United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS/R3/ES

NOV 12 2015

Ms. Kathleen Atkinson
Regional Forester
USDA – Forest Service
Eastern Region
626 E. Wisconsin
Suite 800
Milwaukee, Wisconsin 53202

Subject: Biological Opinion for Activities Affecting the Northern Long-Eared Bat on Eastern Region National Forests

Dear Ms. Atkinson,

This letter transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) of continued implementation of U.S. Department of Agriculture, Forest Service (FS), Forest Land and Resource Management Plans (Forest Plans) and their associated projects on National Forests and a National Tallgrass Prairie in the FS Eastern Region relative to the northern long-eared bat (NLEB). The FS has previously consulted with the Service as required under section 7(a)(2) of the Endangered Species Act (ESA) on each of these Forest Plans addressing effects to other listed species and designated critical habitats that occur on each Forest. The NLEB was listed as a threatened species on April 2, 2015, after these Forest Plans were adopted.

The enclosed BO concludes a batched programmatic re-initiation of consultation that was necessary because the Service listed a species that was not evaluated in the previous forest-specific consultations. It is our opinion that continued implementation of these Forest Plans as described in the FS Biological Assessment provided March 30, 2015, with subsequent revisions and clarifications provided during consultation that are documented in the Proposed Action section of the BO, is not likely to jeopardize the continued existence of the NLEB. The Service has not designated or proposed critical habitat for the NLEB; therefore, the FS does not require a Service opinion regarding the effects of this programmatic action to NLEB critical habitat

Depending on project-specific details and conservation measures, a large fraction of the FS activities evaluated programmatically in the BO are likely excepted from the take prohibitions at 50 CFR

§17.31 and §17.32 under the interim ESA section 4(d) rule adopted for the NLEB with the listing decision. Taking that is incidental to and not intended as a part of 4(d)-excepted activities does not require special exemption through compliance with the terms and conditions of an incidental take statement. Therefore, the incidental take statement with this BO for this programmatic action specifies:

1. a process for FS documentation of its determination that a proposed activity addressed in this BO is an excepted activity under the NLEB interim 4(d) rule, and if so, may rely upon the findings of this BO to document its compliance with section 7(a)(2) of the ESA with respect to the NLEB; and
2. procedures for identifying projects that would require further consultation to obtain the necessary special exemption for anticipated taking that is not excepted by the interim 4(d) rule.

Our analyses in the BO highlight the potential conservation importance of identifying NLEB maternity roosting areas on the Forests to inform project-level siting and scheduling decisions. Several of our conservation recommendations address this need.

The Service appreciates the outstanding cooperation of FS staff throughout this consultation, in particular, Ms. Cynthia Sandeno of your regional office staff. If you have any questions about the BO, please feel free to contact me at (612) 713-5345, or our regional consultation coordinator Karen Herrington at (612) 713-5315.

Sincerely,

Lynn Lewis

Lynn Lewis
Assistant Regional Director,
Ecological Services
Midwest Region

Enclosure

cc: USFWS, Assistant Regional Director, Ecological Services, Region 5
USFWS New York ES Field Office
USFWS New England ES Field Office
USFWS Pennsylvania ES Field Office
USFWS East Lansing Michigan ES Field Office
USFWS Columbus Ohio ES Field Office
USFWS Bloomington Indiana ES Field Office
USFWS Maine ES Field Office
USFWS Marion Illinois ES Sub-office
USFWS Minnesota/Wisconsin Ecological Services Field Office
USFWS Columbia Missouri Ecological Services Field Office
USFWS Rock Island Ecological Services Field Office
USFWS West Virginia Ecological Services Field Office

Biological Opinion

Activities Affecting the Northern Long-Eared Bat on Eastern Region National Forests

FWS Log #03E00000-2015-F-0001

Prepared by:
U.S. Fish and Wildlife Service
Midwest Regional Office
Bloomington, Minnesota
November 3, 2015

Contents

Executive Summary

This Endangered Species Act (ESA) Biological Opinion (BO) addresses the effects to the northern long-eared bat (NLEB) resulting from continued implementation of U.S. Department of Agriculture, Forest Service (FS), Forest Land and Resource Management Plans (Forest Plans) and their associated projects on 14 National Forests and 1 National Tallgrass Prairie (collectively, Forests) in the FS Eastern Region (the Action). The FS has previously consulted with the Service on each of these Forest Plans addressing effects to other listed species and designated critical habitats that occur on each Forest. The NLEB was listed as a threatened species on April 2, 2015 (effective May 4, 2015), after these Forest Plans were adopted. This consultation represents a batched programmatic reinitiation of consultation that is necessary because the Service has listed a species that was not evaluated in the previous forest-specific consultations. The Service has not designated or proposed critical habitat for the NLEB; therefore, this BO does not address effects to critical habitat.

The FS prepared a Biological Assessment (BA) in support of its determination that the Action may adversely affect the NLEB and its request to initiate formal consultation. The BA provided a description of activities implemented under Forest Plans that may affect the NLEB, including the average annual acreage anticipated for these activities on each Forest that would achieve the objectives of the Plans consistent with their standards and guidelines.

The Action Area addressed in the BA and this BO includes all Eastern Region FS lands including 15 Forests within the range of the NLEB. The 15 Forests included in the Action Area encompass a total of about 12.2 million acres, of which about 11.3 million acres is forested land cover of various types. Activities on these Forests that involve harvesting or clearing trees for other purposes amount to 2.4 percent annually of the available forested habitat. Prescribed burning affects a smaller acreage, amounting to 1.0 percent of the available habitat annually.

Status of the NLEB

The NLEB occurs across much of the eastern and north-central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia. The disease known as white-nose syndrome (WNS) is the primary factor affecting the status of the NLEB, which has caused dramatic and rapid declines in abundance, resulting in the local extirpation of the species in some areas. Although other factors, individually or in combination, are likely insignificant at the range-wide scale, they may exacerbate the effects of WNS at the local population scale, thereby accelerating declines and the likelihood of local extirpation due to the disease or reducing surviving populations' ability to recover from impacts of the disease. The species' foremost conservation need is to reduce or eliminate the threat of WNS. A secondary need is to avoid and minimize the adverse effects of other threats in WNS-affected portions of its range in order to delay declines and maximize the chances for local populations to persist.

Environmental Baseline

NLEB populations are declining in the Action Area within a few years following the arrival of WNS, and the Service expects further declines as the disease moves through the Action Area.

Based on post-WNS occupancy rates inferred from summer mist-net data and assumptions about colony size and distribution in forested habitats, we estimate that the Action Area currently supports a population of about 436,950 adult NLEB. The FS has restricted access to all caves and abandoned mines to public access, not just those known to serve as bat hibernacula, which limits humans from acting as vectors for the disease and disturbance during hibernation. Although various forest management activities may incidentally take NLEB, the FS is perpetuating forested habitat in the Action Area, and asserts in the BA that existing standards, guidelines, and best management practices in Forest Plans are likely to improve roosting and foraging habitat and minimize the incidental take of the species.

Effects of the Action

Based on the available scientific literature, the Service identifies various pathways by which environmental changes (stressors) caused by the Action may affect individual NLEB and the expected responses of individuals exposed to the stressors. General response categories include potentially increased fitness, reduced fitness, disturbance, incidental take in the form of harassment, and incidental take in the form of harm (death or injury resulting from habitat modifications). For each pathway, we estimate the number of NLEB individuals exposed by computing the expected overlap on the Forests between the activities and NLEB-occupied habitats.

We estimate the numbers of NLEB for which the proposed Action could potentially increase fitness of individuals to some unknown degree is about 16,043 individuals (2.4 percent of the total Action Area population). This analysis enumerates the FS assertion in the BA that management of the Forests under existing Forest Plans is likely to improve roosting and foraging habitat for the NLEB, but we lack scientific support to interpret the degree to which these effects may influence survival or reproductive success rates for local populations. Our effects analyses identify several possible pathways for the Action to affect NLEB in hibernacula; however, we believe that existing standards and guidelines in Forest Plans that protect known hibernacula avoid adverse effects.

Consistent with the "likely to adversely affect" determination of the BA, we have estimated that the Action is expected to cause incidental take of up to 13,535 volant NLEB (both adults and juveniles, about 2.1 percent of total NLEB numbers) in the form of harassment, all within roosting areas (both maternity and non-maternity), and mostly (72.8 percent) resulting from tree clearing activities. The Action is expected to harm up to 2,102 non-volant juvenile NLEB (about 1.0 percent of the total pup population), all within maternity roosting areas, and mostly (82.6 percent) resulting from tree clearing activities. Tree removal activities are also expected to harm 76 adults. The potential for tree clearing to kill or injure NLEBs depends largely on site-specific circumstances, e.g., the likelihood of felling a tree containing individuals. Not all tree clearing activities in maternity roosting areas will kill or injure all pups present (if the trees cut do not have roosting bats), but our methodology estimates that all potentially vulnerable individuals within the expected area of activity/occupancy overlap are affected. Our analyses for both harassment- and harm-effects pathways highlight the potential conservation importance of identifying maternity roosting areas on the Forests to inform project-level siting and scheduling decisions.

Interrelated and Interdependent Actions; Cumulative Effects

We are unaware of interrelated and interdependent actions to the proposed Action that are not included in the proposed Action. All actions within the Action Area, which is federally owned and managed, have a federal nexus; therefore, the cumulative effects of future state, tribal, local, or private actions are not relevant to this consultation.

Conclusion

The most significant effect to weigh against the status of the NLEB is the anticipated harm to up to 2,102 non-volant pups (1.0 percent of the estimated pup population in the Action Area). Most mortality for most North American bat species, including the NLEB, occurs during the juvenile life stage. The annual level of forest management activity described for the proposed Action is derived from Forest Plans, many of which have been in effect for several years, and the FS BA characterizes the NLEB as "among the most common of forest bats within the Eastern Region" that is "frequently encountered in surveys." This characterization is predominantly based on pre-WNS data. WNS is present throughout the Action Area. Its effects are not yet pronounced in the upper-Midwest Forests; however, mortality is occurring in in the Great Lakes Region. The interim 4(d) rule with the final listing decision provides exceptions to taking prohibitions for all activities outside of the WNS buffer zone, and within the zone, to all forest management activities that avoid impacts to known hibernacula and known roosts. The section of the interim 4(d) rule pertaining to forest management concludes:

> "Therefore, we anticipate that habitat modifications resulting from forest management and silviculture will not significantly affect the conservation of the northern long-eared bat. Further, although activities performed during the species' active season (roughly April through October) may directly kill or injure individuals, implementation of the conservation measures provided for in this interim rule will limit take by protecting currently known populations during their more vulnerable life stages."

After reviewing the current status of the NLEB, environmental baseline for the Action Area, effects of the Action, and cumulative effects, it is the Service's biological opinion that the Action, as proposed, is not likely to jeopardize the continued existence of the NLEB. The Service has not proposed or designated critical habitat for this species; therefore, none is affected.

Incidental Take Statement

The interim 4(d) rule issued with the listing decision for the NLEB adopted the take prohibitions at 50 CFR §17.31 and §17.32 for this species with certain exceptions. These exceptions include forest management and other specifically defined activities. Take resulting from these activities is excepted from the take prohibitions provided that the activities:

- occur more than 0.25 mile (0.4 kilometer) from a known hibernacula;
- avoid cutting or destroying known, occupied maternity roost trees during the pup season; and
- avoid clearcuts and similar harvest methods within 0.25 mile of known, occupied maternity roost trees during the pup season.

Excepted activities do not require special exemption for incidental taking, but federal actions consistent with the definitions of excepted activities require compliance with section 7(a)(2) of the ESA.

Project-level activities that are implemented consistent with the proposed Action may satisfy the definitions of activities excepted from the take prohibitions, provided they are also consistent with the conservation measures of the interim 4(d) rule for such activities, summarized above. However, new roads construction and some forms of non-timber-related clearing may not satisfy the definitions of excepted activities. We are unable to determine in this programmatic consultation whether a particular project of any type proposed is consistent with the conservation measures, as this requires site-specific information that is updated as locations for NLEB known occupied hibernacula and known occupied maternity roosts become known. Therefore, the FS must determine on a project-level basis whether a proposed activity addressed in this BO is excepted under the interim 4(d) rule, and if so, may rely upon the findings of this BO to document its compliance with section 7(a)(2) of the ESA with respect to the NLEB. We specify a streamlined process for such documentation under Reasonable and Prudent Measure #2 and its accompanying Terms and Conditions.

The Action meets the regulatory definition of a framework programmatic action: "a Federal action that approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation" (50 CFR §402.02). An incidental take statement is not required for a framework programmatic action (50 CFR §402.14(i)(6)). Therefore, terms and conditions under this programmatic Incidental Take Statement specify the procedures for identifying projects that would require further section 7 consultation to obtain the necessary special exemption for anticipated take that is not excepted by the NLEB interim 4(d) rule.

The Service anticipates annual take of up to 13,535 volant NLEB (both adults and juveniles) in the form of harassment and up to 2,102 non-volant juvenile NLEB and 76 adults in the form of harm. Due to the difficulty of detecting take of NLEB caused by the proposed Action, the FS will monitor the extent of taking using the acreage of forested habitat that projects implemented under the existing Forest Plans will alter, which is up to 229,468 acres annually for harassment of all individuals, and within these areas, an average of up to 108,881 acres annually for harm of non-volant pups from May 1 – July 31, and up to 171,743 acres annually for harm of adults from April 1 to October 31. For activities conducted under the programmatic Action evaluated in this BO, no take is anticipated to occur during the NLEB inactive season, generally considered November 1 – March 31. Tables showing the annual acreage for each activity on each Forest that cause the anticipated take are provided as a standard for determining when the level of anticipated take is exceeded. The individual Forest numbers may vary in a given year by no more than 30%, provided that the total annual acreages are not exceeded.

Consultation History

2014 March 15 – Initial meeting between Forest Service (FS) Eastern Region and U.S. Fish and Wildlife Service (Service) Southeast Region staff to discuss compliance with ESA section 7(a)(2) for the northern long-eared bat (NLEB), which was proposed for listing as an endangered species. Over the next several months, we outlined the scope of, and information needs for, a FS Eastern Region-wide programmatic conference on the effects of activities implemented under currently effective Forest Plans.

2015 March 4 – Letter from the Kathleen Atkinson (FS, Regional Forester, Eastern Region) to Tom Melius (Service, Regional Director, Midwest Region) requesting concurrence with the FS determination that continued implementation of FS Forest Plans would not jeopardize the continued existence of the NLEB. Enclosed with the letter was a "Non-jeopardy Interim Conference Report for the Continued Implementation of Forest Service Eastern Region Land and Resource Management Plans and Associated Projects" supporting the FS determination.

2015 March 30 – Letter from Kathleen Atkinson (FS, Regional Forester, Eastern Region) to Tony Sullins (Service, Chief of Endangered Species, Midwest Region) requesting initiation of a formal consultation for the effects to NLEB resulting from continued implementation of FS Forest Plans in the FS Eastern Region. Enclosed with the letter was a Biological Assessment (BA).

2015 April 2 – The Service published its decision to list the NLEB as a threatened species with an interim 4(d) rule that adopted the general prohibitions at 50 CFR §17.31 and 17.32 with certain exceptions.

2015 April through September – multiple email and phone correspondence between Service and FS staff clarifying details in the BA and exchanging additional information to inform the Opinion.

2015 May 1 – Letter from Lynn Lewis (Service, Assistant Regional Director, Ecological Services, Midwest Region) to Kathleen Atkinson (FS, Regional Forester) acknowledging receipt of the FS BA and providing a timeline for the formal consultation.

2015 June 12 – The FS met with staff from the Midwest and Northeast Regional Offices of the FWS to discuss consultation and additional data needs.

2015 July 1 and 13 – The FS transmitted updated versions of the BA that included additional information requested by the Service such as a description and rationale for "not likely to adversely affect" activities, additional 7(a)1 conservation activities, and a break-down of all activities by forest for forest-specific analyses.

2015 October 2 – The Service provided a draft Biological Opinion (BO) to the FS.

2015 October 8 to October 28 – The FS provided various comments on the draft BO to the Service.

2015 October 28 – The Service provided the final draft BO to the FS.

2015 November 1 – The FS provided the final updated acreages for each activity type and an updated BA.

A complete administrative record of this consultation is on file at the Service's Midwest Regional Office in Bloomington, Minnesota.

Biological Opinion

A Biological Opinion (BO) is the document required under the Endangered Species Act (ESA) that states the opinion of the U.S. Fish and Wildlife Service (Service) as to whether a proposed federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. This BO addresses the effects to the northern long-eared bat (*Myotis septentrionalis*) (NLEB) resulting from continued implementation of U.S. Department of Agriculture, Forest Service (FS), Forest Land and Resource Management Plans (Forest Plans) and their associated projects on 14 National Forests and 1 National Tallgrass Prairie (collectively, Forests) in the FS Eastern Region (the Action).

The FS has previously consulted with the Service on each of these Forest Plans considering effects to other listed species and designated critical habitats that occur on each Forest. The Service published its decision to list the NLEB as a threatened species on April 2, 2015 (80 FR 17974-18033), after these Forest Plans were adopted. At this time, the FS is not proposing changes to these 15 Forest Plans, and this consultation represents a batched reinitiation of consultation that is necessary because the Service has listed a species that was not evaluated in the previous forest-specific consultations. The Service has not designated or proposed critical habitat for the NLEB; therefore, this BO does not address effects to critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species (50 CFR §402.02). This BO examines whether projects and activities implemented in a manner that is consistent with the objectives, standards, and guidelines of the applicable Forest Plans are likely to jeopardize the continued existence of the NLEB.

Section 9 of the ESA and regulations issued under section 4(d) of the ESA prohibit the taking of endangered and threatened species, respectively, without special exemption. Federal agencies may obtain such exemption through the Incidental Take Statement of a BO that supports a non-jeopardy finding for their proposed actions. The interim 4(d) rule issued with the listing decision for the NLEB adopted the general provisions and take prohibitions at 50 CFR §17.31 and §17.32 to this species with certain exceptions. These exceptions include all activities in areas as yet unaffected by the white-nose syndrome (WNS) disease, which is the primary factor contributing to the species' decline. Within WNS-affected areas, activities excepted from take prohibitions are specifically defined, including forest management that avoids impacts to sites that the species is known to occupy. Excepted activities do not require special exemption for incidental taking.

The FS consults with the Service on Forest Plans to comply with the ESA at a programmatic level. Forest Plan consultations establish whether achieving the objectives of the plan consistent with its standards and guidelines would avoid jeopardizing listed species or adversely modifying designated critical habitats. Forest Plans meet the regulatory definition of a framework programmatic action: "a Federal action that approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species

would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation" (50 CFR §402.02). An incidental take statement is not required for a framework programmatic action (50 CFR §402.14(i)(6)); however, sufficiently detailed information in programmatic consultations may support assessing the anticipated extent of incidental taking of listed species using habitat measures corresponding to program objectives and other available data. If provided, reasonable and prudent measures in a programmatic-level take statement may define generally applicable terms and conditions to minimize the impacts of incidental taking resulting from project-level actions and/or a framework for exempting incidental take at the project level, where site-specific data may better inform effective take minimization measures. The action agency subsequently implements terms and conditions in a programmatic take statement that are applicable to proposed actions at the project level and requests project-level consultation (formal or informal) when proposed actions: (a) are outside the scope of the programmatic consultation; (b) trigger the programmatic reinitiation criteria; or (c) require project-specific terms and conditions for anticipated incidental taking.

1 Proposed Action

The FS Eastern Region proposes to continue implementation of existing Forest Plans, without modification, on 14 National Forests and 1 National Tallgrass Prairie (collectively, "Forests") that are within the range of the NLEB (the Action). The 15 Forests are listed below, and for each, the state(s) in which the Forest is (are) located is noted:

- Allegheny (PA);
- Chequamegon-Nicolet (WI);
- Chippewa (MN);
- Green Mountain & Finger Lakes (VT, NY);
- Hiawatha (MI);
- Hoosier (IN);
- Huron-Manistee (MI);
- Mark Twain (MO);
- Midewin (IL);
- Monongahela (WV);
- Ottawa (MI);
- Shawnee (IL);
- Superior (MN);
- Wayne (OH); and
- White Mountain (NH, ME)

The total area of these 15 Forests in 13 states is about 12.2 million acres, of which 11.3 million areas are forested habitat (Table 1.1) (note: tables and figures for each major section of this BO appear at the end of the section).

Forest Plans provide a framework for integrated resource management and guide project-level decision making. From broader regional and national goals, Forest Plans step down forest-specific conservation and multiple-use objectives. A Forest Plan does not authorize projects or activities, but projects and activities must contribute to Plan objectives and conform to its standards and guidelines. Standards and guidelines are adopted both Forest-wide and within specific management or prescription areas, among other reasons, to promote the conservation of listed species and to avoid and minimize potential adverse effects of projects implemented under the plan.

The FS provided to the Service a biological assessment (BA) of the Action by letter dated March 30, 2015. Several updates were made to the BA, and a final version was delivered by email on November 1, 2015. Although the 16[1] Forest Plans considered in the BA address a wide range of forest resource multiple-use objectives and conservation needs, the scope of the BA is limited to: (a) a description of project-level design criteria (e.g., snag retention in timber harvest areas) in the Plans that may either promote the recovery of, or mitigate adverse effects to, the NLEB; and (b) an analysis of broad classes of project-level actions (e.g., prescribed burning) anticipated under those Plans that the FS has determined may adversely affect the NLEB. The scope of this BO is similarly limited. We have relied on information in the BA to identify activities implemented under the Forest Plans that are relevant to evaluating effects to the NLEB at a programmatic level. We have not reviewed each individual Forest Plan relative to the NLEB. The extent to which, if any, that achieving the objectives of individual Forest Plans consistent with their forest-specific standards and guidelines would have greater or lesser effects to the NLEB than identified in the BA and additional information provided during consultation is not addressed in this BO.

1.1 Action Area

For consultation purposes, 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" (50 CFR §402.02). The "Action Area" for this consultation includes all forested lands under FS ownership within the 15 FS Eastern Region Forests listed under section 1 above. The Eastern Region Forests listed in the Proposed Action are located entirely within the range of the NLEB (Figure 1.1).

1.2 Description of the Proposed Action

The BA describes the activities that are anticipated to achieve the objectives of each of the 16 Forest Plans and that the FS has determined may adversely affect the NLEB. These activities are:

1. Timber harvest (by cutting method);
    - Even-aged;
    - Uneven-aged;
    - Thinning;
    - Salvage/Sanitation;
2. Prescribed burning;
3. Road construction/reconstruction/maintenance/decommissioning;
4. Trail construction/reconstruction/maintenance/decommissioning; and
5. Habitat Improvement/Non-timber clearing.

The following sections (1.2.1 through 1.2.5) provide descriptions of these activities. Section 1.2.6 describes project-level design criteria that are relevant to the conservation of the NLEB and

[1] The Green Mountain and Finger Lakes NFs are actually two proclaimed National Forests that have been combined for administrative purposes, but they have separate Forest Plans.

that apply to these activities across all 15 Forests. Section 1.2.7 provides a summary of the spatial extent of the proposed activities.

1.2.1 Timber Harvest

The BA reports the projected average annual acreage, by Forest, of timber harvest that would achieve Forest Plan objectives under the currently effective Plans (Table 1.2). The total acreage (145,762 acres annually) is partitioned according to the forest management treatment type used to accomplish the harvest: even-aged management; uneven-aged management; thinning; and salvage/sanitation and includes temporary road construction used to access harvest areas (1 mile of temporary road = 1.5 acres of harvest). For each treatment type, the BA further partitions the acreage that would occur during May 1 to July 31 each year, which is when maternity colonies form and flightless (non-volant) bat pups are present on the Forests. The period of non-volancy is variable across the action area, and may persist until late July and even early August depending on latitude, elevation, and weather conditions, but May 1 – July 31 captures most of the period on most Forests in most years.

Lands classified as unsuitable for timber production are not managed for a sustained yield of timber, i.e., trees are not harvested on a regular basis. The FS may cut trees in these acres depending on designation, but not at regular intervals. Trees are never harvested in designated wilderness and wild and scenic river corridors. Areas classified as unsuitable for timber include wilderness, wild and scenic rivers, recreation areas, areas with steep slope, and highly erosive soils. These areas typically are more heavily stocked with trees that are generally older, having more snags and cull trees. These areas may receive prescribed burning. Table 1.1 reports the acreage that is classified as forest suitable for timber production on each of the 15 Forests, which amounts to 61.2 percent of the total forested acreage.

The FS schedules timber harvests (commercial and non-commercial) to achieve Forest Plan objectives for timber production and for ecosystem restoration, endangered/threatened/sensitive species conservation, stand regeneration for forest health, wildlife habitat improvement, insect and disease control, and fuel reduction. Appendix B of the FS BA provides definitions for each harvest treatment type that is listed in Table 1.2. It provides several other definitions as well that are necessary to evaluate the potential effects of project-level activities proposed under the programmatic Action. Therefore, we incorporate by reference Appendix B of the FS BA to this BO, providing excerpts for the three timber harvest types below, and relying on other definitions as necessary throughout this BO.

Even-Aged Management

Even-aged management (EAM) involves stands of trees composed of a single age class in which the FS BA indicates the range of tree ages are usually ±20 percent of the rotation length. The FS BA, with further definition provided in review of a draft of this BO, identifies four specific harvest methods for starting a cycle of EAM:

- Clearcutting (with and without reserves) – The cutting of essentially all trees, producing a fully exposed micro-climate for the development of a new age class. Cutting may be done in groups or patches. Reserve trees are left indefinitely.

- Seed Tree (with and without reserves) – The cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class in a fully-exposed micro-environment. Reserve trees are left indefinitely.
- Shelterwood (with and without reserves) – The cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment. Reserve trees are left indefinitely
- Coppice (with and without reserves) – Reserve trees are left indefinitely

The FS BA does not specify the harvest method anticipated for the harvest acreages reported in Table 1.2.

Unven-Aged Management

Unven-aged management (UAM) involves stands of trees of three or more distinct age classes, either intimately mixed or in small groups. Harvest methods for perpetuating UAM are:

- Group Selection – Trees are removed and new age classes are established in small groups, usually less than 2 acres in size.
- Single (individual) Tree Selection – Individual trees of all size classes are removed more or less uniformly throughout the stand to promote the growth of remaining trees for regeneration.

Thinning

Thinning is reducing the density of a stand of trees, usually to improve growth rates of the remaining trees, to enhance forest health, or restore closed-canopy forests to more open-canopy woodlands. Thinning is a treatment applicable to both even and uneven-aged management, but it is separated from these in the FS BA estimation of annual acreage of timber harvest in Table 1.2. Types of thinning that the FS uses include the following:

- Chemical– The killing of unwanted trees by using an herbicide.
- Crown – The removal of trees from the dominant or co-dominant crown classes in order to favor the best trees of those same crown classes (also known as thinning from above or high thinning).
- Free – The removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position.
- Low – The removal of trees from the lower crown classes to favor those in the upper crown classes (also known as thinning from below).
- Mechanical – The thinning of trees in either even- or uneven-aged stands, involving the removal of trees in rows, strips, or by using fixed spacing intervals (also known as geometric thinning).
- Selection – The removal of trees in the dominant crown class in order to favor the lower crown classes (also known as dominant thinning).

Examples of thinning include recreation site maintenance, cutting trees around a lake or along a stream for fisheries habitat, and general landscape thinning of overstocked conditions in even- or uneven-aged managed stands. Thinning can be followed by prescribed burning to enhance growth and survivorship of desired trees such as oak, hickory, and yellow pines.

Salvage/Sanitation

Salvage cutting is the removal of trees that are dead, damaged, or dying due to injurious agents other than competition (e.g., disease, storms, fire) in order to recover the economic value that would otherwise be lost. Salvage cutting also applies to situations of immediate public safety concerns near roads, trails, and recreation areas. Sanitation cutting is the removal of trees to improve stand health by stopping or reducing the actual or anticipated spread of insects and disease. As with thinning, salvage/sanitation harvest is applicable to both even and uneven-aged management, but it is separated from these in the FS BA estimation of annual acreage of timber harvest in Table 1.2.

1.2.2 Prescribed Burning

The FS anticipates applying prescribed burning to 107,684 acres (1% of the action area) annually across the 15 Forests. Table 1.3 reports the average annual acreage by Forest and by time of year, indicating the portion of the total acreage that would occur during May 1 to July 31 each year, which is when flightless (non-volant) bat pups are present on the Forests.

Prescribed burning is deliberately burning wild-land fuels under specified environmental conditions in a predetermined area with a predetermined fire-line intensity and rate of movement in order to attain resource management objectives. The FS conducts both dormant-season and growing-season prescribed burning. The seasonality varies by latitude and elevation, but the dormant season is generally October –April and the growing season is April 15 – August 15. Dormant-season burning is primarily used to reduce the buildup of hazardous fuels and thereby reduce the likelihood of catastrophic wildfires or to achieve ecological stand objectives. Growing-season burning is used for site preparation, control of undesirable species, and restoration and maintenance of fire-dependent plant communities (e.g., yellow pine and/or oak-dominated forest types) and associated wildlife.

1.2.3 Road Construction/Reconstruction/Maintenance/Decommissioning

FS road construction addressed in the BA includes new construction, reconstruction, maintenance and decommissioning. General guidance for road management on Eastern Region Forests is to expand the use of existing corridors (reconstruction) rather than establish new roads (construction). Construction involves tree removal and clearing in a new corridor and occasionally includes removal or restoration of man-made structures, which generally amounts to about 3 acres per mile. The average road width is 20 feet wide. Reconstruction can entail removing some trees to expand or widen a corridor – generally about 0.5 acres per mile. Reconstruction is necessary when part of a road is washed away in a flood, destroyed by a landslide, or otherwise becomes unusable or unsafe. In some cases, roads are gated (closed to access), for many years and saplings grow in the roadbed. Reconstruction would consist of removing these small trees (not suitable NLEB roost trees) and other necessary repairs prior to use. Tree removal for road maintenance is usually limited to hazard trees that may fall across the road. Decommissioning involves the closure of an existing road (usually a gate or berm), but can also involve scattered tree felling to discourage road use.

Table 1.4 reports the total annual acreage of all types of road work (14,218 acres) by Forest and by time of year, indicating the portion of the total acreage that would occur during May 1 to July 31 each year. The FS BA indicates that new road construction constitutes a small fraction of these projections on most Forests, but did not specify a breakdown between new construction and work on existing roads. There is no new road construction proposed on the Green Mountain & Finger Lakes, Mark Twain, and Shawnee NFs.

1.2.4 Trail Construction/Reconstruction/Maintenance/Decommissioning

Under trail construction, the FS BA includes new construction, maintenance or reconstruction of existing trails, and decommissioning. Trail construction is the clearing of an area for recreational purposes, most often narrow hiking trails, but in some cases off-road vehicle trails no wider than 13 feet, i.e., up to7 feet for the trail and 3 feet on either side for safety clearing. Trail reconstruction can entail removing trees to widen the trail. Tree removal for trail maintenance is usually limited to hazard trees that may fall across the trail or pose a public safety risk. Decommissioning involves the closure of an existing trail with gates or berms, but may also involve scattered tree felling to discourage trail use. Table 1.5 provides the projected annual acreage of trails work on the Forests (total of 2,514 acres); however, the BA does not indicate the fraction that represents new trail construction, which would involve the most tree clearing.

1.2.5 Habitat Improvement/Non-Timber Clearing

Habitat Improvement/Clearing Non-Timber is defined in the BA as tree clearing associated timber stand improvement, wildlife stand improvement, mechanical fuels reduction, firewood cutting, recreation site maintenance, dropping individual trees in lakes and streams for fish habitat, and clearing for special use permits, wildlife opening development/maintenance, oil and gas well facilities, and pond construction because all of these activities have similar effects of reducing stand density and allowing more sunlight to reach the forest floor. Table 1.6 provides the average annual acreage of tree clearing associated with all types of non-timber work on the Forests, a total of 108,472 acres, of which 55 percent is on the Huron-Manistee and Mark Twain Forests.

1.2.6 Design Criteria

Each Forest Plan contains a unique suite of standards and guidelines for conserving Forest resources, including various project-level "design criteria." These design criteria are part of the proposed Action and figure into our analysis of the forest management treatments in section 4 of this BO, "Effects of the Action." Individual forest-wide standards and guidelines that are likely to benefit the NLEB are listed in Appendix E of the FS BA, and we incorporate by reference Appendix E of the FS BA to this BO.

In general, these design criteria require the individual Forests to retain a variety of the largest diameter snags, cavity/den trees, and/or reserve trees in even-aged timber harvest areas, as well as provide riparian protections for ephemeral, intermittent, and perennial streams. Forests with caves and mines that are used by bats also have standards and guidelines for activities occurring in the vicinity of these features. The following Forest Plans include additional design criteria

intended to protect the endangered Indiana bat: Allegheny, Green Mountain, Hoosier, Huron-Manistee, Mark Twain, Monongahela, Shawnee, and Wayne. In addition to protecting snags and den trees, these Forest Plans protect potentially suitable roost trees as well (e.g., lightning scars, splits, cracks, or broken tops) and often shagbark hickory trees.

In addition to Forest-specific standards and guidelines, the Eastern Region has adopted the following additional conservation measures to minimize adverse impacts to NLEB that will be implemented with all new projects as applicable:

1. Designate caves and mines that are occupied by bats as smoke-sensitive targets. Avoid smoke entering these caves and mines any time of the year when Threatened, Endangered, or Sensitive (TES) bats are present.
2. Within 0.25 miles of known, occupied NLEB hibernacula, timber harvest will be designed to maintain, enhance, or restore swarming, staging, roosting, and foraging habitat. The future desired condition is that these areas will feature structurally complex, resilient forest communities with a continuous supply of snags, culls, cavities, and other quality roosts.
3. Application of herbicides and other pesticides will be planned to avoid or minimize direct and indirect effects to known, occupied Threatened, Endangered, or Sensitive (TES) bat hibernacula and maternity roosts.
4. Before old buildings, wells, cisterns, bridges, and other man-made structures are structurally modified or demolished, they will be surveyed for bats. If TES bat roosting is found, demolition or modification of these structures will not occur when bats are present and the need for alternative roosts will be evaluated.
5. Avoid cutting or destroying known, occupied NLEB maternity roost trees unless they are an immediate safety hazard.
6. Where needed to provide drinking sources for bats, create small wetlands or water holes.

1.2.7 Summary of Proposed Action

The FS anticipates activities on the 15 Forests that involve harvesting or clearing trees for other purposes (e.g., roads, trails, habitat improvement, special-use permits) amounting to 2.4 percent annually of the available forested habitat (Table 1.7). Prescribed burning affects a smaller larger acreage, amounting to 1 percent of the available habitat annually. Although not specified in the BA, some of these land management treatments likely overlap within a given year on the Forests, e.g., a thinning harvest is possibly followed by prescribed burning.

For some analyses of the effects of the proposed Action, we must consider the acreage of proposed activities that occur during the NLEB active season between spring and fall migration, which for purposes of this BO we identify as April 1 – October 31 (214 days) (see section 2.2.2). The BA specifies the acreage of all activities occurring during the NLEB non-volant season, defined as May 1 – July 31 (92 days), and during the volant season, defined as the rest of year (273 days). The average annual acreages expected to occur during the non-volant season is 108,881 acres (about 1 percent of the total forested acreage), and 378,650 acres of activity will occur during the rest of the year (about 3 percent of the total forested acreage). Lacking a breakdown of activity acreage for the inactive season months of November – March, we assume

that the acreage of activities assigned to the volant season occur with equal frequency throughout its duration. The duration of the volant season defined in the BA is 273 days, of which 122 days (44.7 percent) (April 1 – 30; August 1 – October 31) are within the active season. We estimate active-season activity acreage as the sum of the non-volant season acreage plus 44.7 percent of the volant-season acreage. Table 1.8 shows the active-season acreages computed in this manner for each of the proposed Action activity types.

For some analyses of the effects of the proposed Action, we use the acreage of proposed activities during the non-volant season as provided in the BA. These acreages are tallied for all actions in Table 1.9.

1.3 Tables and Figures for Proposed Action

Table 1.1. Total acres of ownership, non-forested land, forested land, and forest suitable for timber production on the 15 Forests (sources: FS BA; timber suitability analyses of existing Forest Plans).

Forest	Total NF Lands	Non-Forest	Forest	Forest Suitable for Timber	Percent Forested Lands Suitable for Timber
Allegheny	516,843	41,347	475,496	379,055	79.7%
Chequamegon-Nicolet	1,523,709	204,846	1,318,863	1,163,845	88.2%
Chippewa	671,951	82,261	589,690	461,812	78.3%
Green Mtn & Finger Lakes	425,943	27,564	398,379	217,596	54.6%
Hiawatha	897,507	103,968	793,539	561,670	70.8%
Hoosier	203,499	7,530	195,969	81,650	41.7%
Huron-Manistee	978,859	63,102	915,757	674,736	73.7%
Mark Twain	1,505,329	107,261	1,398,068	996,712	71.3%
Midewin	18,225	16,470	1,755	-	0.0%
Monongahela	920,584	20,584	900,000	337,970	37.6%
Ottawa	996,533	91,533	905,000	488,000	53.9%
Shawnee	286,254	33,354	252,900	137,800	54.5%
Superior	2,172,452	79,390	2,093,062	944,935	45.1%
Wayne	244,225	19,679	224,546	161,752	72.0%
White Mtn	802,359	9,359	793,000	281,300	35.5%
Total	12,164,272	908,248	11,256,024	6,888,833	61.2%

Table 1.2. Average annual timber harvest (acres) by treatment type and season (volant and non-volant).

	Even-Aged		Uneven-Aged		Thinning		Salvage/Sanitation		Total		
Forest	Non-Volant	Volant	Non-Volant	Volant	Non-Volant	Volant	Non-Volant	Volant	Non-Volant	Volant	Annual
Allegheny	589	2,896	103	392	208	792	0	0	900	4,080	4,980
Chequamegon-Nicolet	1,367	4,103	1,882	5,648	1,775	5,325	125	390	5,149	15,466	20,615
Chippewa	1,037	3,112	735	2,203	229	687	25	75	2,026	6,077	8,103
Green Mtn & Finger Lakes	2,190	1,263	700	403	653	377	0	0	3,543	2,043	5,586
Hiawatha	1,680	3,920	1,161	2,709	3,775	3,775	0	0	6,616	10,404	17,020
Hoosier	43	243	143	253	32	94	155	465	373	1,055	1,428
Huron-Manistee	1,542	4,627	204	611	1,518	4,555	63	187	3,327	9,980	13,307
Mark Twain	2,700	6,216	700	1,660	3,000	6,980	5,000	10,000	11,400	24,856	36,256
Midewin	0	0	0	0	0	0	0	0	0	0	0
Monongahela	900	2,100	0	0	300	700	0	0	1,200	2,800	4,000
Ottawa	976	2,274	1,531	6,119	1,050	2,450	97	227	3,654	11,070	14,724
Shawnee	489	734	0	0	0	36	0	0	489	770	1,259
Superior	1,192	9,648	124	1,004	182	1,030	10	90	1,508	11,772	13,280
Wayne	88	179	364	1,092	58	88	0	0	510	1,359	1,869
White Mtn	228	972	165	1,000	213	757	0	0	606	2,729	3,335
Total	15,021	42,287	7,812	23,094	12,993	27,646	5,475	11,434	41,301	104,461	145,762

Table 1.3. Average annual prescribed burning (acres) by season.

Forest	Non-Volant	Volant	Total
Allegheny	0	652	652
Chequamegon-Nicolet	4,000	1,100	5,100
Chippewa	2,976	744	3,720
Green Mtn & Finger Lakes	333	192	525
Hiawatha	468	52	520
Hoosier	250	1,750	2,000
Huron-Manistee	2,000	6,000	8,000
Mark Twain	6,000	54,000	60,000
Midewin	0	200	200
Monongahela	65	850	915
Ottawa	200	50	250
Shawnee	0	12,912	12,912
Superior	232	5,226	5,458
Wayne	713	6,419	7,132
White Mtn	105	195	300
Total	17,342	90,342	107,684

Table 1.4. Average annual acreage of roads work by season (volant and non-volant).

Forest	Non-Volant	Volant	Total
Allegheny	131	160	291
Chequamegon-Nicolet	2,068	2,854	4,922
Chippewa	804	1,223	2,027
Green Mtn & Finger Lakes	0	63	63
Hiawatha	82	109	191
Hoosier	16	20	36
Huron-Manistee	1,004	393	1,397
Mark Twain	36	121	157
Midewin	10	12	22
Monongahela	315	473	788
Ottawa	795	1,423	2,218
Shawnee	126	252	378
Superior	788	848	1,636
Wayne	29	31	60
White Mtn	17	15	32
Total	6,221	7,997	14,218

Table 1.5. Average annual acreage of trails work by season (volant and non-volant).

Forest	Non-Volant	Volant	Total
Allegheny	1	2	3
Chequamegon-Nicolet	169	332	501
Chippewa	32	122	154
Green Mtn & Finger Lakes	116	238	354
Hiawatha	97	131	228
Hoosier	0	2	2
Huron-Manistee	14	0	14
Mark Twain	37	149	186
Midewin	4	4	8
Monongahela	46	46	92
Ottawa	23	111	134
Shawnee	26	23	49
Superior	155	153	308
Wayne	29	37	66
White Mtn	284	131	415
Total	1,033	1,481	2,514

Table 1.6. Average annual acreage of non-timber tree clearing by season (volant and non-volant).

Forest	Non-Volant	Volant	Total
Allegheny	642	3,888	4,530
Chequamegon-Nicolet	3,350	3,350	6,700
Chippewa	3,107	3,912	7,019
Green Mtn & Finger Lakes	899	1,421	2,320
Hiawatha	2,544	2,336	4,880
Hoosier	170	512	682
Huron-Manistee	17,459	17,457	34,916
Mark Twain	7,759	17,476	25,235
Midewin	0	42	42
Monongahela	1,185	2,765	3,950
Ottawa	996	5,283	6,279
Shawnee	905	1,393	2,298
Superior	2,670	3,055	5,725
Wayne	933	2,198	3,131
White Mtn	365	400	765
Total	42,984	65,488	108,472

Table 1.7. Summary of average annual acreage of prescribed burning, timber harvest, roads work, trails work, and non-timber-related clearing on the 15 Forests.

Forest	Total Forested Habitat	Burning	Percent of Habitat with Burning Activity	Harvest	Roads	Trails	Non-Timber Clearing	Percent of Habitat with Non-Burning Activity
Allegheny	475,496	652	0.1%	4,980	291	3	4,530	2.1%
Chequamegon-Nicolet	1,318,863	5,100	0.4%	20,615	4,922	501	6,700	2.5%
Chippewa	589,690	3,720	0.6%	8,103	2,027	154	7,019	2.9%
Green Mtn & Finger Lakes	398,379	525	0.1%	5,586	63	354	2,320	2.1%
Hiawatha	793,539	520	0.1%	17,020	191	228	4,880	2.8%
Hoosier	195,969	2,000	1.0%	1,428	36	2	682	1.1%
Huron-Manistee	915,757	8,000	0.9%	13,307	1,397	14	34,916	5.4%
Mark Twain	1,398,068	60,000	4.3%	36,256	157	186	25,235	4.4%
Midewin	1,755	200	11.4%	0	22	8	42	4.1%
Monongahela	900,000	915	0.1%	4,000	788	92	3,950	1.0%
Ottawa	905,000	250	0.0%	14,724	2,218	134	6,279	2.6%
Shawnee	252,900	12,912	5.1%	1,259	378	49	2,298	1.6%
Superior	2,093,062	5,458	0.3%	13,280	1,636	308	5,725	1.0%
Wayne	224,546	7,132	3.2%	1,869	60	66	3,131	2.3%
White Mtn	793,000	300	0.0%	3,335	32	415	765	0.6%
Total	11,256,024	107,684	1.0%	145,762	14,218	2,514	108,472	2.4%

Table 1.8. Summary of average annual acreage of timber harvest, prescribed burning, roads work, trails work, and non-timber-related clearing on the 15 Forests estimated to occur during the northern long-eared bat active season (April 1 – October 31).

Forest	All Harvest Types	Prescribed Burning	Roads	Trails	Non-Timber Clearing	Total
Allegheny	2,724	291	203	2	2,380	5,599
Chequamegon-Nicolet	12,062	4,492	3,344	318	4,847	25,063
Chippewa	4,742	3,309	1,351	87	4,856	14,344
Green Mtn & Finger Lakes	4,456	419	28	222	1,534	6,660
Hiawatha	11,267	491	131	156	3,588	15,632
Hoosier	845	1,032	25	1	399	2,302
Huron-Manistee	7,788	4,682	1,180	14	25,262	38,926
Mark Twain	22,511	30,138	90	104	15,571	68,413
Midewin	0	89	15	5	19	129
Monongahela	2,452	445	526	66	2,421	5,910
Ottawa	8,602	222	1,431	73	3,358	13,686
Shawnee	833	5,772	239	36	1,528	8,407
Superior	6,770	2,568	1,167	223	4,036	14,764
Wayne	1,117	3,582	43	46	1,916	6,704
White Mtn	1,826	192	24	343	544	2,928
Total	87,995	57,725	9,796	1,695	72,257	229,468

Table 1.9. Summary of average annual acreage of timber harvest, prescribed burning, roads work, trails work, and non-timber-related clearing on the 15 Forests estimated to occur during the northern long-eared bat non-volant season (May 1 – July 31).

Forest	All Harvest Types	Prescribed Burning	Roads	Trails	Non-Timber Clearing	Total
Allegheny	900	0	131	1	642	1,674
Chequamegon-Nicolet	5,149	4,000	2,068	169	3,350	14,736
Chippewa	2,026	2,976	804	32	3,107	8,945
Green Mtn & Finger Lakes	3,543	333	0	116	899	4,891
Hiawatha	6,616	468	82	97	2,544	9,807
Hoosier	373	250	16	0	170	809
Huron-Manistee	3,327	2,000	1,004	14	17,459	23,804
Mark Twain	11,400	6,000	36	37	7,759	25,232
Midewin	0	0	10	4	0	14
Monongahela	1,200	65	315	46	1,185	2,811
Ottawa	3,654	200	795	23	996	5,668
Shawnee	489	0	126	26	905	1,546
Superior	1,508	232	788	155	2,670	5,353
Wayne	510	713	29	29	933	2,214
White Mtn	606	105	17	284	365	1,377
Total	41,301	17,342	6,221	1,033	42,984	108,881

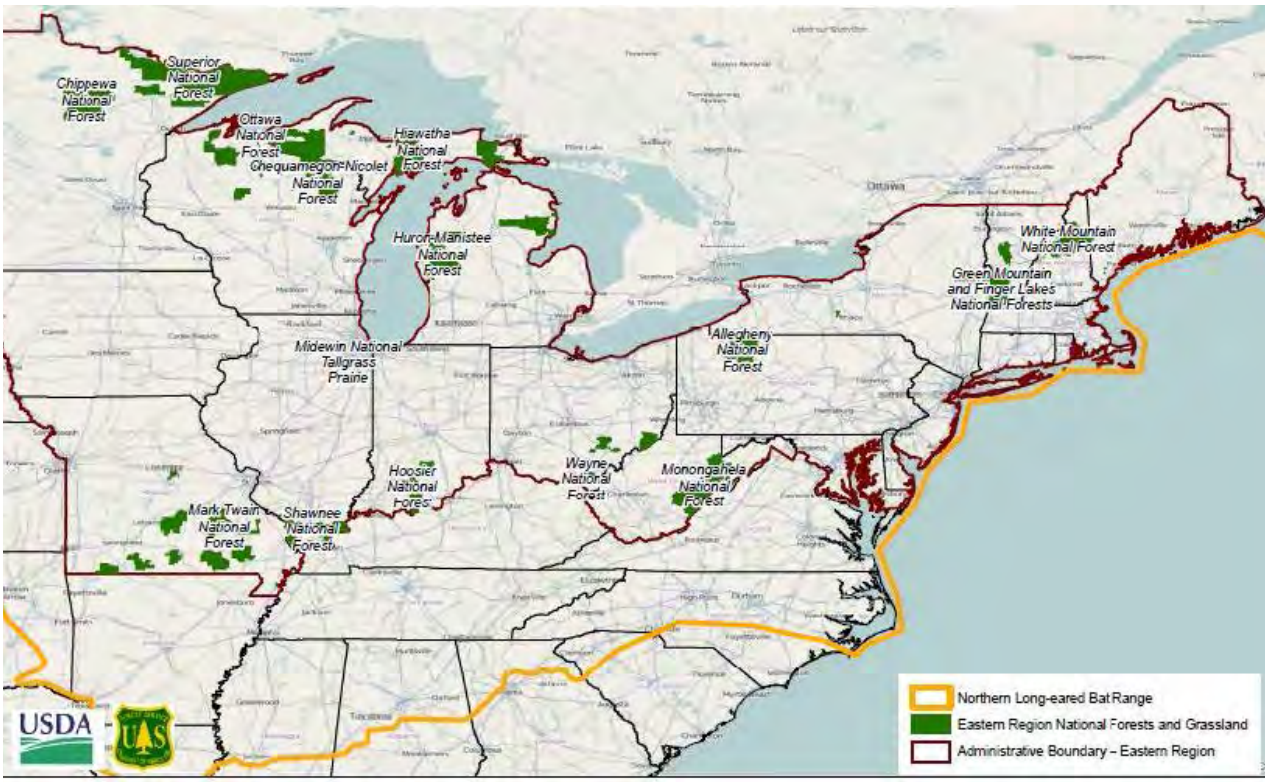

Figure 1.1. The Action Area of this consultation includes all Forest Service-administered lands within the 14 National Forests and 1 National Tallgrass Prairie shown here.

2 Status of the Species/Critical Habitat

The Service published its decision to list the NLEB as a threatened species on April 2, 2015 (80 FR 17974-18033). The effective date of this final rule is May 4, 2015. The final rule determined that critical habitat designation for the NLEB is prudent, but not determinable at the time. Because the final rule was published during the course of this consultation, its description of the status of the species requires no updating, and is hereby incorporated by reference. We summarize and paraphrase portions of the final rule in this section that are most relevant to an evaluation of the proposed Action.

2.1 Species Description

The NLEB is a medium-sized bat, with an average adult body weight of 5 to 8 grams (0.2 to 0.3 ounces). Females are slightly larger than males (Caceres and Pybus 1997). Body length ranges from 77 to 95 millimeters (mm) (3.0 to 3.7 inches (in)); tail length from 35 to 42 mm (1.3 to 1.6 in); forearm length from 34 to38 mm (1.3 to 1.5 in); and wingspread from 228 to 258 mm (8.9 to 10.2 in) (Caceres and Barclay 2000; Barbour and Davis 1969). Fur colors are medium to dark brown on the back; dark brown, but not black, ears and wing membranes; and tawny to pale brown fur on the ventral side (Nagorsen and Brigham 1993; Whitaker and Mumford 2009).

As indicated by its common name, the NLEB is distinguished from other Myotis species by its

relatively long ears (average 17 mm (0.7 in)) (Whitaker and Mumford 2009) that, when laid forward, extend beyond the nose up to 5 mm (0.2 in) (Caceres and Barclay 2000). Within its range, the NLEB is sometimes confused with the little brown bat (*Myotis lucifugus*) or the western long-eared myotis (*Myotis evotis*). The NLEB is distinguished from the little brown bat by its longer ears, tapered and symmetrical tragus, slightly longer tail, and less glossy pelage (Caceres and Barclay 2000), and from the western long-eared myotis by its darker pelage and paler membranes (Caceres and Barclay 2000).

2.2 Biology

The NLEB is insectivorous and migratory, hibernating in caves and mines during the winter and occupying forests in the summer for feeding and reproduction. Adult longevity is up to 18.5 years (Hall et al. 1957). Prior to the arrival of WNS, the highest age-specific annual mortality rates for the northern long-eared and many other species of bats were considered to occur during the juvenile stage (Caceres and Pybus 1997).

2.2.1 Hibernation

NLEB hibernate during the winter months to conserve energy from increased thermoregulatory demands and reduced food resources. Individuals enter a state of torpor, during which internal body temperatures approach ambient temperature, metabolic rates are significantly lowered, and immune function declines (Thomas et al. 1990; Thomas and Geiser 1997; Bouma et al. 2010).

In general, NLEB arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from the hibernacula in March or April (Caire et al. 1979; Whitaker and Hamilton 1998; Amelon and Burhans 2006). In northern latitudes, such as in upper Michigan's copper-mining district, hibernation may begin as early as late August and continue for 8 to 9 months (Stones and Fritz 1969; Fitch and Shump 1979). NLEB demonstrate a high degree of philopatry (using the same site over multiple years) for a hibernaculum (Pearson 1962), although they may not return to the same hibernaculum in successive seasons (Caceres and Barclay 2000).

Typically, NLEB are a small proportion of the total number of bats observed hibernating in a hibernaculum (Barbour and Davis 1969; Mills 1971; Caire et al. 1979; Caceres and Barclay 2000). Although usually observed in small numbers, the species typically inhabits the same hibernacula with large numbers of other bat species, and occasionally are found in clusters with these other bat species. Barbour and Davis (1969, p. 77) found that the species was rarely recorded in concentrations of more than 100 in a single hibernaculum.

NLEB have been observed moving among hibernacula throughout the winter, which may negatively bias hibernaculum-based population estimates (Griffin 1940a; Whitaker and Rissler 1992a; Caceres and Barclay 2000). During winter excursions between hibernacula, NLEB do not feed, and the function of this behavior is not well understood (Whitaker and Hamilton 1998). NLEB exhibit significant weight loss during the overall course of hibernation. Researchers have measured losses of 20 percent in Illinois (Pearson 1962), 31 – 36 percent in Missouri (Caire et al. 1979), and 41 – 43 percent in Indiana (Whitaker and Hamilton 1998).

2.2.2 Migration

The NLEB is not considered a long-distance migratory species. Researchers have documented short regional migratory movements between seasonal habitats (summer roosts and winter hibernacula) of between 56 km (35 mi) and 89 km (55 mi) (Nagorsen and Brigham 1993; Griffin 1940b; Caire et al. 1979). The spring migration period typically runs from mid-March to mid-May (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009); fall migration typically occurs between mid-August and mid-October. The final listing rule for the NLEB identifies the active season for the species between spring and fall migration as approximately April – October. For purposes of this BO, we use April 1 – October 31 as the NLEB active season within the Action Area.

2.2.3 Reproduction

Mating occurs from late July in northern regions to early October in southern regions and commences when males begin to aggregate around hibernacula and initiate copulation activity (Whitaker and Hamilton 1998; Whitaker and Mumford 2009; Caceres and Barclay 2000; Amelon and Burhans 2006). Females store sperm until spring (Racey 1979; Caceres and Pybus 1997), and ovulation occurs near the time of emergence from hibernation, followed by fertilization of a single egg, resulting in a single embryo (Cope and Humphrey 1972; Caceres and Pybus 1997; Caceres and Barclay 2000). Based on similar species, gestation is approximately 60 days (Kurta 1995). Males are generally reproductively inactive from April until late July, with testes enlarging in preparation for breeding in most males during August and September (Caire et al. 1979; Amelon and Burhans 2006).

Maternity colonies consist of about 30 (Whitaker and Mumford 2009) to 60 adult females (Caceres and Barclay 2000); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2009). In West Virginia, maternity colonies in two studies had a range of 7 to 88 individuals (Owen et al. 2002) and 11 to 65 individuals, with a mean size of 31 (Menzel et al. 2002). Lacki and Schwierjohann (2001) found that the number of bats within a given maternity roost declined as the summer progressed. Pregnant females formed the largest aggregations (mean=26) and post-lactating females formed the smallest aggregation (mean=4). Lactating NLEB were observed to roost higher in taller trees situated in areas of relatively less canopy cover and tree density relative to pre- and post-lactation periods (Garroway and Broders 2008).

Adult females give birth to a single pup (Barbour and Davis 1969). Krochmal and Sparks (2007) reported the majority of births within a colony occurred around the same time. Parturition (birth) occurs in late May or early June (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009), but may occur as late as July (Whitaker and Mumford 2009). Broders et al. (2006) estimated a parturition date of July 20 in New Brunswick. Lactating and post-lactating females were observed in mid-June in Missouri (Caire et al. 1979), July in New Hampshire and Indiana (Sasse and Pekins 1996; Whitaker and Mumford 2009), and August in Nebraska (Benedict 2004). Juvenile volancy (flight) occurs 18 – 21 days after birth (Krochmal and Sparks 2007; Kunz 1971). Subadults were captured in late June in Missouri (Caire et al. 1979), early July in Iowa (Sasse and Pekins 1996), and early August in Ohio (Mills 1971).

2.2.4 Foraging Behavior

NLEB are nocturnal foragers, using hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993; Ratcliffe and Dawson 2003). Observations of NLEB foraging on arachnids (spiders) (Feldhamer et al. 2009), and the presence of green plant material in their feces (Griffith and Gates 1985) and non- flying prey in their stomach contents, (Brack and Whitaker 2001) both suggest considerable gleaning behavior. The NLEB has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Nagorsen and Brigham 1993; Brack and Whitaker 2001; Griffith and Gates 1985), with diet composition differing geographically and seasonally (Brack and Whitaker 2001). Feldhamer et al. (2009) noted close similarities of all Myotis diets in southern Illinois, while Griffith and Gates (1985) found significant differences between the diets of NLEB and little brown bats. The most common insects found in the diets of NLEB are lepidopterans (moths) and coleopterans (beetles) (Brack and Whitaker 2001; Lee and McCracken 2004; Feldhamer et al. 2009; Dodd et al. 2012), and arachnids (Feldhamer et al. 2009).

Most foraging occurs above the understory, 1 to 3 m (3 to 10 ft) above the ground, but under the canopy (Nagorsen and Brigham 1993) on forested hillsides and ridges, rather than along riparian areas (Brack and Whitaker 2001; LaVal et al. 1977). This coincides with data indicating that mature forests are an important habitat type for foraging NLEB (Caceres and Pybus 1997). Occasional foraging also takes place over small forest clearings and water, and along roads (van Zyll de Jong 1985). Foraging patterns indicate a peak activity period within 5 hours after sunset followed by a secondary peak within 8 hours after sunset (Kunz 1973). Brack and Whitaker (2001) did not find significant differences between males and females or between adults and juveniles.

2.2.5 Home Range

NLEB exhibit site fidelity to their summer habitats (Perry 2011; Johnson et al. 2009a; Jackson 2004; Foster and Kurta 1999). During the summer, NLEB roost (Sasse and Pekins 1996; Owen et al. 2002; Perry and Thill 2007; Timpone et al. 2010) and forage (Owen et al. 2003; Sheets 2010; Tichenell et al. 2011; Dodd et al. 2012) in forests.

Summer home range includes both roosting and foraging areas, and home range size may vary by sex. Broders et al. (2006) found the maternity roosting area and foraging area of females (mean of 8.6 ha (21.3 acres) and 46.2 ha (114.2 acres), respectively) larger than males (mean of 1.4 ha (3.5 acres) and 13.5 ha (33.4 acres), but Lereculeur (2013) found no difference between sexes at a study site in Tennessee. Broders et al. (2006) and Henderson and Broders (2008) found the foraging areas of either sex were six or more times larger than roosting areas. At sites in the Red River Gorge area of the Daniel Boone National Forest, Lacki et al. (2009b) found female home range size to range from 19 to 172 ha (47 to 425 acres). Owen et al. (2003) estimated average maternal home range size at 65 ha (161 acres).

The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 602 m (1,975 ft) with a range of 60 to 1,719 m (197 to 5,640 ft) (Sasse and Pekins 1996). Henderson and Broders (2008) found that female NLEB on Prince Edward Island traveled approximately 1,100 m (3,609 ft) between maternity roosting and foraging areas. In

New Brunswick, Broders et al. (2006) reported the mean distance between the centers of maternity roosting areas and foraging areas as 584.6 m (1,918.0 ft) for females and 405.8 m (1,331.4 ft) for males.

Roosts trees are often in fairly close proximity to each other. In Missouri, Timpone et al. (2010) radio-tracked 13 NLEB to 39 roosts and found the mean distance traveled between roost trees was 0.67 km (0.42 mi) (range 0.05–3.9 km (0.03–2.4 mi)). In Michigan, the longest distance moved by the same bat between roosts was 2 km (1.2 mi), and the shortest was 6 m (20 ft) (Foster and Kurta 1999). In the Ouachita Mountains of Arkansas, Perry and Thill (2007) found that individuals moved among snags distributed in an area of about 2 ha (5 acres). Johnson et al. (2011) found that NLEB form social groups in networks of roost trees centered on a central-node roost, which may function like a primary maternity roost tree for an Indiana bat colony (i.e., locations for social behavior, thermal buffering), but were identified in this study by the degree of connectivity with other maternity roost trees rather than by the number of individuals using the tree.

Males and females generally roost separately (Caceres and Barclay 2000), and some studies cited above suggest differences in summer home range size between males and females. Despite these differences, males and females may share a large fraction of their foraging habitat within the occupied forested landscape. An analysis of mist net survey data in Kentucky (Service 2014, unpublished data cited in the final listing rule) shows that most males and non-reproductive females are captured in the same locations as reproductively active females (1,712 of 1,825 capture records or 94 percent), suggesting substantial overlap in the summer home range of reproductive females and other individuals.

2.3 Distribution and Abundance

The NLEB occurs across much of the eastern and north-central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993; Caceres and Pybus 1997; Environment Yukon 2011) (Figure 2.1). In the United States, the species' range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east to South Carolina (Whitaker and Hamilton 1998; Caceres and Barclay 2000; Simmons 2005; Amelon and Burhans 2006). Throughout most of the range, its distribution is patchy, and the species was considered less common in the western portions of the range (Amelon and Burhans 2006).

Historically, the species was most frequently observed in the northeastern United States and in the Canadian Provinces of Quebec and Ontario, with sightings increasing during swarming and hibernation periods (Caceres and Barclay 2000). Much of the available data on NLEB are from winter surveys, although they are typically observed in low numbers due to an apparent preference for inconspicuous roosts (Caceres and Pybus 1997). More than 1,100 NLEB hibernacula have been identified in 29 of 37 states of the species' range in the United States (80 FR 17976), although only a few (1 to 3) individuals were observed in many of these (Whitaker and Hamilton 1998).

Abundance and relative abundance (i.e., numbers of the species as a percentage of the total number of bats in an area) of the species varies substantially across its large range, and has

declined dramatically with the spread of WNS (see Section 2.5, Threats). The final listing rule for the NLEB summarizes the abundance data available for each major region within the range, which we do not repeat here, except to note that data to support a range-wide population estimate for the species are not available at this time. However, the final listing rule at 80 FR 17979 provides a rough pre-WNS population estimate for the states of Illinois, Indiana, Iowa, Ohio, Michigan, and Missouri of about 4 million NLEB. This estimate is based on: (a) a population estimate for the Indiana bat in these six States derived from hibernacula counts; and (b) the ratio of Indiana bat captures to NLEB captures in summer mist-net surveys. Because these surveys were mostly conducted before the spread of WNS into some of these states, it is likely an overestimate, and the final rule stresses its limitations.

2.4 Habitat

We organize our discussion of the habitat of the NLEB relative to locations used seasonally during its annual cycle of migration between winter hibernacula and summer breeding/foraging areas.

2.4.1 Winter Habitat

NLEB predominantly overwinter in caves and abandoned mines. These hibernacula have relatively constant, cool temperatures (0 to 9 degrees Celsius (°C) (32 to 48 degrees Fahrenheit (°F))) (Raesly and Gates 1987; Caceres and Pybus 1997; Brack 2007), with high humidity and no air currents (Fitch and Shump 1979; van Zyll de Jong 1985; Raesly and Gates 1987; Caceres and Pybus 1997). The species appears to favor sites with very high humidity, such that droplets of water are often observed on their fur (Hitchcock 1949; Barbour and Davis 1969). NLEB are typically found roosting in small crevices or cracks in cave or mine walls or ceilings, sometimes with only the nose and ears visible, which reduces the likelihood of detection during surveys (Griffin 1940a; Barbour and Davis 1969; Caire et al. 1979; van Zyll de Jong 1985; Caceres and Pybus 1997; Whitaker and Mumford 2009). Caire et al. (1979) and Whitaker and Mumford (2009) commonly observed individuals exiting caves with mud and clay on their fur, also suggesting that they had roosted in cracks and crevices.

Griffin (1945) found NLEB in December in Massachusetts in a dry well, and commented that these bats may regularly hibernate in "unsuspected retreats" where caves or mines are not available. NLEB have been found hibernating in other types of habitat that resemble caves or mines, including:

- abandoned railroad tunnels (Service 2015, unpublished data cited in final listing rule);
- near the entrance of a storm sewer in central Minnesota (Goehring 1954);
- the facilities of a hydroelectric dam in Michigan (Kurta et al. 1997); and
- the Sudbury Aqueduct (Massachusetts Department of Fish and Game 2012, unpublished data cited in final listing rule).

Related bat species (e.g., big brown bats) are known to regularly use hibernacula besides caves and mines, such as attics and hollow trees (Neubaum et al. 2006; Whitaker and Gummer 1992). To date, however, the northern long-eared is only known to over-winter in alternative hibernacula that replicate the physical conditions of suitable caves and mines.

2.4.2 Spring Staging

In the spring, NLEB begin to gradually emerge from hibernation, exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume daily bouts of torpor (Whitaker and Hamilton 1998). This spring staging period for the species is likely short in duration (Whitaker and Hamilton 1998; Caire et al. 1979). In Missouri, Caire et al. (1979) found that NLEB moved into the staging period in mid-March through early May. In Michigan, Kurta et al. (1997) determined that by early May, two-thirds of the Myotis species, including the NLEB, had dispersed to summer habitat. Variation in timing (onset and duration) of staging for Indiana bats was based on latitude and weather (Service 2007, cited in final listing rule); similarly, timing of staging for NLEB is likely based on these same factors.

2.4.3 Summer Habitat

NLEB nightly foraging activity during the summer months begins and ends at the locations, generally trees in a forested setting, selected for day-time roosting. Several studies of the species' summer ecology focus on the characteristics of these trees and their locations in the forested landscape. NLEB typically roost singly or in colonies underneath loose bark or in cavities or crevices of both live trees and snags (Sasse and Pekins 1996; Foster and Kurta 1999; Owen et al. 2002; Carter and Feldhamer 2005; Perry and Thill 2007; Timpone et al. 2010). Males and non-reproductive females may also roost in caves and mines (Barbour and Davis 1969; Amelon and Burhans 2006). NLEB colonies have also been observed roosting in structures, such as in buildings, in barns, on utility poles, behind window shutters, and in bat houses (Mumford and Cope 1964; Barbour and Davis 1969; Cope and Humphrey 1972; Burke 1999; Sparks et al. 2004; Amelon and Burhans 2006; Whitaker and Mumford 2009; Timpone et al. 2010; Bohrman and Fecske 2013).

Roost Tree Species

Tree species selected for roosting varies widely. Roost tree species reported in the literature include: black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*) (Mumford and Cope 1964; Clark et al. 1987; Sasse and Pekins 1996; Foster and Kurta 1999; Lacki and Schwierjohann 2001; Owen et al. 2002; Carter and Feldhamer 2005; Perry and Thill 2007; Timpone et al. 2010). NLEB most likely select trees that form suitable cavities or retain bark, regardless of species (Foster and Kurta 1999), in areas that provide structural habitat complexity (Carter and Feldhamer 2005).

In the majority of NLEB telemetry studies, roost trees consisted predominantly of hardwoods (e.g., Foster and Kurta 1999; Lacki and Schwierjohann 2001; Broders and Forbes 2004). In New Brunswick, Broders and Forbes (2004) reported that females were 24 times more likely to select shade- tolerant, deciduous trees as roosts than conifers. Of the few NLEB telemetry studies in which conifers represented a large proportion of roosts, most were snags (e.g., Cryan et al. 2001; Jung et al. 2004). These data suggest that hardwood trees most often provide the structural and micro-climatic conditions that maternity colonies prefer, which have more specific roosting needs than solitary males (Lacki and Schwierjohann 2001). Other researchers suggest that

softwood snags may offer more suitable roosting habitat for both genders than hardwoods (Perry and Thill 2007; Cryan et al. 2001).

Live Trees and Snags

Many studies have documented both live trees and snags as NLEB roosts, with a range of 10 to 66 percent selection of live roosts (Sasse and Pekins 1996; Foster and Kurta 1999; Lacki and Schwierjohann 2001; Menzel et al. 2002; Carter and Feldhamer 2005; Perry and Thill 2007; Timpone et al. 2010). The use of live trees versus snags may reflect their availability in study areas (Perry and Thill 2007) and flexibility in roost selection when another bat species is present (e.g., Indiana bat) (Timpone et al. 2010). Most telemetry studies have observed a greater number of dead than live roost trees (e.g., Cryan et al. 2001; Lacki and Schwierjohann 2001; Timpone et al. 2010; Silvis et al. 2012). A significant preference for dead or dying trees was reported for NLEB in Kentucky (Silvis et al. 2012), and in South Dakota (Cryan et al. 2001). In West Virginia, plots with NLEB roosts contained a higher than expected proportion of snags (Owen et al. 2002). Most studies reporting a higher proportion of live roosts included trees with visible signs of decline, such as broken crowns or dead branches (e.g., Foster and Kurta 1999; Ford et al. 2006). Although NLEB may use live and healthy trees, most data suggest that dead or dying trees more often provide the structural characteristics preferred for roosting, especially for large maternity colonies.

Canopy Cover/Closure

Canopy cover (proportion of the forest floor covered by the vertical projection of tree crowns) at NLEB roosts is variable, but greater than 50 percent. Measurements reported in the literature include:

- Missouri, 56 percent (Timpone et al. 2010);
- Arkansas, 66 percent (Perry and Thill 2007);
- New Hampshire, greater than 75 percent (Sasse and Pekins 1996); and
- Kentucky, greater than 83 percent (Lacki and Schwierjohann 2001).

Females tend to roost in more open areas than males, likely due to the increased solar radiation, which aids pup development (Perry and Thill 2007). Fewer trees surrounding maternity roosts may also benefit juvenile bats that are learning to fly (Perry and Thill 2007). In southern Illinois, however, Carter and Feldhamer (2005) found that canopy closure (proportion of the sky hemisphere obscured by vegetation as viewed from a single point) measured at the base of roost trees exceeded that of random trees within the same stand (means of 61.3 and 44.0 percent, respectively).

Roost Tree Size

The size of trees selected as roosts varies greatly. Lacki and Schwierjohann (2001) found that the diameter-at-breast height (dbh) of NLEB roost trees exceeded that of randomly selected trees in the same stand. Sasse and Pekins (1996) and Owen et al. (2002) found that both dbh and height of roost trees exceeded that of random trees. However, other studies have found that roost tree mean dbh and height did not differ from random trees (Menzel et al. 2002; Carter and

Feldhamer 2005). The dbh of about 80 percent of 400 documented maternity roosts was in the range of 10 to 25 cm (4 to 10 in) (multiple sources cited in the final listing rule, 80 FR 17985). Although the FS BA describes potential roost trees as suitable roost trees ≥ 5 inch dbh, the Service considers potential roosts to be live trees and/or snags ≥3 inches dbh that have exfoliating bark, cracks, crevices, and/or cavities.

Some studies have found tree roost selection to differ slightly between male and female NLEB. Male NLEB used smaller diameter trees for roosting than females, suggesting that males are more flexible in roost selection than females (Lacki and Schwierjohann 2001; Broders and Forbes 2004; Perry and Thill 2007). Data from West Virginia at the Fernow Experimental Forest and the former Westvaco Ecosystem Research Forest (both of which contain a mix of mature, early successional/mid-age, and fire-modified stands) suggest that females tend to choose smaller diameter, suppressed understory trees, whereas males chose larger, canopy- dominant trees for roosts (Menzel et al. 2002; Ford et al. 2006; Johnson et al. 2009a).

Roost Tree Location

Lacki and Schwierjohann (2001) found that NLEB roost more often on upper and middle slopes than lower slopes, possibly due to increased solar heating. Silvis et al. (2012) suggested that the species may favor mid- and upper-slope roost areas because these landscape positions are subjected to more disturbance than low-lying areas (e.g., greater wind, fire intensity, drought stress, incidence of insect attack), which creates more trees and snags that are suitable as roosts.

In the Ouachita Mountains of Arkansas, where most roosting was in pine snags, females roosted in snags surrounded by fewer mid-story trees than males (Perry and Thill 2007). In New Brunswick, Broders and Forbes (2004) found spatial segregation between male and female roosts, with female maternity colonies typically occupying more mature, shade-tolerant deciduous tree stands and males occupying more conifer-dominated stands. A study in northeastern Kentucky found that males did not use maternity-colony roosting sites and were typically found occupying cavities in live hardwood trees, while females formed colonies more often in both hardwood and softwood snags (Lacki and Schwierjohann 2001).

Summer Roosting Behavior

Lacki et al. (2009b) summarized roost height data from six studies of the NLEB, computing a mean roost height of 6.95 meters. Female NLEB form colonies in the summer (Foster and Kurta 1999), but the composition of these colonies is not constant throughout the summer. In a study with 43 tagged adult females, Garroway and Broders (2007) showed that roosting groups form and dissociate over periods of approximately 10 days after which subsets of individuals remain associated throughout the summer. Barclay and Kurta (2007) described similar fission-fusion behavior, whereby members coalesce to form a group (fusion), with individuals departing frequently to solitary roosts or to form smaller groups (fission), and returning again to the main unit.

NLEB switch tree roosts often (Sasse and Pekins 1996), typically every 2 to 3 days (Foster and Kurta 1999; Owen et al. 2002; Carter and Feldhamer 2005; Timpone et al. 2010). Tracking 32

bats over a period of up to 19 days, the mean number of roosts per bat was 2.2 (range 1–5) (Sasse and Pekins 1996). In a Missouri telemetry study that tracked 13 NLEB for up to 13 days (Timpone et al. 2010), 3 consecutive days was maximum an individual bat roosted in a single tree, but some spent up to 11 consecutive days roosting in a human-made structure. Bats may switch roosts frequently for a variety of reasons, including temperature, precipitation, predation, parasitism, sociality, and the ephemeral nature of roost trees (Carter and Feldhamer 2005). Trees that provide the cavities, cracks, and loose bark favored for roosting can quickly become uninhabitable; therefore, seeking and using alternative roosts frequently as an adaptation to an ephemeral resource is possibly the most likely explanation for this behavior (Kurta et al. 2002; Carter and Feldhamer 2005; Timpone et al. 2010).

2.4.4 Fall Swarming

Several species of bats migrate from summer habitats in the fall and conspicuously aggregate around hibernacula in a phenomenon known as swarming, which is when and where mating occurs for the NLEB (see Section 2.2.3, Reproduction). Swarming may also introduce juveniles to previously-used hibernacula or serve as migratory stop-over between more widely-separated summer and winter habitats (Kurta et al. 1997; Parsons et al. 2003; Lowe 2012; Randall and Broders 2014). The swarming season for some species of the genus Myotis begins shortly after females and young depart maternity colonies (Fenton 1969).

Both male and female NLEB are present at swarming sites, often with other species of bats. Swarming is a period of heightened and concentrated transient activity, mating, and lastly bouts of torpor prior to winter hibernation (Davis and Hitchcock 1965; Fenton 1969; Parsons et al. 2003). NLEB swarming occurs between July and early October, depending on latitude within the species' range (Fenton 1969; Kurta et al. 1997; Lowe 2012; Hall and Brenner 1968; Caire et al. 1979). Individuals may investigate several cave or mine openings during the transient portion of the swarming period, roosting in these openings or in adjacent forest habitat (Kurta et al. 1997; Lowe 2012). Many of the caves and mines associated with the swarming phenomenon are hibernacula for several species of bats in addition to the NLEB (Fenton 1969; Glover and Altringham 2008; Randall and Broders 2014; Kurta et al. 1997; Whitaker and Rissler 1992a).

Little is known about NLEB roost selection outside of caves and mines during the swarming period (Lowe 2012). In a Nova Scotia telemetry study, Lowe (2012) observed northern long-eared captured in a swarming area roosting in coniferous trees, deciduous trees, and stumps as far away as 3 miles (7 km) from the swarming site. Unlike summer roosts, most used during the swarming season of this study had a southwestern orientation in trees that were in the mid-to-late stages of decay in conifer-dominated forests.

2.5 Threats

White-nose syndrome

WNS is an emerging infectious wildlife disease caused by a fungus of European origin, *Pseudogymnoascus destructans,* which poses a considerable threat to hibernating bat species throughout North America, including the NLEB (Service 2011). WNS is responsible for unprecedented mortality of insectivorous bats in eastern North America (Blehert et al. 2009;

Turner et al. 2011). The first evidence of the disease (a photo of bats with fungus) was documented near Albany, New York, on February 16, 2006, but WNS was not actually discovered until January 2007, when it was found at four additional caves in the same vicinity (Blehert et al. 2009). Since that time, WNS has spread rapidly throughout the eastern portions of the NLEB range in the U.S. and Canada. As of February 2015, WNS was confirmed in 25 of the 37 U.S. States within the species' range and in 5 Canadian provinces (80 FR 18000). Spores of the fungus disperse to new locations primarily through bat-to-bat contact (Kunz and Reichard 2010); however, evidence suggests that humans may also transport spores between locations (USGS National Wildlife Health Center 2014), which is likely how the fungus arrived in North America.

Post-WNS hibernacula counts available from the northeast U.S., where the epizoitic began, show the most substantial population declines for the NLEB. Turner et al. (2011) compared the most recent pre-WNS count to the most recent post-WNS count for six cave bat species and reported a 98 percent total decline in the number of hibernating NLEB at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia through 2011. For the final listing rule, the Service conducted an analysis of additional survey information at 103 sites across 12 U.S. States and Canadian provinces (New York, Pennsylvania, Vermont, West Virginia, Virginia, New Hampshire, Maryland, Connecticut, Massachusetts, North Carolina, New Jersey, and Quebec) and found comparable declines in winter colony size. At these sites, total NLEB counts declined by an average of 96 percent after the arrival of WNS; 68 percent of the sites declined to zero NLEB, and 92 percent of sites declined by more than 50 percent. Frick et al. (2015) consider the NLEB now extirpated from 69 percent of the hibernacula in Vermont, New York, Pennsylvania, Maryland, Virginia, and West Virginia that had colonies of NLEB prior to WNS. Langwig et al. (2012) reported that 14 populations of NLEB in New York, Vermont, and Connecticut became locally extinct within 2 years due to disease.

Long-term summer survey data (including pre- and post-WNS) for the NLEB, where available, corroborate the population decline evident in hibernacula survey data. For example, summer surveys from 2005 – 2011 near Surry Mountain Lake in New Hampshire showed a 98 percent decline in capture success of NLEB post-WNS, which is similar to the hibernacula data for the State (a 95 percent decline) (Moosman et al. 2013). Other data, much of it received as comments on the proposed listing rule from State wildlife agencies, demonstrate that various measures of summer NLEB abundance and relative abundance (mist net surveys, acoustic surveys) have declined following detection of WNS in the state.

Although the dispersal rate of *P. destructans* across the landscape and the onset of WNS after the fungus arrives at a new site are variable, it appears unlikely that any site within the range of the NLEB is not susceptible to WNS. Some evidence suggests that certain microclimatic conditions may hinder disease progression at some sites, but given sufficient exposure time, WNS has had similar impacts on NLEB everywhere the disease is documented. Absent direct evidence that some NLEB exposed to the fungus do not contract WNS, available information suggests that the disease will eventually spread throughout the species' range.

The final listing rule for the NLEB provides additional details about WNS and its effects on the species, which we do not summarize further here, but some of which we summarize in section 3 (Environmental Baseline) for its relevance to the Action Area.

Conservation Efforts to Reduce Effects of WNS

In partnership with several other State, Federal, and Tribal agencies including the U.S. Forest Service, the Service developed "A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats" (https://www.whitenosesyndrome.org/national-plan/white-nose-syndrome-national-plan). Canada has developed a comparable plan, allowing for a broader coordinated response to the disease in both countries. The multi- agency, multi-organization WNS response team, under the U.S. National Plan and in coordination with Canadian partners, has and continues to develop recommendations, tools, and strategies to slow the spread of WNS, minimize disturbance to hibernating bats, and improve conservation strategies for affected bat species. Some of these include:

- decontamination protocols to prevent human transport of fungal spores;
- cave management strategies and best management practices (BMPs);
- nuisance wildlife control operator BMPs;

Several other BMP documents are in development.

In 2009, the Service also issued a recommendation for a voluntary moratorium on all caving activity in States known to have hibernacula affected by WNS, and all adjoining States, unless conducted as part of an agency-sanctioned research or monitoring project (Service 2009). These recommendations have been reviewed annually and a revised version, including a multi-agency endorsement through the national WNS Steering Committee, is expected soon. Though not mandatory or required, many State, Federal, and Tribal agencies, along with other organizations and entities, operating within the NLEB's range have incorporated the recommendations and protocols in the WNS National Plan in their own local response plans.

Research is also under way to develop control and treatment options for WNS-infected bats and environments. Several potential treatments are in various stages of development. At this time, none have been tested on the NLEB, and none have been demonstrated safe or effective for any bat species. A landscape-scale approach to reduce the impacts of WNS is still at least a few years away.

Other Threats

The final listing rule for the NLEB describes known threats to the species under each of the five statutory factors for listing decisions, of which disease/predation, discussed above, is the dominant factor. We summarize here the findings of the final listing rule regarding the other four factors that are relevant to this consultation.

Human and non-human modification of hibernacula, particularly altering or closing hibernacula entrances, is considered the next greatest threat after WNS to the NLEB. Some modifications, e.g., closure of a cave entrance with structures/materials besides a bat-friendly gate, can cause a

partial or complete loss of the utility of a site to serve as hibernaculum. Humans can also disturb hibernating bats, either directly or indirectly, resulting in an increase in energy-consuming arousal bouts during hibernation (Thomas 1995; Johnson et al. 1998).

During the summer, NLEB habitat loss is primarily due to forest conversion, and to a lesser degree, unsustainable forest management. Throughout the range of NLEB, forest conversion is expected to increase due to commercial and urban development, energy production and transmission, and natural changes. Forest conversion causes loss of potential habitat, fragmentation of remaining habitat, and if occupied at the time of the conversion, direct injury or mortality to individuals. Forest management activities, unlike forest conversion, typically result in temporary impacts to the habitat of NLEB, but like forest conversion, may also cause direct injury or mortality to individuals. The net effect of forest management may be positive, neutral, or negative, depending on the type, scale, and timing of various practices. The primary potential benefit of forest management to the species is perpetuating forests on the landscape that provide suitable roosting and foraging habitat. The primary potential impacts of forest management are greatly reduced with the use of various measures that avoid or minimize effects to bats and their habitat, e.g., limiting the size of clearcuts, avoiding or minimizing timber harvest during the flightless period for bat pups, leaving sufficient numbers of snags and other trees suitable as roosts following harvests, etc.

Wind energy facilities are known to cause mortality of NLEB. While mortality estimates vary between sites and years, sustained mortality at particular facilities could cause declines in local populations. Wind energy development within portions of the species' range is projected to continue.

Climate change may also affect this species, as NLEB are particularly sensitive to changes in temperature, humidity, and precipitation. Climate change may indirectly affect the NLEB through changes in food availability and the timing of hibernation and reproductive cycles.

Environmental contaminants, in particular insecticides, other pesticides, and inorganic contaminants, such as mercury and lead, may also have detrimental effects on NLEB. Contaminants may bio-accumulate (become concentrated) in the tissues of bats, potentially leading to a myriad of sub-lethal and lethal effects.

Fire is one of the environmental stressors that contribute to the creation of snags and damaged trees on the landscape, which NLEB frequently use as summer roosts. Fire may also kill or injure bats, especially flightless pups. Prescribed burning is a common tool for forest management in many parts of the species' range.

There is currently no evidence that the natural or manmade factors discussed above (hibernacula modification, forest conversion, forest management, wind energy, climate change, contaminants, fire) were separately or cumulatively contributing to significant range-wide population effects on the NLEB prior to the onset of WNS.

2.6 Summary of Species' Status

WNS is the primary factor affecting the status of the NLEB, which has caused dramatic and rapid declines in abundance, resulting in the local extirpation of the species in some areas. Although other factors, individually or in combination, are likely insignificant at the range-wide scale, they may exacerbate the effects of WNS at the local population scale, thereby accelerating declines and the likelihood of local extirpation due to the disease. The species' foremost conservation need is to reduce or eliminate the threat of WNS. A secondary need is to avoid and minimize the adverse effects of other threats in WNS-affected portions of its range in order to delay declines and maximize the chances for local populations to persist at some level.

2.7 Tables and Figures for Species' Status

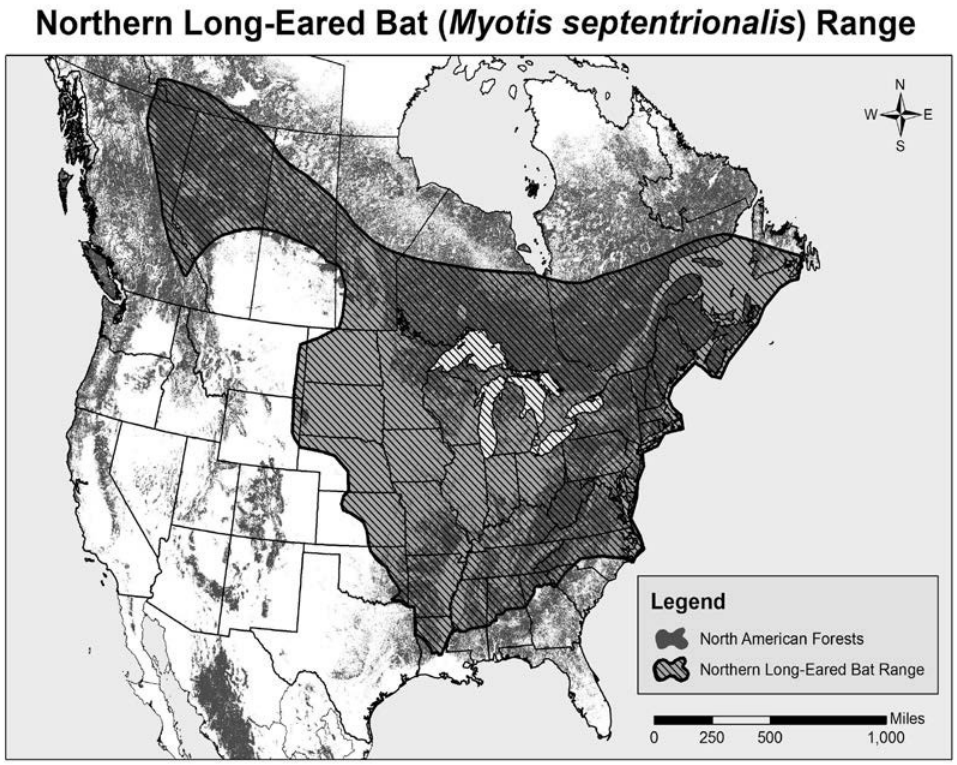

Figure 2.1. Range of the NLEB (Source: 80 FR 17976).

3 Environmental Baseline

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

3.1 Status of the Species within the Action Area

3.1.1 Distribution and Abundance

Of the 13 states in which the 15 Forests of the Action Area occur, the NLEB is currently considered more common in the Midwestern tier of states (Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, and Wisconsin), and less common in the northeastern tier of states (Maine, New Hampshire, New York, Pennsylvania, and Vermont) (final listing rule 80 FR 17981-17983). As described in Section 2.5, WNS has resulted in substantial population declines (up to 99%) of NLEBs in the Northeast, and there are many gaps within the historical range in the Northeast where NLEBs are no longer detected or captured. The NLEB is more commonly encountered in summer mist-net surveys in the Midwest; however, similar rates of population decline are already occurring in Ohio and Illinois. Early reports also indicate declines in Missouri and Indiana (final listing rule 80 FR 17979-17980). Based on the mortality of other bat species in Michigan in 2014-2015, we expect that the population is declining in Michigan as well.

NLEBs have been confirmed on all 15 Forests. At the time the FS submitted the BA, no surveys had been conducted on the Chippewa Forest; however, presence of NLEBs was confirmed there during surveys in the summer of 2015. The FS BA assumes presence of the NLEB on all 15 Forests of the proposed Action, and also states that the species is among the most common of forest bats encountered in surveys within the FS Eastern Region. On an as-needed and funding-available basis, most Forests have conducted project-specific acoustic and/or mist net surveys for bats. The BA does not provide a summary or synthesis of these bat survey results on the 15 Forests. However, we requested and received a summary of mist net and acoustic surveys conducted on the Forests since the year 1997 to 2014, which is provided herein as Tables 3.1 and 3.2[2]. The level of effort between the Forests is variable, ranging from surveys conducted every year since 1997 (e.g., the Mark Twain and Monongahela Forests), to one year of mist net surveys (e.g., the Huron-Manistee Forest). The FS data include 99 NLEB hibernacula and 9,215 occurrence records from 14 of the 15 Forests (Table 3.2).

We further discuss the occurrence data below under *Occupancy Rates* in section 3.1.2. We use the hibernacula data only to provide a count of known hibernacula on the Forests relative to the numbers of hibernacula that are likely unknown (see section 4.1).

3.1.2 Estimation of Forest Populations

Hibernacula counts are generally the best census method for bats that hibernate, because individuals are concentrated and relatively stationary. However, because the NLEB is difficult to detect in hibernacula, moves between hibernacula during the winter, and many hibernacula are likely not known (see Section 2.2.1), a range-wide population estimate for the species is not available, nor for its range within the Action Area. The NLEB is most widely dispersed on the landscape during the summer where it is most likely exposed, directly or indirectly (i.e., later in time), to the widely dispersed forest management activities implemented under Forest Plans, e.g.,

[2] The 2015 surveys on the Chippewa NF are not included because the data are preliminary.

timber harvest, prescribed burning, clearing for roads, etc.

For purposes of this BO, we estimate NLEB numbers in the Action Area based on total forested acres (see Section 1) and assumptions about:

- Forest-specific occupancy rates;
- maternity colony home-range size (collective extent of colony-member individual home ranges);
- number of adult females per colony;
- overlap between adult male home range and maternity colony home range;
- overlap between maternity colonies; and
- landscape-scale adult sex ratio (we assume 1:1).

We explain these data and assumptions in the following sub-sections.

Occupancy Rates

The FS provided a summary of all bat mist-net surveys on the 15 Forests from 1997 to 2014 (Table 3.1)[3]. These data tabulate the number of mist net survey sites[4], by Forest and by year, and the number of sites that captured at least one NLEB. Some have only one or two years of data, and others have 10 or more consecutive years of data. In many cases, the numbers and locations of these survey sites do not constitute a representative sample of the available forest habitat on each Forest. Regardless, the alternative to using these data is to consider the NLEB ubiquitous on each Forest, which would likely greatly overestimate effects. Instead, we use these data as the best available information from which to make inferences about the extent of NLEB occupancy on these Forests.

Table 3.1 identifies the years in which WNS was detected in the state where each Forest predominantly or wholly occurs. This table also includes the cut-off year to determine post-WNS trends based on data from the Forests and recommendations from the local Service Field Offices. We compute pre- and post-WNS occupancy rates as the number of net sites with NLEB divided by the total number of bat capture sites on each Forest. The remainder of this discussion on *Occupancy Rates* explains our decisions about the rates we apply to each Forest based on the data in Table 3.1.

There were sufficient post-WNS data from the Allegheny, Hoosier, Mark Twain, Monongahela, Shawnee, and Wayne Forests to calculate an independent occupancy rate for each of these Forests. Pre-WNS occupancy rates for these Forests were relatively high, ranging from 59-88%. With the exception of the Mark Twain, these Forests have exhibited post-WNS declines in occupancy rates. We apply the following post-WNS occupancy rates to these Forests: Allegheny (28.0%), Hoosier (29.4%), Mark Twain (58.8%), Monongahela (60.2%), Shawnee (57.1%), and Wayne (26.2%).

[3] Acoustic surveys were also reported for some Forests. Unless otherwise noted, we rely on the mist-net data for several reasons: (1) consistent methodology between years and Forests, (2) the sample sizes were generally more robust, and (3) we have greater confidence in species identifications from mist nets.

[4] All mist net sites were included even if no bats were captured, with the exception of partial nights of netting (such as rainouts) or any non-standard summer net site (such as a cave or mine opening). This reduces sample bias.

Data from the Green Mountain and Finger Lakes Forests are combined in all years prior to the onset of WNS in 2007 because they are administered together and all activity acreages provided by the FS were combined. We used the acoustic data from Green Mountain to calculate the post-WNS occupancy rate because mist-net sampling did not occur on Green Mountain post-WNS, and only 1 small mist-netting effort occurred in the Finger Lakes in 2010. We apply the post-WNS occupancy rate of 33.3% to Green Mountain and the Finger Lakes, which declined from a pre-WNS rate of 69.6%. We also used acoustic data from White Mountain Forest to calculate the post-WNS rate because mist-net sampling has not occurred on White Mountain post-WNS. We apply the post-WNS occupancy rate of 9.3% to White Mountain, which declined from a pre-WNS rate of 92.3%.

WNS has not been present long enough in the upper-Midwest to determine post-WNS occupancy rates. We have little data for the Chippewa, Hiawatha, Ottawa, and Superior Forests, and 9 years of data for the Chequamegon-Nicolet with relatively small sample sizes. For purposes of this BO, we consider these upper-Midwest Forests similarly situated in the species range and to support a comparable NLEB occupancy. Therefore, we combine the 2004-2014 mist net data for these upper-Midwest Forests and apply the pre-WNS occupancy rate of 56.1% (60 sites with NLEB/107 total sites). The Huron-Manistee Forest is at a lower latitude than the upper-Midwest Forests and also likely has fewer readily available hibernacula than the upper-Midwest Forests. Therefore, we apply the pre-WNS occupancy rate of 21.7% to the Huron-Manistee Forest.

The Midewin National Tallgrass prairie is unique in that there is little forested habitat to support the NLEB. We apply the pre-WNS occupancy rate of 9.5% to Midewin because post-WNS sampling has not occurred, and there are no comparable prairie habitats with occupancy rates available.

Colony Size (numbers of bats and occupied area)

In addition to the occupancy rates described above, we rely in this BO primarily on colony characteristics reported in the literature to estimate Forest-wide bat numbers. NLEB colonies are comprised of variable numbers of adult females. Two important studies give a range of 30–60 adult females per colony (see Section 2.2.3). Given the number of colonies that a Forest likely supports, we then estimate total NLEB numbers in the occupied available habitat assuming a 1:1 adult female/adult male ratio and a maximum of 1 pup per female. For purposes of this BO, we use 45 females per colony (the mid-point of the 30–60 range) as the basis for estimating bat numbers. For each colony present on a Forest, we assume a NLEB population is comprised of 45 adult females, 45 sympatric adult males, and 45 juveniles following parturition. It is possible that the number of individuals per colony is lower in areas that are strongly affected by WNS, and higher elsewhere, but we have no data that would support applying Forest-specific colony sizes for this BO. It is evident that the spatial extent of NLEB occupancy has declined post-WNS on several of the Forests (see previous subsection *Occupancy Rates*), which we use to estimate the expected number of colonies per Forest, but we apply the same number of individuals per colony for all 15 Forests.

Telemetry-based studies estimate a relatively small mean summer home range size for individual NLEB (not colony): 161 acres (range 44–241) (Owen et al. 2003); and 179 acres (range 46–425)

(Lacki et al. 2009b). Although home ranges are not necessarily circular, but to compare these home-range areas with data on travel distances, the radius of a circle of these sizes is 1,492 and 1,574 ft, respectively. Adult females and volant juveniles forage nightly departing from a day roost, and individuals switch roosts frequently (see Section 2.4.3). In two studies, individual bats used up to 5 roosts in less than 19 days (Sasse and Perkins 1996), and up to 5 roosts in less than 13 days (Timpone et al. 2010). The distance traveled between consecutive roosts varies widely from 20 ft (Foster and Kurta 1999) to 2.4 miles (Timpone et al. 2010). Likewise, the distance traveled between roost trees and foraging areas in telemetry studies varies widely, e.g., a mean of 1,975 ft (Sasse and Perkins 1996) and a mean of 3,609 ft (Henderson and Broders 2008). Circles with a radius of these distances have an area of 281 and 939 acres, respectively, which is larger than individual home range size reported in the literature.

The home range of a colony, i.e., the collective area used by its members over the course of a summer, is necessarily larger than the home range of an individual, due both to the variability of individual behavior and because the center of individual bat activity shifts with frequent roost changes over the course of a summer season. Based on reported maximum individual home range (425 acres) and travel distances between roosts and foraging areas described above (939 acres), we use 1,000 acres for purposes of this BO as the area a colony uses. Within this area, one or more members of a colony and sympatric adult males would likely appear in mist net or acoustic surveys. Such appearance is the basis for the occupancy rates we use to estimate the acreage of available forested habitat that NLEB may use during the active season on the Forests, which are given in Table 3.3.

The Proposed Action identifies the annual acreage of non-volant season (May 1–July 31) activities on each Forest (Tables 1.2 – 1.6). The numbers of non-volant bat pups and adult female bats affected depends on whether maternity roosting areas are located within these activity areas. Maternity roosting areas are a subset of the 1,000-acre colony size we use in this BO. Silvis et al. (2015) estimated maternity roosting area size using telemetry methods for three colonies in Kentucky, both before and after winter removal of selected maternity roost trees from two of the colonies. Maternity roosting area size ranged from 3 acres to 144 acres (1.3 ha to 58.3 ha). Perry and Thill (2007) found roost trees concentrated in a 5-acre area (2 ha). Carter and Feldhamer (2005) reported that 10 telemetered female NLEB, tracked for an average of 3.9 nights each, used 19 roost trees encompassing an area of 460 acres (186.3 ha). Broders et al. (2006) and Henderson and Broders (2008) found that foraging areas were six or more times larger than maternity roosting areas. One sixth of our 1,000-acre colony size is 167 acres, which is larger than the largest maternity roosting area Silvis et al. (2015) reported, but smaller than the maternity roosting area Carter and Feldhamer (2005) reported. For purposes of this BO, we use a maternity roosting area of 167 acres. Table 3.4 shows our estimates of the percentage of each Forest that is used as maternity roost areas based on the number of expected colonies (Table 3.3) and 167 acres per colony.

Overlap

Lacking information about the degree of spatial overlap between NLEB maternity colonies, for this BO we assume that colonies do not overlap, e.g., we assume that 1,000 acres of occupied habitat supports one colony. Estimated or assumed occupancy rates on all of the Forests are all

less than 60.2 percent (Table 3.1); therefore, it is unlikely that limited habitat availability would contribute to substantial colony-range overlap. If incorrect, the possible effect of this assumption is to underestimate the population size on a Forest (i.e., 1,000 acres supports more than 1 colony).

An analysis of mist net survey data in Kentucky cited in the final listing rule shows that most males and non-reproductive females are captured in the same locations as reproductively active females (1,712 of 1,825 capture records, or 94 percent), suggesting substantial overlap in the summer home range of reproductive females and other individuals. The Service further analyzed this data to determine the percentage of capture locations for males and non-reproductive females that were not capture locations for reproductive female captures or within 3 miles of a reproductive female capture location (Service 2015b). Of 909 capture locations, 87 (9.57 percent) did not have reproductively active females and were more than 3 miles away from captures of reproductive females, suggesting a 100 – 9.57 = 90.43 percent overlap between the home range of individuals belonging to maternity colonies and other individuals. We lack Forest-specific information about the overlap between reproductively active females and other bats; therefore, for this BO, we assume the 90.43 percent overlap suggested by the Kentucky data. We multiply occupied forest acres by 0.9043 to compute the number of probable maternity colonies; e.g., 100,000 occupied acres × 0.9043 = 90,430 acres supporting 90,430 ÷ 1000 = 91 maternity colonies, rounding up any fractional remainder.

Although the summer home range of adult male and adult females appear to substantially overlap, males tend to roost singly and to select roost trees in stands with different characteristics than the roosting area of maternity colonies (Ford et al. 2006; Perry and Thill 2007). The size of adult male roosting areas is not reported in the literature; however, Ford et al. (2006) noted that in each instance where a telemetered male in a West Virginia study relocated its roost, none moved more than 100 m to alternative roosts, suggesting that the roost-area concept is also applicable to adult male NLEB. To avoid underestimating effects to maternity colonies, we have assigned a relatively large area to maternity colony roost areas (167 acres, see *Colony Size* discussion above). For the analyses in which we need to also estimate effects to roosting adult males in addition to females and pups (e.g., estimating number of bats affected by disturbance in roosting areas), we include males in computing the density of bats for the 167-acre roosting area of maternity colonies, recognizing that adult females and adult males do not necessarily roost in the same stands.

Population Estimates

Table 3.3 provides our estimates of the summer adult population size of NLEB on the 15 Forests. It relies on the total forested acres from Table 1.1 and the assumptions described above; i.e., occupancy rates for each Forest in Table 3.1, 90.43 percent overlap between the range of males and maternity colonies, 1,000 acres per colony, no overlap between colonies, 45 adult females per colony, and a 1:1 male/female sex ratio. Here are example calculations for the Allegheny National Forest as reported in Table 3.3:

- 475,496 Forest acres × 0.280 occupancy rate = 133,139 occupied acres;
- 133,139 occupied acres × 0.9043 overlap with males = 120,397 colony-occupied acres;
    - 120,397 acres ÷ 1,000 acres per colony = 121 colonies;

- 121 colonies × 45 adult females per colony = 5,445 adult females; and
- 5,445 adult females + 1 adult male per female (or 5,445 adult males) = 10,890 total adults.

Based on these calculations, we estimate that the 15 Forests support a NLEB summer population of 436,950 adults. The Superior Forest supports the largest population (95,580 adults), and the Midewin Prairie the smallest (90 adults).

3.2 Factors Affecting Species' Environment within the Action Area

White-nose Syndrome

A general overview of WNS and its effects on bat populations is provided in Section 2.5, Status of the Species, Threats, and additional information is provided about the Action Area in Section 3.1.

The 15 Forests of the Action Area occur in 13 states, and all of these states have detected WNS or is its causative agent (*P. destructans*) within its borders (Table 3.5). The fungus is present in Minnesota, but the disease is not yet evident in bats. WNS is established in the other 12 states and all have reported WNS bat mortality. The BA reported that WNS has been confirmed on every Forest except the Chequamegon-Nicolet, Chippewa, and Huron-Manistee. WNS has been confirmed for at least four years in all Forests with known caves, and the disease is likely widespread on these Forests.

As described in the Occupancy Rates discussion in section 3.1.2, about half of the Forests have demonstrated declines in occupancy rates post-WNS: Allegheny, Green Mountain and Finger Lakes, Hoosier, Monongahela, Shawnee, Wayne and White Mountain Forests. This includes nearly all of the Forests (with the exception of the Mark Twain) where WNS has been established for the longest time. Although the occupancy rate for Mark Twain has not declined according to the mist-net data, surveys conducted on the Mark Twain National Forest in 2014 indicate a decline in the overall number of captures of all bat species, including fewer NLEBs than expected (Amelon 2014, pers. comm.; Harris 2014, pers. comm.). In addition, acoustic data indicate a decline in pre-WNS occupancy rates from 89.2% to 67.7% post-WNS. WNS has not been present long enough on the remaining Forests to determine post-WNS occupancy rates and population trends; however, we anticipate that population declines will continue to occur in the midwestern portion of the Action Area as effects of WNS become more pronounced.

Recreational Use of Caves and Mines

The FS BA states that nine Eastern Region Forests have caves, mines, or other potential hibernacula: Allegheny, Green Mountain, Hoosier, Mark Twain, Monongahela, Ottawa, Shawnee, and Wayne. In May 2009, the FS issued a one-year regional closure order for all caves and abandoned mines in all Eastern Region Forests to proactively slow the spread of *P. destructans*. Access to these sites has remained closed through Forest-level closure orders and in some cases by structures such as bat-friendly gates. Most of these closures are reviewed annually and reauthorized for either two or five years.

Multiple-use Forest Management

The FS BA states that the current levels of management activity to support the various multiple-use goals and objectives on the Forests, implemented consistent with existing Forest standards, guidelines, and best management practices, are likely to maintain or improve roosting and foraging habitat available for the NLEB. The FS has taken proactive measures to protect hibernacula from the spread of WNS and reduce disturbance to hibernating bats. The BA acknowledges the potential taking of NLEB that may occur incidental to the activities described in the proposed Action of this consultation. The FS BA states that adaptive forest management and prescribed fire activities as described in the Forest Plans are designed to lessen the adverse impacts to forest-dependent species, which would have similar impacts to NLEB.

3.3 Summary of Environmental Baseline

The data available about the distribution and abundance of NLEB in the Action Area is limited, as the species was considered common and not of specific conservation interest prior to the onset of WNS. WNS has spread throughout the Action Area on a west/southwest trajectory. WNS was first confirmed in the Action Area during the winter of 2006-2007, and most recently confirmed in Michigan during the winter of 2014-2015 (Table 3.5). Corresponding to this trajectory, the frequency of NLEB captures in summer mist-net surveys (measured by occupancy rates) has declined on the Forests where WNS has been established for the longest amount time. The most severe declines have occurred on White Mountain (from 92 to 9 percent), Allegheny (70 to 28 percent), Hoosier (71 to 29%), Green Mountain and Finger Lakes (70 to 33%), and Wayne Forests (66 to 26 percent) (Table 3.1). WNS has not been present long enough on most of the remaining Forests to determine post-WNS population trends.

We expect population declines to follow the disease trajectory as it continues to infect and eventually kill more individuals. Based on post-WNS occupancy rates inferred from summer mist-net data and assumptions about colony size and distribution in forested habitats, we estimate that Action Area currently supports a population of about 436,950 adult NLEB. The FS has closed all known caves and abandoned mines to public access, not just those known to serve as bat hibernacula, to limit humans from acting as vectors for the disease and to limit disturbance during hibernation. Although various forest management activities may incidentally take NLEB, the FS is perpetuating forested habitat in the Action Area. Existing standards, guidelines, and best management practices in Forest Plans are likely to maintain or improve roosting and foraging habitat and to minimize incidental take of the species.

3.4 Tables and Figures for Environmental Baseline

Table 3.1. NLEB summer occupancy estimates for the 15 Forests, based on mist net survey results[5].

	Number of Net Sites (first value), Number of Sites with Northern Long-Eared Bat (NLEB) Captures (second value)														
Year	Allegheny	Chequamegon-Nicolet	Chippewa	Green Mtn & Finger Lakes	Hiawatha	Hoosier	Huron-Manistee	Mark Twain	Midewin	Monongahela	Ottawa	Shawnee	Superior	Wayne	White Mtn
1997								13, 12		20, 16				37, 30	
1998	25, 13					34, 27		16, 12		66, 47				11, 5	
1999	33, 19											15, 14		36, 22	
2000	49, 41			11, 9						37, 34		16, 15		41, 22	
2001	62, 38			14, 9				24, 9		46, 31		11, 9			
2002	27, 21			12, 8				65, 16		11, 8					5, 5
2003	49, 40			4, 4		10, 3		13, 13		51, 47		6, 4			
2004	38, 34			9, 4		40, 28		32, 15		58, 43	19, 9			55, 38	8, 7
2005	29, 24			6, 5				30, 27		58, 44	8, 8				
2006	55, 22	4, 2				5, 3		19, 17		57, 50	8, 8	12, 11		4, 4	
2007		5, 1						50, 31	8, 0	51, 43		5, 5			
2008		5, 0						47, 22	7, 0	53, 38		10, 8		17, 12	
2009		5, 3						45, 26	6, 2	51, 42					
2010	29, 21	5, 4		9, 4		10, 9		27, 13		30, 23		9, 9			10, 3
2011		5, 0				6, 5		11, 10		31, 25		10, 8			10, 3
2012		4, 2		14, 5	10, 6			21, 19		36, 23					10, 0
2013	26, 12	9, 4						26, 15		30, 17		10, 7	7, 4		
2014	24, 2	8, 4		22, 6		11, 0	23, 5	71, 42		31, 12		11, 5	5, 5	65, 17	153, 14
Pre-White-Nose Syndrome Totals (unshaded cells)															
Net Sites	334	50		56	10	99	23	242	21	589	35	94	12	201	13
NLEB Sites	235	20		39	6	70	5	413	2	466	25	83	9	133	12
Occupancy Rate:	70.4%	40.0%		69.6%	60.0%	70.7%	21.7%	58.6%	9.5%	79.1%	71.4%	88.3%	75.0%	66.2%	92.3%
Post-White-Nose Syndrome Totals (shaded cells)															
Net Sites	50			45		17		97		128		21		65	183
NLEB Sites	14			15		5		57		77		12		17	17
Occupancy Rate:	28.0%			33.3%		29.4%		58.8%		60.2%		57.1%		26.2%	9.3%
Occupancy Rate We Apply:	28.0%	56.1%	56.1%	33.3%	56.1%	29.4%	21.7%	58.8%	9.5%	60.2%	56.1%	57.1%	56.1%	26.2%	9.3%

[5] Acoustic data from comprises the post-WNS occupancy rates for Green Mountain and Finger Lakes and White Mountain because mist-net sampling did not occur post-WNS.

Table 3.2. Summary of Forest Service hibernacula and mist net surveys for the NLEB on the 15 Forests from 1997 to 2014.

Forest	Hibernacula	Total Number Observed in Hibernacula During the Last Survey	Total Number Captured in Mist Nets
Allegheny	1	1	1324
Chequamegon-Nicolet	NA	NA	54
Chippewa	NA	NA	NA
Green Mtn & Finger Lakes	1	0	139
Hiawatha	NA	NA	19
Hoosier	5	12	251
Huron-Manistee	NA	NA	28
Mark Twain	35	552	1699
Midewin	NA	NA	2
Monongahela	8	18	4968
Ottawa	8	280	24
Shawnee	14	470	116
Superior	NA	NA	37
Wayne	27	268	519
White Mtn	NA	NA	35
Total	99	1601	9215

Table 3.3. NLEB adult summer population estimates for the 15 Forests.

Forest	Forest Acres	Percent Occupancy	Occupied Acres	Maternity Colonies	Adult Females	Total Adults	Total Pups
Allegheny	475,496	28.0%	133,139	121	5,445	10,890	5,445
Chequamegon-Nicolet	1,318,863	56.1%	739,549	669	30,105	60,210	30,105
Chippewa	589,690	56.1%	330,667	300	13,500	27,000	13,500
Green Mtn & Finger Lakes	398,379	33.3%	132,780	121	5,445	10,890	5,445
Hiawatha	793,539	56.1%	444,975	403	18,135	36,270	18,135
Hoosier	195,969	29.4%	57,634	53	2,385	4,770	2,385
Huron-Manistee	915,757	21.7%	199,086	181	8,145	16,290	8,145
Mark Twain	1,398,068	58.8%	821,505	743	33,435	66,870	33,435
Midewin	1,755	9.5%	167	1	45	90	45
Monongahela	900,000	60.2%	541,440	490	22,050	44,100	22,050
Ottawa	905,000	56.1%	507,477	459	20,655	41,310	20,655
Shawnee	252,900	57.1%	144,507	131	5,895	11,790	5,895
Superior	2,093,062	56.1%	1,173,680	1,062	47,790	95,580	47,790
Wayne	224,546	26.2%	58,719	54	2,430	4,860	2,430
White Mtn	793,000	9.3%	73,670	67	3,015	6,030	3,015
Total	11,256,024	47.6%	5,358,994	4,855	218,475	436,950	218,475

Table 3.4. Estimated acreage of NLEB maternity roosting areas for the 15 Forests.

Forest	Forest Acres	Maternity Colonies[1]	Maternity Roost Area Acres (167 acres per Colony)	Percent of Forest Habitat Used as Maternity Roost Areas
Allegheny	475,496	121	20,207	4.25%
Chequamegon-Nicolet	1,318,863	669	111,723	8.47%
Chippewa	589,690	300	50,100	8.50%
Green Mtn & Finger Lakes	398,379	121	20,207	5.07%
Hiawatha	793,539	403	67,301	8.48%
Hoosier	195,969	53	8,851	4.52%
Huron-Manistee	915,757	181	30,227	3.30%
Mark Twain	1,398,068	743	124,081	8.88%
Midewin	1,755	1	167	9.52%
Monongahela	900,000	490	81,830	9.09%
Ottawa	905,000	459	76,653	8.47%
Shawnee	252,900	131	21,877	8.65%
Superior	2,093,062	1,062	177,354	8.47%
Wayne	224,546	54	9,018	4.02%
White Mtn	793,000	67	11,189	1.41%
Total	11,256,024	4,855	810,785	7.20%

[1] From Table 3.2

Table 3.5. White-nose syndrome (WNS) and *Pseudogymnoascus destructans* (Pd) occurrence in the 13 States of the Action Area (15 Forests addressed in this consultation) (source: NLEB final listing rule, 80 FR 17994).

State	WNS or Pd Present?	First Winter WNS Confirmed	Documented WNS Mortality in Bats?	Post-WNS Year for Forests in the State
Illinois	WNS	2012-2013	Yes	2013
Indiana	WNS	2010-2011	Yes	2011
Maine	WNS	2010-2011	Yes	2010
Michigan	WNS	2014-2015	Yes	NA
Minnesota	Pd	Pd only (2011-2012)	No	NA
Missouri	WNS	2011-2012	Yes	2013
New Hampshire	WNS	2008-2009	Yes	2010
New York	WNS	2006-2007	Yes	2007
Ohio	WNS	2010-2011	Yes	2014
Pennsylvania	WNS	2008-2009	Yes	2012
Vermont	WNS	2007-2008	Yes	2007
West Virginia	WNS	2008-2009	Yes	2011
Wisconsin	WNS	2013-2014	Yes	NA

4 Effects of the Action

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

4.1 Effects Analysis Methodology

For each of the five categories of activities described in Section 1.2 (Description of the Proposed Action), we apply the following steps to analyze effects at the programmatic level.

- **Literature Review** – We review best available science and commercial information about how the activity may affect the NLEB.
- **Stressor-Exposure-Response Pathways** – Based on the literature review, we identify the stressor(s) (alteration of the environment that is relevant to the species) that may result from the proposed activity.
    - For each stressor, we identify the circumstances for an individual bat's exposure to the stressor (overlap in time and space between the stressor and a NLEB).
    - Given exposure, we identify the likely individual response(s), both positive and negative. For this consultation, we group responses into one of five categories:
        - potentially increased fitness (e.g., increased access to, or availability of, prey organisms);
        - disturbance (e.g., smoke in a foraging area, causing bats to forage elsewhere);
        - reduced fitness (e.g., reduced food resources, reduced suitable roosting sites);
        - harass (e.g., day-time disturbance in a maternity roosting area, causing bats to flee and increasing the likelihood of injury or predation); and
        - harm (e.g., harvesting a tree occupied by adults and flightless bat pups resulting in death or injury).
    - For each pathway, we consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual bat's exposure (e.g., avoiding clearing known and occupied maternity roosts).
- **Population-Level Effects** – For each pathway, we apply the annual average acreage of the activity, bat occupancy rates, and bat density within occupied areas to estimate population-level effects (numbers of individual bats included in the pathway), which we describe below.

Methodology for Population-Level Effects Estimation

Estimating the numbers of individuals of a species exposed to stressors in a programmatic consultation is difficult, because programs (e.g., Forest Plans) do not usually specify with sufficient detail when and where projects will occur relative to the species' occurrence. For this consultation, we have very little site-specific data about NLEB distribution and abundance in the Action Area, but we do not assume that the species is ubiquitous, which would grossly overestimate effects. We have estimated NLEB occupancy with the available summary results

of mist-net surveys on some Forests and assumed an occupancy rate on others (see section 3.1). These occupancy rates range from about 9 to 60 percent.

The BA provides the average annual acreage of various activities that are expected to occur when NLEB pups cannot fly (May 1 – July 31) and during the rest of the year, which is about 1 and 3 percent of the total forested acreage, respectively (section 1.2.7, Summary of Proposed Action). For spatial exposure to stressors, however, we must consider that the proposed activities and NLEB-occupied areas may occur anywhere within the forested acreage of each Forest. It is possible for the proposed activities, which annually affect about 3 percent of the available forested habitat, to occur entirely on the 9 to 60 percent of the habitat on each Forest that we consider occupied, or not at all, because we have no information indicating whether certain activities are more or less likely to occur in occupied areas. Therefore, our effects analyses compute the expected (probable) degree of spatial overlap between activities and occupied areas as the product of two independent probabilities, namely, the percentage of the Forest that is proposed for an activity (section 1.2) multiplied by the percentage of the Forest that the NLEB occupies in a particular manner, e.g., for roosting or foraging (section 3.1.3).

The following example demonstrates our methodology for estimating population-level effects corresponding to the stressor-exposure-response pathway for timber harvest during the non-volant season (May 1–July 31) within a maternity roost, which may kill or injure non-volant pups. The period of non-volancy is variable across the action area, and may persist until late July and even early August depending on latitude, elevation, and weather conditions, but May 1–July 31 captures most of the period on most Forests in most years.

a) Forest A, with 500,000 acres of forested habitat, will annually harvest 2,500 acres (0.5 percent of the total habitat) during the non-volant season.
b) Forest A has a 30 percent occupancy rate for NLEB, i.e., 150,000 acres of Forest A are within the active-season home range of individuals of this species.
c) We assume that individuals belonging to maternity colonies collectively occupy 90 percent (co-capture rate of reproductive females with males and non-reproductive females; see section 3.1.3 for the basis of this and other NLEB distribution and abundance assumptions) of these 150,000 acres, or $0.90 \times 150{,}000 = 135{,}000$ acres.
d) We assume maternity colonies do not overlap and occupy 1,000 acres each; therefore Forest A supports $135{,}000 \div 1{,}000 = 135$ colonies.
e) We assume that individuals in a maternity colony roost in trees within an area of 167 acres; therefore, the colonies of Forest A occupy 135×167 acres = 22,545 acres for roosting, which is 4.5 percent of Forest A.
f) Each colony supports 45 non-volant pups during the harvest time frame (1 pup per adult female, section 3.1.3).

In this example, 2,500 acres (0.5 percent) of the forest is proposed for harvest during the non-volant season, and 22,545 acres (4.5 percent) harbors non-volant pups. The mathematically expected (probable) degree of spatial overlap is the product of the two percentages, or 0.5 percent × 4.5 percent = 0.0225 percent, which is 112.7 acres of the 500,000 acres in Forest A. To estimate the number of bat pups affected, we multiply the density of bat pups in maternity roosting areas (45 pups per 167 acres) by the expected acreage of overlap: $(45 \div 167) \times 112.7 = 30.3$, which we round up to 31 pups. We aggregate the results of this type of analysis for all

actions within a Forest and across all 15 Forests, which provides a basis for estimating the total expected effects of multiple project-level actions at a scale not exceeding the total programmatic annual acreages provided in the BA for those actions.

Consistent with the example above, our calculations for estimating the effects corresponding to each stressor-exposure-response pathway that we identify are presented in tabular form in section 4.9. Each table lists the 15 Forests with the following six columns of data:

(a) annual, active-season, or non-volant-season extent (acres) of the proposed activity causing the stressor, depending on the pathway;
(b) total forest habitat acres;
(c) percent of the forest habitat receiving the activity (a ÷ b);
(d) percent of the forest habitat that NLEB use at a time and in a manner (from section 3.1.3) that the stressor could affect causing a specific type of individual response;
(e) expected overlap (acres) of the activity and the bat-occupied area (b × c × d); and
(f) expected number of individuals affected (e × bat density in the occupied area).

In the final step of the calculations described above, the density we multiply by the expected area of overlap depends on the manner in which NLEB use the habitat exposed to the stressor. In the preceding example, non-volant pups in maternity roosting areas are the individuals responding to the stressor, and the density is 45 pups per 167 acres (0.2695). Based on the data and assumptions identified in section 3.1.3 about NLEB populations in the Action Area, we use the following NLEB densities in computing column "e" of each effects estimation table:

Habitat	NLEB individuals	Number	Acres	Density
Summer home range	Adult females and sympatric adult males	45 + 45 = 90	1,000 / 0.9043 = 1,106	0.0814
Maternity roosting areas	Non-volant pups	45	167	0.2695
Summer home range	Adult females, volant juveniles, and sympatric adult males	135	1,106	0.1221
Roosting areas	Adult females, volant juveniles, and sympatric adult males	135	167	0.8084

This methodology generates results in terms of numbers of individual NLEB affected, but we must acknowledge its inherent imprecision. It relies on assumptions about Forest-specific occupancy rates and applies constant values for colony size, sex ratios, etc., that we believe are reasonable and based on best available information, but which are either uncertain or variable across the Action Area. Although it is coarse, this methodology provides a transparent basis for quantifying effects for interpretation relative to the status of the species, which is the purpose of an effects analysis in a BO.

Estimating Effects to NLEB in Fall-Swarming and Spring-Staging Areas

Adult and young-of-the-year NLEB migrate to hibernacula in the fall, gathering in swarming areas near hibernacula for mating and preparation for hibernation (section 2.4.4). They emerge from hibernacula in the spring, staging in roughly the same areas in preparation for migration to summer habitats (section 2.4.2). Because of the seasonal concentration of bats in these areas near hibernacula, environmental changes to these areas, beneficial and adverse, affect a greater number of individuals per acre than our methodology using summer bat densities predicts. The description of the proposed Action specifies the acreage of activities occurring during the non-volant season (May 1 – July 31), but not the acreage during the spring staging and fall swarming periods, which are variable across the Action Area and between years, depending on the weather and other factors. As described in section 1.2.7, we have prorated the acreage of volant-season activities and added it to the non-volant-season acreage to estimate the acreage occurring during the months of April through October when NLEB are active on the Forests, which encompasses the spring staging and fall swarming periods.

Although we could further prorate active-season activity acreages into assumed portions occurring during the spring and fall, estimating the expected spatial overlap between such acreages and the acreage of occupied staging and swarming habitat is also problematic. Available data on known NLEB hibernacula very likely represents a small fraction of the winter habitats the species uses. Our adult population estimate for the 15 Forests is about 436,950 (Table 3.3). The NLEB is rarely counted in numbers greater than 100 in hibernacula (see section 2.2.1), but assuming 500 bats per hibernaculum, the 15-Forest population of 436,950 NLEB would use 874 hibernacula. Based on the FS data, only 99 hibernacula are known to occur on 8 of the 15 Forests.

Therefore, without additional data about the timing of the Action activities and more comprehensive data about the extent of occupied spring staging/fall swarming habitats in the Action Areas, we do not attempt to explicitly assess effects to the NLEB in these habitats. Our methodology does not recognize the concentration of bats to staging/swarming areas during these periods, which has the effect of overestimating the expected spatial overlap of stressors and occupied areas during the spring and fall while underestimating the density of bats in areas of such overlap. To the extent that the NLEB using the 15 Forests as summer habitat also stage and swarm on these Forests, we believe these two biases of the methodology likely offset each other in estimating numbers of individual bats affected. Given the limitations of our data with respect to the locations of hibernacula, associated spring/fall habitats, and the timing of Action activities, we believe our methodology represents a reasonable approach.

4.2 Timber Harvest

4.2.1 Literature Review for Effects of Timber Harvest

Menzel et al. (2002) found NLEB roosting in intensively managed stands in West Virginia. At the same study site, Owen et al. (2002) concluded that NLEB roosted in areas with abundant snags, and that in intensively managed forests of the central Appalachians, roost availability was not a limiting factor. Perry and Thill (2007) tracked NLEB in central Arkansas and found roosts in eight different forest classes, of which 89 percent were in three classes of mixed pine-

hardwood forest. The mixed pine-hardwood forest stands that supported most of the roosts were partially harvested or thinned, unharvested (50–99 years old), or harvested by group selection.

Timber harvest accomplished through thinning, group selection, and individual selection may create canopy openings in an otherwise densely-forested setting, which may promote more rapid development of bat pups. In central Arkansas, Perry and Thill (2007) found female bat roosts were more often located in areas with partial harvesting than males, with more male roosts (42 percent) in un-harvested stands than female roosts (24 percent). They postulated that females roosted in relatively more open forest conditions because they may receive greater solar radiation, which may increase developmental rates of young or permit young bats a greater opportunity to conduct successful initial flights (Perry and Thill 2007). Cryan et al. (2001) found several reproductive and non-reproductive female NLEB roosts in recently harvested (less than 5 years) stands in the Black Hills of South Dakota where snags and small stems (dbh of 5 to 15 cm (2 to 6 inches)) were the only trees left standing. In this study, however, the largest colony (n=41) was found in a mature forest stand that had not been harvested in more than 50 years. Lacki and Schwierjohann (2001) stated that silvicultural practices could meet both male and female roosting requirements by maintaining large-diameter snags, while allowing for regeneration of forests.

Forest patch size and contiguity are factors that appear to influence habitat use by NLEB. Henderson et al. (2008) observed gender-based differences in mist-net capture rates of NLEB on Prince Edward Island related to forest patch size. The area of deciduous stands had a consistent positive relationship with the probability of presence of both males and females, but males were found more often in smaller stands than females. In southeastern Missouri, Yates and Muzika (2006) reported that NLEB showed a preference for contiguous tracts of forest cover (rather than fragmented or open landscapes) for foraging or traveling, and that different forest types interspersed on the landscape increased the likelihood of occupancy.

In West Virginia, Owen et al. (2003) radio-tracked nine female NLEB that spent their foraging and travelling time in the following habitat types (in descending order of use):

- 70–90-year-old stands without harvests in more than 10–15 years ("intact forest") (mean use 52.4 percent);
- 70–90 year-old stands with 30–40 percent of basal area removed in the past 10 years ("diameter-limit harvests") (mean use 42.9 percent);
- open areas (clearcuts and roads) (clear cut = all trees > 2.5 cm (1.0 inch) dbh removed) (mean use 4.6 percent); and
- clearcuts with approximately 4.5 m^2/ha (19.6 ft^2/acre) tree basal area remaining ("deferment harvests") (mean use 0.03 percent).

Habitat selection differed significantly relative to habitat availability, with diameter-limit harvests ranking as the strongest habitat preference, where percent use exceeded percent availability for 7 of the 9 bats.

In Alberta, Canada, NLEB avoided the center of clearcuts and foraged more in intact forest than expected (Patriquin and Barclay 2003). On Prince Edward Island, Canada, female NLEB preferred to forage in areas centered along creeks running through forests (Henderson and Broders 2008). In mature forests on the Sumter National Forest in northwestern South Carolina,

10 of the 11 stands in which NLEB were detected were mature stands (Loeb and O'Keefe 2006). Within those mature stands, NLEB were recorded more often at points with sparse or medium-density vegetation than at points with dense vegetation, suggesting that small openings within forest stands facilitate commuting and/or provide suitable foraging habitat. However, in southwestern North Carolina, Loeb and O'Keefe (2011) found that NLEB rarely used forest openings, but often used roads.

At Fort Knox in Kentucky, Silvis et al. (2014) tracked three maternity colonies of NLEB to evaluate their social and resource networks, i.e., roost trees. Roost and social network structure differed between maternity colonies, and roost availability was not strongly related to network characteristics or space use. In model simulations based on the tracking data, removal of more than 20 percent of roosts initiated social network fragmentation, with greater loss causing more fragmentation. The authors suggested that flexible social dynamics and tolerance of roost loss are adaptive strategies for coping with ephemeral conditions in dynamic forest habitats. Sociality among bats may contribute to reproductive success, and fragmented colonies may experience reduced success (see *Summer Roosting Behavior* in Section 2.4.3).

In the same Fort Knox study area with the same three maternity colonies, Silvis et al. (2015) removed during winter a primary maternity roost tree from one colony, 24 percent of the secondary roosts from another colony, and none from the third. Neither removal treatment altered the number of roosts used by individual bats, but secondary roost removal doubled the distances moved between sequentially used roosts. Overall location and spatial size of colonies was similar pre- and post-treatment. Patterns of roost use before and after removal treatments also were similar. Roost height, diameter at breast height, percent canopy openness, and roost species composition were similar pre- and post-treatment. NLEB use a wide range of tree species and sizes as roosts, and potential roosts were not limited in the treatment areas.

Although the literature we have reviewed contains no reports of NLEB mortality resulting from tree harvest, there have been three documented instances of Indiana bat adults and pups killed or injured when an occupied roost tree was felled. Indiana bats and NLEB are congeners with similar behavior (i.e., forest-dwelling, forming maternity colonies, roosting in trees in the summer). Cope et al. (1974) reported the first felling of an occupied Indiana bat maternity roost tree in Wayne County, Indiana. The landowner observed bats exiting the tree when it was bulldozed down. The original account stated that eight bats (2 adult females and 6 juveniles) were "captured and identified as Indiana bats," and that about 50 bats flew from the tree. Although the original account did not specify how the eight bats were captured, J. Whitaker (Indiana State University, pers. comm., 2005) recounted that those bats were killed or disabled, retrieved by the landowner, and subsequently identified by a biologist. In another case, Belwood (2002) reported on the felling of a dead maple in a residential lawn in Ohio. One dead adult female and 33 non-volant young were retrieved by the researcher. Three of the young bats were already dead when they were picked up, and two more died subsequently. The rest were apparently retrieved by adult bats that had survived. In a third case, 11 dead adult female Indiana bats were retrieved (by people) when their roost was felled in Knox County, Indiana (J. Whitaker, pers. comm., 2005).

These accounts suggest that some individuals, including non-volant pups, can survive the felling of a maternity roost tree. It is not possible to infer injury rates from these studies. It is only possible to crudely estimate mortality rates from the Belwood case. If we assume that there were 66 individuals in the tree (the 33 pups observed plus 1 dead adult female and 32 presumed additional adult females who retrieved their pups), the overall survival rate was high at 91%. Only 1 adult bat was observed dead (about 3% of adults), and the juvenile mortality rate was about 15%. We acknowledge that timber harvest operations in a forest bear little resemblance to these three instances, but available evidence indicates that both adults and pups can be killed when an occupied roost tree is felled. For the purposes of this consultation, we assume that all non-volant bats have the potential to be harmed, and 3% of adult bats could be killed or injured in a felled tree. Adults may be at greater risk during the spring during colder temperatures and increased use of torpor. It is also possible that trees felled adjacent to roost trees could strike roosting bats and result in injury or death.

Disturbance associated with harvest activity could cause NLEB to flee or abandon day-time roosts, which increases the likelihood of predation. This may also result in females aborting or not being impregnated. Gardner et al. (1991) reported that Indiana bats continued to roost and forage in an area with active timber harvest, but this will depend on the scale of harvest and whether there is any remaining suitable habitat. Callahan (1993) attributed the abandonment of a primary maternity roost tree to disturbance from a bulldozer clearing brush adjacent to the tree.

Surface-disturbing activities in the vicinity of hibernacula may affect bat populations if those activities result in changes to the microclimate (temperature, humidity, and air flow) of the cave or mine (Ellison et al. 2003). Tree removal in karst areas can alter soil characteristics, water quality, local hydrology to the extent that it alters cave microclimates and affects bats (Bilecki 2003, Hamilton-Smith 2001). Bats in hibernation are susceptible to dehydration due to high evaporative loss from their naked wings and large lungs (Perry 2013). Richter et al. (1993) documented temperature increases resulting from structural modifications to a cave entrance that substantially reduced its suitability for bats. The creation of new openings or filling in existing openings could also result from obstructing cave entrances with dirt or logging slash.

4.2.2 Stressor-Exposure-Response Pathways for Timber Harvest

The primary alteration of the environment associated with timber harvest that is relevant to the NLEB is the removal of trees that provide roosts or serve as foraging, spring staging, or fall swarming habitat. The disturbance (noise, exhaust from machinery, etc.) that accompanies harvest activities is another stressor caused by timber harvest. Thinning mid-story clutter may have a beneficial effect on the suitability of adjacent maternity roost trees. The species' responses to these stressors depends on the type of harvest (e.g., thinning, salvage, even-aged management, clear cut, etc.) and the context of exposure, i.e., when and where it occurs. Based on the description of the Action and the preceding literature review, we identify the following six pathways of NLEB responses to timber harvest.

Pathway 1
Activity – Salvage/sanitation harvest.
Stressor – Removing existing snags and other dead/dying trees.
Exposure (time) – Year-round; indirect effect.

Exposure (space) – All occupied areas except hibernacula.
Resource affected – Roost trees.
Individual response – Reduced fitness; bats have reduced roosting opportunities in salvage areas to exploit adjacent forested habitat.
Interpretation – Dead and dying trees disproportionately provide the characteristics of suitable roost trees. Loss of suitable roosts decreases opportunities for efficient use of forest habitat. The individual LRMPs include design criteria (see section 1.2.6) to retain a variety of the largest diameter snags, cavity/den trees, and/or reserve trees in even-aged timber harvest areas. Nine of the 16 LRMPs have additional requirements to protect potentially suitable roost trees for Indiana bats; therefore, we limit the spatial extent of this stressor to salvage/sanitation harvests where these standards do not apply.

Pathway 2
Activity – Thinning and uneven-aged harvest.
Stressor – Reducing mid-story clutter adjacent to roost trees.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Vegetation near roost trees.
Individual response – Increased fitness and survival of pups.
Interpretation –Beneficial through increased solar radiation on roosts; improved access to roosts; travel corridors to foraging areas; however, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success. Response may vary with harvest proximity to roost trees from no benefit to pup survival to some benefit for some pups.

Pathway 3
Activity – Even- and uneven-aged harvest.
Stressor – Removing trees that provide habitat used for foraging, swarming, or staging.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – All occupied areas except hibernacula.
Resource affected – Insect prey, forest cover that supports (shelters) bat activity.
Individual response – Reduced fitness; energy expenditure for relocating from traditional use areas to alternative habitat.
Interpretation – Loss of forest habitat decreases opportunities for growth and successful reproduction. Depending on location and size of the harvest, forest cover removal in the summer home range may cause a shift in home range or relocation. Loss of habitat in staging/swarming areas near hibernacula may cause a similar shift in habitat use for larger numbers of individuals, due to their seasonal concentration in these areas, and may reduce fall mating success and/or reduced fitness in preparation for spring migration.

Pathway 4
Activity – All harvest types.
Stressor – Altering the flow of air and water through hibernacula.
Exposure (time) – Winter (direct effect) and active season (indirect effect).
Exposure (space) – Near hibernacula.
Resource affected – Individuals.

Individual response – Arousal from hibernation; reduced fitness, mortality; take in the form of harm.
Interpretation – Response depends on proximity of harvest to hibernacula entrances, airflow patterns, and local hydrology. Sufficient modification may cause injury or mortality (take in the form of harm). We believe conservation measure #2 reduces this risk to insignificant levels by avoiding adverse changes within 0.25 mile of entrances.

Pathway 5
Activity – All harvest types.
Stressor – Disturbance (noise, machinery exhaust, activity) associated with harvest.
Exposure (time) – Active season, daytime; direct effect.
Exposure (space) – Roosting areas (maternity and non-maternity).
Resource affected – Individuals.
Individual response – Disturbance (fleeing from disturbance); take in the form of harass.
Interpretation – Fleeing disturbance during daylight hours increases the likelihood of predation.

Pathway 6
Activity – All harvest types.
Stressor – Removing roost trees.
Exposure (time) – Non-volant season for pups; direct effect. Active season for adults; direct effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Individuals; mostly non-volant pups. A smaller percentage of adults are also vulnerable.
Individual response – Injury, mortality (take in the form of harm).
Interpretation – Removing occupied trees is likely to kill or injure pups and adults. For the purposes of this consultation, we assume that all non-volant bats in felled trees may be harmed, but only 3% of adults may be injured or killed. It is also possible that trees felled adjacent to roost trees could strike roosting bats and result in injury or death, but this is covered by the same assumptions for felling occupied roosts.

4.2.3 Estimation of Population Effects from Timber Harvest

Tables 4.1 through 4.5 show our calculations for estimating the effects of timber harvest stressor-exposure-response pathways on NLEB populations in the Action Area. Pathways 1 (salvage harvest) and 3 (even- and uneven-aged harvest) cause reduced fitness by reducing available habitat resources, annually affecting up to 787 and 3,551 adult bats, respectively, across all 15 Forests (Tables 4.1 and 4.3). Pathway 2 (thinning and uneven-aged harvest) may increase fitness by improving the suitability of adjacent roost trees, affecting up to 1,459 NLEB pups (Table 4.2).

We do not believe that Pathway 4 affecting bats in hibernacula is likely to have significant effects due to FS standards for protecting known bat hibernacula; therefore, we have not included an effects analysis table for this pathway in this section.

Pathway 5 (all harvest types during the active season [April – October] within maternity roosting areas) causes take in the form of harassment affecting up to 5,409 volant NLEB annually (Table

4.4). We estimate the acreage of active-season timber harvest activity that we use in Table 4.4 as the sum of the non-volant season acreage plus 44.7 percent of the volant season acreage (see section 1.2.7; Table 1.8).

Pathway 6 (all harvest types in the non-volant season within maternity roosting areas for pups; all harvest types in the active season within maternity roosting areas for adults) causes take in the form of harm of up to 855 NLEB non-volant pups annually (Table 4.5) and 24 adults annually (Table 4.6).

4.3 Prescribed Burning

4.3.1 Literature Review for Effects of Prescribed Burning

Perry (2012) provides a review of fire effects on bats in the eastern oak region of the U.S., and Carter et al. (2002) provides a similar review for bats in the southeastern and mid-Atlantic states. Forest-dwelling bats, including the wide-ranging NLEB, were presumably adapted to the fire-driven disturbance regime that preceded European settlement and fire suppression in many parts of the eastern U.S. Concurrent changes in habitat conditions preclude any reasonable inferences about the overall impact of fire suppression on populations of forest-dwelling bats. It is apparent that fire may affect individual bats directly (negatively) through exposure to heat, smoke, and carbon monoxide, and indirectly (both positively and negatively) through habitat modifications and resulting changes in their food base (Dickinson et al. 2009).

Direct Effects – Summer Roosting

Little is known about the direct effects of fire on cavity and bark roosting bats, such as the NLEB, and few studies have examined escape behaviors, direct mortality, or potential reductions in survival associated with effects of fire. Dickinson et al. (2009) monitored two NLEB (one male and one female) in roosts during a controlled summer burn. Within 10 minutes of ignition near their roosts, both bats flew to areas that were not burning. Among four bats they tracked before and after burning, all switched roosts during the fire, with no observed mortality. Rodrigue et al. (2001) reported flushing a Myotis bat from an ignited snag during an April controlled burn in West Virginia.

Carter et al. (2002) suggested that the risk of direct injury and mortality to southeastern forest-dwelling bats resulting from summer prescribed fire is generally low. During warm temperatures, bats are able to arouse from short-term torpor quickly. Most adult bats are quick, flying at speeds > 30 km/hour (Patterson and Hardin 1969), enabling escape to unburned areas. NLEB use multiple roosts, switching roost trees often (see *Summer Roosting Behavior* in Section 2.4.3), and could likely use alternative roosts in unburned areas, should fire destroy the current roost. Non-volant pups are likely the most vulnerable to death and injury from fire. Although most eastern bat species are able to carry their young for some time after they are born (Davis 1970), the degree to which this behavior would allow females to relocate their young if fire threatens the nursery roost is unknown.

Dickinson et al. (2010) used a fire plume model, field measurements, and models of carbon monoxide and heat effects on mammals to explore the risk to the Indiana bat and other tree-

roosting bats during prescribed fires in mixed-oak forests of southeastern Ohio and eastern Kentucky. Carbon monoxide levels did not reach critical thresholds that could harm bats in low-intensity burns at typical roosting heights for the Indiana bat (8.6 m) (28.2 ft). NLEB roost height selection is more variable, but on average lower (6.9 m) (22.8 ft) than the Indiana bat (Lacki et al. 2009b). In this range of heights, direct heat could cause injury to the thin tissue of bat ears. Such injury would occur at roughly the same height as tree foliage necrosis (death) or where temperatures reach 60 °C (140 °F). Most prescribed fires for forest management are planned to avoid significant tree scorch.

Direct and Indirect Effects – Winter Roosting

Little is known about the direct effects of fire on bats in adjacent caves and mines. Smoke and noxious gases could enter caves and mines, depending on airflow characteristics and weather conditions (Carter et al. 2002; Perry 2011). Although smoke from winter fires may not reach toxic levels in caves and mine, introduced gases could arouse bats from hibernation, causing energy expenditure and reduced fitness (Dickinson et al. 2009). Caviness (2003) observed smoke intrusion into hibernacula during winter burning in Missouri, but did not observe any bat arousal. Fire could alter vegetation surrounding the entrances to caves and mines, which could indirectly affect temperature and humidity regimes of hibernacula by modifying airflow (Carter et al. 2002, Richter et al. 1993).

Indirect Effects – Roost Availability/Suitability

Fire can affect the availability of roosting substrate (cavities, crevices, loose bark) by creating or consuming snags, which typically provide these features, or by creating these features in live trees. Although stand-replacing or intense wildfires may create large areas of snags, the effects of multiple, low-intensity prescribed burning on snag dynamics are less obvious, especially for forests consisting mostly of fire-adapted species. Low-intensity, ground-level fire may injure larger hardwood trees, creating avenues for pathogens such as fungi to enter and eventually form hollow cavities in otherwise healthy trees (Smith and Sutherland 2006). Fire may scar the base of trees, promoting the growth of basal cavities or hollowing of the bole in hardwoods (Nelson et al. 1933, Van Lear and Harlow 2002). Repeated burning could potentially create forest stands with abundant hollow trees. Trees located near down logs, snags, or slash may be more susceptible to damage or death, and aggregations of these fuels can create clusters of damaged trees or snags (Brose and Van Lear 1999, Smith and Sutherland 2006).

Bats are known to take advantage of fire-killed snags and continue roosting in burned areas. Boyles and Aubrey (2006) found that, after years of fire suppression, initial burning created abundant snags, which evening bats (*Nycticeius humeralis*) used extensively for roosting. Johnson et al. (2010) found that after burning, male Indiana bats roosted primarily in fire-killed maples. In the Daniel Boone National Forest, Lacki et al. (2009a) radio-tracked adult female NLEB before and after prescribed fire, finding more roosts (74.3 percent) in burned habitats than in unburned habitats. Burning may create more suitable snags for roosting through exfoliation of bark (Johnson et al. 2009a), mimicking trees in the appropriate decay stage for roosting bats.

In addition to creating snags and live trees with roost features, prescribed fire may enhance the suitability of trees as roosts by reducing adjacent forest clutter (see *Canopy Cover/Closure* in Section 2.4.3). Perry et al. (2007) found that five of six species, including NLEB, roosted disproportionally in stands that were thinned and burned 1-4 years prior but that still retained large overstory trees. Boyles and Aubrey (2006) found evening bats used burned forest exclusively for roosting.

Indirect Effects – Summer Foraging

Adult insects are the predominant prey of NLEB (see Section 2.2.4 Foraging Behavior). On the Daniel Boone National Forest, Lacki et al. (2009a) found that abundance of coleopterans (beetles), dipterans (flies), and all insects combined captured in black-light traps increased following prescribed fires. The mechanism of this increase is presumably the new growth of ground vegetation that a burn stimulates. In fecal samples of NLEB, lepidopterans (moths), coleopterans, and dipterans were the three most important groups of insect prey, with dipteran consumption increasing after burning. NLEB appeared to track the observed changes in insect availability, i.e., home ranges were closer to burned habitats following fires than to unburned habitats, but home range size did not vary before and after fires.

4.3.2 Stressor-Exposure-Response Pathways for Prescribed Burning

In general, exposure to prescribed burning can cause direct adverse responses (disturbance, injury, death) and indirect adverse and beneficial responses via changes to roosting and foraging resources. Stressors caused by burning include heat and smoke during the actual movement of a fire through forested areas and fire-induced changes in vegetation structure and composition. Bat exposure to these direct and indirect stressors depends on timing of the burn and how bats may use the burned area, e.g., for roosting, foraging, spring staging, fall swarming, or hibernation in a cave/mine where the entrance is within or near the burned area. Based on the description of the Action and the preceding literature review, we identify the following eight pathways of NLEB responses to prescribed burning, which we number sequentially from the preceding analysis of timber harvest.

Pathway 7
Stressor – Creating snags, creating roost features in live trees.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – All occupied areas except hibernacula.
Resource affected – Trees.
Individual response – Increased fitness.
Interpretation –Beneficial through greater availability of suitable roosts increasing opportunities for successful reproduction, more efficient use of forest habitat however, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success.

Pathway 8
Stressor – Destroying existing snags and other trees suitable for roosting.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – All occupied areas except hibernacula.
Resource affected – Trees.

Individual response – Reduced fitness.
Interpretation – Loss of suitable roosts decreases opportunities for successful reproduction, more efficient use of forest habitat.

Pathway 9
Stressor – Heat and smoke.
Exposure (time) – Winter; direct effect.
Exposure (space) – Near hibernacula.
Resource affected – Individuals.
Individual response – Arousal from hibernation; reduced fitness, mortality; take in the form of harm.
Interpretation – Response depends on proximity of fire to hibernacula entrances and airflow patterns. Sufficient smoke entering hibernacula may cause injury or mortality. We believe conservation measure #1 (Section 1.2.6) reduces this risk to insignificant levels by identifying cave and mine entrances as smoke-sensitive targets in burn plans.

Pathway 10
Stressor – Heat and smoke.
Exposure (time) – Active season, day time; direct effect.
Exposure (space) – Roosting areas (maternity and non-maternity)
Resource affected – Individuals; adults and volant juveniles.
Individual response – Disturbance (fleeing from fire); take in the form of harass.
Interpretation – Fleeing the line of fire of a prescribed burn during daylight hours increases the likelihood of predation.

Pathway 11
Stressor – Heat and smoke.
Exposure (time) – Active season, night time; direct effect.
Exposure (space) – Foraging areas.
Resource affected – Individuals; adults and volant juveniles.
Individual response – Disturbance (fleeing from fire).
Interpretation – Fleeing the line of fire of a prescribed burn during night-time foraging is unlikely to cause injury.

Pathway 12
Stressor – Heat and smoke.
Exposure (time) – Non-volant season; direct effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Individuals; non-volant juveniles.
Individual response – Injury, mortality; take in the form of harm.
Interpretation – Response varies with fire intensity and roost height; a combination of high-intensity burns and/or low roosts is likely to cause injury or mortality.

Pathway 13
Stressor – Stimulating growth of ground cover and insect populations.
Exposure (time) – Growing-season months following the burn; indirect effect.

Exposure (space) – Foraging areas.
Resource affected – Insect prey.
Individual response – Increased fitness.
Interpretation –Beneficial through greater availability of insect prey increasing foraging efficiency; however, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success.

Pathway 14
Stressor – Thinning mid-story clutter adjacent to roost trees.
Exposure (time) – Growing-season months following the burn; indirect effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Vegetation near roost trees.
Individual response – Increased fitness and survival of pups.
Interpretation –Beneficial through increased solar radiation on roosts; improved access to roosts however, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success. Response may vary with fire intensity; low-intensity fire is unlikely to reduce clutter at roost height, but high intensity is likely to harm non-volant pups (Pathway 12); therefore, we limit the spatial extent of this stressor for estimating beneficial effects to burning acreage during the volant season.

4.3.3 Estimation of Population Effects for Prescribed Burning

Tables 4.7 through 4.13 show our calculations for estimating the effects of the eight prescribed burning stressor-exposure-response pathways on NLEB populations in the Action Area. The responses for four of the eight pathways occur through vegetation resources upon which the NLEB relies, of which three may be beneficial (7, 13, and 14) and one is adverse (8). The other four pathways (9, 10, 11, and 12) represent direct responses of individuals if present when and where burning occurs.

Pathways 7 and 8 are opposite faces of the same coin: i.e., burning can both create and destroy trees suitable for roosting, thereby potentially increasing or decreasing the fitness of the local population by increasing or decreasing opportunities for successful reproduction and efficient use of forest habitat. Because prescribed burning for forest management is generally conducted in a manner to avoid burning down larger trees, we believe that the beneficial effects of Pathway 7 likely outweigh the adverse effects of Pathway 8. However, our methodology for estimating exposure using activity and bat-occupancy acreages is not precise enough to recognize this difference and yields identical results: the expected number of NLEB adults affected is 4,582 for both pathways (Tables 4.7 and 4.8).

We believe the Region-wide conservation measure involving fire near caves (#1 under Section 1.2.6) (e.g., treating caves as smoke-sensitive targets in prescribed burn plans) reduces the risk of the Pathway 9 response to an insignificant scale or discountable probability. Therefore, we do not include an effects analysis table for Pathway 9 in section 4.9.

Tables 4.9 and 4.10 estimate the number of bats that will flee the advance of a line of fire during active-season burns through maternity roosting areas (day time, Pathway 10) and through foraging areas (night time, Pathway 11), respectively. Table 1.8 provides the FS acreage

estimates of active-season burning that we use in Tables 4.9 and 4.10. Because day-time flights from roosts increases the likelihood of predation and/or other injury, we classify this effect as take in the form of harassment, which we estimate may affect up to 3,681 volant NLEB (Table 4.9). Burns through occupied areas that are conducted at or persist through the night could affect up to 3,670 volant NLEB, but this disturbance to foraging bats is unlikely to cause injury (Table 4.10).

Table 4.11 estimates that 365 NLEB pups are at risk of take in the form of harm, i.e., injury and mortality, resulting from heat and smoke in maternity roosting areas during non-volant season burns (Pathway 12). This risk is greatest on the Mark Twain Forest (estimated 144 pups), which conducts the largest acreage of prescribed burning annually during the non-volant season (6,000 acres). The potential for death or injury resulting from prescribed burning depends largely on site-specific circumstances, e.g., fire intensity near the maternity roost tree and the height above ground of pups in the maternity roost tree. Not all fires through maternity roosting areas will kill or injure all pups present, but our methodology in this BO (uses the reasonable worst case scenario and) estimates that all potentially vulnerable individuals within the expected area of activity/occupancy overlap are affected.

Pathway 13 (beneficial effect via increased insect prey abundance) (Table 4.12) may affect a larger number of bats (6,872), as the bat density we apply to the expected acreage of overlap between prescribed burning and occupied areas includes volant juveniles as well as all adults. This potential increased fitness effect is greatest on the Mark Twain Forest, which accounts for about two thirds of these bats. Although a large number of bats are included in this pathway, we cannot determine the degree to which increased prey abundance may increase survival or reproductive success.

Pathway 14 is the beneficial effect of fire in reducing midstory clutter, which may enhance the suitability of maternity roosts for pup growth and survival. We interpret this effect reported in the literature (Perry et al. 2007) as more likely associated with higher intensity burns that kill small trees that reach the elevation of typical roost heights or with lower intensity burns in the same areas as recent thinning operations. Higher intensity burns would also harm non-volant pups present; therefore we used only the volant season acreage in estimating effects for this pathway, which amounts to 1,231 pups (Table 4.13). As with the beneficial effects of Pathway 13, we cannot determine the degree to which reducing midstory clutter via prescribed burning may increase survival or reproductive success.

4.4 Road Construction/Reconstruction/Maintenance/Decommissioning

The proposed Action addresses the construction, reconstruction, maintenance, and decommissioning of relatively permanent roads (not temporary harvest roads that return to forest habitat following the harvest) for which the FS – not local, state, or federal transportation authorities – is responsible for building and maintaining. These roads are mostly unpaved and support local traffic only, i.e., the vehicles of forest visitors, FS personnel, logging operations, etc.

4.4.1 Literature Review for Effects of Roads

The Federal Highway Administration (FWHA) and Federal Railroad Administration (FRA) recently completed a range-wide informal consultation with the Service for the effects of transportation projects on the Indiana bat and the NLEB (FHWA and FRA 2015). The literature cited in the Biological Assessment for this consultation pertains mostly to the effects of paved roads on bats, for which right-of-way corridors are much wider and traffic volume is much higher than for the generally narrower, unpaved, local-use roads within National Forests. Stressors caused by constructing, using, improving, expanding, and maintaining roads in forested habitats that were identified as relevant to the NLEB in the FHWA/FRA consultation included: (a) tree removal; (b) disturbance (e.g., noise, machinery exhaust, lighting); (c) altering water sources; (d) smoke from slash pile burning; and (e) collisions with vehicles. The transportation assessment also identified bridges and other structures as locations for potential exposure to stressors when bats use these structures as roosts. Replacing or repairing bridges and other structures is included in the proposed Action of this consultation. Conservation measure #4 prevents the modification or demolition of bridges and other man-made structures while bats are present; therefore, we do not anticipate that bridge repair or replacement will result in adverse effects to the NLEB. After examining the potential exposure and response pathways for the stressors listed above, the FWHA/FRA assessment determined, and the Service concurred, that projects to maintain and improve existing transportation corridors that are more than half a mile away from known hibernacula are not likely to adversely affect the NLEB, provided such projects:

- implement standard water quality best management practices;
- do not remove trees that are documented roosts or foraging habitat; and
- remove trees only when bats are absent (i.e., during winter) and within 100 feet of existing road surfaces.

4.4.2 Stressor-Exposure-Response Pathways for Roads

Unlike transportation projects that satisfy criteria for "not likely to adversely affect" determinations described in the previous subsection, the proposed extent of work on Forest roads under this Action does not limit tree removal to the winter months when NLEB are within hibernacula, and we expect that this activity will overlap with roosting and foraging habitat to some degree, according to the methodology described in section 4.1. Further, the environmental setting of FS roads activity is fundamentally different from that of paved roads, which carry a much higher volume of traffic, which effectively fragments the habitat for bats' use (FHWA and FRA 2015). By contrast, Loeb and O'Keefe (2011) found that NLEB often used forest roads. Tree removal is minimal for the reconstruction, maintenance, and decommissioning of existing FS roads. Clearing and earth-moving activity is generally conducted during day-light hours, and except for limited cases of road widening, is confined almost entirely to the footprint of the existing road. Therefore, disturbance of bats roosting in areas adjacent to roads is the primary stressor that is relevant to the NLEB for work on existing FS roads, as the roads themselves are unlikely to support trees large enough for roosting.

However, in addition to the disturbance associated with work on existing roads, new road construction removes trees from the new road corridor, which makes its stressors similar to those

of timber harvest. The FS BA indicates that new road construction constitutes a small fraction of road work on most Forests, but did not specify a breakdown between new construction and work on existing roads. The spatial extent proposed of road construction for the Action is very small, amounting to about 14,000 acres per year in the nearly 12.2 million acres of the 15 Forests (section 1.2.3), compared to about 145,000 acres of tree removal for the various types of timber harvest. Therefore, we do not consider it necessary to evaluate all of the stressor pathways we identified for timber harvest in the context of new unpaved Forest road construction, e.g., the beneficial effect of reducing midstory clutter adjacent to roost trees resulting from thinning harvests. We limit the pathways for work on existing roads and building new roads to two stressors that, given exposure, result in take of individual NLEB, listed below.

Pathway 15
Activity – All types of road construction, reconstruction, maintenance, and decommissioning.
Stressor – Disturbance (noise, machinery exhaust, activity).
Exposure (time) – Active season, daytime; direct effect.
Exposure (space) – Roosting areas (maternity and non-maternity)
Resource affected – Individuals.
Individual response – Disturbance (fleeing from disturbance); take in the form of harass.
Interpretation – Fleeing disturbance during daylight hours increases the likelihood of predation.

Pathway 16
Activity – New road construction; however, the FS did not provide new road construction acreages, so we use the acreages provided for all roads work.
Stressor – Removing roost trees.
Exposure (time) – Non-volant season for pups; direct effect. Active season for adults; direct effect. *Exposure (space)* – Maternity roosting areas.
Resource affected – Individuals; mostly or entirely non-volant pups. A smaller percentage of adults are also vulnerable.
Individual response – Injury, mortality; take in the form of harm.
Interpretation – Removing occupied trees is likely to kill or injure pups and adults. For the purposes of this consultation, we assume that all non-volant bats in felled trees may be harmed, but only 3% of adults may be injured or killed. It is also possible that trees felled adjacent to roost trees could strike roosting bats and result in injury or death, but this is covered by the same assumptions for felling occupied roosts.

4.4.3 Estimation of Population Effects from Roads

For purposes of this analysis, we consider the possibility of NLEB take resulting from the minimal tree removal associated with repairs and maintenance of existing roads as discountable. Disturbance resulting mostly from work on existing roads (Pathway 15, Table 4.14) is expected to cause take in the form of harassment affecting up to 619 volant NLEB annually. Most of this total is on the Chequamegon-Nicolet Forest. We estimate the acreage of active-season road activity that we use in Table 4.14 as the sum of the non-volant season acreage plus 44.7 percent of the volant season acreage (see section 1.2.7; Table 1.8).

Take in the form of harm resulting from road construction (Pathway 16, Tables 4.15 and 4.16) is expected to affect 133 non-volant pups and 15 adults. This is likely an over-estimate because we

used the acreages associated with all road construction, and new construction is expected to be much less than the acreages provided for all road activities. In addition, we round up the Forest-specific estimates of individuals to the nearest whole number, and all Forest-specific estimates for adults are less than or equal to 1 bat.

4.5 Trail Construction/Reconstruction/Maintenance/Decommissioning

4.5.1 Literature Review for Effects of Trails

Trails on FS lands primarily serve recreational access to areas away from paved and unpaved roads. We are aware of no literature that pertains specifically to the effects of building and maintaining forest trails on bats. We consider the stressors associated with these activities as generally lesser-intensity analogs of the stressors associated with the construction and maintenance of unpaved Forest roads (see section 4.4.1).

4.5.2 Stressor-Exposure-Response Pathways for Trails

Trails are narrow unpaved roads with less stringent requirements for surface regularity, and the work associated with their construction and maintenance is often accomplished with hand tools and small off-road vehicles, if any. We limit the pathways we consider for the effects of trails work to the same two stressors (disturbance and tree removal) we identified for roads work in section 4.4.2 that, given exposure, result in take of individual NLEB. Similar to road construction, the BA does not indicate the fraction that represents new trail construction, which would involve the most tree clearing.

Pathway 17
Activity – All types of trail construction, reconstruction, maintenance, and decommissioning.
Stressor – Disturbance (noise, machinery exhaust, activity).
Exposure (time) – Active season, daytime; direct effect.
Exposure (space) – Roosting areas (maternity and non-maternity)
Resource affected – Individuals.
Individual response – Disturbance (fleeing from disturbance); take in the form of harass.
Interpretation – Fleeing disturbance during daylight hours increases the likelihood of predation.

Pathway 18
Activity – New trail construction; however, the FS did not provide new road construction acreages, so we use the acreages provided for all trails work.
Stressor – Removing roost trees.
Exposure (time) – Non-volant season for pups; direct effect. Active season for adults; direct effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Individuals; mostly non-volant pups. A smaller percentage of adults are also vulnerable.
Individual response – Injury, mortality; take in the form of harm.
Interpretation – Removing occupied trees is likely to kill or injure pups and adults. For the purposes of this consultation, we assume that all non-volant bats in felled trees may be harmed, but only 3% of adults may be injured or killed. It is also possible that trees felled

adjacent to roost trees could strike roosting bats and result in injury or death, but this is covered by the same assumptions for felling occupied roosts.

4.5.3 Estimation of Population Effects from Trails

For purposes of this analysis, as with roads (section 4.4.3), we consider the possibility of NLEB take resulting from the limited tree removal associated with repairs and maintenance of existing trails as discountable. Disturbance resulting from work on existing trails during the active season (April through October) is expected to cause take in the form of harassment affecting up to 96 volant NLEB annually (Pathway 17, Table 4.17). We estimate the acreage of active-season trail activity that we use in Table 4.17 as the sum of the non-volant season acreage plus 44.7 percent of the volant season acreage (see section 1.2.7; Table 1.8).

Take in the form of harm resulting from trail construction (Pathway 18, Tables 4.18 and 4.19) is expected to affect 26 non-volant pups and 15 adults. This is likely an over-estimate because we used the acreages associated with all trail construction, and new construction is expected to be much less than the acreages provided for all road activities. In addition, we round up the Forest-specific estimates of individuals to the nearest whole number, and all Forest-specific estimates are less than or equal to 1 bat.

4.6 Habitat Improvement/Non-Timber Clearing

4.6.1 Literature Review for Effects of Non-Timber Clearing

The project-level purposes for habitat improvement/non-timber clearing described in the BA are limited to the following examples: "timber stand improvement, wildlife stand improvement, mechanical fuels reduction, firewood cutting, recreation site maintenance, dropping individual trees in lakes and streams for fish habitat, and clearing for special use permits, wildlife opening development/maintenance, oil and gas well facilities, and pond construction." The primary effect of these activities relevant to the NLEB is tree removal, for which we have summarized the applicable literature under our discussion of timber harvest effects (section 4.1.1).

4.6.2 Stressor-Exposure-Response Pathways for Non-Timber Clearing

Tree removal for non-timber purposes is unlikely to resemble either the thinning or salvage/sanitation timber harvest types, and is more likely comparable to small clear cuts or group-selection cuts accomplished under even-aged and uneven-aged timber management, respectively. Stressor Pathways 2, 3, 4, 5, and 6, which we identified for these two timber harvest methods, are therefore applicable to tree-removal for non-timber purposes. These five pathways are repeated below with new pathway numbers and activity descriptions for purposes of attributing the sources of effects in our summary of effects (section 4.8).

Pathway 19
Activity – Non-timber tree clearing.
Stressor – Removing trees that provide habitat used for foraging, swarming, or staging.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – All occupied areas except hibernacula.

Resource affected – Insect prey, forest cover that supports (shelters) bat activity.
Individual response – Reduced fitness; energy expenditure for relocating from traditional use areas to alternative habitat.
Interpretation – Loss of forest habitat decreases opportunities for growth and successful reproduction. Depending on location and size of the clearing, forest cover removal in the summer home range may cause a shift in home range or relocation. Loss of habitat in staging/swarming areas near hibernacula may cause a similar shift in habitat use for larger numbers of individuals, due to their seasonal concentration in these areas, and may reduce fall mating success and/or reduced fitness in preparation for spring migration.

Pathway 20
Activity – Non-timber tree clearing.
Stressor – Altering the flow of air and water through hibernacula.
Exposure (time) – Winter (direct effect) and active season (indirect effect).
Exposure (space) – Near hibernacula.
Resource affected – Individuals.
Individual response – Arousal from hibernation; reduced fitness, mortality; take in the form of harm.
Interpretation – Response depends on proximity of clearing to hibernacula entrances, airflow patterns, and local hydrology. Sufficient modification may cause injury or mortality (take in the form of harm). We believe conservation measure #2 reduces this risk to insignificant levels by avoiding adverse changes within 0.25 mile of entrances.

Pathway 21
Activity – Non-timber tree clearing.
Stressor – Disturbance (noise, machinery exhaust, activity) associated with clearing.
Exposure (time) – Active season, daytime; direct effect.
Exposure (space) – Roosting areas (maternity and non-maternity)
Resource affected – Individuals.
Individual response – Disturbance (fleeing from disturbance); take in the form of harass.
Interpretation – Fleeing disturbance during daylight hours increases the likelihood of predation.

Pathway 22
Activity – Non-timber tree clearing.
Stressor – Removing roost trees.
Exposure (time) – Non-volant season for pups; direct effect. Active season for adults; direct effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Individuals; mostly non-volant pups. A smaller percentage of adults may also be affected.
Individual response – Injury, mortality (take in the form of harm).
Interpretation – Removing occupied trees is likely to kill or injure pups and adults. For the purposes of this consultation, we assume that all non-volant bats in felled trees may be harmed, but only 3% of adults may be injured or killed. It is also possible that trees felled

adjacent to roost trees could strike roosting bats and result in injury or death, but this is covered by the same assumptions for felling occupied roosts.

Pathway 23
Activity – Non-timber tree clearing for habitat improvement.
Stressor – Reducing clutter adjacent to roost trees.
Exposure (time) – Year-round; indirect effect.
Exposure (space) – Maternity roosting areas.
Resource affected – Vegetation near roost trees.
Individual response – Increased fitness and survival of pups.
Interpretation – Beneficial through increased solar radiation on roosts; improved access to roosts; travel corridors to foraging areas; however, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success. Response may vary with harvest proximity to roost trees from no benefit to pup survival to some benefit for some pups.

4.6.3 Estimation of Population Effects from Non-Timber Clearing

Tables 4.20, 4.21, 4.22, and 4.23 show our calculations for estimating the effects of Pathways 19, 21, 22, and 23, respectively, on NLEB populations in the Action Area. Pathway 19 causes reduced fitness by reducing available habitat resources, annually affecting up to 3,783 adult bats across all 15 Forests (Table 4.20). We do not believe that Pathway 20 affecting bats in hibernacula is likely to have significant effects due to FS standards for protecting known bat hibernacula.

Pathway 21 (clearing during the active season [April through October] within maternity roosting areas) causes take in the form of harassment affecting up to 3,730 volant NLEB (Table 4.21). The activity acreage we use for Pathway 21 is that for the non-volant season plus 44.7 percent of the volant season (August 1 – April 30) acreages reported in section 1.2.5, which accounts for the time when bats are hibernating and are not vulnerable to this disturbance (see section 4.2.3 for the calculation of this percentage). Pathway 22 (clearing during the non-volant season within maternity roosting areas for pups; all harvest types in the active season within maternity roosting areas for adults) causes take in the form of harm of up to 723 NLEB non-volant pups and 22 adults (Table 4.22 and Table 4.23). Pathway 23 acknowledges the potential beneficial effects of habitat improvement, which may result in increased fitness by improving the suitability of adjacent roost trees, affecting up to 1,899 NLEB pups (Table 4.24).

4.7 Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation.

As discussed in Section 1 (Proposed Action introduction), Forest Plans provide a framework for integrated resource management and guide project-level decision making. A Forest Plan does not authorize projects or activities, but projects and activities must contribute to Plan objectives and conform to its standards and guidelines. This consultation is a batched reinitiation of

consultation for 16 Forest Plans, which is necessary because the Service has listed a species that was not evaluated in the previous forest-specific consultations. All FS project-level actions in the Action Area are interrelated with the proposed Action, because they depend on the applicable Forest Plans for their justification. We are unaware of actions that would have independent utility (interdependent actions) that are not also governed by provisions of the Forest Plans and addressed in the FS BA. Sections 4.1 through 4.5 of this BO address all broad classes of activities that the FS has determined may adversely affect the NLEB. No additional interrelated or interdependent actions require analysis in this BO.

4.8 Summary of Effects

Table 4.25 combines the total estimated effects of the activities analyzed in sections 4.2 – 4.7 for each of the five general response categories we defined in section 4.1 for this effects analysis: increased fitness, reduced fitness, disturbance, harass, and harm. All of these estimates are based on the average annual impacted acres provided by the FS for each individual Forest. Acreages were derived based on full Forest Plan implementation, which is typically an overestimate. As such, the FS has stated that they do not anticipate exceeding the total amount of annual estimated effects across all 15 Forests. However, it is possible that the individual Forest numbers may vary in a given year by no more than 30% of the total number estimated for each response category on each Forest.

The largest category is increased fitness resulting from thinning/uneven-aged harvests, habitat improvement/non-timber clearing, and prescribed burning, which affects up to 16,043 NLEB annually. The smallest category is harm (death or injury resulting from habitat modification), which affects up to 2,102 pups and 76 adults by tree removal or burning in maternity roosting areas during the non-volant season. Our effects analyses identify several possible pathways for the Action to affect NLEB in hibernacula (harvest Pathway 4, burning Pathway 9, and habitat improvement/non-timber clearing Pathway 20); however, we believe that existing standards and guidelines in Forest Plans that protect known hibernacula avoid adverse effects. The following discussion and accompanying tables provide further interpretation of the results for each response category.

Increased Fitness

Thinning/uneven-aged harvest (Pathway 2), habitat improvement/non-timber clearing (Pathway 23) and three effects pathways for prescribed burning (Pathways 7, 13, and 14) may to some unknown degree increase the fitness of 16,043 NLEB annually, or 2.4 percent of the total NLEB estimated population (436,950 adults plus 218,475 pups) across all 15 Forests (Table 4.26). Habitat is not considered a limiting factor to the NLEB throughout its range; however, where there is suboptimal habitat, these practices may improve habitat conditions through greater availability of suitable roosts increasing opportunities for successful reproduction and more efficient use of forest habitat. Regardless, we are unable to quantify the degree of benefit in terms of increased survival or reproductive success.

Reduced Fitness

Our estimate of Action-induced reduced fitness of NLEB individuals amounts to 12,703 adult bats (Table 4.27), because juveniles (either volant or non-volant) are not exposed to the four pathways causing these effects (harvest Pathways 1, and 3; burning Pathway 8; and non-timber clearing Pathway 19).

Disturbance

One pathway for prescribed burning (Pathway 11) is the sole source of the disturbance response category, which amounts to 3,670 volant bats annually affecting 0.6 percent of the total adult and juvenile population (Table 4.10). Fleeing the heat and smoke of fires that persist through the night in foraging areas is unlikely to directly injure bats, but instead divert them to alternative and possibly less productive foraging areas. Despite the number of bats exposed to this stressor, we consider it a minor effect that is unlikely to result in any measurable reduction in bat numbers or reproduction, and only temporary, localized changes in their distribution.

Harass

Each of the five categories of proposed activities – harvest, burning, roads, trails, and non-timber clearing – may occur in maternity roosting areas during the active season (April – October). The disturbance associated with these activities (harvest Pathway 5, burning Pathway 10, roads Pathway 15, trails Pathway 17, and non-timber Pathway 21) can cause volant bats to flee their roosts and expend additional energy while exposed to day-time predators. Our methodology computes the number of NLEB within these pathways as 13,535 bats (2.1 percent of total NLEB numbers) (Table 4.28). The numbers vary by individual Forest, but less than 5% of the total number of NLEBs may be affected on all Forests except the Midewin (9%) (Table 4.28). We recognize that not all bats roosting in an activity area necessarily respond to disturbance by fleeing their roosts, likely depending on the disturbance intensity and proximity. Table 4.28 shows that 27.2 percent of the potential disturbance in maternity roosting areas is due to prescribed burning, 45.2 percent to harvest, roads, and trails, and 27.6 percent to habitat improvement/non-timber clearing. Disturbance that disrupts normal behavior patterns and creates the likelihood of injury to listed species (e.g., causing a nocturnal species to travel during daylight hours) is take in the form of harass. The total extent of active-season activity that may cause harassment is 229,468 acres (Table 1.8); however, our analysis does not identify the occupied maternity roosting areas within this extent where the take occurs. Our estimate of the amount of take is derived from the expected overlap between activity areas and occupied areas (see section 4.1).

Harm

Each of the five categories of proposed activities – harvest, burning, roads, trails, and habitat improvement/non-timber clearing – may occur in maternity roosting areas during the non-volant season (May 1 – July 31). Heat and smoke from prescribed burning, and tree removal from the other activities, may kill or injure a non-volant pup, who cannot flee the threat unless carried by its mother, which we do not presume precludes this potential harm. We estimate that up to 2,102

NLEB pups (1 percent of the total pup population) are exposed to potentially lethal habitat modification. The numbers vary by individual Forest, but less than 2% of the total number of NLEBs may be affected on all Forests except the Huron (3%) and Midewin (4%) (Table 4.29). Prescribed burning may affect 17.4 percent of the total pup population (Table 4.29). The potential for death or injury resulting from prescribed burning depends largely on site-specific circumstances, e.g., fire intensity near the maternity roost tree and the height above ground of pups in the maternity roost tree. Not all fires through maternity roosting areas will kill or injure all pups present, but our methodology in this BO estimates that all potentially vulnerable individuals within the expected area of activity/occupancy overlap are affected. Timber harvest, new road construction, and new trail construction account for 48.2 percent of the estimated harm to non-volant pups, and 34.4 percent is due to habitat improvement/non-timber clearing (Table 4.29). Similar to prescribed burning, not all tree removal activities through maternity roosting areas will kill or injure all pups present, but our methodology estimates that all potentially vulnerable individuals within the expected area of activity/occupancy overlap are affected.

Tree removal from timber harvest, road and trail construction, and habitat improvement/non-timber clearing, may also kill or injure adults when occupied roost trees are felled. We estimate that up to 76 NLEB adults (less than 0.02 percent of the total adult population) are exposed to potentially lethal habitat modification (Table 4.30). Less than 1% of the total number of NLEB adults are affected on all Forests except Midewin (Table 4.30). Timber harvest, new road construction, and new trail construction account for 71.1 percent of the estimated harm to adults, and 28.9 percent is due to habitat improvement/non-timber clearing (Table 4.30).

The total extent of non-volant-season activity that may cause harm for pups is 108,881 acres (total in Table 1.9), and the total extent of active season activity that may cause harm for adults is 171,743 (229,468 total acres minus 57,725 acres of prescribed burning in Table 1.8). However, our analysis does not identify the occupied maternity roosting areas within this extent where the take occurs. Our estimate of the amount of take is derived from the expected overlap between activity areas and occupied areas (see section 4.1). A further source of imprecision in our estimate of harm relates to our use of May 1–July 31 as the non-volant season and April 1-October 31 for the active season. These periods are variable across the action area depending on latitude, elevation, and weather conditions. However, we believe these ranges captures most of the periods on most Forests in most years.

Our analyses for both harassment- and harm-effects pathways highlight the potential conservation importance of identifying maternity roosting areas on the Forests to inform project-level siting and scheduling decisions.

4.9 Tables and Figures for Effects of the Action

Table 4.1. Estimated numbers of NLEB adults affected by roosting habitat loss from annual salvage harvest.

Forest	A. Annual Salvage Harvest (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[2] x E)
Allegheny	0	475,496	0%	28.0%	0	0
Chequamegon-Nicolet	515	1,318,863	0%	56.1%	289	24
Chippewa	100	589,690	0.017%	56.1%	56	5
Green Mtn & Finger Lakes	0	398,379	0.000%	33.3%	0	0
Hiawatha	0	793,539	0.000%	56.1%	0	0
Hoosier	620	195,969	0.316%	29.4%	182	15
Huron-Manistee	250	915,757	0.027%	21.7%	54	5
Mark Twain	15,000	1,398,068	1.073%	58.8%	8,814	718
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	0	900,000	0.000%	60.2%	0	0
Ottawa	324	905,000	0.036%	56.1%	182	15
Shawnee	0	252,900	0.000%	57.1%	0	0
Superior	100	2,093,062	0.005%	56.1%	56	5
Wayne	0	224,546	0.000%	26.2%	0	0
White Mtn	0	793,000	0.000%	9.3%	0	0
Total	16,909	11,256,024	0.150%		9,633	787

[1] From Table 3.2

[2] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.2. Estimated numbers of NLEB pups potentially affected by improved roosting conditions from annual thinning harvest in maternity roosting areas.

Forest	A. Annual Thinning & Uneven-Aged Harvest (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	1,495	475,496	0.314%	4.2%	64	18
Chequamegon-Nicolet	14,630	1,318,863	1.109%	8.5%	1,239	334
Chippewa	3,854	589,690	0.654%	8.5%	327	89
Green Mtn & Finger Lakes	2,133	398,379	0.535%	5.1%	108	30
Hiawatha	11,420	793,539	1.439%	8.5%	969	261
Hoosier	522	195,969	0.266%	4.5%	24	7
Huron-Manistee	6,888	915,757	0.752%	3.3%	227	62
Mark Twain	12,340	1,398,068	0.883%	8.9%	1,095	296
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	1,000	900,000	0.111%	9.1%	91	25
Ottawa	11,150	905,000	1.232%	8.5%	944	255
Shawnee	36	252,900	0.014%	8.7%	3	1
Superior	2,340	2,093,062	0.112%	8.5%	198	54
Wayne	1,602	224,546	0.713%	4.0%	64	18
White Mtn	2,135	793,000	0.269%	1.4%	30	9
Total	71,545	11,256,024	0.636%		5,384	1,459

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.3. Estimated numbers of NLEB adults affected by habitat loss from annual even- and uneven-aged harvest.

Forest	A. Annual Even- and Uneven-Aged Harvest (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[2] x E)
Allegheny	3,980	475,496	0.837%	28.0%	1,114	91
Chequamegon-Nicolet	13,000	1,318,863	0.986%	56.1%	7,290	594
Chippewa	7,087	589,690	1.202%	56.1%	3,974	324
Green Mtn & Finger Lakes	4,556	398,379	1.144%	33.3%	1,519	124
Hiawatha	9,470	793,539	1.193%	56.1%	5,310	433
Hoosier	682	195,969	0.348%	29.4%	201	17
Huron-Manistee	6,984	915,757	0.763%	21.7%	1,518	124
Mark Twain	11,276	1,398,068	0.807%	58.8%	6,626	540
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	3,000	900,000	0.333%	60.2%	1,805	147
Ottawa	10,900	905,000	1.204%	56.1%	6,112	498
Shawnee	1,223	252,900	0.484%	57.1%	699	57
Superior	11,968	2,093,062	0.572%	56.1%	6,711	547
Wayne	1,723	224,546	0.767%	26.2%	451	37
White Mtn	2,365	793,000	0.298%	9.3%	220	18
Total	88,214	11,256,024	0.784%		43,549	3,551

[1] From Table 3.2

[2] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.4. Estimated numbers of NLEB affected (harassed) by disturbance from active-season harvest activity (all types) in maternity roosting areas.

Forest	A. All Harvest Types, Bat Active Season (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[2] x E)
Allegheny	2,724	475,496	0.573%	4.2%	116	94
Chequamegon-Nicolet	12,062	1,318,863	0.915%	8.5%	1,022	827
Chippewa	4,742	589,690	0.804%	8.5%	403	326
Green Mtn & Finger Lakes	4,456	398,379	1.119%	5.1%	226	183
Hiawatha	11,267	793,539	1.420%	8.5%	956	773
Hoosier	845	195,969	0.431%	4.5%	38	31
Huron-Manistee	7,788	915,757	0.850%	3.3%	257	208
Mark Twain	22,511	1,398,068	1.610%	8.9%	1,998	1,616
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	2,452	900,000	0.272%	9.1%	223	181
Ottawa	8,602	905,000	0.951%	8.5%	729	589
Shawnee	833	252,900	0.329%	8.7%	72	59
Superior	6,770	2,093,062	0.323%	8.5%	574	464
Wayne	1,117	224,546	0.498%	4.0%	45	37
White Mtn	1,826	793,000	0.230%	1.4%	26	21
Total	87,995	11,256,024	0.782%		6,683	5,409

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.2

[3] 0.8084 adult and volant juvenile northern long-eared bats per acre of roosting habitat (see section 4.1).

Table 4.5. Estimated numbers of NLEB pups affected (harmed) by non-volant season harvest (all types) in maternity roosting areas.

Forest	A. All Havest Types, Non-Volant Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	900	475,496	0.189%	4.2%	38	11
Chequamegon-Nicolet	5,149	1,318,863	0.390%	8.5%	436	118
Chippewa	2,026	589,690	0.344%	8.5%	172	47
Green Mtn & Finger Lakes	3,543	398,379	0.889%	5.1%	180	49
Hiawatha	6,616	793,539	0.834%	8.5%	561	152
Hoosier	373	195,969	0.190%	4.5%	17	5
Huron-Manistee	3,327	915,757	0.363%	3.3%	110	30
Mark Twain	11,400	1,398,068	0.815%	8.9%	1,012	273
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	1,200	900,000	0.133%	9.1%	109	30
Ottawa	3,654	905,000	0.404%	8.5%	309	84
Shawnee	489	252,900	0.193%	8.7%	42	12
Superior	1,508	2,093,062	0.072%	8.5%	128	35
Wayne	510	224,546	0.227%	4.0%	20	6
White Mtn	606	793,000	0.076%	1.4%	9	3
Total	41,301	11,256,024	0.367%		3,144	855

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.6. Estimated numbers of NLEB adults affected (harmed) by active season harvest (all types) in maternity roosting areas.

Forest	A. All Havest Types, Active Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[3] x E)
Allegheny	2,724	475,496	0.573%	4.2%	116	1
Chequamegon-Nicolet	12,062	1,318,863	0.915%	8.5%	1,022	3
Chippewa	4,742	589,690	0.804%	8.5%	403	1
Green Mtn & Finger Lakes	4,456	398,379	1.119%	5.1%	226	1
Hiawatha	11,267	793,539	1.420%	8.5%	956	3
Hoosier	845	195,969	0.431%	4.5%	38	1
Huron-Manistee	7,788	915,757	0.850%	3.3%	257	1
Mark Twain	22,511	1,398,068	1.610%	8.9%	1,998	5
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	2,452	900,000	0.272%	9.1%	223	1
Ottawa	8,602	905,000	0.951%	8.5%	729	2
Shawnee	833	252,900	0.329%	8.7%	72	1
Superior	6,770	2,093,062	0.323%	8.5%	574	2
Wayne	1,117	224,546	0.498%	4.0%	45	1
White Mtn	1,826	793,000	0.230%	1.4%	26	1
Total	87,995	11,256,024	0.782%		6,683	24

[1] From Table 3.3

[3] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.7. Estimated numbers of NLEB adults affected by new snags/roosts created from annual prescribed burning.

Forest	A. Annual Burning (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[2] x E)
Allegheny	652	475,496	0.1%	28.0%	183	15
Chequamegon-Nicolet	5,100	1,318,863	0.4%	56.1%	2,860	233
Chippewa	3,720	589,690	0.6%	56.1%	2,086	170
Green Mtn & Finger Lakes	525	398,379	0.1%	33.3%	175	15
Hiawatha	520	793,539	0.1%	56.1%	292	24
Hoosier	2,000	195,969	1.0%	29.4%	588	48
Huron-Manistee	8,000	915,757	0.9%	21.7%	1,739	142
Mark Twain	60,000	1,398,068	4.3%	58.8%	35,256	2,870
Midewin	200	1,755	11.4%	9.5%	19	2
Monongahela	915	900,000	0.1%	60.2%	550	45
Ottawa	250	905,000	0.0%	56.1%	140	12
Shawnee	12,912	252,900	5.1%	57.1%	7,378	601
Superior	5,458	2,093,062	0.3%	56.1%	3,061	250
Wayne	7,132	224,546	3.2%	26.2%	1,865	152
White Mtn	300	793,000	0.0%	9.3%	28	3
Total	107,684	11,256,024	0.957%		56,219	4,582

[1] From Table 3.2

[2] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.8. Estimated numbers of NLEB adults affected by destroying existing snags/roosts from annual prescribed burning.

Forest	A. Annual Burning (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[2] x E)
Allegheny	652	475,496	0.1%	28.0%	183	15
Chequamegon-Nicolet	5,100	1,318,863	0.4%	56.1%	2,860	233
Chippewa	3,720	589,690	0.6%	56.1%	2,086	170
Green Mtn & Finger Lakes	525	398,379	0.1%	33.3%	175	15
Hiawatha	520	793,539	0.1%	56.1%	292	24
Hoosier	2,000	195,969	1.0%	29.4%	588	48
Huron-Manistee	8,000	915,757	0.9%	21.7%	1,739	142
Mark Twain	60,000	1,398,068	4.3%	58.8%	35,256	2,870
Midewin	200	1,755	11.4%	9.5%	19	2
Monongahela	915	900,000	0.1%	60.2%	550	45
Ottawa	250	905,000	0.0%	56.1%	140	12
Shawnee	12,912	252,900	5.1%	57.1%	7,378	601
Superior	5,458	2,093,062	0.3%	56.1%	3,061	250
Wayne	7,132	224,546	3.2%	26.2%	1,865	152
White Mtn	300	793,000	0.0%	9.3%	28	3
Total	107,684	11,256,024	0.957%		56,219	4,582

[1] From Table 3.2

[2] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.9. Estimated numbers of NLEB affected (harassed) by heat and smoke from active-season prescribed burning in maternity roosting areas.

Forest	A. Active Season Burning (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[3] x E)
Allegheny	291	475,496	0.1%	4.2%	12	11
Chequamegon-Nicolet	4,492	1,318,863	0.3%	8.5%	380	308
Chippewa	3,309	589,690	0.6%	8.5%	281	228
Green Mtn & Finger Lakes	419	398,379	0.1%	5.1%	21	18
Hiawatha	491	793,539	0.1%	8.5%	42	34
Hoosier	1,032	195,969	0.5%	4.5%	47	38
Huron-Manistee	4,682	915,757	0.5%	3.3%	155	125
Mark Twain	30,138	1,398,068	2.2%	8.9%	2,675	2,163
Midewin	89	1,755	5.1%	9.5%	9	7
Monongahela	445	900,000	0.0%	9.1%	40	33
Ottawa	222	905,000	0.0%	8.5%	19	16
Shawnee	5,772	252,900	2.3%	8.7%	499	404
Superior	2,568	2,093,062	0.1%	8.5%	218	176
Wayne	3,582	224,546	1.6%	4.0%	144	117
White Mtn	192	793,000	0.0%	1.4%	3	3
Total	57,725	11,256,024	0.5%		4,544	3,681

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.3

[3] 0.8084 adult and volant juvenile northern long-eared bats per acre of roosting habitat (see section 4.1).

Table 4.10. Estimated numbers of NLEB affected by heat and smoke from active-season prescribed burning in foraging areas.

Forest	A. Active Season Burning (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[3] x E)
Allegheny	291	475,496	0.1%	28.0%	82	10
Chequamegon-Nicolet	4,492	1,318,863	0.3%	56.1%	2,519	308
Chippewa	3,309	589,690	0.6%	56.1%	1,855	227
Green Mtn & Finger Lakes	419	398,379	0.1%	33.3%	140	18
Hiawatha	491	793,539	0.1%	56.1%	275	34
Hoosier	1,032	195,969	0.5%	29.4%	304	38
Huron-Manistee	4,682	915,757	0.5%	21.7%	1,018	125
Mark Twain	30,138	1,398,068	2.2%	58.8%	17,709	2,162
Midewin	89	1,755	5.1%	9.5%	9	2
Monongahela	445	900,000	0.0%	60.2%	268	33
Ottawa	222	905,000	0.0%	56.1%	125	16
Shawnee	5,772	252,900	2.3%	57.1%	3,298	403
Superior	2,568	2,093,062	0.1%	56.1%	1,440	176
Wayne	3,582	224,546	1.6%	26.2%	937	115
White Mtn	192	793,000	0.0%	9.3%	18	3
Total	57,725	11,256,024	0.5%		29,995	3,670

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.2

[3] 0.1221 adult and volant juvenile northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.11. Estimated numbers of NLEB pups affected (harmed) by heat and smoke from non-volant season prescribed burning in maternity roosting areas.

Forest	A. Non-Volant Season Burning (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	0	475,496	0.0%	4.2%	0	0
Chequamegon-Nicolet	4,000	1,318,863	0.3%	8.5%	339	92
Chippewa	2,976	589,690	0.5%	8.5%	253	69
Green Mtn & Finger Lakes	333	398,379	0.1%	5.1%	17	5
Hiawatha	468	793,539	0.1%	8.5%	40	11
Hoosier	250	195,969	0.1%	4.5%	11	4
Huron-Manistee	2,000	915,757	0.2%	3.3%	66	18
Mark Twain	6,000	1,398,068	0.4%	8.9%	533	144
Midewin	0	1,755	0.0%	9.5%	0	0
Monongahela	65	900,000	0.0%	9.1%	6	2
Ottawa	200	905,000	0.0%	8.5%	17	5
Shawnee	0	252,900	0.0%	8.7%	0	0
Superior	232	2,093,062	0.0%	8.5%	20	6
Wayne	713	224,546	0.3%	4.0%	29	8
White Mtn	105	793,000	0.0%	1.4%	1	1
Total	17,342	11,256,024	0.154%		1,331	365

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.12. Estimated numbers of NLEB affected by increased insect prey in foraging areas from annual prescribed burning.

Forest	A. Annual Burning (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[2] x E)
Allegheny	652	475,496	0.1%	28.0%	183	23
Chequamegon-Nicolet	5,100	1,318,863	0.4%	56.1%	2,860	350
Chippewa	3,720	589,690	0.6%	56.1%	2,086	255
Green Mtn & Finger Lakes	525	398,379	0.1%	33.3%	175	22
Hiawatha	520	793,539	0.1%	56.1%	292	36
Hoosier	2,000	195,969	1.0%	29.4%	588	72
Huron-Manistee	8,000	915,757	0.9%	21.7%	1,739	213
Mark Twain	60,000	1,398,068	4.3%	58.8%	35,256	4,305
Midewin	200	1,755	11.4%	9.5%	19	3
Monongahela	915	900,000	0.1%	60.2%	550	68
Ottawa	250	905,000	0.0%	56.1%	140	18
Shawnee	12,912	252,900	5.1%	57.1%	7,378	901
Superior	5,458	2,093,062	0.3%	56.1%	3,061	374
Wayne	7,132	224,546	3.2%	26.2%	1,865	228
White Mtn	300	793,000	0.0%	9.3%	28	4
Total	107,684	11,256,024	0.957%		56,219	6,872

[1] From Table 3.2

[2] 0.1221 adult and volant juvenile northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.13. Estimated numbers of NLEB pups affected by improved roosting conditions during the non-volant season following volant-season annual prescribed burning.

Forest	A. Active Season Burning (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[3] x E)
Allegheny	291	475,496	0.1%	4.2%	12	4
Chequamegon-Nicolet	4,492	1,318,863	0.3%	8.5%	380	103
Chippewa	3,309	589,690	0.6%	8.5%	281	76
Green Mtn & Finger Lakes	419	398,379	0.1%	5.1%	21	6
Hiawatha	491	793,539	0.1%	8.5%	42	12
Hoosier	1,032	195,969	0.5%	4.5%	47	13
Huron-Manistee	4,682	915,757	0.5%	3.3%	155	42
Mark Twain	30,138	1,398,068	2.2%	8.9%	2,675	721
Midewin	89	1,755	5.1%	9.5%	9	3
Monongahela	445	900,000	0.0%	9.1%	40	11
Ottawa	222	905,000	0.0%	8.5%	19	6
Shawnee	5,772	252,900	2.3%	8.7%	499	135
Superior	2,568	2,093,062	0.1%	8.5%	218	59
Wayne	3,582	224,546	1.6%	4.0%	144	39
White Mtn	192	793,000	0.0%	1.4%	3	1
Total	57,725	11,256,024	0.513%		4,544	1,231

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.2

[3] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.14. Estimated numbers of NLEB affected (harassed) by disturbance from active-season work on Forest roads in maternity roosting areas.

Forest	A. All Roads Work, Bat Active Season (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[3] x E)
Allegheny	203	475,496	0.043%	4.2%	9	7
Chequamegon-Nicolet	3,344	1,318,863	0.254%	8.5%	283	229
Chippewa	1,351	589,690	0.229%	8.5%	115	93
Green Mtn & Finger Lakes	28	398,379	0.007%	5.1%	1	2
Hiawatha	131	793,539	0.016%	8.5%	11	9
Hoosier	25	195,969	0.013%	4.5%	1	1
Huron-Manistee	1,180	915,757	0.129%	3.3%	39	32
Mark Twain	90	1,398,068	0.006%	8.9%	8	7
Midewin	15	1,755	0.875%	9.5%	1	2
Monongahela	526	900,000	0.058%	9.1%	48	39
Ottawa	1,431	905,000	0.158%	8.5%	121	98
Shawnee	239	252,900	0.094%	8.7%	21	17
Superior	1,167	2,093,062	0.056%	8.5%	99	80
Wayne	43	224,546	0.019%	4.0%	2	2
White Mtn	24	793,000	0.003%	1.4%	0	1
Total	9,796	11,256,024	0.087%		759	619

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.2

[3] 0.8084 adult and volant juvenile northern long-eared bats per acre of roosting habitat (see section 4.1).

Table 4.15. Estimated numbers of NLEB pups affected (harmed) by tree removal from non-volant-season work on Forest roads in maternity roosting areas.

Forest	A. All Roads Work, Non-Volant Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	131	475,496	0.028%	4.2%	5.57	2
Chequamegon-Nicolet	2,068	1,318,863	0.157%	8.5%	175.18	48
Chippewa	804	589,690	0.136%	8.5%	68.31	19
Green Mtn & Finger Lakes	0	398,379	0.000%	5.1%	0.00	0
Hiawatha	82	793,539	0.010%	8.5%	6.95	2
Hoosier	16	195,969	0.008%	4.5%	0.72	1
Huron-Manistee	1,004	915,757	0.110%	3.3%	33.14	9
Mark Twain	36	1,398,068	0.003%	8.9%	3.20	1
Midewin	10	1,755	0.570%	9.5%	0.95	1
Monongahela	315	900,000	0.035%	9.1%	28.64	8
Ottawa	795	905,000	0.088%	8.5%	67.34	19
Shawnee	126	252,900	0.050%	8.7%	10.90	3
Superior	788	2,093,062	0.038%	8.5%	66.77	18
Wayne	29	224,546	0.013%	4.0%	1.16	1
White Mtn	17	793,000	0.002%	1.4%	0.24	1
Total	6,221	11,256,024	0.055%		469.07	133

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.16. Estimated numbers of NLEB adults affected (harmed) by tree removal from active-season work on Forest roads in maternity roosting areas.

Forest	A. All Roads Work, Active Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[3] x E)
Allegheny	203	475,496	0.043%	4.2%	8.61	1
Chequamegon-Nicolet	3,344	1,318,863	0.254%	8.5%	283.25	1
Chippewa	1,351	589,690	0.229%	8.5%	114.75	1
Green Mtn & Finger Lakes	28	398,379	0.007%	5.1%	1.43	1
Hiawatha	131	793,539	0.016%	8.5%	11.09	1
Hoosier	25	195,969	0.013%	4.5%	1.13	1
Huron-Manistee	1,180	915,757	0.129%	3.3%	38.94	1
Mark Twain	90	1,398,068	0.006%	8.9%	8.00	1
Midewin	15	1,755	0.875%	9.5%	1.46	1
Monongahela	526	900,000	0.058%	9.1%	47.86	1
Ottawa	1,431	905,000	0.158%	8.5%	121.21	1
Shawnee	239	252,900	0.094%	8.7%	20.64	1
Superior	1,167	2,093,062	0.056%	8.5%	98.89	1
Wayne	43	224,546	0.019%	4.0%	1.72	1
White Mtn	24	793,000	0.003%	1.4%	0.33	1
Total	9,796	11,256,024	0.087%		759.32	15

[1] From Table 3.3

[3] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.17. Estimated numbers of NLEB affected (harassed) by disturbance from active-season work on Forest trails in maternity roosting areas.

Forest	A. All Trails Work, Bat Active Season (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[3] x E)
Allegheny	1.7	475,496	0.000%	4.2%	0.1	1
Chequamegon-Nicolet	317.8	1,318,863	0.024%	8.5%	26.9	22
Chippewa	86.8	589,690	0.015%	8.5%	7.4	6
Green Mtn & Finger Lakes	222.4	398,379	0.056%	5.1%	11.3	10
Hiawatha	155.6	793,539	0.020%	8.5%	13.2	11
Hoosier	1.4	195,969	0.001%	4.5%	0.1	1
Huron-Manistee	14.2	915,757	0.002%	3.3%	0.5	1
Mark Twain	103.7	1,398,068	0.007%	8.9%	9.2	8
Midewin	5.4	1,755	0.309%	9.5%	0.5	1
Monongahela	66.4	900,000	0.007%	9.1%	6.0	5
Ottawa	72.5	905,000	0.008%	8.5%	6.1	5
Shawnee	36.3	252,900	0.014%	8.7%	3.1	3
Superior	222.9	2,093,062	0.011%	8.5%	18.9	16
Wayne	45.8	224,546	0.020%	4.0%	1.8	2
White Mtn	342.6	793,000	0.043%	1.4%	4.8	4
Total	1,695.5	11,256,024	0.015%		110.0	96

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.3

[3] 0.8084 adult and volant juvenile northern long-eared bats per acre of roosting habitat (see section 4.1).

Table 4.18. Estimated numbers of NLEB affected (harmed) by disturbance from non-volant-season work on Forest trails in maternity roosting areas.

Forest	A. All Trails Work, Non-Volant Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	1	475,496	0.0002%	4.2%	0.03	1
Chequamegon-Nicolet	169	1,318,863	0.0128%	8.5%	14.35	4
Chippewa	32	589,690	0.0055%	8.5%	2.74	1
Green Mtn & Finger Lakes	116	398,379	0.0291%	5.1%	5.88	2
Hiawatha	97	793,539	0.0122%	8.5%	8.23	3
Hoosier	0	195,969	0.0002%	4.5%	0.02	1
Huron-Manistee	14	915,757	0.0015%	3.3%	0.47	1
Mark Twain	37	1,398,068	0.0027%	8.9%	3.29	1
Midewin	4	1,755	0.2074%	9.5%	0.35	1
Monongahela	46	900,000	0.0051%	9.1%	4.17	2
Ottawa	23	905,000	0.0025%	8.5%	1.94	1
Shawnee	26	252,900	0.0103%	8.7%	2.25	1
Superior	155	2,093,062	0.0074%	8.5%	13.10	4
Wayne	29	224,546	0.0130%	4.0%	1.18	1
White Mtn	284	793,000	0.0358%	1.4%	4.01	2
Total	1,033	11,256,024	0.0092%		62.00	26

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.19. Estimated numbers of NLEB affected (harmed) by disturbance from active-season work on Forest trails in maternity roosting areas.

Forest	A. All Trails Work, Active Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[3] x E)
Allegheny	2	475,496	0.0004%	4.2%	0.07	1
Chequamegon-Nicolet	318	1,318,863	0.0241%	8.5%	26.92	1
Chippewa	87	589,690	0.0147%	8.5%	7.37	1
Green Mtn & Finger Lakes	222	398,379	0.0558%	5.1%	11.28	1
Hiawatha	156	793,539	0.0196%	8.5%	13.20	1
Hoosier	1	195,969	0.0007%	4.5%	0.06	1
Huron-Manistee	14	915,757	0.0015%	3.3%	0.47	1
Mark Twain	104	1,398,068	0.0074%	8.9%	9.20	1
Midewin	5	1,755	0.3093%	9.5%	0.52	1
Monongahela	66	900,000	0.0074%	9.1%	6.04	1
Ottawa	73	905,000	0.0080%	8.5%	6.14	1
Shawnee	36	252,900	0.0143%	8.7%	3.14	1
Superior	223	2,093,062	0.0107%	8.5%	18.89	1
Wayne	46	224,546	0.0204%	4.0%	1.84	1
White Mtn	343	793,000	0.0432%	1.4%	4.83	1
Total	1,695	11,256,024	0.0151%		109.98	15

[1] From Table 3.3

[3] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.20. Estimated numbers of NLEB adults affected by habitat loss from annual habitat/improvement non-timber tree clearing.

Forest	A. Annual Non-Timber Clearing (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Occupied[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[2] x E)
Allegheny	4,530	475,496	0.953%	28.0%	1,268	104
Chequamegon-Nicolet	6,700	1,318,863	0.508%	56.1%	3,757	306
Chippewa	7,019	589,690	1.190%	56.1%	3,936	321
Green Mtn & Finger Lakes	2,320	398,379	0.582%	33.3%	773	63
Hiawatha	4,880	793,539	0.615%	56.1%	2,736	223
Hoosier	682	195,969	0.348%	29.4%	201	17
Huron-Manistee	34,916	915,757	3.813%	21.7%	7,591	618
Mark Twain	25,235	1,398,068	1.805%	58.8%	14,828	1,207
Midewin	42	1,755	2.393%	9.5%	4	1
Monongahela	3,950	900,000	0.439%	60.2%	2,376	194
Ottawa	6,279	905,000	0.694%	56.1%	3,521	287
Shawnee	2,298	252,900	0.909%	57.1%	1,313	107
Superior	5,725	2,093,062	0.274%	56.1%	3,210	262
Wayne	3,131	224,546	1.394%	26.2%	819	67
White Mtn	765	793,000	0.096%	9.3%	71	6
Total	108,472	11,256,024	0.964%		46,405	3,783

[1] From Table 3.2

[2] 0.0846 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.21. Estimated numbers of NLEB affected (harassed) by disturbance from active-season-habitat/improvement non-timber tree clearing in maternity roosting areas.

Forest	A. Non-Timber Clearing, Bat Active Season (acres)[1]	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Roost Areas[2]	E. Expected Overlap (acres) (BxCxD)	F. Number of Bats Affected (Density[2] x E)
Allegheny	2,380	475,496	0.501%	4.2%	101	82
Chequamegon-Nicolet	4,847	1,318,863	0.368%	8.5%	411	332
Chippewa	4,856	589,690	0.823%	8.5%	413	334
Green Mtn & Finger Lakes	1,534	398,379	0.385%	5.1%	78	63
Hiawatha	3,588	793,539	0.452%	8.5%	304	247
Hoosier	399	195,969	0.204%	4.5%	18	15
Huron-Manistee	25,262	915,757	2.759%	3.3%	834	675
Mark Twain	15,571	1,398,068	1.114%	8.9%	1,382	1,118
Midewin	19	1,755	1.070%	9.5%	2	2
Monongahela	2,421	900,000	0.269%	9.1%	220	178
Ottawa	3,358	905,000	0.371%	8.5%	284	230
Shawnee	1,528	252,900	0.604%	8.7%	132	107
Superior	4,036	2,093,062	0.193%	8.5%	342	277
Wayne	1,916	224,546	0.853%	4.0%	77	63
White Mtn	544	793,000	0.069%	1.4%	8	7
Total	72,257	11,256,024	0.642%		4,605	3,730

[1] Non-volant season acreages plus 44.7 percent of volant-season acreages (from Table 1.8).

[2] From Table 3.3

[3] 0.8084 adult and volant juvenile northern long-eared bats per acre of roosting habitat (see section 4.1).

Table 4.22. Estimated numbers of NLEB pups affected (harmed) by non-volant-season-non-timber tree clearing in maternity roosting areas.

Forest	A. Non-Timber Clearing, Non-Volant Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	642	475,496	0.135%	4.2%	27	8
Chequamegon-Nicolet	3,350	1,318,863	0.254%	8.5%	284	77
Chippewa	3,107	589,690	0.527%	8.5%	264	72
Green Mtn & Finger Lakes	899	398,379	0.226%	5.1%	46	13
Hiawatha	2,544	793,539	0.321%	8.5%	216	59
Hoosier	170	195,969	0.087%	4.5%	8	3
Huron-Manistee	17,459	915,757	1.907%	3.3%	576	156
Mark Twain	7,759	1,398,068	0.555%	8.9%	689	186
Midewin	0	1,755	0.000%	9.5%	0	0
Monongahela	1,185	900,000	0.132%	9.1%	108	30
Ottawa	996	905,000	0.110%	8.5%	84	23
Shawnee	905	252,900	0.358%	8.7%	78	22
Superior	2,670	2,093,062	0.128%	8.5%	226	61
Wayne	933	224,546	0.416%	4.0%	37	11
White Mtn	365	793,000	0.046%	1.4%	5	2
Total	42,984	11,256,024	0.382%		2,648	723

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.23. Estimated numbers of NLEB adults affected (harmed) by active-season-non-timber tree clearing in maternity roosting areas.

Forest	A. Non-Timber Clearing, Active Season (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Adults Affected (Density[3] x E)
Allegheny	2,380	475,496	0.501%	4.2%	101	1
Chequamegon-Nicolet	4,847	1,318,863	0.368%	8.5%	411	2
Chippewa	4,856	589,690	0.823%	8.5%	413	2
Green Mtn & Finger Lakes	1,534	398,379	0.385%	5.1%	78	1
Hiawatha	3,588	793,539	0.452%	8.5%	304	1
Hoosier	399	195,969	0.204%	4.5%	18	1
Huron-Manistee	25,262	915,757	2.759%	3.3%	834	3
Mark Twain	15,571	1,398,068	1.114%	8.9%	1,382	4
Midewin	19	1,755	1.070%	9.5%	2	1
Monongahela	2,421	900,000	0.269%	9.1%	220	1
Ottawa	3,358	905,000	0.371%	8.5%	284	1
Shawnee	1,528	252,900	0.604%	8.7%	132	1
Superior	4,036	2,093,062	0.193%	8.5%	342	1
Wayne	1,916	224,546	0.853%	4.0%	77	1
White Mtn	544	793,000	0.069%	1.4%	8	1
Total	72,257	11,256,024	0.642%		4,605	22

[1] From Table 3.3

[3] 0.0814 adult northern long-eared bats per acre of occupied habitat (see section 4.1).

Table 4.24. Estimated numbers of NLEB pups affected by improved roosting conditions from annual habitat improvement/non-timber clearing in maternity roosting areas.

Forest	A. Annual Non-Timber Clearing (acres)	B. Forest Habitat (acres)	C. Percent of Forest Affected (A/B)	D. Percent of Forest Used as Maternity Roost Areas[1]	E. Expected Overlap (acres) (BxCxD)	F. Number of Pups Affected (Density[2] x E)
Allegheny	4,530	475,496	0.953%	4.2%	193	52
Chequamegon-Nicolet	6,700	1,318,863	0.508%	8.5%	568	153
Chippewa	7,019	589,690	1.190%	8.5%	596	161
Green Mtn & Finger Lakes	2,320	398,379	0.582%	5.1%	118	32
Hiawatha	4,880	793,539	0.615%	8.5%	414	112
Hoosier	682	195,969	0.348%	4.5%	31	9
Huron-Manistee	34,916	915,757	3.813%	3.3%	1,152	311
Mark Twain	25,235	1,398,068	1.805%	8.9%	2,240	604
Midewin	42	1,755	2.393%	9.5%	4	2
Monongahela	3,950	900,000	0.439%	9.1%	359	97
Ottawa	6,279	905,000	0.694%	8.5%	532	144
Shawnee	2,298	252,900	0.909%	8.7%	199	54
Superior	5,725	2,093,062	0.274%	8.5%	485	131
Wayne	3,131	224,546	1.394%	4.0%	126	34
White Mtn	765	793,000	0.096%	1.4%	11	3
Total	108,472	11,256,024	0.964%		7,026	1,899

[1] From Table 3.3

[2] 0.2695 non-volant northern long-eared bats per acre of maternity roost habitat (see section 4.1).

Table 4.25. Summary by response category (increased fitness, reduced fitness, disturbance, harass, and harm) of estimated numbers of NLEB affected by the Action.

Forest	Increased Fitness	Reduced Fitness	Disturbance	Harass	Harm (pups)	Harm (adults)
Allegheny	112	210	10	195	22	4
Chequamegon-Nicolet	1,173	1,157	308	1,718	339	7
Chippewa	751	820	227	987	208	5
Green Mtn & Finger Lakes	105	202	18	276	69	4
Hiawatha	445	680	34	1,074	227	6
Hoosier	149	97	38	86	14	4
Huron-Manistee	770	889	125	1,041	214	6
Mark Twain	8,796	5,335	2,162	4,912	605	11
Midewin	10	3	2	12	2	3
Monongahela	246	386	33	436	72	4
Ottawa	435	812	16	938	132	5
Shawnee	1,692	765	403	590	38	4
Superior	868	1,064	176	1,013	124	5
Wayne	471	256	115	221	27	4
White Mtn	20	27	3	36	9	4
Total	16,043	12,703	3,670	13,535	2,102	76

Table 4.26. Estimated numbers of NLEB affected by activities that may increase fitness.

Forest	Total # Bats with Increased Fitness	Percent Non-Volant Pups	Percent Volant Bats	Total # Bats on Forests	Percent Total Bats Affected
Allegheny	112	19.6%	80.4%	16,335	0.7%
Chequamegon-Nicolet	1,173	37.3%	62.7%	90,315	1.3%
Chippewa	751	22.0%	78.0%	40,500	1.9%
Green Mtn & Finger Lakes	105	34.3%	65.7%	16,335	0.6%
Hiawatha	445	61.3%	38.7%	54,405	0.8%
Hoosier	149	13.4%	86.6%	7,155	2.1%
Huron-Manistee	770	13.5%	86.5%	24,435	3.2%
Mark Twain	8,796	11.6%	88.4%	100,305	8.8%
Midewin	10	30.0%	70.0%	135	7.4%
Monongahela	246	14.6%	85.4%	66,150	0.4%
Ottawa	435	60.0%	40.0%	61,965	0.7%
Shawnee	1,692	8.0%	92.0%	17,685	9.6%
Superior	868	13.0%	87.0%	143,370	0.6%
Wayne	471	12.1%	87.9%	7,290	6.5%
White Mtn	20	50.0%	50.0%	9,045	0.2%
Total	16,043	16.8%	83.2%	655,425	2.4%

Table 4.27. Estimated numbers of NLEB affected by activities expected to reduce fitness.

Forest	Total # Adult Bats with Reduced Fitness	Percent Reduced Fitness due to Burning	Percent Reduced Fitness due to Tree Clearing	Total # Bats on Forests	Percent Total Bats Affected
Allegheny	210	7.1%	92.9%	16,335	1.29%
Chequamegon-Nicolet	1,157	20.1%	79.9%	90,315	1.28%
Chippewa	820	20.7%	79.3%	40,500	2.02%
Green Mtn & Finger Lakes	202	7.4%	92.6%	16,335	1.24%
Hiawatha	680	3.5%	96.5%	54,405	1.25%
Hoosier	97	49.5%	50.5%	7,155	1.36%
Huron-Manistee	889	16.0%	84.0%	24,435	3.64%
Mark Twain	5,335	53.8%	46.2%	100,305	5.32%
Midewin	3	66.7%	33.3%	135	2.22%
Monongahela	386	11.7%	88.3%	66,150	0.58%
Ottawa	812	1.5%	98.5%	61,965	1.31%
Shawnee	765	78.6%	21.4%	17,685	4.33%
Superior	1,064	23.5%	76.5%	143,370	0.74%
Wayne	256	59.4%	40.6%	7,290	3.51%
White Mtn	27	11.1%	88.9%	9,045	0.30%
Total	12,703	36.1%	63.9%	655,425	1.94%

Table 4.28. Estimated numbers of NLEB affected by activities expected to cause take in the form of harass.

Forest	Total # Bats Harassed	Percent Harass due to Burning	Percent Harass due to Harvest, Roads, and Trails	Percent Harass due to Non-Timber Clearing	Total # Bats on Forests	Percent Total Bats Affected
Allegheny	195	5.6%	52.3%	42.1%	16,335	1.2%
Chequamegon-Nicolet	1,718	17.9%	62.7%	19.3%	90,315	1.9%
Chippewa	987	23.1%	43.1%	33.8%	40,500	2.4%
Green Mtn & Finger Lakes	276	6.5%	70.7%	22.8%	16,335	1.7%
Hiawatha	1,074	3.2%	73.8%	23.0%	54,405	2.0%
Hoosier	86	44.2%	38.4%	17.4%	7,155	1.2%
Huron-Manistee	1,041	12.0%	23.2%	64.8%	24,435	4.3%
Mark Twain	4,912	44.0%	33.2%	22.8%	100,305	4.9%
Midewin	12	58.3%	25.0%	16.7%	135	8.9%
Monongahela	436	7.6%	51.6%	40.8%	66,150	0.7%
Ottawa	938	1.7%	73.8%	24.5%	61,965	1.5%
Shawnee	590	68.5%	13.4%	18.1%	17,685	3.3%
Superior	1,013	17.4%	55.3%	27.3%	143,370	0.7%
Wayne	221	52.9%	18.6%	28.5%	7,290	3.0%
White Mtn	36	8.3%	72.2%	19.4%	9,045	0.4%
Total	13,535	27.2%	45.2%	27.6%	655,425	2.1%

Table 4.29. Estimated numbers of NLEB pups affected by activities expected to cause take in the form of harm.

Forest	Total # Pups Harmed	Percent Harm due to Burning	Percent Harm due to Harvest, Roads, and Trails	Percent Harm due to Non-Timber Clearing	Total # Pups on Forests	Percent Total Pups Affected
Allegheny	22	0.0%	63.6%	36.4%	5,445	0.4%
Chequamegon-Nicolet	339	27.1%	50.1%	22.7%	30,105	1.1%
Chippewa	208	33.2%	32.2%	34.6%	13,500	1.5%
Green Mtn & Finger Lakes	69	7.2%	73.9%	18.8%	5,445	1.3%
Hiawatha	227	4.8%	69.2%	26.0%	18,135	1.3%
Hoosier	14	28.6%	50.0%	21.4%	2,385	0.6%
Huron-Manistee	214	8.4%	18.7%	72.9%	8,145	2.6%
Mark Twain	605	23.8%	45.5%	30.7%	33,435	1.8%
Midewin	2	0.0%	100.0%	0.0%	45	4.4%
Monongahela	72	2.8%	55.6%	41.7%	22,050	0.3%
Ottawa	132	3.8%	78.8%	17.4%	20,655	0.6%
Shawnee	38	0.0%	42.1%	57.9%	5,895	0.6%
Superior	124	4.8%	46.0%	49.2%	47,790	0.3%
Wayne	27	29.6%	29.6%	40.7%	2,430	1.1%
White Mtn	9	11.1%	66.7%	22.2%	3,015	0.3%
Total	2,102	17.4%	48.2%	34.4%	218,475	1.0%

Table 4.30. Estimated numbers of NLEB adults affected by activities expected to cause take in the form of harm.

Forest	Total # Adults Harmed	Percent Harm due to Harvest, Roads, and Trails	Percent Harm due to Non-Timber Clearing	Total # Adults on Forests	Percent Total Adults Affected
Allegheny	4	75.0%	25.0%	10,890	0.0%
Chequamegon-Nicolet	7	71.4%	28.6%	60,210	0.0%
Chippewa	5	60.0%	40.0%	27,000	0.0%
Green Mtn & Finger Lakes	4	75.0%	25.0%	10,890	0.0%
Hiawatha	6	83.3%	16.7%	36,270	0.0%
Hoosier	4	75.0%	25.0%	4,770	0.1%
Huron-Manistee	6	50.0%	50.0%	16,290	0.0%
Mark Twain	11	63.6%	36.4%	66,870	0.0%
Midewin	3	66.7%	33.3%	90	3.3%
Monongahela	4	75.0%	25.0%	44,100	0.0%
Ottawa	5	80.0%	20.0%	41,310	0.0%
Shawnee	4	75.0%	25.0%	11,790	0.0%
Superior	5	80.0%	20.0%	95,580	0.0%
Wayne	4	75.0%	25.0%	4,860	0.1%
White Mtn	4	75.0%	25.0%	6,030	0.1%
Total	76	71.1%	28.9%	436,950	0.02%

5 Cumulative Effects

The FS BA includes a cumulative effects analysis that complies with the National Environmental Policy Act (NEPA) definition of cumulative effects. However, in the context of a section 7 consultation under the ESA, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under section 7 of the ESA.

The proposed Action is continued implementation of Forest Plans and their associated projects on 14 National Forests and 1 National Tallgrass Prairie in the FS Eastern Region. The Action Area is entirely under federal ownership and management; therefore, all future actions are federal actions and are subject to consultation. Therefore, cumulative effects are not relevant to this consultation.

6 Conclusion

WNS is the primary factor affecting the status of the NLEB, which has caused dramatic and rapid declines in abundance, resulting in the local extirpation of the species in some areas. Although other factors, individually or in combination, are likely insignificant at the range-wide scale, they may exacerbate the effects of WNS at the local population scale, thereby accelerating declines and the likelihood of local extirpation due to the disease or reducing the population's ability to survive and potential rebound. The species' foremost conservation need is to reduce or eliminate the threat of WNS. A secondary need is to avoid and minimize the adverse effects of other threats in WNS-affected portions of its range in order to delay declines and maximize the chances for local populations to persist at some level.

From our assessment of the environmental baseline, we have observed NLEB population declines within a few years following the arrival of WNS, and can expect further declines as the disease moves through the Action Area. Based on post-WNS occupancy rates inferred from summer mist-net data and assumptions about colony size and distribution in forested habitats, we estimate that Action Area currently supports a population of about 436,950 adult NLEB. The FS has closed all caves and abandoned mines to public access, not just those known to serve as bat hibernacula, to preclude humans from acting as vectors for the disease and to limit disturbance during hibernation. Although various forest management activities may incidentally take NLEB, the FS is perpetuating forested habitat in the Action Area, and asserts in the BA that existing standards, guidelines, and best management practices in Forest Plans are likely to improve roosting and foraging habitat and minimize the incidental take of the species.

From our analysis of the effects of the Action, we estimate the numbers of NLEB for which the proposed Action could potentially increase fitness of about 16,043 individuals (2.4 percent of the total Action Area population), and reduce fitness for 12,703 individuals. Although we lack scientific support to interpret the degree to which these effects may influence survival or reproductive success rates for local populations, we agree with the FS assertion in the BA that

management of the Forests under existing Forest Plans is likely to maintain or improve roosting and foraging habitat for the NLEB. Our effects analyses identify several possible pathways for the Action to affect NLEB in hibernacula; however, we believe that existing standards and guidelines in Forest Plans that protect known hibernacula avoid these adverse effects.

Consistent with the "likely to adversely affect" determination of the BA, we have estimated that the Action is expected to cause incidental take of up to 13,535 volant NLEB (both adults and juveniles) each year in the form of harassment, all within roosting areas (both maternity and non-maternity), and mostly (72.8 percent) resulting from tree clearing. The Action is expected to harm up to 2,102 non-volant juvenile NLEB and 76 adults annually, all within maternity roosting areas, and mostly resulting from tree clearing activities conducted during the active season.

The harassment estimate amounts to 2.1 percent of the total Action Area population, including young-of-the-year (1 per adult female following parturition). With the exception of the Midewin, less than 5% of the total number of NLEBs are affected on all individual Forests. We do not expect this harassment of less than 5% of most Forest populations to significantly affect the numbers or reproduction of the species on the Forests, as only a small fraction of those fleeing roosts due to disturbance are likely to suffer injury from day-time predators or other hazards encountered before roosting elsewhere. Further, we do not expect this harassment to significantly affect the distribution of the species on the Forests, as the disturbances causing it are temporary, ceasing when project-level activity ceases.

The harm estimate of 2,102 NLEB pups amounts to 1.0 percent of the total Action Area population of non-volant pups. With the exception of two forests, less than 2% of the total number of NLEB pups may be affected on individual Forests. However, these numbers are overestimates. As noted above, most of this harm (82.6 percent) is caused by tree clearing activities, where the potential for death or injury depends largely on site-specific circumstances, e.g., the likelihood of felling a tree containing a maternity colony. Not all tree clearing activities through maternity roosting areas will kill or injure all pups present, but our methodology in this BO estimates that all potentially vulnerable individuals within the expected area of activity/occupancy overlap are affected. The same is true for prescribed fire. We also estimated that 76 adults (less than 0.02% of the total population) may be affected by tree clearing activities. With the exception of Midewin, less than 1% of the total number of NLEB adults may be affected on all individual Forests. These numbers are more realistic estimations because we did not assume that all potentially vulnerable individuals would be affected – we assumed that only 3% of adults would be impacted.

As described in Section 4.8, we do not anticipate that the total amount of annual estimated effects across all 15 Forests will be exceeded, but it is possible that the individual Forest numbers may vary in a given year by no more than 30%. Because our estimates of harm and harassment are overestimates as described above, we do not consider a potential 30% variation in individual Forest impacts to be significant to the NLEB.

A further source of imprecision in our estimate of harm relates to our use of May 1–July 31 as the non-volant season and April 1-October 31 for the active season. These periods are variable

across the action area depending on latitude, elevation, and weather conditions. However, we believe these ranges captures most of the periods on most Forests in most years.

Our analyses for both harassment- and harm-effects pathways highlight the potential conservation importance of identifying maternity roosting areas on the Forests to inform project-level siting and scheduling decisions.

We are unaware of interrelated and interdependent actions to the proposed Action that are not included in the proposed Action. All actions within the Action Area, which is federally owned and managed, have a federal nexus; therefore, the cumulative effects of future state, tribal, local, or private actions are not relevant to this consultation.

The most significant effect to weigh against the status of the NLEB is the anticipated harm to up to 2,102 non-volant pups (1.0 percent of the estimated pup population in the Action Area). As described above, this is an overestimate. Injury or death to pups may result in a reduction of the colony's reproductive potential through loss of intra-season recruitment into the colony. There are an estimated 4,855 maternity colonies present on these Forests. Data regarding the year-to-year recruitment of NLEBs into a maternity colony is lacking at the current time; however, a less than one to four percent reduction in recruitment in an individual Forest should not result in a reduction of the overall viability of the NLEB on the Forests.

To further interpret the significance of annually harming up to 1.0 percent of the bat pups in the Action Area and one to four percent on each individual Forest, we consider the following. Most mortality for most North American bat species, including the NLEB, occurs during the juvenile life stage (Tuttle and Stevenson 1982, cited in Caceres and Pybus 1997). The annual level of forest management activity described for the proposed Action is derived from Forest Plans, many of which have been in effect for several years, and the FS BA characterizes the NLEB as "among the most common of forest bats within the Eastern Region" that is "frequently encountered in surveys." The final listing rule for the NLEB considers the impacts of stressors resulting from forest management and other activities throughout the species range as collectively insignificant at the range-wide scale prior to the onset of WNS. WNS has only recently arrived in most of the Action Area, and has not yet arrived in some parts. The interim 4(d) rule with the final listing decision provides exceptions to taking prohibitions for all activities outside of the WNS buffer zone, and within the zone, to all forest management activities that avoid impacts to known hibernacula and known roosts. The section of the interim 4(d) rule pertaining to forest management concludes:

> "Therefore, we anticipate that habitat modifications resulting from forest management and silviculture will not significantly affect the conservation of the northern long-eared bat. Further, although activities performed during the species' active season (roughly April through October) may directly kill or injure individuals, implementation of the conservation measures provided for in this interim rule will limit take by protecting currently known populations during their more vulnerable life stages."

The Service defines "to jeopardize the continued existence of a listed species" as to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the

reproduction, numbers, or distribution of the species. After reviewing the current status of the NLEB, environmental baseline for the Action Area, effects of the Action, and cumulative effects, it is the Service's biological opinion that the Action, as proposed, is not likely to jeopardize the continued existence of the NLEB. The Service has not proposed or designated critical habitat for this species; therefore, none is affected.

7 Incidental Take Statement

Section 9 of the ESA and regulations issued 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 where it actually kills or injures wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

The interim 4(d) rule issued with the listing decision for the NLEB adopted the take prohibitions at 50 CFR §17.31 and §17.32 for this species with certain exceptions. These exceptions include all activities in areas as yet unaffected by the white-nose syndrome (WNS) disease, which is the primary factor contributing to the species' decline. The range of the NLEB within the Action Area of this consultation is entirely within the current WNS "buffer zone." Within this zone, activities excepted from the take prohibitions are specifically defined. Those relevant to the Action include:

- forest management;
- routine maintenance and limited expansion of existing rights-of-way and transmission corridors;
- prairie management;
- projects resulting in minimal tree removal; and
- hazardous tree removal.

Take resulting from these activities is excepted from the take prohibitions provided that the activities:

- occur more than 0.25 mile (0.4 kilometer) from a known, occupied hibernacula;
- avoid cutting or destroying known, occupied maternity roost trees during the pup season (June 1 – July 31); and
- avoid clearcuts (and similar harvest methods, e.g., seed tree, shelterwood, and coppice) within 0.25 mile of known, occupied maternity roost trees during the pup season (June 1– July 31).

Excepted activities do not require special exemption for incidental taking, but federal actions consistent with the definitions of excepted activities require compliance with section 7(a)(2) of the ESA (consultation to insure that actions are not likely to jeopardize the continued existence of listed species or to destroy/adversely modify designated critical habitat).

Project-level activities that are implemented consistent with the Description of the Proposed Action (section 1.2 of the BO), both in extent (average annual acreage) and in observing the applicable standards and guidelines, may satisfy the definitions of activities excepted from the

NLEB take prohibitions, provided they are also consistent with the conservation measures of the interim 4(d) rule for such activities, summarized above. However, new roads construction and some forms of non-timber clearing may not satisfy the definitions of excepted activities. We are unable to determine in this programmatic consultation whether projects are consistent with the conservation measures, as this requires site-specific information that is updated as locations for NLEB hibernacula and roosts become known. Therefore, the FS must determine on a project-level basis whether a proposed activity addressed in this BO is excepted under the interim 4(d) rule, and if so, may rely upon the findings of this BO to document its compliance with section 7(a)(2) of the ESA with respect to the NLEB. We specify a streamlined process for such documentation under the Reasonable and Prudent Measures and the accompanying Terms and Conditions of this ITS (sections 7.3 and 7.4).

The Action evaluated in the preceding BO meets the regulatory definition of a framework programmatic action: "a Federal action that approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation" (50 CFR §402.02). An incidental take statement is not required for a framework programmatic action (50 CFR §402.14(i)(6)). As explained in the preceding paragraph, the FS may document at the project level that activities implemented under this framework programmatic Action are excepted from take prohibitions by the interim 4(d) rule and do not require special exemption in an ITS. Therefore, the terms and conditions under this programmatic ITS specify the procedures for identifying projects that would require further section 7 consultation to obtain the necessary special exemption for anticipated take that is not excepted by the interim 4(d) rule. We also provide general measures applicable to project-level formal consultations in this ITS; however, the FS must obtain project-specific terms and conditions that would allow anticipated incidental taking to occur lawfully under 7(b)(4) and section 7(o)(2) of the ESA through consultation with the Service Field Office of applicable jurisdiction.

The measures described below are non-discretionary, and must be undertaken by the FS so that they become binding conditions of any grant, contract, or permit issued to an applicant, contractor, or permittee for the exemption in section 7(o)(2) to apply. The FS has the continuing duty to regulate the activity covered by this Incidental Take Statement. If the FS fails:

(a) to assume and implement the terms and conditions; or
(b) to require an applicant, contractor, or permittee to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the grant, contract, or permit document;

the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FS must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement (see Section 7.5).

7.1 Amount or Extent of Take Anticipated

The total amount of incidental taking of NLEB per year that the Service anticipates will result from projects implemented under existing Forest Plans is not more than the following (see section 4.8 of the BO, Summary of Effects):

Number of Individuals	Life Stage	Form of Take
13,535	Adults and volant juveniles	Harass
2,102	Non-volant juveniles	Harm
76	Adults	Harm

Take in the form of harassment will result from harvest, prescribed burning, road construction and maintenance, trails maintenance, and habitat improvement/non-timber-related tree clearing activities occurring during the months of April – October on up to 229,468 acres annually when those activities overlap with occupied roosting areas (both maternity and non-maternity). Our estimate of the amount of harassment take reflects the expected degree of overlap using the NLEB occupancy rates specified in section 3.1.3 and the effects analysis methodology specified in section 4.1 of the BO.

Take in the form of harm of non-volant pups will result from the same activities listed for harassment during May 1 – July 31 on up to 108,881 acres annually when those activities overlap with occupied maternity roosting areas. Take in the form of harm to adults will result from the same acres and activities listed for harassment (except prescribed burning) during the months of April to October on up to 171,743 acres annually when those activities with occupied maternity roosting areas. Our estimate of the amount of harm take reflects the expected degree of overlap using the NLEB occupancy rates specified in section 3.1.3 and the effects analysis methodology specified in section 4.1 of the BO. Activities occurring during May 1 – July 31 and April 1 – October 31 cause both harassment and harm, but are separated for purposes of this ITS due the differing severity of the harass and harm effects to the species as described in the BO.

The Service anticipates the incidental taking of NLEB associated with FS projects will be difficult to detect for the following reasons:

- The individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to observe;
- The species forms small (i.e., 30-60 individuals) maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- Finding dead or injured specimens during or following project implementation is unlikely; and
- Most incidental take is in the form of non-lethal harassment and not directly observable (e.g., bats fleeing disturbance caused by project activity, which creates the likelihood of death or injury due to predation, collision with vehicles, etc.).

Due to the difficulty of detecting take of NLEB caused by the proposed Action, the FS will monitor the extent of taking using the acreage of forested habitat that projects implemented under the existing Forest Plans will alter, which is up to 229,468 acres annually for harassment,

and within these areas, up to 108,881 acres annually for harm of non-volant pups from May 1 – July 31, and up to 171,743 acres annually for harm of adults from April 1 to October 31, as shown in Tables 7.1 to 7.3 below. As described in the biological opinion, we do not anticipate that the total annual acreages for harm and harass across all 15 Forests will be exceeded, but it is possible that the individual Forest numbers may vary in a given year by no more than 30%.

Table 7.1. Acreage of activities April 1 - October 31 causing take in the form of harass.

Forest	All Harvest Types	Prescribed Burning	Roads	Trails	Non-Timber Clearing	Total
Allegheny	2,724	291	203	2	2,380	5,599
Chequamegon-Nicolet	12,062	4,492	3,344	318	4,847	25,063
Chippewa	4,742	3,309	1,351	87	4,856	14,344
Green Mtn & Finger Lakes	4,456	419	28	222	1,534	6,660
Hiawatha	11,267	491	131	156	3,588	15,632
Hoosier	845	1,032	25	1	399	2,302
Huron-Manistee	7,788	4,682	1,180	14	25,262	38,926
Mark Twain	22,511	30,138	90	104	15,571	68,413
Midewin	0	89	15	5	19	129
Monongahela	2,452	445	526	66	2,421	5,910
Ottawa	8,602	222	1,431	73	3,358	13,686
Shawnee	833	5,772	239	36	1,528	8,407
Superior	6,770	2,568	1,167	223	4,036	14,764
Wayne	1,117	3,582	43	46	1,916	6,704
White Mtn	1,826	192	24	343	544	2,928
Total	87,995	57,725	9,796	1,695	72,257	229,468

Table 7.2. Acreage of activities May 1 - July 31 causing take in the form of harm to non-volant pups.

Forest	All Harvest Types	Prescribed Burning	Roads	Trails	Non-Timber Clearing	Total
Allegheny	900	0	131	1	642	1,674
Chequamegon-Nicolet	5,149	4,000	2,068	169	3,350	14,736
Chippewa	2,026	2,976	804	32	3,107	8,945
Green Mtn & Finger Lakes	3,543	333	0	116	899	4,891
Hiawatha	6,616	468	82	97	2,544	9,807
Hoosier	373	250	16	0	170	809
Huron-Manistee	3,327	2,000	1,004	14	17,459	23,804
Mark Twain	11,400	6,000	36	37	7,759	25,232
Midewin	0	0	10	4	0	14
Monongahela	1,200	65	315	46	1,185	2,811
Ottawa	3,654	200	795	23	996	5,668
Shawnee	489	0	126	26	905	1,546
Superior	1,508	232	788	155	2,670	5,353
Wayne	510	713	29	29	933	2,214
White Mtn	606	105	17	284	365	1,377
Total	41,301	17,342	6,221	1,033	42,984	108,881

Table 7.3. Acreage of activities April 1 - October 31 causing take in the form of harm to adults.

Forest	All Harvest Types	Roads	Trails	Non-Timber Clearing	Total
Allegheny	2,724	203	2	2,380	5,308
Chequamegon-Nicolet	12,062	3,344	318	4,847	20,571
Chippewa	4,742	1,351	87	4,856	11,036
Green Mtn & Finger Lakes	4,456	28	222	1,534	6,241
Hiawatha	11,267	131	156	3,588	15,141
Hoosier	845	25	1	399	1,270
Huron-Manistee	7,788	1,180	14	25,262	34,244
Mark Twain	22,511	90	104	15,571	38,275
Midewin	0	15	5	19	40
Monongahela	2,452	526	66	2,421	5,465
Ottawa	8,602	1,431	73	3,358	13,463
Shawnee	833	239	36	1,528	2,636
Superior	6,770	1,167	223	4,036	12,196
Wayne	1,117	43	46	1,916	3,122
White Mtn	1,826	24	343	544	2,736
Total	87,995	9,796	1,695	72,257	171,743

A habitat surrogate measure of take is appropriate because all anticipated take will result from habitat alteration or disturbance caused by activities associated with that alteration, and because it sets a clear standard for determining when the level of anticipated take is exceeded, including take that is excepted from the prohibitions at 50 CFR 17.31 and 17.32 under the interim 4(d) rule for the NLEB. The FS will use the tables above as the standard for determining when the level of anticipated take is exceeded in monitoring and reporting the annual extent of the habitat surrogates for each activity type on each Forest. We provide details for such reporting in section 7.5 below. It is necessary to partition the habitat surrogate monitoring both by activity and by Forest as shown above rather than the acreages for the Action as a whole or for each Forest as a whole, because the amount of take estimated in this BO is derived from Forest-specific occupancy rates and activity acreages. As described above, the individual Forest numbers may vary in a given year by no more than 30%, provided that the total annual acreages are not exceeded. All acres tracked as a surrogate measure of take in the form of harm are also separately tracked as take in the form of harass.

7.2 Effect of the Take

In the preceding BO, the Service has determined that the anticipated level of incidental take is not likely to jeopardize the continued existence of the NLEB (see Section 6, Conclusion).

7.3 Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary or appropriate to minimize the anticipated taking of NLEB that is incidental to the Action.

RPM 1. Project-level consultation to obtain terms and conditions necessary to minimize the impacts of incidental taking. The FS will request project-level consultation with the Service Field Office of applicable jurisdiction for timber harvest, prescribed burning, roads, trails, and habitat improvement/non-timber clearing projects when such projects may affect the NLEB and are:

- proposed in areas that are partially or wholly within a 0.25-mile radius of known, occupied NLEB hibernacula;
- proposed in areas that are partially or wholly within a 0.25-mile radius of known, occupied NLEB maternity roost trees during the pup season; or
- otherwise not consistent with the definitions for activities that are excepted from taking prohibitions under the NLEB interim 4(d) rule.

RPM 2. Project-level documentation that an activity is excepted from incidental taking prohibitions and does not require terms and conditions. The FS will provide written documentation to the Service Field Office of applicable jurisdiction when it determines that timber harvest, prescribed burning, roads, trails, and habitat improvement/non-timber clearing projects may affect the NLEB, but that any taking resulting from such projects is excepted from the taking prohibitions applicable to the NLEB.

The following general RPMs apply only to projects that must implement RPM1 (project-level consultation). The effects analysis in a project-specific biological opinion will consider impacts to individuals, populations, and the species. These RPMs may inform the conservation measures incorporated into project proposals, and the Service may provide terms and conditions for these RPMs, and additional RPMs with implementing terms and conditions, in project-specific biological opinions as necessary and appropriate to minimize the impacts of incidental taking considering project- and site-specific information.

RPM 3. Avoid the removal or destruction of documented roost trees. Service Field Offices may provide specific measures to minimize impacts to the colony affected, including, but not limited to, modifications of project plans that avoid or minimize project-specific anticipated taking consistent with the minor changes rule at 50 CFR §402.14(i)(2).

RPM 4. Avoid direct and indirect impacts to documented hibernacula. Service Field Offices may provide specific measures to minimize impacts to the hibernacula affected, including, but not limited to, modifications of project plans that avoid or minimize project-specific anticipated taking consistent with the minor changes rule at 50 CFR §402.14(i)(2).

7.4 Terms and Conditions

In order to be exempt from the prohibitions under 50 CFR §17.31 and §17.32, the FS must comply with the following terms and conditions (T&Cs), which carry out the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

T&C 1. Identify NLEB hibernacula and roosts (RPM 1 and RPM 2). In coordination with the Service Field Office of applicable jurisdiction, each Forest will maintain a database of the locations of known NLEB hibernacula and roosts on the Forest and within 0.25 mile of

the Forest boundaries. The FS will update this database as new information becomes available, but at least annually, and use it to identify projects that require further consultation under RPM1 or that may document compliance with ESA section 7(a)(2) under RPM2.

T&C 2. Documenting excepted activities (RPM 2). At least 30 days in advance of signing a decision for a timber harvest, prescribed burning, roads, trails, or habitat improvement/non-timber clearing project that may affect (i.e., not likely to adversely affect or likely to adversely affect) the NLEB, and for which the FS has determined that any taking incidental to such project is excepted from taking prohibitions, the FS will provide written notification of such determination to the Service Field Office of applicable jurisdiction.

(a) For this determination, the FS will rely on the definitions of excepted activities provided in the NLEB interim 4(d) rule, the hibernacula/roost data base developed and maintained under T&C 1, and Appendix A of this BO, which provides the FS working interpretation of the interim 4(d) rule relative to activities considered in this BO.
(b) The notification shall include a description of the project and its action area of sufficient detail to support the determination.
(c) The FS may provide its determination as part of a request for coordination or consultation relative to project-affected resources in addition to the NLEB or separately.
(d) Service concurrence with the FS determination is not required, but the Service will advise the FS whether additional information indicates project-level consultation for the NLEB is required; i.e., that the proposed project is not an excepted activity and is subject to RPM 1.
(e) Absent receiving advice under (d) above from the Service within 30 days of providing its determination, the FS may presume its determination is informed by best available information and consider its project responsibilities under ESA section 7(a)(2) with respect to the NLEB fulfilled through this programmatic BO.

The reasonable and prudent measures, with their terms and conditions, are designed to minimize the impacts of incidental taking. The Service believes that FS projects will incidentally harass no more than 13,535 volant NLEB resulting from no more than 229,468 acres annually of habitat-altering project activity during April – October of any calendar year while existing Forest Plans are in effect. The Service believes that FS projects will incidentally harm no more than 2,102 NLEB non-volant pups resulting from no more than 108,881 acres annually of habitat-altering project activity during May 1 – July 31 of any calendar year while existing Forest Plans are in effect. The Service believes that FS projects will incidentally harm no more than 76 NLEB adults resulting from no more than 171,743 acres annually of habitat-altering project activity during April 1 – October 31 of any calendar year while existing Forest Plans are in effect. As described above, the individual Forest numbers may vary in a given year by no more than 30%, provided that the total annual acreages are not exceeded. If, during the course of the Action, the level of habitat alteration specified in Tables 7.1, 7.2 or 7.3 is exceeded, such incidental take represents new information requiring a reinitiation of consultation and review of the reasonable and prudent measures provided. The FS must immediately provide an explanation of the causes of the taking and review with the Service the need for revising the reasonable and prudent measures.

7.5 Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Federal agency or any 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)). The following incidental take monitoring and reporting requirements apply to the programmatic Action covered under this statement.

1. For the duration of each Forest Plan that is included in the proposed Action and that relies upon this BO for compliance with ESA section 7(a)(2) with respect to the NLEB, the FS will file a report not later than December 31 covering the preceding fiscal year ending September 30. The report will:
   (a) Tally the acreage of projects implemented during April 1 – October 31 for comparison with Table 7.1 and Table 7.3 of this ITS, which summarizes the average acreage during the NLEB active season for harvest, prescribed burning, roads, trails, and habitat improvement/non-timber clearing projects on each Forest that was evaluated in this BO.
   (b) Tally the acreage of projects implemented during May 1 – July 31 for comparison with Table 7.2 of this ITS, which summarizes the average acreage during the NLEB non-volant season for harvest, prescribed burning, roads, trails, and habitat improvement/non-timber clearing projects on each Forest that was evaluated in this BO.

   The FS will file the report with the two following offices:
   U.S. Fish and Wildlife Service
   Midwest Regional Office
   Assistant Director for Ecological Services
   5600 American Blvd. West, Suite 990
   Bloomington, MN 55437-1458

   U.S. Fish and Wildlife Service
   Midwest Regional Office
   Assistant Director for Ecological Services
   300 Westgate Center Drive
   Hadley, MA 01035

2. The FS, its cooperators, and any FS contractors must take care when handling dead or injured NLEB or any other federally listed species that are found at FS project sites in order to preserve biological material in the best possible state and to protect the handler from exposure to diseases, such as rabies. Project personnel are responsible for ensuring that evidence for determining the cause of death or injury is not unnecessarily disturbed. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this BO is exceeded and to ensure that the terms and conditions are appropriate and effective. Parties finding a dead, injured, or sick specimen of any endangered or threatened species, must promptly notify the Service's Midwest Region Division of Law Enforcement at 5600 American Blvd. West, Suite 990, Bloomington, MN 55437-1458 (Telephone: 612/713-5283) or Northeast Region Division of Law Enforcement 300 Westgate Center Dr., Hadley, MA 01035 (Telephone: 413/253-8274), and then the Service Field Office of applicable jurisdiction.

8 Conservation Recommendations

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

1. Assist with WNS investigations, by:
    a. Monitoring the status/health of known colonies; and
    b. Collecting samples for ongoing or future studies.

2. Monitor the pre- and post-WNS distribution of NLEB on the Forests, by:
    a. Searching for hibernacula;
    b. Conducting bat inventory surveys;
    c. Conducting radio telemetry studies to locate NLEB colonies and their maternity roost trees;
    d. Continuing to participate in the North American Bat Monitoring Program (NABat; a national effort to monitor and track bats) through submission of survey data; and
    e. Analyzing acoustic survey data, both previously collected and not as yet collected, to determine when and where NLEB occur on the Forests.

3. Encourage administrative studies and research on the summer habitat requirements of NLEB on the Forests that:
    a. Investigate habitat characteristics of the forest in areas where pre- and post-WNS NLEB occurrences are documented (acoustically or in the hand) (e.g. forest type, cover, distance to water); and
    b. Investigate NLEB use (acoustics, radio telemetry) of recently-managed areas of different prescriptions.

Please notify the Service when the FS implements any of these recommendations so that we may better track the status of the species.

9 Reinitiation Notice

This concludes formal consultation on FS continued implementation of Forest Plans and their associated projects on 14 National Forests and 1 National Tallgrass Prairie in the FS Eastern Region that are within the range of the NLEB (the Action). Reinitiation of formal consultation is required where discretionary FS involvement or control over the Action has been retained (or is authorized by law) and if:

(a) the amount or extent of incidental take is exceeded;
(b) new information reveals effects of the FS Action that may affect the NLEB in a manner or to an extent not considered in this consultation;

(c) the FS Action is later modified in a manner that causes an effect to the NLEB not considered in this consultation; or
(d) a new species is listed or critical habitat is designated that may be affected by the Action.

The anticipated incidental take is exceeded when FS projects affect in one calendar year forested habitat acreages exceeding those specified in Tables 7.1, 7.2, and 7.3 of this BO, which is up to 229,468 acres annually for harassment of all individuals, and within these areas, up to 108,881 acres annually for harm of non-volant pups from May 1 – July 31, and up to 171,743 acres annually for harm of adults from April 1 to October 31. The individual Forest numbers may vary in a given year by no more than 30%, provided that the total annual acreages are not exceeded. These are the amounts of habitat alteration that are exempted from the taking prohibitions under 50 CFR §17.31 and §17.32 by this BO and by the interim 4(d) rule for the NLEB.

Thank you for the information and cooperation provided by your offices in this consultation. Please refer any questions to Karen Herrington (612-713-5315) of this office.

Sincerely,

Lynn Lewis

Lynn Lewis
Assistant Regional Director, Ecological USFWS

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Appendix A

This appendix provides the USDA Eastern Region Forest Service (FS) working interpretation of the interim 4(d) rule (80 FR 17974-18033) for the northern long-eared bat (NLEB) relative to projects relying on the "Biological Opinion: Activities Affecting the Northern Long-Eared Bat on Eastern Region National Forests" (FWS Log #03E00000-2015-F-0001) (BO) for compliance with section 7(a)(2) of the Endangered Species Act (ESA). This appendix supplements "Terms and Conditions #2" of the Incidental Take Statement provided with the BO. The U.S. Fish and Wildlife Service (Service) agrees to this interpretation for this compliance purpose.

The following definitions are how the FS interprets the interim 4(d) rule and this BO.

Known occupied roost tree or roosting area: The interim 4(d) rule and the BO use the terms known occupied maternity roost, known occupied maternity roosting area, roost tree, and roosting area in various contexts. The FS interprets any reference to management restrictions regarding roost trees or areas **to pertain only to known occupied maternity roosts and known occupied maternity roosting areas.** The interim 4(d) rule when referencing roost trees specifies "during the pup season," which the FS interprets as a clear indication the intent is to protect known occupied maternity roosts.

Management implications: Trees that may serve as potential roosts for NLEB are a relatively abundant resource on Forest System lands across the Eastern Region. The roost trees and roost areas that are critical to conserve are those occupied by maternity colonies. It is the policy in the Eastern Region to not remove known bat roost trees at any time unless the tree is deemed to be a hazard. Hazard roost trees will be removed during the hibernation season (November – March), unless the tree is an immediate hazard, in which case it can be removed during the active season (April – October). Whenever possible, trees that are an immediate hazard would be removed following an emergence count that indicates the tree is not occupied. However, if a tree is a danger to human life or human facilities, the tree can be removed immediately if necessary. If an immediate hazard tree is known to be occupied, the Fish and Wildlife Service will be consulted as soon as possible. However, the tree may need to be removed before the consultation is completed.

Temporary versus permanent road construction: The FS interprets the interim 4(d) rule exception for "forest management" to include temporary road construction when such new road construction is directly linked to one or more forest management treatments. New permanent road construction is not an excepted activity and would require consultation with the appropriate Service Field Office. To qualify as an excepted activity, any temporary road construction must occur more than 0.25 mile from a known occupied hibernacula and more than 0.25 mile from a known occupied maternity roost during the pup season (June – July).

Management implications: The interim 4(d) rule defines forest management as "the practical application of biological, physical, quantitative, managerial, economic, social, and policy principles to the regeneration, management, utilization and conservation of forests to meet specific goals and objectives (Society of American Foresters (SAF)(a), http://dictionaryofforestry.org/dict/term/forest_management). The inclusion of "utilization" is

what leads us to interpret temporary road construction as an excepted activity. One cannot utilize forest products without access to those products.

Road reconstruction, maintenance, and decommissioning: The FS interprets the interim 4(d) rule exception for "routine maintenance and limited expansion of existing rights-of-way and transmission corridors" to include road reconstruction, maintenance, and decommissioning as described in the BO. Any road reconstruction, maintenance, and decommissioning occurring within 0.25 mile of a known occupied hibernacula or within 0.25 mile of a known occupied maternity roost during the pup season (June – July) would require project-level consultation with the appropriate Service Field Office.

Management implications: The interim 4(d) rule states routine maintenance within an existing corridor or ROW or the expansion of a corridor or ROW by up to 100 feet (30 m) from the edge of an existing cleared corridor is excepted from take prohibitions provided that the activity is more than 0.25 mile from a known occupied hibernacula and more than 0.25 mile from a known occupied maternity roost during the pup season.

Trail reconstruction, maintenance, and decommissioning: The FS interprets the interim 4(d) rule exception for "routine maintenance and limited expansion of existing rights-of-way and transmission corridors" to include trail reconstruction, maintenance, and decommissioning as described in the BO. Any trail reconstruction, maintenance, and decommissioning occurring within 0.25 mile of a known occupied hibernacula or within 0.25 mile of a known occupied maternity roost during the pup season (June – July) would require project-level consultation with the appropriate Service Field Office.

Management implications: Although the "right-of-way" (ROW) concept is rarely applied to forest trails, an existing trail occupies a specific corridor and all reconstruction, maintenance, and decommissioning activities would occur in the existing corridor. The interim 4(d) rule states that routine maintenance within an existing corridor or ROW or the expansion of a corridor or ROW by up to 100 feet (30 m) from the edge of an existing cleared corridor is excepted from take prohibitions provided that the activity is more than 0.25 mile from a known occupied hibernacula and more than 0.25 mile from a known occupied maternity roost during the pup season (June – July).

Effects determination for project-level Biological Assessments (BA) consistent with the BO and the definitions of excepted activities under the interim 4(d) rule: The FS will use the following language in BAs for projects that will rely upon the BO for compliance with ESA Section 7(a)(2):

> This project is likely to adversely affect the northern long-eared bat; however, there are no effects beyond those previously disclosed in the programmatic biological opinion dated November 3, 2015 (FWS Log #03E00000-2015-F-0001). Any taking that may occur incidental to this project is excepted from the prohibitions for taking threatened species under 50 CFR 17.31 and 17.32. This project is consistent with the Land and Resource Management Plan, the description of the proposed action in the programmatic biological opinion, the Eastern Region's six conservation measures as applicable, and

activities excepted from taking prohibitions under the ESA section 4(d) rule applicable to the northern long-eared bat; therefore, the programmatic biological opinion satisfies the Forest Service's responsibilities under ESA section 7(a)(2) relative to the northern long-eared bat for this project.