. As of October 2008, the Service has winter records of extant winter populations (i.e. positive winter occurrence since 1995) of the Indiana bat at approximately 281 different hibernacula located in 19 states (Figure 6). Likewise, based on the 2005 winter surveys, there were a total of 23 Priority 1 hibernacula in seven states – Illinois (n=1), Indiana (n=7), Kentucky (n=5), Missouri (n=6), New York (n=2), Tennessee (n=1), and West Virginia (n=1). A total of 53 Priority 2 hibernacula are known from the aforementioned states, as well as Arkansas, Ohio,

Pennsylvania, and Virginia. A total of 150 Priority 3 hibernacula have been reported in 16 states. A total of 213 Priority 4 hibernacula have been reported in 23 states.

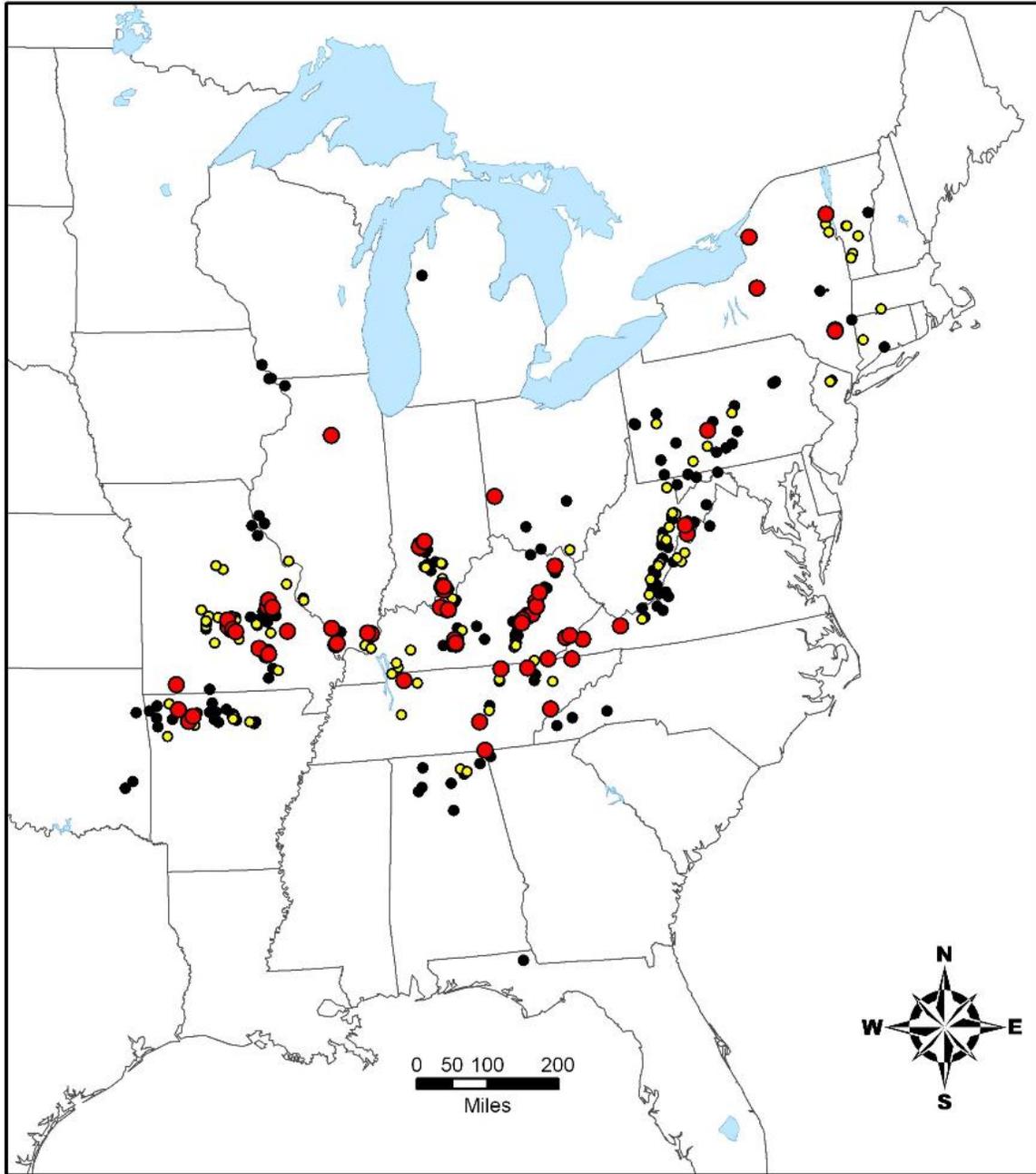
Winter surveys in 2006-2007 found hibernating Indiana bats dispersed across 15 states. However, over 90% of the estimated range-wide population hibernated in five states – Indiana (46.4%), Missouri (12.6%), Kentucky (13.4%), Illinois (10.5%), and New York (10.3%) (Table 1, Service 2008).

Current Winter Population Groups

The following summary is from the Indiana Bat Draft Recovery Plan (Service 2007). M.J. Vonhof and G.F. McCracken's statistical analysis of genetic samples (mtDNA extracted from wing membrane punches) collected from hibernating Indiana bats from widely dispersed hibernacula suggested that genetic variance among samples was best explained by dividing sampled hibernacula (n=13) into four separately defined population groups, as follows:

- Midwest, included sampled populations in AR, MO, IN, KY, OH, Cumberland Gap, Saltpeter Cave in southwestern VA, and Jamesville Quarry Cave in Onondaga Co., NY,
- Appalachia, included White Oak Blowhole Cave in east TN, and Hellhole Cave in WV,
- Northeast 1 (NE1), included Barton Hill Mine and Glen Park Caves in northern NY (Essex and Jefferson Cos., respectively), and
- Northeast 2 (NE2), included Walter Williams Preserve Mine in Ulster Co., NY (Service 2007).

For more information on wintering bat distribution, abundance, and potential genetic variation, see the Indiana Bat Draft Recovery Plan (Service 2007).



- Priority 1 & 2 IBat Hibernacula Sites (to be surveyed in 2009)
- Priority 3 (may or may not be surveyed in 2009)
- Priority 4 (many will not be surveyed in 2009)

Figure 6. Distribution of known Indiana bat hibernacula and their current priority status (Service 2007). Source: Andrew King, Service, Bloomington, Indiana.

Table 1. 2007 Range-wide population estimate for the Indiana bat.



U.S. Fish & Wildlife Service

Revised* 2007 Range-wide Population Estimate for the Indiana Bat, *Myotis sodalis*

Estimates are based on winter surveys conducted at all known Priority 1 and 2 hibernacula throughout the species' range. Additional data from Priority 3 and 4 hibernacula have also been included when available.

Service Region	State	2001	2003	2005	2007	% Change from 2005	% of 2007 Total
Region 2	Oklahoma	0	5	2	0	-100.0%	0.0%
Region 3	Indiana	173,111	183,337	206,610	238,009	15.2%	50.8%
	Missouri	18,999	17,722	16,102	15,895	-1.3%	3.4%
	Illinois	21,677	43,646	55,166	54,095	-1.9%	11.6%
	Ohio	9,817	9,831	9,769	7,629	-21.9%	1.6%
	Michigan	20	20	20	20	0.0%	0.0%
	Total		223,624	254,556	287,667	315,648	9.7%
Region 4	Kentucky	51,053	49,544	65,611	71,250	8.6%	15.2%
	Tennessee	9,564	9,802	12,074	8,906	-26.2%	1.9%
	Arkansas	2,475	2,228	2,067	1,829	-11.5%	0.4%
	Alabama	173	265	296	258	-12.8%	0.1%
	Total		63,265	61,839	80,048	82,243	2.7%
Region 5	New York	29,671	32,981	41,727	52,803	26.5%	11.3%
	Pennsylvania	702	931	835	1,038	24.3%	0.2%
	West Virginia	9,714	11,444	13,417	14,745	9.9%	3.1%
	Virginia	969	1,158	769	723	-6.0%	0.2%
	New Jersey	335	644	652	659	1.1%	0.1%
	Vermont	246	472	313	325	3.8%	0.1%
	Total		41,637	47,630	57,713	70,293	21.8%
Range-wide Total:		328,526	364,030	425,430	468,184		100.0%

2-yr. Net Increase of:	35,504	61,400	42,754
% Increase of:	10.8%	16.9%	10.0%

* Missouri's 2001 - 2007 estimates had previously assumed 50,550 Indiana bats in Pilot Knob Mine (PKM) based on external fall capture rates at the mine's primary entrance, but a February 2008 internal survey of this mine documented a total population of 1,678 Indiana bats (Elliott and Kennedy 2008, unpublished technical report; available at http://www.utexas.edu/tmm/sponsored_sites/biospeleology/pdf/index.htm). The Service considers this new data to more closely estimate the true population within the mine and adjusted the MO estimates accordingly. Some other, smaller adjustments were made based upon the discovery of new hibernacula in Kentucky and New York in 2008 (i.e. we assumed the same number of Indiana bats that were found at these new sites in 2008 were also present in 2007).

Compiled by Andy King, U.S. Fish and Wildlife Service, Bloomington, Indiana, Ecological Services Field Office from data gathered from bat biologists throughout the species' range. (andrew_king@fws.gov)

Current Summer Distribution

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. In the past decade, many summer maternity colonies have been found in the northeastern states of Pennsylvania, Vermont, New Jersey, New York, West Virginia, and Maryland. Maternity colonies extend south as far as northern Arkansas, southeastern Tennessee, and southwestern North Carolina (Britzke et al. 2003, Service 2007).

Non-reproductive summer records for the Indiana bat have also been documented in eastern Oklahoma, northern Mississippi, Alabama, and Georgia.

Maternity Colonies

The first Indiana bat maternity colony was not discovered until 1971 in east-central Indiana (Cope et al. 1974). As of publication of the Indiana Bat Draft Recovery Plan (Service 2007), we have records of 269 maternity colonies in 16 states that are considered locally extant. Of the 269 colonies, 54% (n=146) have been found, mostly during mist-netting surveys, within the past 10 years (i.e. since 1997). This number is an underestimate as additional colonies were discovered in New York and probably found elsewhere in 2007. Because maternity colonies are widely dispersed during the summer and difficult to locate, it is presumed that all the combined summer survey efforts have found only a fraction of the maternity colonies based on the range-wide population estimates derived from winter hibernacula surveys.

In New York, there are at least 36 documented maternity colonies across the landscape in 8 counties – Cayuga, Dutchess, Essex, Jefferson, Onondaga, Orange, Oswego, and Ulster. Many of these colonies have been located by tracking females as they emerge from hibernation to their spring roosting areas using radio telemetry. Each documented roost tree was recorded using a Global Positioning System handheld unit. Many of the radio transmitter batteries lasted into “summer” season (after May 15, or approximately 30 days) documenting the use of these sites by potential colonies. Many sites had large exit counts in spring either before or after May 15 and many sites were documented as colonies by subsequent mist-netting and radio telemetry efforts.

Adult Males

Male Indiana bats are found throughout the range of the species, but in summer are most common in areas near hibernacula (Gardner and Cook 2002) (Figure 7).

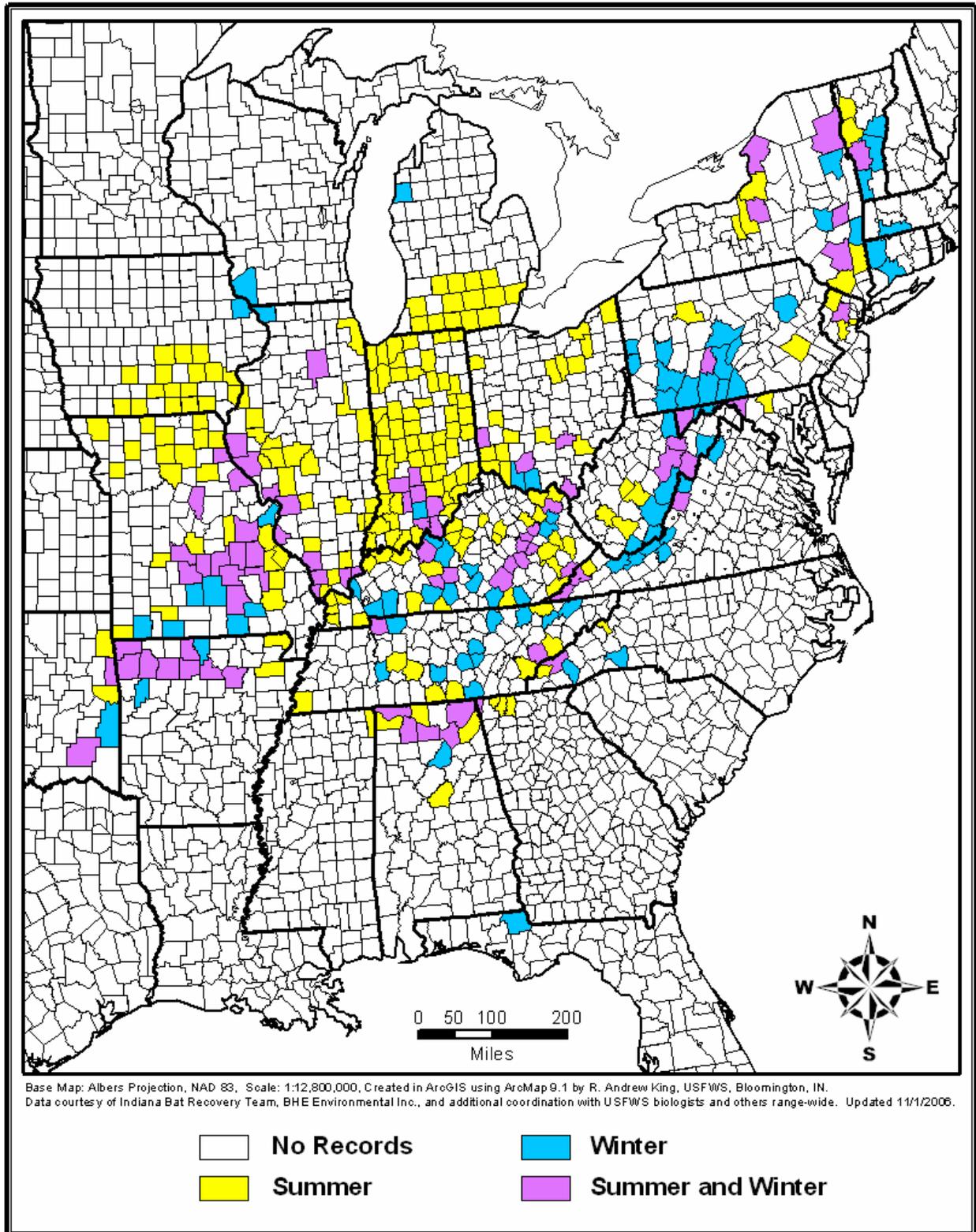


Figure 7. Distribution of counties with known summer and winter records of the Indiana bat as of publication of the Indiana Bat Draft Recovery Plan (Service 2007).

Reasons for Listing/Threats

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

Summer habitat modification is also suspected to have contributed to the decline of bat populations, however, it is difficult to quantify how forest management or disturbance may affect Indiana bats. Forests used by foraging and roosting Indiana bats during spring, summer, and autumn have changed dramatically from pre-settlement conditions. Forests have been fragmented in areas, fire has been suppressed, and much of the vegetation in flatlands (i.e. prairie) has been converted for agricultural purposes (Service 1999). Summer habitat can include small woodlots connected by hedgerows or extensive forests. The removal of such habitats is occurring rapidly in some portions of the Indiana bat's range due to urban development, mining, and other infrastructure, including roadways and utility corridors.

In addition, chemical contamination while bats are outside of hibernacula has been suggested as a cause for the decline of Indiana bats (Service 1999). The effect of acute or chronic toxicity on population declines is still unknown. However, additional research should improve our knowledge of the effects of chemical contaminants on bats. More recently, climate change has been suggested as a cause of population shift from southern to northern hibernacula (Clawson 2002). Collisions with man-made objects (e.g., wind turbines, communication towers, and vehicles) are also a potential risk for Indiana bats.

New Threats

White-nose syndrome (WNS) is a malady of unknown origin that is killing cave-dwelling bats in unprecedented numbers in the northeastern U.S. This affliction was first documented at four sites in eastern New York in the winter of 2006-07, but photographic evidence emerged subsequently of apparently affected bats at an additional site, Howe's Cave, collected the previous winter in February 2006. Overall mortality rates (primarily of little brown bats) have ranged from 81% to over 97% at several of the sites where data have been collected for at least 2 years (Hicks et al. 2008). While little brown bats appear to be the most affected of the 6 species of cave-wintering bats in the Northeast, Indiana bats have been greatly impacted by WNS. It is important to note, however, that most of these species do not form large clusters in the winter, as little brown bats and Indiana bats do, and so they are not easily counted; therefore, we have poor baseline estimates for other species at most sites by which to compare post-WNS abundance estimates. The apparent loss of all 685 Indiana bats in Hailes Cave, and all but 124 of 13,014

Indiana bats in the Williams Preserve Mine in New York, was documented in the first winter WNS was observed at each site (Hicks et al. 2008). However, counts of Indiana bats at other WNS-affected New York hibernacula (e.g., Jamesville and Barton Hill Mine) have remained steady (Service unpubl. data).

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

As of today, at least 81 sites in nine states (Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, West Virginia, and Virginia) appear to be affected by WNS, and suspicious fungal growth has been observed in hibernacula in two additional states (New Hampshire and Virginia). The affected hibernacula are located in 40 different counties across the nine states, with a distribution that mainly extends along the Appalachian Mountain range (Figure 8). Significant bat mortality (> 50% of known population) has been observed at several of these locations, especially in the northernmost regions. The annual distribution of WNS appears to be expanding rapidly from the initially affected hibernacula in western Albany/eastern Schoharie Counties, New York. The initial five sites where WNS was found in 2006 and 2007 were all within 15 km of a point that has come to be defined as the “epicenter.” By April 2008, all of the hibernacula surveyed within 130 km of the epicenter were affected by WNS, and the farthest extent of the affliction reached approximately 200 km to a site near Watertown, New York. In 2009, affected sites have been discovered as far as approximately 900 km from the epicenter. There is no evidence of any resistance to WNS among survivors. If current trends for spread and mortality at affected sites continue, and there is currently no indication that they will not, WNS threatens to drastically reduce the abundance of many species of hibernating bats in much of North America in what may only be a matter of years.

Identifying the cause of WNS is a critical concern if we have any hope of addressing the problem.

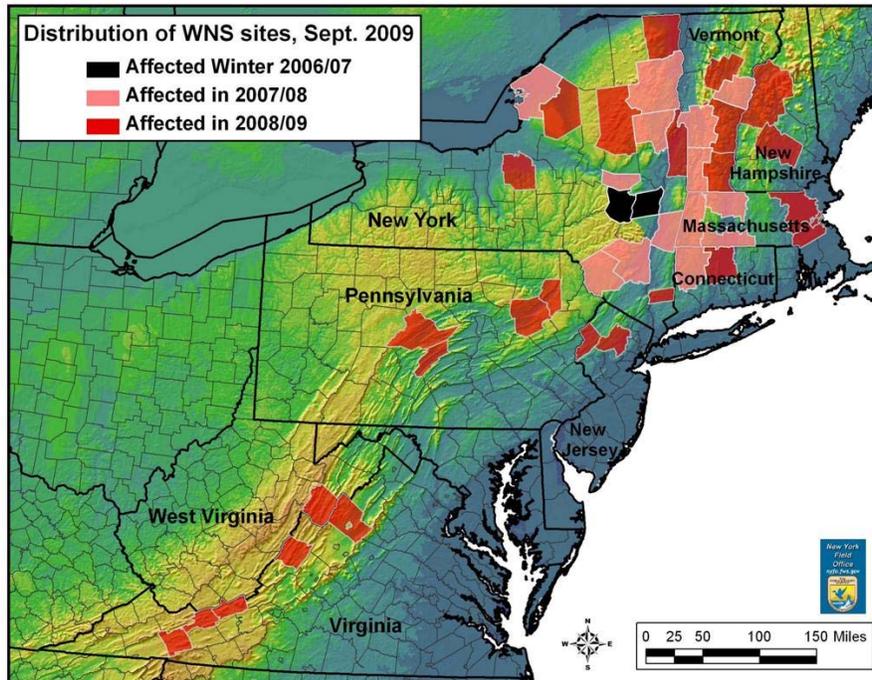


Figure 8. Distribution of counties affected by White-nose syndrome (WNS) as of September 2009.

It has not yet been demonstrated how, or if, WNS is transmitted. However, the temporal presentation of WNS among bats in a single New York cave in 2006 to numerous sites in 9 contiguous northeastern states by 2009 suggests that WNS is spread from bat-to-bat, or from bat-to-hibernacula, through direct contact. Further, current data suggest that a newly identified fungus (*Geomyces destructans*) (Gargas et al. 2009) is responsible, at least in part, for the impacts and mortality associated with WNS (Blehert et al. 2009). This vector of transmission is consistent with the rate of spread observed from 2006 through 2009, based on assumptions from available tracking data for local bat movements and from knowledge of inter- and intraspecific bat contact at spring, summer, and fall roosting and staging sites. However, an equally plausible mode of transport for the causative agent(s) for WNS is by anthropogenic sources. Fungal spores, and/or other microscopic organisms, can easily become attached to skin, hair, clothing, and equipment with which they come in contact, and it is possible that such elements could remain viable for weeks or months after leaving a subterranean environment. Hard evidence that people are, or have been, responsible for transporting WNS to naïve hibernacula is currently not available. However, the occasionally discontinuous nature of the spread of WNS, especially to the most recently discovered sites in West Virginia and Virginia, does suggest that something other than bat-to-bat transmission may be responsible. Another piece of supporting evidence for anthropogenic spread is the coincidental observation that many of the recently affected sites are also popular destinations for recreational users of caves and mines. In fact, the site where WNS was first documented photographically, Howe’s Cave, is itself directly connected to one of the most visited commercial cave systems in the northeastern U.S. Therefore, although currently anecdotal, there is evidence to suggest that the spread of WNS may be multifactorial, and so

precaution must be exercised to reduce any and all activities that may contribute to the continued transport of potential causative agents of WNS.

Another outstanding question regarding the effects of WNS is if susceptibility varies by species within and among caves or if observed symptoms are expressed differentially by species. For example, the NYSDEC has reported that symptoms of WNS may manifest differently between Indiana bats and little brown bats, even within the same site. It is also unclear how long symptoms take to manifest after exposure to the causative agent(s). Captive inoculation trials currently underway at the National Wildlife Health Center will hopefully provide clues into the transmissibility of *Geomyces destructans*, as well as the period of time it takes for bats to exhibit signs of WNS after exposure. Finally, it is unclear what the long-term effects (e.g., geographic spread, mortality within affected sites) to the Indiana bats will be.

All known Indiana bat hibernacula in New York, except for a recently-discovered site (P3 or P4) in Orange County (Bull Mine), have been documented with WNS. In addition, all known Indiana bat hibernacula in Vermont and New Jersey and at least three sites in Pennsylvania and two in Virginia and West Virginia are likewise affected with WNS.

New York's Indiana bat population estimates from the last four surveys periods were: 2001 – 29,671; 2003 – 32,981; 2005 – 41,727; and 2007 – 52,803 bats; this steady increase was consistent with trends range-wide. The average increase between surveys during this time range was 21% (every two years). In sharp contrast, surveys conducted at New York's hibernacula during early 2008 (post-WNS) estimated the population at 37,141 Indiana bats (a drop of 15,662 bats), which is a 30% decrease from the previous year's estimate. We presume the observed decline in the New York population was a direct result of WNS-related mortality. In fact, the decline probably should be considered a conservative estimate of the mortality associated with WNS because: 1) surveys were conducted prior to the end of hibernation, and mortality associated with WNS continued throughout the hibernation period, and 2) there is evidence from the Northeast that some WNS-affected bats continued to die throughout the summer. From a broader perspective, the loss of 15,662 Indiana bats from WNS in 2008 represented a loss of approximately 3.3% of the revised 2007 total population for the species. Preliminary 2009 population estimates for New York are 32,734 Indiana bats with an additional loss of 4,407 bats since 2008.

As mentioned above, impacts to Indiana bats are inconsistent between affected hibernacula. Biologists with NYSDEC conducted photographic surveys of all New York State Indiana bat hibernacula in March 2008, to compare with the 2006-2007 counts and there are some notable discrepancies in the population trends evident between different affected sites. For example, Indiana bat numbers and roosting locations appeared normal at both Barton Hill and Williams Hotel in 2008 (Service unpublished data); however, at Glen Park Cave, the "K-cluster" of Indiana bats appeared to be where expected at the end of March 2008, but preliminary analyses indicate that there were approximately 600-800 fewer individuals that season compared to the 2006-2007 count of 1,932 Indiana bats (a decrease of 30-40%). Preliminary 2008-2009 winter counts were back up to 1,719 Indiana bats.

A more drastic decline (100%) was observed at Hailes Cave, where Indiana bats had been documented during every survey since 1981. In 2004-2005, 685 Indiana bats were observed at the site, but no Indiana bats (living or dead) were found at Hailes Cave during surveys in 2007, 2008, or 2009 (Hicks and Newman 2007, A. Hicks, NYSDEC, pers. comm.). Hailes Cave has been classified as an ecological trap hibernaculum in the Indiana Bat Draft Recovery Plan (Service 2007) due to the history of occasional flooding and freezing events at this site; however, the total and persistent loss of all Indiana bats at this site is unprecedented.

Finally, 2007-2008 counts in Williams Preserve and Williams Lake were down by 92-99% when compared to 2006-2007 mid-winter surveys. In 2006-2007, there were approximately 13,014 and 1,003 Indiana bats in the Williams Preserve and Williams Lake, respectively. In April 2008, counts were closer to 124 and 80 Indiana bats (Hicks et al. 2008). Because the surveys were conducted late in the season, and no carcasses were found at these sites, it was hoped the missing Indiana bats had moved to new hibernacula or had emerged prior to the survey. Preliminary count data collected during the 2009 survey at these sites, conducted in February, are 341 and 32 Indiana bats at Williams Preserve and Williams Lake for overall declines of ~97% since 2006-2007. However, Williams Hotel, which is in the same complex of hibernacula, has declined by only 29% (24,307 to 17,255) in the same timeframe.

In summary, WNS has now been documented in nine states, and the degree of impact to bats varies greatly by site and species. Based on observations of continued mass-mortality at several sites, we anticipate the loss of Indiana bats to continue in the Northeast/mid-Atlantic regions. In addition, we anticipate that WNS will continue to radiate out to new sites, however, the potential for climate, or some other environmental factor, to influence the spread of WNS, or the severity of its impact on affected bats, is unknown. Final range-wide counts from 2009 and observations and winter count data from any surveys in 2010 will continue to reveal the severity of the spread of WNS since 2008 and hopefully provide valuable insight into the mechanisms behind the transmission or transportation of WNS between hibernacula. Given the evidence to date, however, it is abundantly clear that WNS presents a significant threat to the species.

Previous Incidental Take Authorizations

All previously issued Service BO's 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 (FHWA) for various transportation projects, (c) the Corps for various water-related projects, and (d) the Department of Defense for operations at several 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 (i.e. Six Points Road Interchange HCP). A table of previous consultations can be found at <http://www.fws.gov/midwest/endangered/mammals/inba/inbaBOs.html>.

It is important to note that in many of these consultations, survey information was lacking. As Federal agencies are not required to conduct surveys, often the Service relied on a host of valid

factors in helping the Federal agency determine whether Indiana bats were likely to be present. To ensure the Federal agency and Service met the mandate of the Section 7(a)(2), if the best available information suggested that Indiana bats may be present, the assumption was often made that one or more maternity colonies occurred within the action area. Although this approach, we believe, fully accords with the intent of the Congress in writing the ESA, it likely resulted in an over-estimate of the number of individuals or colonies that may have been impacted by Federal actions.

Take has primarily been authorized in the form of harm through habitat loss because of the difficulty of detecting and quantifying take of Indiana bats. This is due to the bat's small body size, widely dispersed individuals under loose bark or in tree cracks/crevices, and unknown spatial extent and density of much of their summer roosting population range. For some incidental take statements, take has also been extrapolated to include an estimated number of individual Indiana bats.

Previous habitat impacts have been both temporary (e.g., USFS timber management) and permanent (e.g., FHWA road alignments). Some of these projects were certain to impact known Indiana bat habitat. To minimize the effects of projects, the action agencies agreed to implement various conservation measures including seasonal tree clearing restrictions, protection of roost trees, minimization of project footprints, and retention of adequate roosting and/or foraging habitat to sustain the maternity colony into the future, and permanent protection or restoration of off-site habitat 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 Contour Coal Mining projects), none of the BO's and associated incidental take statements anticipated the loss of a maternity colony. Required monitoring for at least three formal consultations (Camp Atterbury, Newport Military Installation, and Indianapolis Airport) has confirmed that the affected colonies persisted through the life of the project and continue to exist today. We recognize that given the philopatric nature of Indiana bats and the 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. Only with long-term monitoring will we definitely be able to determine the true effectiveness of our conservation measures. However, WNS may confound monitoring results of projects in the near future.

There have been two previous projects with incidental take authorization for the Indiana bat in the State of New York – the Fort Drum Connector highway project and 2009-2011 activities on Fort Drum military installation. Both are in Jefferson County and not in the Action Area for the proposed project.

Overall, there has been limited incidental take authorization for the Indiana bat in the proposed Northeast Recovery Unit.

In general, the take exempted to date via Section 7 consultations is anticipated to have resulted in short-term effects to Indiana bats. As many of the consultations necessarily made conservative

assumptions about Indiana bat presence, the number of maternity colonies actually exposed to the environmental impacts of the Federal actions is likely less. Furthermore, although not definitive, monitoring of several 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 Indiana bats, including maternity colonies. However, we now consider WNS losses in our evaluations.

Species Recovery

The existing recovery program for the Indiana bat focuses on protection of hibernacula (Service 1983). The proposed recovery program for this species has four broad components:

- 1) range-wide population monitoring at the hibernacula with improvements in census techniques;
- 2) conservation and management of habitat (hibernacula, swarming, and to a degree, summer);
- 3) further research into the requirements of and threats to the species; and
- 4) public education and outreach (Service 2007).

This recovery program continues to have a primary focus on protection of hibernacula, but also increases the focus on summer habitat and proposes use of Recovery Units. It is important to note that WNS was not a current threat at the time of the release of the 2007 Recovery Plan and is now the primary threat being addressed by the Service.

Recovery Units

The Service's proposed delineation of Recovery Units relied on a combination of preliminary evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in macrohabitats and land use. When Recovery Unit delimitations suggested by these factors were geographically close to state boundaries, the Recovery Unit borders were shifted to match the state boundaries in order to facilitate future conservation and management. The Indiana Bat Draft Recovery Plan proposes four Recovery Units for the species – Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 9) (Service 2007).

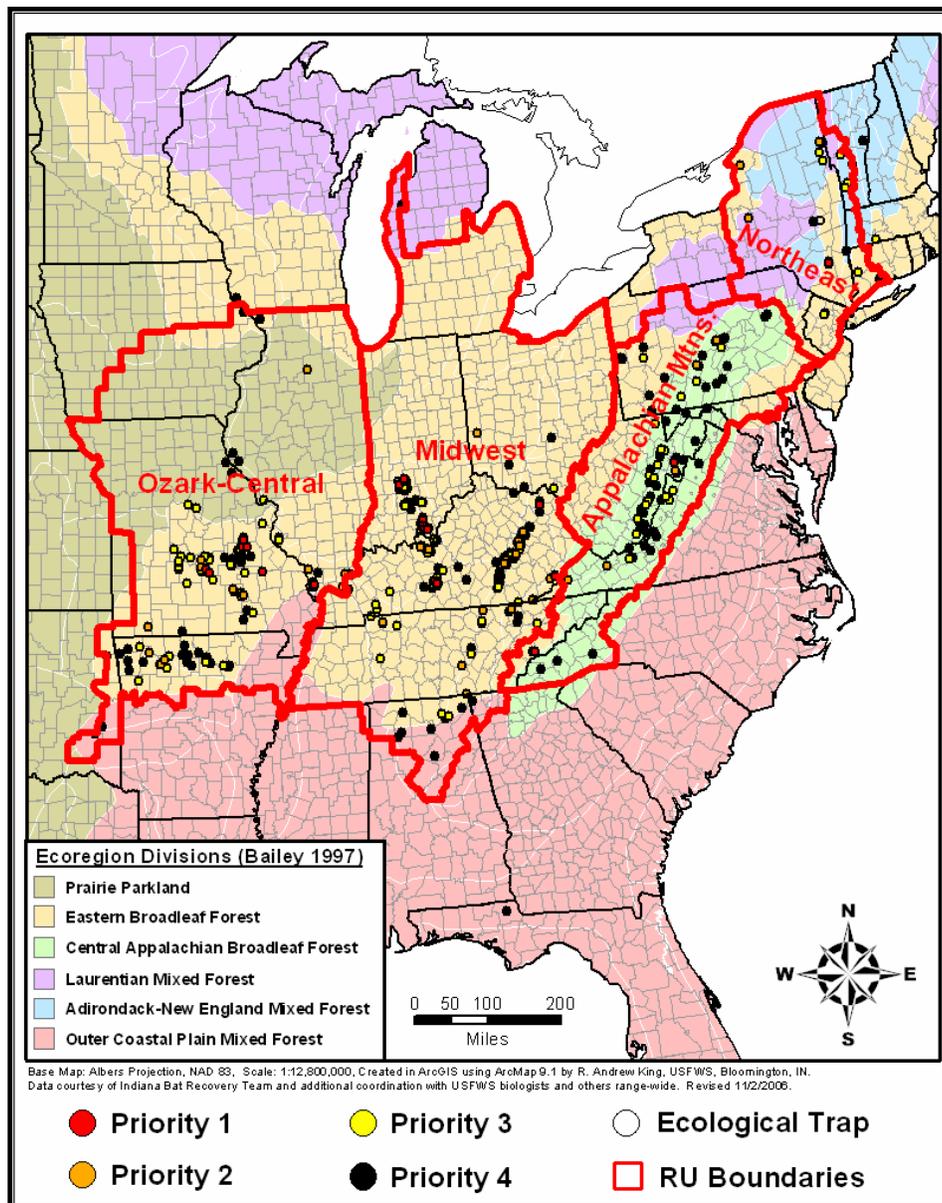


Figure 9. Proposed Indiana bat Recovery Units (Service 2007).

Range-wide Trend

The overall population distribution has not changed, however, the abundance of Indiana bats in the northeast has declined significantly and the threat to the species from WNS remains at a high level. Recovery efforts are primarily focused on the WNS investigation at this time. When we consider the positive trends observed over the last several range-wide hibernacula counts (prior to WNS) along with the newly gathered information on WNS, we have concerns about the status of the species. As of the fall of 2009, the Service considers the 1-year trend (2008 to 2009) (annual required reporting metric) to be declining. We are observing a leveling off of a previous

positive trend and this appears to be the beginning of an overall negative trend of the status of the species.

Analysis of the Species/Critical Habitat Likely to be Affected

The Service has reviewed the BA and supporting information for the proposed project. The BA evaluated the potential and likely effects of a variety of actions on the Indiana bat. There are no other Federally-listed or proposed species known or likely to occur within the action area.

The Service concurs with the Corps' determination that the project may adversely affect the Indiana bat due to the loss or alteration of roosting and foraging habitat. Critical habitat has been designated for the Indiana bat, but none of those critical habitat areas occur within the project area. Therefore, the proposed project is not likely to adversely modify critical habitat for the species.

ENVIRONMENTAL BASELINE

Under Section 7(a)(2) of the ESA, when considering the “effects of the action” on Federally-listed species, the Service is required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all Federal, State, or private actions and other activities in the action area (50 CFR 402.02), including Federal actions in the area that have already undergone Section 7 consultation, and the impacts of State or private actions that are contemporaneous with the consultation in process. As such, the environmental baseline is “an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including critical habitat), and ecosystem, within the action area (Service and National Marine Fisheries Service [NMFS] 1998, page 4-22).” The environmental baseline is, therefore, a “snapshot” of the species' health at a given point in time, but it does not include the effects of the proposed action.

Status of the Species in New York

In New York, winter counts range from 22 Indiana bats in 1981 (Hailes Cave only) to 52,803 in 2006-2007. In that 25-year span, new sites or new sections of sites were discovered and added to the surveys. In addition, in 2004-2005, the survey methodology in New York of taking photographs and counting bats back at the office was modified with enhanced digital photography imaging. As stated above, the primary threat to Indiana bats in New York at this time is WNS. We do not have final count information for winter 2008-2009, however, the preliminary results are 32,734 Indiana bats in New York.

Status of the Species within the Action Area

The identified action area includes the roosting and foraging habitat used by one maternity colony. In addition, the action area may be used in the early fall, and likely the spring. Therefore, the status of the documented maternity colony and the status of the nearby hibernating population are examined below.

Winter Hibernation

The Williams Lake Hibernacula Complex is located approximately 22 miles northwest of the project in Ulster County, New York. The NYSDEC monitors Indiana bat use of the hibernacula by conducting biennial mid-winter counts. This complex comprises the largest wintering population of Indiana bats in the northeast and was increasing in numbers through 2006. However, losses of about 17,000 Indiana bats have been observed as of the end of winter 2008-2009 (Hicks, pers. comm., 2009). Of the three main hibernacula at Williams Lake, the Williams Lake hibernaculum was most affected. See **Status of the Species** Section for additional information.

Spring Emergence Study

As mentioned in the Action Area section, the NYSDEC and Service tracked Indiana bats from the Williams Lake Complex as they emerged in spring to their summer roosting areas in 2004, 2005, and 2007. Forty-three females were successfully tracked to at least one roost tree, all of which remained within 45 miles of the hibernacula. Thirteen maternity colonies (conservative estimate) were identified during this project. The closest roosts from those projects to the Adams Fairacre Farms project are approximately 3.4 miles southwest the Town of Wappinger and approximately 4 miles southeast in the Town of East Fishkill.

Project-related Mist-netting and Tracking

The following is a summary of field work conducted for the proposed project. Additional information can be found in the BA.

Two mist-net sites were surveyed for the Indiana bat within the proposed project area from August 1-2, 2008. Seven Indiana bats, including 2 males and 5 females (4 post-lactating females and 1 juvenile) were captured. Two adult females received radio transmitters on August 1, 2008, and were tracked for eleven days. Three roost trees were located. All roosts were off the project property but within 0.5 mile of the net sites (Figure 10). The maximum emergence counts from these roost trees were 13 bats seen exiting a single tree. Thus, these roosts were likely to be alternate roosts (Kurta et al. 1993). One roost was located on the adjacent property immediately southwest of the subject site near the property boundary. Another roost was located on the north side of the car dealer located to the north of the site. A third roost tree was located on the south side of MacFarlane Road. A fourth roost location was estimated to be on the west side of U.S. Route 9, but the individual tree was never definitively identified. Given the capture of a juvenile and four post-lactating females, we assume that there is at least one maternity colony resident in the immediate vicinity of the project site.

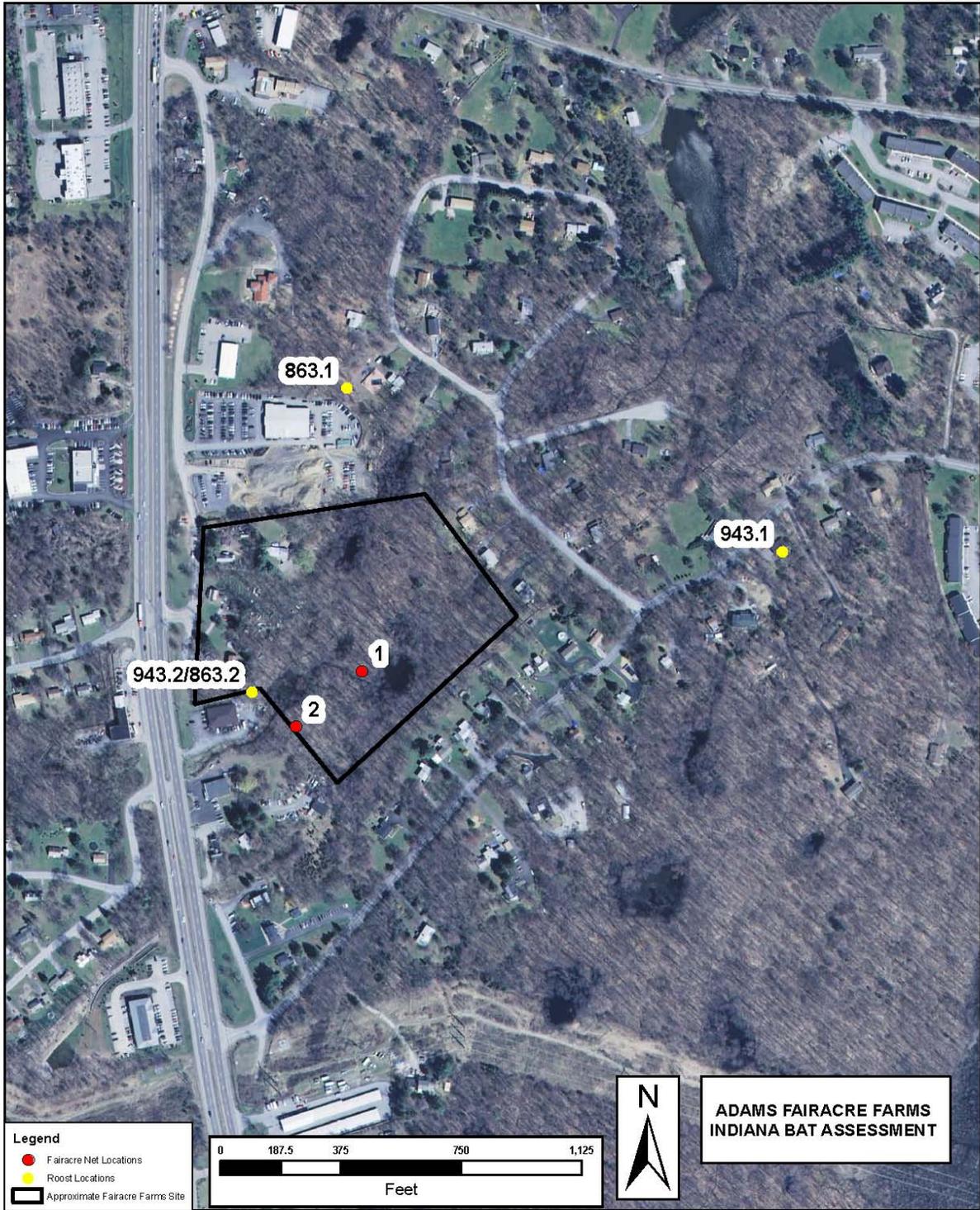


Figure 10. Project boundary, mist-net, and roost locations.

Bat Conservation and Management, Inc.'s (2008) radio-telemetry study also revealed local foraging areas for these bats in the following areas:

- On the subject site by each bat almost every night;
- South of the junction of MacFarlane Road and Beechwood Circle;
- In a swamp located west of U.S. Route 9, north of Old Hopewell Road, and south of Pleasant Lane and Middlebush Road;
- In a wooded swamp located north of Old Hopewell Road, east of U.S. Route 9, and east of Sucich Place; and
- In a corridor that connected the site with the swamp located north of Old Hopewell Road, east of U.S. Route 9, and east of Sucich Place.

All foraging areas located were within one mile of the project boundary.

These areas were defined based on radio tracking of only two bats, each of which was only tracked for a few nights. Thus, it is possible, and even likely that more foraging and roosting habitat exists within the summer action areas that were not detected by Bat Conservation and Management, Inc.'s efforts.

Factors Affecting the Species' Environment within the Action Area

In order to ensure the consideration of all potential direct, indirect, and cumulative effects of the proposed action on the Indiana bat, the Corps and Service determined that the action area under consideration includes the project area and any Indiana bat habitat within three miles of roost trees (summer action area), and Indiana bat habitat within approximately ten miles of the Williams Lake Complex (winter action area). Additional description of the action area is provided in the **Action Area** section above.

There are numerous land use activities that affect the Indiana bat and that likely occur within the action area. However, the primary activities include residential and commercial development, and operations and maintenance of powerline rights-of-way. Many of these are private actions, but many involve Corps permits for impacts to waters of the United States.

In addition to land activities, WNS is affecting Indiana bats in the action area. As stated in the **Status of the Species** section, WNS has been documented at the Williams Lake Complex and significant declines have been observed at some of the hibernacula.

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.

This section includes an analysis of the direct and indirect effects of the proposed actions on the species and/or critical habitat and its interrelated and interdependent activities. While analyzing direct and indirect effects of the proposed action, the Service considered the following factors:

Proximity of the action: As stated in the environmental baseline, at least one maternity colony is known to occur in the action area. Only 3 roosts have been located to date and it is highly unlikely that all roost trees have been discovered.

Hibernacula of the Williams Lake Complex are located within the fall/winter action area. No effects to bats in winter or fall are anticipated from the proposed project. No designated critical habitat for the Indiana bat is located within the action area.

Distribution: The project will primarily result in indirect effects on the species within the construction disturbance limits. Indirect effects on the species may also occur as a result of the project throughout some of the remainder of the action area defined previously due to fragmentation, alteration of maternity, foraging, and swarming habitats, alterations to individual bat behavior patterns, and modifications of population dynamics in the action area.

Timing: Removal or destruction of habitat during the spring staging and migration, summer roosting, maternity, and/or fall migration of the Indiana bat would cause the removal of habitat during a time that the species actively need and/or use the habitat. However, direct effects from tree removal will be avoided as tree removal activities will occur while bats are in hibernation (October 1- March 31).

Nature of the effect: The proposed project activities are expected to result in: a) permanent loss of occupied and/or potential foraging and roosting habitat through removal of that habitat (e.g., removal of roost trees and foraging habitat); and b) alteration and/or modification of normal Indiana bat behaviors (e.g., reproduction effects, foraging effects, and sheltering behaviors). Additional details are discussed below.

Duration: The proposed action will cause the permanent destruction, alteration, and fragmentation of the available habitat for Indiana bats utilizing the site throughout various needed times of the year.

Disturbance frequency: The disturbance associated with construction will be a one-time disturbance that will likely be sustained over two spring staging and migration, summer roosting/foraging, and/or fall migration periods while the proposed project is being constructed. After completion of the construction, the disturbance will be continuous because the habitat will be lost permanently and activities will occur at the site on a daily basis which is anticipated to cause Indiana bats to modify their normal behavior patterns.

Disturbance intensity: 9.33 acres of forest will be permanently lost and at least 3.48 acres of forest patches remaining onsite are likely to be degraded in terms of suitability for Indiana bats. However, the applicant is permanently protecting 12.66 acres of suitable habitat offsite.

Disturbance severity: The species' resiliency to natural and anthropogenic disturbances on some level has been demonstrated through monitoring (see **Previous Incidental Take Authorizations** and **Status of the Species** in the **Action Area** sections above). While the proposed project will result in some incidental take of Indiana bats, previous studies suggest that most bats should adjust to construction activities and limited habitat removal.

Analyses of Effects of the Action

Loss of Roosting and Foraging Habitat

The primary effect of the proposed activities on Indiana bats in the action area will be the loss of 9.33 acres of forest. This clearing will occur in the winter to avoid direct effects to the bats from tree removal. No known roost trees will be removed from the project; however, potential roosting habitat will be lost and/or degraded. In addition, the site appears to be an important foraging area as 7 Indiana bats were captured in just 2 days and radio tracking of 2 females showed consistent use of the project area.

There is a total of 7,008 acres of forest in this summer action area. The construction of the project would remove 9.33 acres or 0.12% of the forested habitat in the summer action area. While this loss may appear low, this reduction results in smaller remaining forest patches and, when combined with disturbance and lighting from the project (see below), is anticipated to result in reduced foraging and/or roosting in these forest patches. In addition, the actual home range of the Indiana bats is likely much smaller than the potential range (summer action area). With very limited radio-tracking, the identified range includes 52 acres of available forested habitat (Stearns & Wheler 2009). Proposed clearing for the project will remove approximately 18.03% of available forest habitat within the radio-tracked range of two bats from the site.

While Indiana bats using the affected forest patches for foraging will have alternative foraging habitat available within the action area, they will likely have to shift or expand their foraging ranges into areas previously unused by them to make up for the loss of foraging habitat. The impact of shifting flight patterns and foraging areas on individual bats will vary. Recovery from the stress of hibernation and migration may be slower as a result of the added energy demands of searching for new foraging habitat especially in an already fragmented landscape such as this one where forested habitat is limited. Pregnant females displaced from preferred foraging areas will have to expend additional energy to search for alternative foraging habitat which would likely

result in reduced reproductive success (failure to carry to full-term or failure to raise pup through first summer) for some females. Females that do give birth may have pups with lower birth weights given the increased energy demands associated with longer flights, or their pups may experience delayed development. These longer flights would also be experienced by pups once they become volant which could affect the survival of these pups as they enter hibernation with potentially reduced fat reserves. Indiana bats may also experience higher rates of predation or competition when searching for new foraging areas. Overall, the effect of the loss of foraging habitat on individual bats from the maternity colony in the action area is anticipated to range from no effect to death. The effect on the colony would then be reduced reproduction and loss of a small portion of the colony. These effects are anticipated to be relatively short-lived as Indiana bats are anticipated to acclimate to the altered landscape.

As discussed in the **Conservation Measures** section, the applicant is permanently protecting 12.66 acres of forest habitat within the action area. Conservation of these 12.66 acres connects other fragmented conservation lands to create one contiguous conservation area of 77 acres, all of which is within 1 mile of the project site. While permanent protection of existing forest will not offset the loss of 9.33 acres of forest and degradation of the remaining forest patches, it will prevent the loss of those particular patches and maintain roosting/foraging sites for Indiana bats in the action area. Given the intense development pressure around U.S. Route 9, we believe that permanent protection of existing forest is essential to maintain Indiana bats on the landscape.

In addition, the site plan has been modified so that a ±35-foot forested buffer will be maintained between the edge of the proposed development envelope and the one existing roost tree that is located adjacent to the property. This buffer is the existing buffer that occurs between this tree and the adjacent residential lawn that is already absent of trees.

Effects on Fall Swarming Habitat

The project is outside the likely range of fall swarming activities around the Williams Lake Complex. No impacts to fall swarming habitat or fall swarming bats are anticipated.

Effects on Wintering Bats

The project will result in no direct physical impacts to the Williams Lake Complex. In addition, given the distance of the project to the hibernacula, no indirect impacts to the cave from project construction, operation, or maintenance are likely. No impacts to wintering bats are anticipated.

Effects on Habitat Quality

In addition to habitat loss, the proposed actions are anticipated to result in a decrease in quality of the remaining approximately 3.48 acres of forested habitat within the project boundary and potentially extending further from the actual project site. Factors that may lead to reduced habitat quality include habitat fragmentation, increased human disturbance (e.g., noise, lighting, dust), and water quality impacts.

Construction Lighting

Lighting is not anticipated during construction.

Construction Noise

Noise generated by construction equipment during the following activities could disturb roosting bats during the day:

- Tree clearing (October 2009-March 2010);
- Construction of retaining walls (April 5, 2010 – June 11, 2010);
- Early part of grading and drainage installation (June 7, 2010 – October 22, 2010);
- Early construction of the main building exterior (August 9, 2010 – May 6, 2011);
- Early paving, and curb and site lighting installation (August 23, 2010 – November 19, 2010);
- Greenhouse construction (April 11, 2011 – May 27, 2011);
- Building interior finishing (April 11, 2011 – July 22, 2011); and
- Store stocking, testing, and staff training; begin operation (September 26, 2011 – October 28, 2011)

No construction operations are anticipated on the site at night. Gardner et al. (1991) suggested that noise and exhaust fumes from machinery could disturb roosting colonies of bats, but such disturbance would have to be very severe to cause roost abandonment. No specific auditory data relating to disturbance of Indiana bats are available in the current literature. However, a similar species, the little brown bat, is sensitive to sound between 10 kilohertz (kHz) and 130 kHz, with greatest hearing sensitivity between 35 and 40 kHz (Grinnell 1963). Based on analysis in Montgomery Watson and 3D/I (1998), operation of heavy equipment (bulldozers and earthmovers) at Fort Leonard Wood, Missouri, generated sound frequencies between 25 and 20,000 Hz with peak frequencies less than 125 Hz. Thus, while bats can hear such sound, most construction equipment noise is well below the frequency range audible to bats.

Given the busy commercial community and active highway immediately adjacent to the site, it is unlikely that noise generated during construction of the facility will greatly exceed ambient noise levels. While noise during tree clearing may be more severe than the rest of the construction activities, this activity is scheduled to take place when the bats will not be on the site. Overall, it is reasonable to assume that some Indiana bats may be temporarily disturbed by noise and vibration of construction activities within or directly adjacent to previous roosting habitat and that combined with the loss of forest habitat, we would anticipate a shift in roosting behavior away from the project.

Construction Dust

The creation of airborne dust by construction equipment is likely to occur in all earth moving projects, the magnitude is dependent on many factors, including humidity, wind velocities and direction, and location of soil disturbances. Dust will be created during the spring, summer, and

autumn when Indiana bats are roosting in adjacent forested habitats and possibly foraging throughout the project corridor.

Airborne dust from earth moving activities is a short-term temporary effect, occurring only during activities in the daytime, and abating at night when relative humidity increases, causing dust to settle. Suspended dust could interfere with roosting bats if it causes respiratory distress or coats their fur, causing them to relocate to roosts farther offsite. Any potential effects from dust would be very local within and immediately adjacent to the corridor. The implementation of dust control strategies and presence of adjacent vegetation will eliminate or greatly reduce the settling distance. It is very unlikely that dust created from construction would drift underneath the bark where an Indiana bat is roosting.

Dust is known to coat adjacent vegetation, thus possibly reducing insect production locally along a narrow band; this may result in decreased foraging opportunities adjacent to the road. Data are not available for the effect of dust on bats. However, contractors will implement dust control strategies (e.g., water sprays).

Construction Water Quality Impacts

Stormwater runoff from disturbed soil during construction could contaminate surface waters on the site, rendering it unfit for bats to drink, or interfering with breeding of aquatic insects on which bats may feed. Insects associated with aquatic habitats make up part of the diet of Indiana bats; therefore, impacts to water quality may result in temporary, short-term indirect effects on foraging Indiana bats during spring, summer, and autumn. However, Best Management Practices incorporated will minimize erosion and subsequent sedimentation, thus reducing potential impacts on aquatic ecosystems.

Temporary measures will be incorporated into the project to protect water quality during construction. However, it is still possible to have periods where erosion and sedimentation may cause short-term declines in aquatic insect populations in adjacent wetlands. Since potential impacts from sedimentation are expected to be localized and remain within the project area, foraging Indiana bats will be able to relocate upstream or downstream to forage. The Service believes that water quality impacts will cause a temporary reduction in prey base and drinking resources for the Indiana bat. However, we presume that the surrounding landscape will continue to provide an abundant prey base of both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential direct effects to Indiana bats from a reduction in water quality are anticipated to be insignificant.

Project Operation and Maintenance Noise and Lighting

Noise impacts are anticipated to be greatest during construction (discussed above). Given the busy commercial community and active highway immediately adjacent to the site, it is unlikely that noise generated during operation of the facility will greatly exceed ambient noise levels. Since noise levels are not likely to significantly exceed ambient noise levels of a busy commercial district and highway, or be below the frequency level of sound audible to bats, the effects of noise from this operation of the project are insignificant.

Parking lot lights will remain on until 10:00 p.m. during business operation, and security lights (8 fixtures on the entire site) will remain on all night. High light levels may deter Indiana bats from areas as their nocturnal behavior may have evolved in response to predation risks (Speakman 1995, Sparks et al. 2005b). However, the entire adjacent car dealership lot to the north is brightly illuminated all night, every night, and the bats used a roost tree (Roost Tree 863.1, Bat Conservation and Management, Inc. 2008) located on the northern edge of that property where they were exposed to such lighting. In addition, the applicant is including measures to minimize impacts from lighting (see **Conservation Measures** section).

Operation and Maintenance Water Quality Impacts

Stormwater runoff from parking lot pavement during operation of the facility could contaminate surface waters on the site, rendering it unfit for bats to drink, or interfering with breeding of aquatic insects on which bats may feed. These effects will be avoided by the implementation of soil conservation best management practices during operation by the treatment of stormwater runoff in catch basins and the forebay and main basin of the stormwater treatment basin (see **Conservation Measures** section).

Hydrocarbons (e.g., fuel) may leak from vehicles onto pavement and affect water quality resulting in reduced densities of aquatic insects that bats consume. However, if chemicals did reach surface waters (wetlands), a short-term reduction in both aquatic and terrestrial insects could occur, thus reducing the spring, summer, or autumn prey base for foraging Indiana bats. If this occurred, it would be localized, thus allowing foraging Indiana bats to move nearby and continue foraging.

According to an electronic mail dated November 5, 2009, from the applicant's consultant, snow removal will include plowing and stockpiling of snow in the parking lot. Deicing agents will also be used. Since these activities will occur during cold, snowy weather conditions primarily during winter, they will have no direct effect on the Indiana bat.

Once the snow and ice melts, the deicing agents would be carried from the parking area into the stormwater basin where they are expected to be confined. Deicing agents have been documented as having short-term effects on aquatic macroinvertebrates depending on dilution rates. Even though application of these agents will occur during the winter, potential indirect effects to Indiana bats, if they occur, would be during the spring and summer foraging periods. Deicing agents are not expected to reach levels to affect most aquatic insects, but it is possible that some pollution intolerant species could be temporarily eliminated from the affected surface waters. If this occurs and they are species that Indiana bats consume as prey, then it could result in a short-term indirect effect on foraging behavior. However, the Indiana bat is considered a selective opportunistic forager and thus would be able to locate additional aquatic and/or terrestrial insects nearby.

In addition, direct consumption of contaminated waters from the retention basin or wetlands is a possibility. However, we anticipate reduced overall use of the site for foraging and insignificant adverse effects to Indiana bats from uptake of potential contaminants.

Summary

Given the late season capture of the bats and very limited duration of tracking, we do not know where the primary roosting areas are. However, the site appears to be an important part of an Indiana bat maternity colony foraging area. The combined effects of tree removal, lighting, and disturbance at the site are anticipated to result in the loss of roosting and foraging habitat. We do not anticipate that Indiana bats will continue to use any portion of the project site during or after construction is complete.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

No specific proposed development plans are known from the local area, but it is reasonable to assume that vacant land along the U.S. Route 9 corridor will continue to be developed over time, as demand for commercial resources increases in this region. As such, further localized habitat loss may be anticipated over time. However, many of these projects will likely involve future authorizations by the Corps and will be part of a consultation. In the long-term, wooded wetlands (which receive some level of protection in comparison with upland forest and which Indiana bats are known to use for foraging and roosting) may become their primary habitat resource.

Indiana bats appear to be habitat opportunists and use a wide variety of habitats for foraging and roosting. They also naturally rely on an ephemeral resource (snags) for roosting, so they are adapted to constantly searching for new roosts within their home range. However, they exhibit strong fidelity to their home ranges and individual roost trees (while they are suitable). There are extensive regulated wetland areas within the summer action area, and since development of wetlands is restricted under Federal, State, and local regulations, ample forested wetland habitat is likely to remain for foraging and roosting habitat.

CONCLUSION

After reviewing the current status of the Indiana bat, the environmental baseline for the action area, the effects of the proposed activities as proposed for the Adams Fairacre Farms commercial facility, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Indiana bat and is not likely to destroy or adversely modify designated critical habitat. Critical habitat for the Indiana bat has been designated at a number of locations throughout its range; however, this action does not affect any of those designated critical habitat areas and no destruction or adverse modification of that critical habitat is expected.

Because of our analysis, we do not believe that the proposed action "would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the

Indiana bat by reducing the reproduction, numbers, or distribution of the Indiana bat (50 CFR 402).” For the proposed action to “reduce appreciably” the Indiana bat’s survival and recovery, the proposed action would have to impede or stop the process by which the Indiana bat’s ecosystems are restored and/or threats to Indiana bat are removed so that self-sustaining and self-regulating populations can be supported as persistent members of native biotic communities (Service and NMFS 1998, page 4-35). We do not believe the proposed project impedes or stops the survival and recovery process for the Indiana bat because:

The species’ resiliency to some level of natural and anthropogenic disturbances has been demonstrated (See **Previous Incidental Take Authorizations**). We believe that the proposed actions at Adams Fairacre Farms, while potentially resulting in the incidental take of some individuals associated with one maternity colony, are not a significant threat to the species in the Northeast regional population (proposed Northeast Recovery Unit) or the species as a whole and, therefore, do not rise to the level of jeopardy. No component of the proposed action is expected to result in harm, harassment, or mortality at a level that would reduce appreciably the reproduction, numbers, or distribution of the Indiana bat. While we recognize that the status of the species is uncertain, we considered the environmental baseline, and the intensity, frequency, and duration of the project impacts, and found that the proposed project is unlikely to greatly decrease the reproduction, numbers, or distribution of the Indiana bat.

INCIDENTAL TAKE STATEMENT

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

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

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service anticipates incidental take of the Indiana bat will be difficult to detect for the following reasons:

1. The individuals are small and occupy summer habitats where they are difficult to find;
2. Indiana bats form small (i.e. 25-100 individuals), widely dispersed maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually which makes finding the species or occupied habitats difficult;
3. Finding dead or injured specimens during or following project implementation is unlikely;
4. The extent and density of the species within its summer habitat in the action area is unknown; and
5. Most incidental take will be non-lethal and undetectable.

Because of the difficulty in determining a level of take based on the number of Indiana bats that will be adversely affected, the Service has decided that it is appropriate to base the level of authorized incidental take on the known presence of Indiana bats in the vicinity and habitat acreage that will be affected by the proposed project.

We anticipate harm of a small percentage of Indiana bats known to winter in the Williams Lake Complex and that are associated with one maternity colony that are traveling, roosting, and foraging within the action area as a result of the removal of approximately 9.33 acres of forest and the degradation of remaining forest (approximately 3.48 acres) along the edge of the development. "Harm," as defined within the definition of "take" in the ESA, means an act that actually kills or injures wildlife. Such acts may include significant habitat loss and/or alteration where the act actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. This impact is anticipated in the first spring/summer after tree removal has occurred and foraging patterns/range may be shifted. Alternative foraging areas are available in the action area and likely used (little foraging data are available) and limited impacts are anticipated in subsequent years.

EFFECT OF THE TAKE

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Indiana bat or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of the Indiana bat:

1. The Corps and applicant will ensure that the described proposed project components, including all conservation measures, will occur as planned and documented in the BA and September 14, 2009, electronic mail.
2. The Corps will ensure that the applicant conducts measures to accomplish intended conservation benefits as described in the BA. These measures are clarifications of those included as conservation measures.
3. The Corps and applicant must monitor their activities associated with the proposed project to determine if the Terms and Conditions of this BO are being implemented adequately in order to ensure that take is minimized and provide an annual report of those activities to the Service.

TERMS AND CONDITIONS

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

1. The applicant shall ensure that all appropriate/applicable conservation measures and Terms and Conditions are included in contracts for work conducted at the project site. This Term and Condition is associated with Reasonable and Prudent Measures 1-3.
2. To monitor the effects of the action, the applicant shall conduct additional mist-netting surveys in the year after construction is completed (2012). Current Indiana bat mist-netting protocols shall be followed. The scope of the netting and radio-tracking shall be similar to the study conducted in 2008. For example, all captured Indiana bats shall be banded and radio transmitters shall be attached (if body weights are sufficient). Radio-tracking to day roosts shall occur for a minimum of 1 week (or until transmitter loss or failure). At least 3 exit counts shall occur for each bat. This Term and Condition is associated with Reasonable and Prudent Measures 1-3.
3. The applicant shall coordinate with the Corps, Service, and NYSDEC regarding conservation easement language by March 31, 2010. This Term and Condition is associated with Reasonable and Prudent Measures 1 and 2.
4. The applicant shall ensure that easements are in place by December 31, 2010. This Term and Condition is associated with Reasonable and Prudent Measures 1 and 2.
5. The Service, Corps, and NYSDEC, and their representatives shall have access to conservation lands (protected) for future research and monitoring. This Term and Condition is associated with Reasonable and Prudent Measures 2 and 3.

6. The applicant shall provide an annual report summarizing the activities described in this BO by December 31, 2010-2012. This Term and Condition is associated with Reasonable and Prudent Measures 1-3.
7. The applicant shall provide shapefiles of the final clearing limits and conservation area by December 31, 2010. This Term and Condition is associated with Reasonable and Prudent Measures 1-3.
8. The Corps/applicant may request an extension, for the Service's consideration, to the time limitations in meeting the requirements outlined in all terms and conditions. An extension request shall be provided to the Service in writing within one year from the completion date of this BO and clearly identify the additional timeframe needed. This Term and Condition is associated with Reasonable and Prudent Measures 1-3.
9. The Corps/applicant shall report any dead bats located **in the project area** during construction, operations, and maintenance, or monitoring activities, regardless of species, within 24 hours to the Service's NYFO at 607-753-9334 and NYSDEC 845-256-3000, and subsequently transported on ice to that office. No one, with the exception of researchers contracted to conduct bat monitoring activities, should attempt to handle any live bat, regardless of its condition; report bats that appear to be sick or injured to NYFO and the NYSDEC or the New York State Health Department. NYFO and/or NYSDEC will make a species determination on any dead or moribund bats. If an Indiana bat is identified, NYFO will contact the appropriate Service law enforcement office. In the extremely rare event that someone has been bitten by a bat, please keep the bat in a container and contact the Dutchess County Public Health Service at 845-486-3400.

In conclusion, **9.33 acres** of suitable roosting and foraging habitat for Indiana bats will be permanently lost and an additional **3.48 acres** of forest will be degraded. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures and/or conservation measures.

CONSERVATION RECOMMENDATIONS

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

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

1. Assist with WNS investigations (No Recovery Actions specific to WNS in draft Recovery Plan but Action 3.5.1 addresses disease threats). For example, the Corps could:
 - a. Monitor the status/health of bat colonies on Corps lands;
 - b. Collect samples for ongoing or future studies;
 - c. Provide funding for WNS research activities; and
 - d. Allow staff to participate in research projects.
2. Work with the Service to develop standard best management practices and programmatic consultation approaches to address potential impacts to Indiana bats from residential and commercial development projects. (Recovery Actions 2.1.3- Minimize development and encourage activities that prevent degradation or destruction of summer habitat on private lands, 2.6.1- Minimize adverse impacts to the Indiana bat and its habitat during review of Federal, State, county, municipal, and private activities with a Federal nexus under the ESA: Section 7(a)(2))
3. Pursue additional acquisition of parcels or easements to protect Indiana bat roosting, foraging, and commuting habitat. (Recovery Actions 2.1-Manage habitat on private lands, 2.2-Conserve and manage Indiana bats and their habitat on Federal lands, 2.4.2-Identify and conserve foraging habitat, water sources, and travel corridors).

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

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the information presented with the September 21, 2009, requests for initiation of formal consultation. As written in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law), and if (1) the amount or extent of incidental take is exceeded; (2) new information reveals the agency action may affect listed species or critical habitat in a manner or to an extent not considered in this BO; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

LITERATURE CITED

Barclay, R.M.R. and A. Kurta. 2007. Ecology and behavior of bats roosting in tree cavities and under bark. Pp. 17-59 in M.J. Lacki, J.P. Hayes, and A. Kurta (eds), *Bats in forests: conservation and management*. Johns Hopkins University Press, Baltimore, MD.

- Bat Conservation and Management, Inc. 2008. Summer woodland bat survey, Adams Fair Acre Farm. Unpublished report prepared for Adams Fairacre Farm. Bat Conservation and Management, Inc., Carlisle, PA. 25 pp.
- Blehert, D.S., A.C. Hicks, M. Behr, C.U. Meteyer, B.M. Berlowski-Zier, E.L. Buckles, J.T.H. Coleman, S.R. Darling, A. Gargas, R. Niver, J.C. Okoniewski, R.J. Rudd, and W.B. Stone. 2009. Bat White-Nose Syndrome: An Emerging Fungal Pathogen? *Science* 323:227.
- Britzke, E.R., M.J. Harvey, and S.C. Loeb. 2003. Indiana bat, *Myotis sodalis*, maternity roosts in the southern United States. *Southeastern Naturalist* 2(2):235-242.
- Britzke, E., A. Hicks, S. von Oettingen, and S. Darling. 2006. Description of spring roost trees used by female Indiana bats (*Myotis sodalis*) in the Lake Champlain Valley of Vermont and New York. *American Midland Naturalist* 155:181-187.
- Callahan, E.V. 1993. Indiana bat summer habitat requirements. M.S. Thesis. University of Missouri, Columbia. 84 pp.
- Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. *Journal of Mammalogy*, 78:818-825.
- Carter, T.C., G. Feldhamer, and J. Kath. 2001. Notes on summer roosting of Indiana bats. *Bat Research News* 42:197-198.
- Clawson, R.L. 2002. Trends in population size and current status. Pp. 2-8 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX. 253 pp.
- Cope, J.B., A.R. Richter, and R.S. Mills. 1974. A summer concentration of the Indiana bat, *Myotis sodalis*, in Wayne County, Indiana. *Proceedings Indiana Academy of Science* 83:482-484.
- Environmental Solutions and Innovations. 2006. Mist net and radio-telemetry surveys for the Indiana bat (*Myotis sodalis*) on Clover Construction Management's proposed Eagle Ridge Townhouses Project, Jefferson County, New York. Final Report. Environmental Solutions and Innovations, Inc., Cincinnati, Ohio.
- Gargas, A., M.T. Trest, M. Christensen, T.J. Volk, and D.S. Blehert. 2009. *Geomyces destructans* sp. nov. associated with bat white-nose syndrome. *Mycotaxon* 108:147-154.
- Gardner, J.E. and E.A. Cook. 2002. Seasonal and geographic distribution and quantification of potential summer habitat. Pp. 9-20 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX.

- Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Unpublished report to Region-3 U.S. Fish and Wildlife Service, Fort Snelling, MN. 56 pp.
- Grinnell, A.D. 1963. Neurophysiology of audition in bats: intensity and frequency parameters. *Journal of Physiology (London)* 167:38-66.
- Hall, J.S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Scientific Publications No. 12. Reading Public Museum and Art Gallery, Reading, PA.
- Hicks, A.C. and P.G. Novak. 2002. History, status, and behavior of hibernating populations in the northeast. Pp. 35-47 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX.
- Hicks, A. and D. Newman. 2007. Bat Management and Protection in New York State, Fiscal Year April 1, 2006-April 1, 2007. New York Department of Environmental Conservation, Albany, NY.
- Hicks, A.C., C.J. Herzog, R.I. von Linden, S.R. Darling, and J.T.H. Coleman. 2008. White-Nose Syndrome, field observations from the first two winters. Proceedings of the first national White-Nose Syndrome meeting, Albany, New York, 9-11 June 2008.
- Humphrey, S.R. and J.B. Cope. 1977. Survival rates of the endangered Indiana bat, *Myotis sodalis*. *Journal of Mammalogy* 58:32-36.
- Humphrey, S.R., A.R. Richter, and J.B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. *Journal of Mammalogy*, 58:334-346.
- Kurta, A. 2005. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. Pp. 29-42 in K.C. Vories and A. Harrington (eds.), *Proceedings of the Indiana bat and coal mining: a technical interactive forum*. Office of Surface Mining, U.S. Department of the Interior, Alton, IL. Available at: <http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/TOC.pdf>.
- Kurta, A. and H. Rice. 2002. Ecology and management of the Indiana bat in Michigan. *Michigan Academician* 33:361-376.
- Kurta, A., S.W. Murray, and D.H. Miller. 2002. Roost selection and movements across the summer landscape. Pp. 118-129 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX. 253 pp.
- Kurta, A., D. King, J.A. Teramino, J.M. Stribley and K.J. Williams. 1993. Summer roosts of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. *American Midland Naturalist*, 129:132-138.

- Montgomery Watson and 3D/I. 1998. Biological assessment: effects to Indiana bats and bald eagles from construction and operation of the proposed multi-purpose training range Atterbury Reserve Forces Training Area, Edinburgh, Indiana. Submitted to Military Department of Indiana.
- Murray, S.W. and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis*). *Journal of Zoology* 262:197-206.
- Richter, A.R., S.R. Humphrey, J.B. Cope, and V.W. Brack, Jr. 1993. Modified cave entrances: thermal effect on body mass and resulting decline of endangered Indiana bats (*Myotis sodalis*). *Conservation Biology* 7:407-415.
- Rommé, R.C., K. Tyrell, and V. Brack. 1995. Literature summary and habitat suitability index. Model components of summer habitat for the Indiana bat, *Myotis sodalis*. Federal Aid Project E-1-7, Study No. 8. 3/D Environmental, Cincinnati, OH.
- Sparks, D.W., J.O. Whitaker, Jr., and C.M. Ritzi. 2005a. Foraging ecology of the endangered Indiana bat. Pp. 15-27 in K.C. Vories and A. Harrington (eds.), *The Proceedings of the Indiana bat and coal mining: a technical interactive forum*. Office of Surface Mining, U.S. Department of the Interior, Alton, IL.
- Sparks, D.W., C.M. Ritzi, J.E. Duchamp, and J.O. Whitaker, Jr. 2005b. Foraging habitat of the Indiana bat, (*Myotis sodalis*) at an urban-rural interface. *Journal of Mammalogy* 86:713-718.
- Speakman, J.R. 1995. Chiropterian nocturnality. *Symposia of the Zoological Society of London* 67:187-201.
- Stearns & Wheler, LLC. 2009. Biological Assessment of the Proposed Adams Fairacre Farms Store, Town of Wappinger, Dutchess County, New York. Stearns & Wheler, LLC, Cazenovia, NY.
- U.S. Fish and Wildlife Service. 1983. Recovery Plan for the Indiana Bat. Twin Cities, MN.
- U.S. Fish and Wildlife Service. 1999. Agency Draft Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. Fort Snelling, MN.
- U.S. Fish and Wildlife Service. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp.
- U.S. Fish and Wildlife Service. 2008. Revised 2007 Rangewide Population Estimate for the Indiana Bat, *Myotis sodalis*. Available at:
<http://www.fws.gov/midwest/endangered/mammals/inba.html>
- U.S. Fish and Wildlife Service. 2009. Indiana Bat (*Myotis sodalis*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Midwest Region, Bloomington, Indiana.

- U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook - Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act. Washington, D.C.
- Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48-54 *in* A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
- Winhold, L. and A. Kurta. 2006. Aspects of Migration by the Endangered Indiana Bat, *Myotis sodalis*. Bat Research News 47:1-11.

APPENDIX A

U.S. Fish and Wildlife Service. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 258 pp. - *Provided electronically.*