U.S. Fish & Wildlife Service

APPENDIX A. Interim Consultation Framework for the Northern Long-Eared Bat: Standing Analysis

Valid from March 31, 2023 through April 1, 2024

Contents

INTRODUCTION

The northern long-eared bat (NLEB) was previously listed as threatened under the Endangered Species Act (ESA) in 2015, and a special rule pursuant to section 4(d) of the ESA was finalized in 2016. The U.S. Fish and Wildlife Service (Service) reclassified the NLEB as endangered on November 30, 2022, which rendered the 4(d) rule obsolete on the effective date of March 31, 2023, as 4(d) rules are not available for endangered species. All take[1] is now prohibited by section 9 of the ESA. All new and ongoing federal[2] actions that are reasonably certain to result in incidental take need exemption from the taking prohibitions of section 9, which is provided by the Service in an Incidental Take Statement (ITS).

The Service developed the Interim Consultation Framework for the NLEB to provide a mechanism to streamline formal consultations for projects consistent with the former 4(d) rule and exempt take of NLEBs that occurs prior to April 1, 2024. This document constitutes the Standing Analysis for the Interim Consultation Framework. In this Standing Analysis we examine whether potential federal actions covered by the Interim Consultation Framework are likely to jeopardize the continued existence of the NLEB; this analysis will streamline the development of the Biological Opinion and ITS for each qualified project.

This Standing Analysis will be updated if: 1) the amount or extent of the impacts evaluated in the Standing Analysis are cumulatively exceeded during individual project reviews, or 2) the effects in the Standing Analysis may affect the NLEB in a manner or to an extent not previously considered. Project-specific consultations based on this Standing Analysis are subject to the reinitiation provisions at 50 CFR 402.16.

DESCRIPTION OF ACTIVITY TYPES EVALUATED

The Interim Consultation Framework covers projects consistent with the 4(d) rule using four general activity types updated[3] from the 2016 Programmatic Biological Opinion (2016 PBO) for the 4(d) rule (USFWS 2016): 1) forest management, 2) prescribed fire; 3) habitat removal; and 4) other activities that may affect the NLEB. The 2016 PBO also addressed the general effects of removal from human structures (which were defined as houses, garages, barns, sheds, and other buildings designed for human entry) and wind turbine operation; however, this Standing Analysis does not include those actions because they do not typically have a federal nexus. This Standing Analysis addresses the general effects of these four general activity types instead of describing all the possible federal actions that may include these activities.

---

[1] The ESA and its implementing regulations (50 CFR 17) define take as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Incidental taking" is defined at 50 CFR 17.3 as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, an otherwise lawful activity."

[2] Federal actions include all activities or programs authorized, funded, carried out, or permitted -- in whole or in part -- by Federal agencies in the United States or on the high seas.

[3] We updated Timber Harvest from the 2016 PBO to Forest Management and Forest Conversion to Habitat Removal for consistent use and understanding of terms.

We anticipate the four general activity types will cover a wide variety of federal actions including, but not limited to, authorizing, funding, or carrying out:

- Forest management practices including the manipulation and management of trees
- Prescribed fire activities in forests or the intersection of grassland and forested habitat
- Vegetation management in rights-of-ways and other areas, including mowing, tree clearing, and tree trimming
- Construction, maintenance, operation, and/or removal of infrastructure such as roads and trails, communication towers, transmission and utility lines, oil and gas pipelines, solar power facilities, canals, levees, or dikes, commercial, residential and recreational developments
- Military operations
- Agricultural activities that involve tree clearing and receive federal funding such as constructing buildings or making farm improvements or participating in the Environmental Quality Incentives Program
- Use of pesticides following the label
- Habitat restoration and enhancement
- Dredging and filling of wetlands or waterbodies

The following activities are not evaluated in this Standing Analysis and are therefore not eligible for the Interim Consultation Framework:

- Activities resulting in the disruption or disturbance of NLEBs in their hibernacula during hibernation. These could include entry into a known hibernacula or the following activities within 0.25 miles of a known hibernacula: prescribed fire, blasting, pile driving, drilling, and certain military operations. Smaller buffer sizes may be appropriate depending on the intensity of the activity. Projects with smaller buffer sizes are eligible for the Interim Consultation Framework with the approval of the local Ecological Services Field Office.
- Activities resulting in the physical or other alteration of a hibernaculum's entrance or its environment at any time of year. These could include the following activities within 0.25 miles of a known hibernacula: prescribed fire, blasting, pile driving, drilling, certain pesticide use, and certain military operations. Smaller buffer sizes may be appropriate depending on the intensity of the activity. Projects with smaller buffer sizes are eligible for the Interim Consultation Framework with the approval of the local Ecological Services Field Office.
- Tree clearing activities within 0.25 miles of a known NLEB hibernaculum at any time of the year.

- Tree clearing activities that result in cutting or destroying known, occupied maternity roost trees or any other trees within a 150-ft radius around the roost tree from June 1 – July 31, which was the generic pup season (i.e., the time of year when females care for young that are unable to fly) in the 4(d) rule.
- Activities that include purposeful take of NLEBs.
- Wind facility development or wind turbine operation.
- Broad-scale aerial applications of pesticides over suitable forested habitat

Forest Management

Forest management focuses on managing vegetation, restoring ecosystems, reducing hazards, and maintaining forest health. It is accomplished by applying different types of treatments such as thinning, harvesting, planting, and prescribed burning. For the purposes of this Standing Analysis, we treat prescribed fire separately and the general activity type of forest management focuses on manipulation and management of trees. Unlike habitat removal, forest management maintains, and typically retains, forest habitat on the landscape, and the impacts from forest management treatments are usually temporary.

Forest management includes a wide variety of practices from selected harvest of individual trees to clearcutting. Intermediate treatments (thinning) are designed to enhance growth, quality, vigor, and composition of the stand after establishment or regeneration and prior to final harvest. Regeneration treatments (harvesting) are applied to mature stands in order to establish a new age class of trees. It is conducted for a variety of purposes including, but not limited to, harvests (commercial and non-commercial) for forest products and for ecosystem restoration, endangered/threatened/sensitive species conservation, stand regeneration for forest health, wildlife habitat improvement, insect and disease control, and fuel reduction.

Prescribed Fire

Prescribed fire is the controlled application of fire by experts under specified environmental conditions to attain resource management objectives. Prescribed fire also maintains forest habitat on the landscape. It is a management tool used in a variety of landscapes (e.g., grassland, brushland, forests). However, this Standing Analysis considers prescribed fire in northern long-eared bat habitat (i.e., forests, or the intersection of grassland and forested habitat).

Prescribed fire is typically classified as dormant-season and growing-season burning. Most growing season burning takes place in the spring and fall; however, growing season burning occurs throughout the time when NLEBs are not hibernating.

Habitat Removal

Habitat removal is the loss of forest to another land cover type (e.g., development, grassland, cropland, etc.). For the purposes of this Standing Analysis, we define habitat removal as any activity that removes forested habitat that is suitable for the NLEB. This includes, but is not limited to, tree removal for commercial or residential development, energy production and transmission (oil, gas, solar), mining, agriculture, transportation, military operation or training, and other ecosystem management. Unlike forest management, habitat removal permanently removes forested habitat on the landscape, or in some cases, habitat is impacted for decades as in the case of mining.

Other Activities that May Affect NLEB

The NLEB may be affected by a variety of other activities beyond those associated with forest management, prescribed fire, and habitat removal. These activities include, but may not be limited to:

- Disturbance/noise from human activities
- Lighting
- Use of pesticides for pest and vegetation control
- Contamination
- Water quality alteration
- Vehicle use/collision risk
- Noise from munitions, detonations, and training vehicles
- Use of military training smoke and obscurants
- Bridge maintenance, repair, or replacement
- Subsurface drilling or blasting for utility line and road installation

Some of these activities occur in conjunction with forest management, prescribed fire, or habitat removal, and others occur independently. We describe these activities in more detail and consider potential exposure pathways and effects to NLEB in the Other Activity Types that May Affect the NLEB Section below.

Conservation Measures

All individual projects must comply with the former 4(d) rule, and must include the following conservation measures:

1. The project will not disturb or disrupt hibernating NLEBs in a known hibernaculum during hibernation.
2. The project will not alter the entrance or interior environment of a known hibernaculum at any time of year.
3. The project will not remove any trees within 0.25 miles of a known NLEB hibernaculum at any time of the year. The 0.25-mile tree clearing buffer serves multiple purposes including protecting hibernating bats from disturbance, protecting the hibernaculum's

microclimate (4d rule, pages 1909-1910), protecting roosting habitat around the hibernacula, and providing some roosting and foraging protection during spring staging and fall swarming.

4. The project will not cut or destroy known occupied maternity roost trees, or any other trees within a 150-foot radius from the maternity roost tree, from June 1 – July 31.

Note: winter roosts in areas where the species may be active year-round (see Areas Where the NLEB is Active Year-Round, below) were not subject to any restrictions under the former 4(d) rule; therefore, no conservation measures or restrictions apply to these areas.

ACTION AREA

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 is not limited to the "footprint" of the project but rather encompasses the aerial extent of the biotic, chemical, and physical impacts to the environment resulting from the action.

The Interim Consultation Framework is not a federal action. This Standing Analysis is an analysis of the federal actions that could occur under the Interim Consultation Framework over the next year (until April 1, 2024). The Interim Consultation Framework considers and analyzes certain federal actions across the entire range of the NLEB within the United States, which includes all or portions of the following 37 States and the District of Columbia: Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

The action area for individual projects will be provided by the action agency in the template BA form and confirmed by the Service in the template BO.

STATUS OF THE SPECIES/CRITICAL HABITAT

This section presents the biological and ecological information relevant to formulating this Standing Analysis. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. Portions of this information are also presented in listing documents (USFWS 2015), the 2016 PBO (USFWS 2016), the Species Status Assessment (SSA) for the Northern long-eared (version 1.1; USFWS 2022), and available literature.

The NLEB was proposed for federal listing as endangered on 2 October 2013. On 2 April 2015, the species was given a proposed listing of threatened with an interim 4(d) rule, which was finalized on 14 January 2016 (USFWS 2016). No critical habitat has been designated for the species. On November 30, 2022, the Service published a final rule reclassifying the NLEB as endangered under the ESA (87 FR 73488). The 4(d) rule was rendered obsolete on March 31, 2023, which was the effective date of the final rule (88 FR 4908, January 26, 2023), as 4(d) rules only apply to threatened species.

Range and Distribution

The NLEB ranges across much of the eastern and north central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Figure 1) (Nagorsen and Brigham 1993; Caceres and Pybus 1997; Environment Yukon 2011). 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, p. 99; Caceres and Barclay 2000, p. 2; Simmons 2005, p. 516; Amelon and Burhans 2006, pp. 71–72). The species' range includes all or portions of the following 37 states and the District of Columbia (USFWS 2022, p. 15). Historically, the species has been most frequently observed in the northeastern United States and in Canadian Provinces, Quebec and Ontario, with sightings increasing during swarming and hibernation (Caceres and Barclay 2000).

Prior to 2006 (i.e., before white-nose syndrome was first documented), the NLEB was considered abundant and widespread throughout much of its range (despite having low winter detectability). The Service gathered information from a variety of sources (e.g., state agencies, federal agencies, tribes, and other organizations) and compiled a list of all known hibernacula and associated yearly winter counts (NABat 2021). Overall, the NLEB is known from 737 hibernacula, a maximum count of 38,181 individuals across >1.2 billion acres in 29 states and 3 Canadian provinces. Other States within the species' range have no known hibernacula (due to no suitable hibernacula present, lack of survey effort, or existence of unknown retreats). Among the five representation units (RPUs) identified in the NLEB SSA, the Eastern Hardwoods RPU historically encompassed approximately 90% of the total known hibernacula and 78% of the species' known winter abundance. The Southeast RPU contained 7% of the sites and 1% of total abundance, while the Subarctic RPU comprised 1% of the sites and 14% of the abundance. The Midwest and East Coast RPUs comprised 1% of the sites and 3% and 4% of the abundance, respectively (USFWS 2022, p. 28).

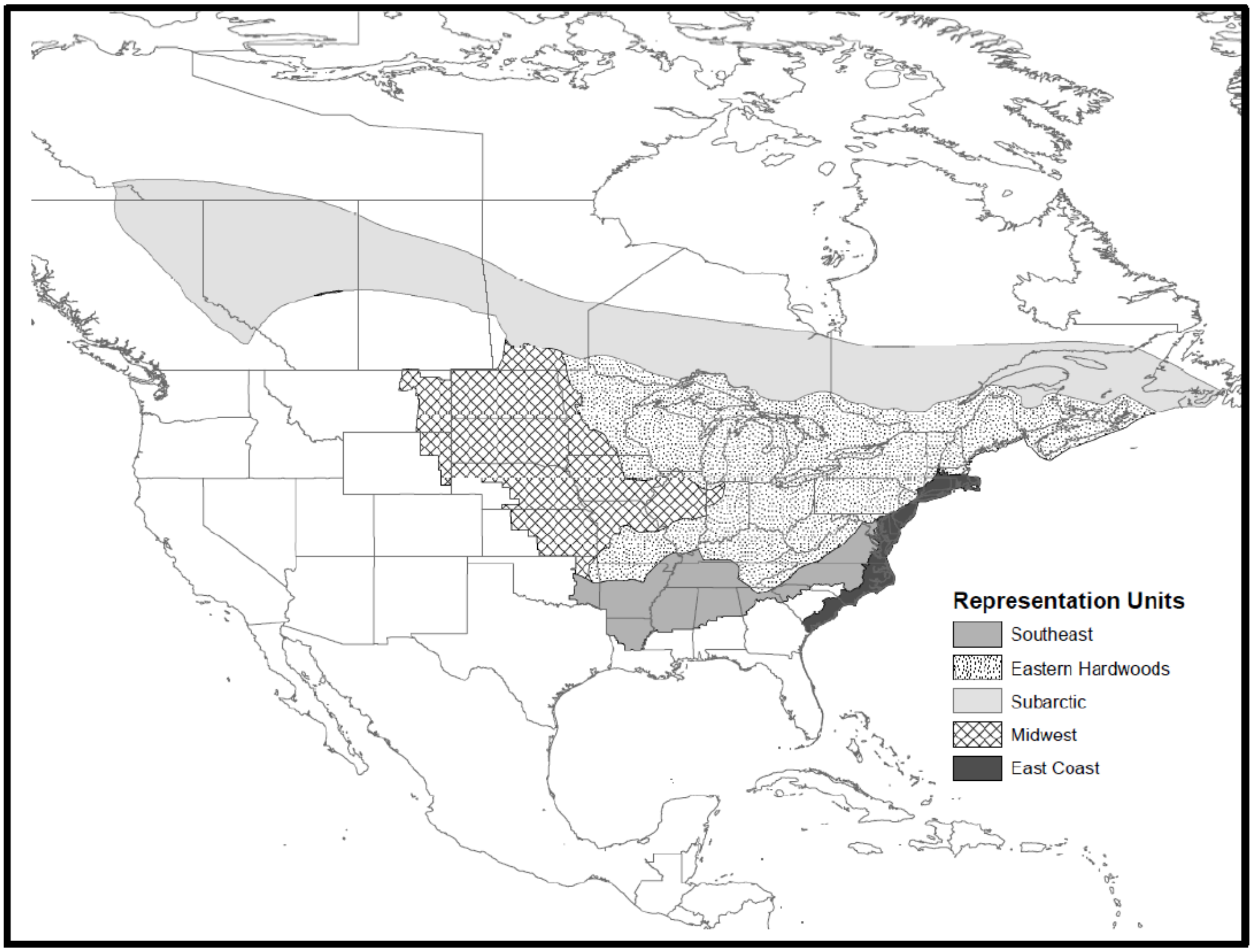

Figure 1. NLEB range organized into representation units (from USFWS 2022, p. 26).

Life History and Habitat use

The species generalized annual life history is summarized for NLEB in Figure 2.

Important definitions for time periods for the NLEB include:

1. The active season is the range of time when NLEBs may be present outside of hibernacula and using trees for roosting.

2. The inactive season is the range of time when NLEBs are hibernating. This season does not apply to coastal areas of Virginia, North Carolina, South Carolina, and Louisiana where NLEBs are expected to be active year-round.

3. The maternity season is the range of time when NLEBs are concentrated in maternity colonies.

4. The pup season[4] is the range of time when females are close to giving birth (two weeks prior to birth) and have non-volant (i.e., unable to fly) young.

The time periods associated with these seasons vary depending on geographic location; however, we make some generalized time period assumptions in the Effects Analysis Section below.

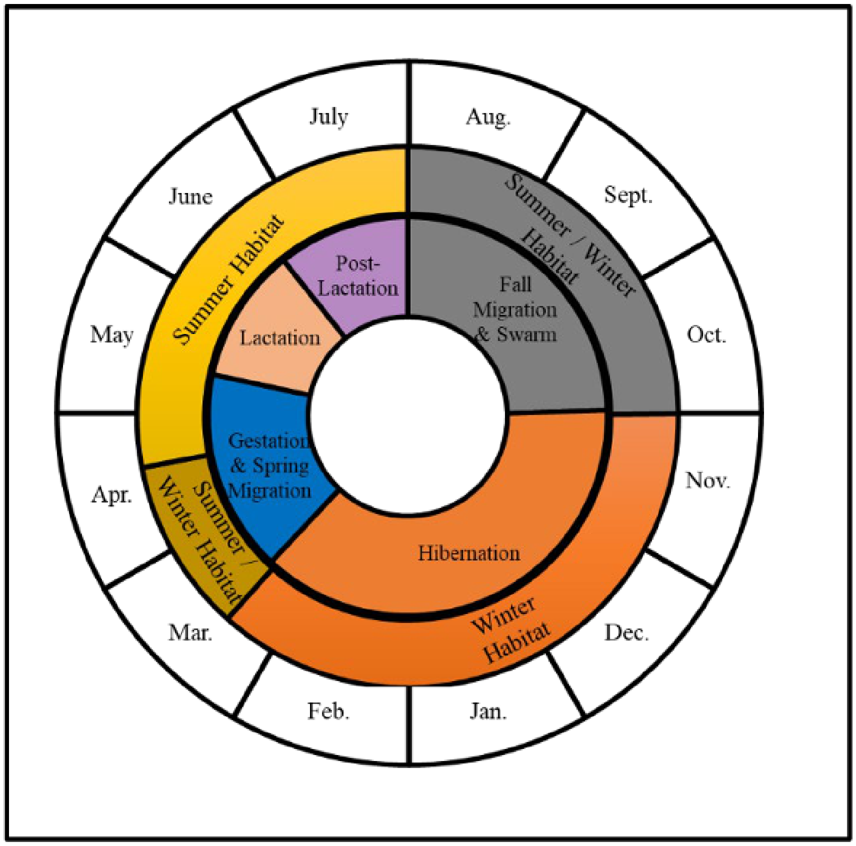

Figure 2. Generalized annual life history diagram for NLEB (adapted from Silvis et al. 2016).

Winter Hibernation

NLEBs are thought to predominantly overwinter in hibernacula that include caves and abandoned mines. These hibernacula have relatively constant, cooler temperatures (0 to 9 degrees Celsius [°C] or 32 to 48 degrees Fahrenheit [°F]) (Raesly and Gates 1987, p. 18; Caceres and Pybus 1997, p. 2; Brack 2007, p. 744), with high humidity and no strong currents (Fitch and Shump 1979, p. 2; van Zyll de Jong 1985, p. 94; Raesly and Gates 1987, p. 118; Caceres and Pybus 1997, p. 2). NLEBs are typically found roosting singly or in small numbers in cave or mine walls or ceilings, often in small crevices or cracks, sometimes with only the nose and ears visible and thus are easily overlooked during surveys (Griffin 1940a, pp. 181–182; Barbour and Davis 1969, p. 77; Caire et al. 1979, p. 405; van Zyll de Jong 1985, p. 9; Caceres and Pybus 1997, p. 2; Whitaker and Mumford 2009, pp. 209–210).

[4] The generic pup season used in the 4(d) rule only included the time of year when females care for non-volant young.

NLEBs have also been observed overwintering in other types of habitat that have similar conditions (e.g., temperature, humidity levels, air flow) to cave or mine hibernacula. The species may use these alternate hibernacula in areas where caves or mines are not present (Griffin 1945, p. 22).

Spring staging and fall swarming

Spring staging for the NLEB is the time period between winter hibernation and spring migration to summer habitat (Whitaker and Hamilton 1998, p. 80). During this time, bats 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 (state of mental or physical inactivity) (Whitaker and Hamilton 1998, p. 80). NLEBs also roost in trees near hibernacula during spring staging, and Thalken et al. (2018) found that roost trees were situated within 2-km (1.2 mi) of hibernacula during spring staging and the early maternity season.

The swarming season occurs between the summer and winter seasons (Lowe 2012, p. 50) and the purpose of swarming behavior may include: introduction of juveniles to potential hibernacula, copulation, and stopping over sites on migratory pathways between summer and winter regions (Kurta et al. 1997, p. 479; Parsons et al. 2003, p. 64; Lowe 2012, p. 51; Randall and Broders 2014, pp. 109–110). NLEBs roost in hibernacula and also in trees during the swarming season, and Lowe (2012) found tree roosts were evenly distributed over distances within 7.3-km (4.5-mi) from hibernacula.

Migration

Typical of most bat species in the eastern United States, NLEBs migrate between winter hibernacula and summer roosting habitat. When female NLEBs emerge from hibernation, they migrate to maternity colonies. While information is lacking, short regional migratory movements between seasonal habitats (summer roosts and winter hibernacula) of 56 kilometer (km) (35 mi) to 89 km (55 mi) have been documented (Griffin 1940b, pp. 235, 236; Caire et al. 1979, p. 404; Nagorsen and Brigham 1993 p. 88). Depending on location within range, the spring migration period typically runs from mid-March to mid-May (Easterla 1968, p. 770; Caire et al. 1979, p. 404; Whitaker and Mumford 2009, p. 207); fall migration typically occurs between mid-August and mid-October (USFWS 2022, p. 19).

Summer habitat use

Suitable summer habitat for NLEB consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts, as well as linear features such as fencerows, riparian forests, and other wooded corridors. 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, p. 88) on forested hillsides and ridges, rather than along riparian areas (LaVal et al. 1977, p. 594; Brack and Whitaker 2001, p. 207). NLEB seem to prefer intact mixed-type forests with small gaps (i.e., forest trails, small roads, or forest-covered creeks) in forest with sparse or medium vegetation for forage and travel rather than fragmented habitat or areas that have been clear cut (USFWS 2015, p. 17992; USFWS 2022, p. 18-19).

NLEBs typically roost singly or in maternity colonies underneath bark or more often in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 662; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007, p. 222; Timpone et al. 2010, p. 119). Males' and non-reproductive females' summer roost sites may also include cooler locations, such as caves and mines (Barbour and Davis 1969, p. 77; Amelon and Burhans 2006, p. 72). NLEBs are flexible in tree species selection and while they may select for certain tree species regionally, likely are not dependent on certain species of trees for roosts throughout their range; rather, many tree species that form suitable cavities or retain bark will be used by the bats opportunistically (Foster and Kurta 1999, p. 668; Silvis et al. 2016, p. 12; Hyzy 2020, p. 62). To a lesser extent, NLEBs have also been observed roosting in colonies in human-made structures, such as in buildings, in barns, on utility poles, behind window shutters, in bridges, and in bat houses (Mumford and Cope 1964, p. 72; Barbour and Davis 1969, p. 77; Cope and Humphrey 1972, p. 9; Burke 1999, pp. 77–78; Sparks et al. 2004, p. 94; Amelon and Burhans 2006, p. 72; Whitaker and Mumford 2009, p. 209; Timpone et al. 2010, p. 119; Bohrman and Fecske 2013, pp. 37, 74; ; Feldhamer et al. 2003, p. 109; Sasse et al. 2014, p. 172; USFWS 2015, p. 17984; Dowling and O'Dell 2018, p. 376). It has been hypothesized that use of human-made structures may occur in areas with fewer suitable roost trees (Henderson and Broders 2008, p. 960; Dowling and O'Dell 2018, p. 376, (De La Cruz et al. 2018, p. 496).

Before WNS, maternity colonies, consisting of females and young, were generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, larger colonies of up to 100 adult females have been observed (Whitaker and Mumford 2009, p. 212). Maternity colonies are smaller after WNS declines. In Kentucky, recent exit counts for WNS-impacted northern long-eared bat maternity colonies averaged <4 bats per roost in Mammoth Cave National Park (Thalken et al. 2018) and <6 bats per roost in the Robinson Forest experimental forest reserve (Arant et al. 2022), with maximum counts of 40 and 24 individuals, respectively. The highest exit counts observed post-WNS in the Fernow Experimental Forest (FEF) in West Virginia were 5 in 2015 and 7 in 2016 (Kalen et al. 2022), in contrast to the maximum pre-WNS exit count of 48 reported for northern long-eared bat colonies in the FEF by Johnson et al. (2012).

Most studies have found that the number of individuals roosting together in a given roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, p. 667; Lacki and Schwierjohann 2001, p. 485; Garroway and Broders 2007, p. 962; Perry and Thill 2007, p. 224; Johnson et al. 2012, p. 227). NLEBs switch tree roosts often (Sasse and Pekins 1996, p. 95), typically every 2 to 3 days (Foster and Kurta 1999, p. 665; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 261; Timpone et al. 2010, p. 119). Adult females give birth to a single pup (Barbour and Davis 1969, p. 104). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007, p. 654). Parturition (birth) may occur as early as late May or early June (Easterla 1968, p. 770; Caire et al. 1979, p. 406; Whitaker and Mumford 2009, p. 213) and may occur as late as mid-July

(Whitaker and Mumford 2009, p. 213). Juvenile volancy (flight) often occurs by 21 days after birth (Kunz 1971, p. 480; Krochmal and Sparks 2007, p. 651) and has been documented as early as 18 days after birth (Krochmal and Sparks 2007, p. 651; USFWS 2022, p. 17-18).

Although many studies have calculated individual female northern long-eared bat home ranges, few studies have estimated the roosting area used by entire colonies. Henderson and Broders (2008) found that roosting areas for two northern long-eared bat colonies on Prince Edward Island ranged from 0.3 to 31.1 ha (0.7 to 77 acres). In 2008, Johnson et al. 2012 radio-tracked 32 female northern long-eared bats (including pregnant, lactating, and non-reproductive bats) to 64 roost trees in West Virginia. Using cluster analysis, the bats were assigned to 16 social groups, ranging in size from 1 to 5 individuals. Groups (including those of 1 individual) roosted in 1 to 11 roost trees, and roost areas ranged from 0.39 to 14.77 ha (0.96 to 36.50 acres). In 2009, they radio-tracked 38 females to 51 roost trees. The 38 bats were clustered into 11 social groups ranging in size from 1 to 12 individuals and roosted in 1 to 16 roost trees. Roost areas ranged from 5.24 to 35.33 ha (12.95 to 87.30 acres). Although the social groups characterized in the study were notably smaller than typical northern long-eared bat maternity colony estimates, Johnson et al. found that the roosting areas of many groups overlapped, with some being entirely enveloped by others. Finally, Silvis et al (2014) estimated core and whole roosting areas for three northern long-eared bat maternity colonies containing 8-15 bats in Kentucky. Core roosting areas were between 0.2 and 10.8 ha (0.5 to 26.7 acres), and whole roosting areas were between 1.3 and 59.5 ha (2.3 to 150 acres).

Areas Where the NLEB is Active Year-Round

There is evidence populations in southeast coastal areas and Louisiana are active year-round due to mild temperatures during the winter and the availability of insect prey (Caceres and Barclay 2000, Grider et al. 2016, p. 11; White et al. 2018, p. N4; Jordan 2020). This area includes the Southeast Coastal Plain from the James River in Virginia south to the border of Georgia and the species' entire range in Louisiana. Northern long-eared bats in these areas are actively roosting in trees year-round and only entering torpor (i.e., a state of lowered body temperature and metabolic activity) during extreme cold spells (Jordan 2020). Jordan (2020) also found that 94.6% of winter tree roosts were in wetland forest, and the remaining winter roosts were close (<0.5 km) to wetland forest. They may also use bridges and culverts for winter roosts because maternity colonies have been documented using bridges and cluverts in Louisiana.

In the coastal plain of North Carolina, there are no known non-cavernicolous (cave-like) hibernacula (Grider et al. 2016; Jordan 2020). Some NLEBs here have been swabbed and confirmed negative for the fungus that causes the disease, *Pseudogymnoascus destructans* (Pd) and WNS (Jordan 2020). Because they are not dependent on caves or mines for hibernation, they may not be susceptible to WNS, and these populations may serve as refugium from WNS (Jordan 2020). This may be the case for all the areas where NLEBs are active year-round; however, Pd has been detected in Louisiana and in coastal Virginia.

Population Status and Size

Species Population Status

Prior to the onset of WNS (see below), the NLEB was abundant throughout much of the eastern United States and thus, was not a focus of detailed demographic studies. Although numbers varied temporally and spatially, abundance and occurrence on the landscape were considered stable prior to 2006 (Cheng et al. 2022, p. 204; Wiens et al. 2022, p. 233). USFWS estimated the U.S. population in 2016 to be 6,500,000 individuals (adults and juveniles; USFWS 2015b). However, catastrophic population declines have been continuing across the species' range since the emergence of WNS.

Available evidence from the SSA, including both winter and summer data, indicates NLEB abundance has and will continue to decline substantially over the next 10 years under current demographic conditions. Evidence of the past decline is demonstrated in available data in both winter and summer. For example, rangewide winter abundance has declined by 49% and the number of extant winter colonies (populations) by 81%. There has also been a noticeable shift towards smaller colony sizes, with a 96–100% decline in the number of large hibernacula (≥100 individuals). Although the declines are widespread, the magnitudes of the winter declines vary spatially. In the Eastern Hardwoods, the core of species' range, abundance declined by 56% and the number of sites by 88%. Abundance and the number of sites declined in the remaining 4 RPUs (87% and 82% - East Coast RPU, 90% and 44% - Midwest RPU, 24% and 70% - Southeast RPU, and 0% and 40% - Subarctic RPU, respectively). Across all RPUs, the potential of population growth is low; the probability of RPU growth rates (λ) ≥1 ranges from 0 to 11% (USFWS 2022, p. 53).

Declining trends in abundance and occurrence are also evident across much of NLEB's summer range. Based on derived rangewide summaries from Stratton and Irvine (2022, p. 102), rangewide occupancy has declined by 80% from 2010–2019 (Table A-3B4, Figure 5.7 in USFWS 2022). Although these declines attenuate westward, the probability of occupancy declined in all RPUs (Table A-3B4 in USFWS 2022). Similarly, Whitby et al. (2022, p. 160), using data collected from mobile acoustic transects, found a 79% decline in rangewide relative abundance from 2009–2019. Measurable declines were also found in the Midwest RU (91%) followed by the Eastern Hardwoods (85%), East Coast (71%), and Southeast (57%) RPUs. Data were not analyzed in the Subarctic RPU due to a lack of observations. Finally, Deeley and Ford (2022, p. 18, 21–23) observed a significant decrease in mean capture rate post-WNS arrival. Estimates derived from their results indicted a 43–77% decline in summer mist net captures compared pre and post arrival of WNS (USFWS 2022, p. 54).

Population Size

As described in the SSA, winter colony counts produce the most direct, representative, and feasible method for estimating abundance of NLEB. These data represent a sound estimate of the site-specific winter abundances, relative abundances, and population trends. However, winter colony counts only represent minimum estimates of abundance because the NLEB is difficult to detect in hibernacula and not all hibernacula are known or accessible. Other hibernation sites across their range that may not lend themselves well to typical hibernacula surveys due to inaccessibility and lack of information on bat occurrence include structures like storm cellar entrances, dry wells, crawl spaces, and rock faces and bluffs (Lemen et al. 2016, Hurt 2017). In addition, hibernacula counts to not account for the populations that are active year-round.

Winter colony counts underestimate the total number of NLEBs that may be present on the landscape and thus susceptible to impacts from activities evaluated under this Standing Analysis. Using winter colony counts size is therefore likely to underestimate the extent of impacts. In order to understand the extent of impacts the species could incur under this Standing Analysis, we updated the estimated populations from the 2016 PBO and developed a maximum population size for each RPU in 2022. The 2016 PBO estimates were based on summer occupancy data and the amount of forested habitat.

There are limitations and uncertainty associated with the population estimates in the 2016 PBO. Like our purposes now, the estimates were calculated to assess the potential relative impact of activities contemplated in the 2016 PBO, not as a precise estimate of NLEB populations. Importantly, we acknowledged in the 2016 PBO these were likely overestimates for several reasons: 1) we assumed all forested habitat was suitable for NLEBs; 2) the surveys used to generate the occupancy data were often very sparse and not designed for this purpose; and 3) the estimates did not fully account for declines due to WNS because most data was at least one year old at the time and some occupancy rates were based on surveys conducted pre-WNS. Other experts have agreed the state populations were overestimated in the 2016 PBO, for example, bat experts in the states of Michigan, Minnesota, and Wisconsin (ICF 2023, Appendix C).

The same data limitations continue to apply today; however, because the 2016 PBO population estimates are likely overestimates, we consider them to be the best available data to quickly derive a maximum population estimate. As described in the SSA, a variety of methods have been developed and continue to be improved to fulfil this important information need, including winter and summer colony counts, mist-netting, acoustic monitoring, and mark-recapture studies. However, these efforts have been limited in scope or inconsistently applied across the species' range. We expect the true population census of the NLEB is the less than the maximum population estimates in this Standing Analysis.

2016 Population Estimates from PBO

Below is a short summary of how the population estimates in the 2016 PBO were initially derived. *For more information about the assumptions, limitations, and methods, refer to the 2016 PBO.*

For purposes of the 2016 PBO, we estimated the population of NLEBs based on total forested acres in most states and the occupancy rate, as described in stepwise fashion below:

1. <u>States included:</u> We excluded states with less than 50% of their area within the species range because including the total forested acreage from states not fully within the species' range could greatly overestimate the population size. This eliminated Montana, Wyoming, Oklahoma, Louisiana, Alabama, Georgia, and South Carolina. We assumed

the inclusion of the full states of Nebraska, Kansas, Mississippi, and North Carolina would compensate for any individuals not included in the excluded states.

2. Total forested acres for each state were determined using the U.S. Forest Service's 2015 State and Private Forestry Fact sheets (USFWS 2016 Section 2.4.2).

3. Occupancy rate was calculated using available summer survey results from recent years and calculated the proportion of sites occupied with NLEB from the total number of sites sampled. Where no data were available, we used the post-WNS survey data provided by the Forest Service within the respective state (USFWS 2016 Section 2.4.1).

4. Total occupied acres were determined by multiplying the number of forested acres (step 1) by the occupancy rate (step 2) in each state.

5. Colony-occupied acres were determined by multiplying the total occupied acres by the overlap between the adult male home range and maternity colony home range, and we assumed maternity colonies did not overlap. An overlap of 90.4% was assumed for adult male home range and maternity colony home range based on data from mist-net surveys in Kentucky (USFWS 2016 Section 2.4.4).

6. Number of colonies was determined by dividing the colony-occupied acres by the assumed home range size of 1,000 acres per colony (USFWS 2016 Section 2.1.1);

7. Total number of adult females were determined by multiplying the number of colonies by the number of females per colony. We assumed each maternity colony would be comprised of 30-60 adult females prior to the effects of WNS, and 20 adult females for states where bat populations were already impacted by WNS (USFWS 2016 Section 2.4.1); and

8. Total number of adults in a state were determined by adding the total number of adult females plus 1 adult male per female; we assumed an equal adult sex ratio

We estimated the range-wide population of NLEBs in 2016 was comprised of 6,546,718 adults based on the calculations summarized above, and the assumption that the 30 states included in the analysis represented the range-wide population (USFWS 2016 Table 2.4).

2023 Maximum Population Estimate

To estimate the maximum current population, we updated the 2016 Population Estimates with the following information:

- Total acres of habitat for each state were determined using the Service's One Range model. The model used National Land Cover Dataset data to identify habitat based on forest layers, canopy cover, and forest patch size. Streams and rivers were incorporated into the model as these forested corridors often support movement between patches of forested habitat and provide important food and water resources (Gorman et al. 2022).

- Occupancy rate was updated for each state to reflect the percent change in populations based on the arrival of *Pd* in each state (Cheng et al. 2022), with the exception of North

Carolina and Mississippi. Specifically, we used Cheng et al. 2022's reported percent change in winter colony counts by disease stage relative to predicted median count prior to arrival of *Pd* (with 95% credible interval): invasion -37% (-54,-10); epidemic -56% (-70,-37); established -73% (-85,-59); and endemic -94% (-100,-78). All states included in the population estimates from the 2016 PBO (USFWS 2016 Table 2.4) are now considered post-WNS (endemic) except for KS, NE, ND, and SD. For North Carolina and Mississippi, we used an occupancy rate of 13% to account for areas where the species may be active year-round. Although we are uncertain whether populations in Mississippi are active year-round, we used included this state due to the limitations of excluding states with less than 50% of their area within the species range.

- <u>Average maternity colony</u> size was updated to 13 adult females based on colony counts published in several studies and FWS data (Kalen et al. 2022; Arant et al. 2022, USFWS unpubl. data). We also assumed a colony size of 20 during the established phase of WNS (NE, SD) and 22 during the epidemic phase (KS, ND) based on the decline rates in Cheng et al. 2022.

We estimate that the maximum current population of NLEBs is comprised of about 201,266 adults based on the calculations summarized above, and the assumption that the 30 states included in the 2016 PBO represent the range-wide population (Table 1).

For comparison purposes, the biological opinion for the Lake States HCP estimates 5,428 NLEB in Michigan, 4,391 in MN, and 1,056 in WI. These estimates were derived using little brown bat to NLEB abundance ratios using summer capture rates provided by bat experts and available literature. The populations were then reduced by 98.5% based on the percent decline in hibernating NLEBs reported for Michigan (Kurta and Smith 2020), which is higher than the 94% decline used for these states in this Standing Analysis. We estimate there are a maximum of 8,086 NLEB adults in Michigan, 11,232 in MN, and 9,698 in WI.

Threats

Although there are countless stressors affecting NLEBs, the primary factor influencing the viability of the species is white-nose syndrome (WNS), a disease of bats caused by a fungal pathogen. Other primary factors influencing the NLEB's viability include wind energy mortality, effects from climate change, and habitat loss.

WNS has been the foremost stressor on the NLEB for more than a decade. The fungus that causes the disease (Pd), invades the skin of bats, and infection leads to increases in the frequency and duration of arousals during hibernation and eventual depletion of fat reserves needed to survive winter, and often results in mortality. WNS has caused estimated NLEB population declines of 97–100% across 79% of the species' range. Wind energy-related mortality of NLEB is also proving to be a consequential stressor at local and regional levels, especially in combination with impacts from WNS. Most bat mortality at wind energy projects is caused by direct collisions with moving turbine blades. Wind energy mortality may occur over 49% of the NLEB range. Climate change variables, such as changes in temperature and precipitation, may influence NLEB resource needs, such as suitable roosting habitat for all seasons, foraging habitat, and prey availability. Although there may be some benefit to NLEB from a changing climate, overall negative impacts are anticipated, especially at local levels. Habitat loss may include loss of suitable roosting or foraging habitat, resulting in longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality. Loss of or modification of winter roosts (i.e., making hibernaculum no longer suitable) can result in impacts to individuals or at the population level (USFWS 2022, p. iv).

Table 1. Estimated maximum current NLEB summer population estimates from for the 30 states included in the analysis.

State	Updated Forested Acres	Percent Occupancy	Occupied Acres	Maternity Colonies	Maternity Colony Size	Adult Females	Total Adults	Total Pups
Iowa	2,028,770	2.5%	50,760	46	13	598	1,196	598
Illinois	4,438,658	3.8%	166,450	151	13	1,963	3,926	1,963
Indiana	4,763,934	2.3%	107,189	97	13	1,261	2,522	1,261
Michigan	18,155,284	1.9%	343,135	311	13	4,043	8,086	4,043
Minnesota	13,563,290	3.5%	477,699	432	13	5,616	11,232	5,616
Missouri	14,353,492	1.6%	225,637	205	13	2,665	5,330	2,665
Ohio	7,709,348	2.5%	194,738	177	13	2,301	4,602	2,301
Wisconsin	15,281,072	2.7%	411,672	373	13	4,849	9,698	4,849
Connecticut	1,873,585	0.6%	10,567	10	13	130	260	130
Delaware	19,412	0.3%	58	1	13	13	26	13
Maine	15,874,992	0.6%	89,535	81	13	1,053	2,106	1,053
Maryland	2,032,174	0.3%	6,097	6	13	78	156	78
Massachusetts	2,957,543	0.4%	12,067	11	13	143	286	143
New Hampshire	4,540,517	0.6%	26,698	25	13	325	650	325
New Jersey	1,881,274	1.9%	36,120	33	13	429	858	429
New York	18,058,361	2.0%	360,806	327	13	4,251	8,502	4,251
Pennsylvania	16,490,954	2.0%	334,437	303	13	3,939	7,878	3,939
Rhode Island	351,455	0.6%	1,982	2	13	26	52	26
Vermont	4,399,160	0.6%	25,867	24	13	312	624	312
Virginia	14,325,047	2.9%	415,140	376	13	4,888	9,776	4,888
West Virginia	11,913,113	3.2%	383,126	347	13	4,511	9,022	4,511
Arkansas	16,333,451	3.9%	639,945	579	13	7,527	15,054	7,527
Kentucky	12,850,213	2.4%	313,802	284	13	3,692	7,384	3,692
Mississippi	11,644,940	13.0%	1,513,842	1,369	13	17,797	35,594	17,797
North Carolina	12,938,367	13.0%	1,681,988	1,522	13	19,786	39,572	19,786
Tennessee	13,634,358	2.5%	336,223	305	13	3,965	7,930	3,965
Kansas	1,441,221	9.9%	142,681	130	22	2,860	5,720	2,860
Nebraska	520,114	6.1%	31,597	29	20	580	1,160	580
North Dakota	173,117	9.9%	17,139	16	22	352	704	352
South Dakota	610,547	6.1%	37,091	34	20	680	1,360	680
Total	245,157,764	3.4%	8,394,086	7,606		100,633	201,266	100,633

Conservation Needs

The SSA serves as a synthesis of the best available information on the biological status and thus is helpful in assessing the current and future conservation needs of the species. The needs of the NLEB include having a sufficient number and distribution of healthy populations to ensure NLEB can withstand annual variation in its environment (resiliency), catastrophes (redundancy), and novel or extraordinary changes in its environment (representation). Resiliency is best measured by the number, distribution, and health of populations across the species' range. Redundancy can be measured through the duplication and distribution of resilient populations across the species' range relative to potential catastrophic events. Representation can be measured by the number and distribution of healthy populations across areas of unique adaptive diversity. For NLEB, five representation units (RPUs) were identified: Eastern Hardwoods, Southeast, Midwest, Subarctic, and East Coast (Figure 1). NLEB's requirements for resiliency, redundancy, and representation are summarized in Table 2.

Overall, for survival and reproduction at the individual level, the NLEB requires access to food and water resources when not hibernating, along with suitable habitat throughout its annual life cycle. During the spring, summer and fall seasons, NLEB requires suitable foraging, roosting, traveling (between summer and winter habitat) and swarming habitat with appropriate conditions for maternity colony members; during the winter, NLEB requires habitat with suitable conditions for prolonged bouts of torpor. For NLEB populations to be healthy, they require a population size and growth rate sufficient to withstand natural environmental fluctuations, habitat of sufficient quantity and quality to support all life stages, gene flow among populations, and a matrix of interconnected habitats that support spring migration, summer maternity colony formation, fall swarming, and winter hibernation (USFWS 2022).

Table 2. Species-level ecology: Requisites for long-term viability (ability to maintain self-sustaining populations over a biologically meaningful timeframe) (from USFWS 2022).

3 Rs	Requisites Long-Term Viability	Description
Resiliency (populations able to withstand stochastic events)	Demographic, physically, and genetically healthy populations across a diversity of environmental conditions	Self-sustaining populations are demographically, genetically, and physiologically robust, have sufficient quantity of suitable habitat
Redundancy (number & distribution of populations to withstand catastrophic events)	Multiple and sufficient distribution of populations within areas of unique variation, i.e., Representation units	Sufficient number and distribution to guard against population losses and losses in species adaptive diversity, i.e., reduce covariance among populations; spread out geographically but also ecologically
Representation (genetic & ecological diversity to maintain adaptive potential)	Maintain adaptive diversity of the species	Populations maintained across breadth of behavioral, physiological, ecological, and environment diversity
	Maintain evolutionary processes	Maintain evolutionary drivers--gene flow, natural selection--to mimic historical patterns

ENVIRONMENTAL BASELINE

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline. 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.

This Standing Analysis an analysis of effects of the potential federal actions on NLEB across its range within the U.S. that are conducted under the Interim Consultation Framework; therefore, the environmental baseline is reflected by the Status of the Species Section of this Standing Analysis described above. When the Service issues a project-specific BO under the Interim Consultation Framework, we will describe the environmental baseline within the action area of the individual project.

EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the Action on the NLEB. In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See 50 CFR § 402.17).

As previously stated, the Interim Consultation Framework is not a federal action but rather an optional process by which Federal actions may attain section 7(a)(2) compliance in a consistent and efficient manner. This Standing Analysis is a range-wide (within the U.S.) analysis of effects of the potential federal actions that may be conducted under the Interim Consultation Framework. Below, we evaluate effects of the general activity types that could result from federal actions that qualify for the Interim Consultation Framework: 1) forest management, 2) prescribed fire; 3) habitat removal; and 4) other activities that may affect the NLEB.

Effects Analysis Methodology

Our effects analysis considers the following factors:

1. Proximity of the Action: Formal consultation under the Interim Consultation Framework will only occur for projects where NLEBs are reasonably certain to occur. Outside of

known locations, we are uncertain where the NLEB occurs on the landscape. Because of the steep declines in the species and vast amount of suitable forest habitat available, the presence of suitable forest habitat alone is a far less reliable predictor of their presence, and most suitable habitat is now expected to be unoccupied. During the period covered by the Interim Consultation Framework, we conclude take is not reasonably certain to occur in areas of suitable habitat where presence has not been documented. However, we do consider potential effects of projects that qualify for the Interim Consultation Framework to both known (i.e., occupied) and suitable but undocumented habitat.

2. Timing: The Interim Consultation Framework will apply for the next year. Because bat densities in forests vary seasonally, the timing of activities greatly influences the potential risk to covered species. Activities will affect NLEBs during the spring staging, maternity, fall swarming, and migratory stages of their life cycles and may result in direct injury and/or mortality from roughly April through October. We do not expect any adverse effects to known hibernacula or known hibernating bats due to the conservation measures. Forest management and prescribed fire conducted outside known hibernacula may result in additional beneficial effects. It is possible that some adverse effects to undocumented hibernating NLEBs may occur from roughly November to March.
3. Duration: Although the Interim Consultation Framework only applies for one year, activities covered in this Standing Analysis will have both short- and long-term effects to NLEBs (see Exposure-Response Table 3 below).
4. Disturbance Frequency and Intensity: In general, intensity increases as activities impact more acres of suitable habitat or a greater number of individuals.
5. Disturbance Severity: Disturbance severity is related to the type of individuals or populations impacted. Severity is expected to be highest for impacts to maternity colonies because NLEBs are concentrated during the maternity season and especially sensitive during the pup season because NLEBs are birthing and caring for non-volant pups. We anticipate severity will be low for swarming/staging populations because these individuals are able to fly and escape impacts, individuals are more likely roosting singly or in smaller groups during this time, and the 0.25 mile buffer around known hibernacula will reduce impacts. Severity could be high for undocumented hibernating bats; however, we expect it to be minimal for reasons described further below, and we do not anticipate direct effects to migratory NLEBs.

For each of the four categories of activities described above, we apply the following steps to analyze effects at the programmatic level:

Effects of the Activity

We review best available science and commercial information about how the activity may affect the NLEB. Based on the literature review, we identify the stressor(s) (i.e., alteration of the environment that can lead to results in a negative response) 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). For this consultation, we group responses into one of three negative categories: (1) reduced fitness (e.g., reduced food resources, reduced suitable roosting sites); (2) disturbance (e.g., day-time disturbance in a maternity roosting area, causing bats to flee and increasing the likelihood of injury or predation); and (3) harm (e.g., harvesting a tree occupied by adults and flightless bat pups resulting in death or injury; predation resulting from disturbance). This analysis is captured in the Exposure-Response Table (Table 3). This table is intended to be read in concert with and support this effects analysis section. In addition, we describe the positive (i.e., beneficial, increased fitness) responses for activities, where relevant, within the text of each section.

Table 3. Exposure-response analysis for activities conducted in accordance with the final 4(d) rule that may affect the NLEB.

Activity	Stressor	Exposure (time)	Exposure (space)	Resource Affected	Individual Response	Interpretation
Forest Management, Habitat Removal	Removing occupied roost trees via the removal of maternity roosting habitat	Active season; direct effect	Maternity roosting areas; Swarming or Staging Habitat	Individuals (pups, juveniles, adults)	Harm; Injury, mortality	This can cause harm (death or injury) of pups, juveniles, and adults from predation resulting from fleeing roost trees during the day. Only a subset will be harmed
Forest Management, Habitat Removal	Removing occupied roost trees via the removal of maternity roosting habitat	Maternity season; direct effect	Maternity roosting areas	Individuals (pups, adults)	Harm; Injury, mortality	This can cause harm (death or injury) of pups and adults when the tree falls or from predation. Only a subset will be harmed
Forest Management, Habitat Removal	Removing occupied roost trees via the removal of swarming or staging habitat	Swarming or staging Season; direct effect	Swarming or Staging Habitat	Individuals (pups, juveniles)	Harm; Injury, mortality	This can cause harm (death or injury) of pups and adults when the tree falls or from predation if bats are in torpor. Only a subset will be harmed
Forest Management, Habitat Removal	Removing occupied roost trees in areas where NLEB are active year-round via the removal of roosting habitat in forested wetlands during the cold winter months	Winter Season; direct effect	Winter Roosting areas	Individuals (juveniles, adults)	Harm; Injury, mortality	If bats are in torpor (i.e., state of mental or physical inactivity), this can cause harm (death or injury) of adults and juveniles when the tree falls or from predation. Only a subset will be harmed
Habitat Removal	Removing unoccupied roost trees via the permanent removal of maternity roosting habitat	Winter; indirect effect	Maternity roosting areas	Trees	Harm via reduced reporductive fitness	Removal of roost trees where bat colonies have demonstrated repeated use could reduce fitness through additional energy expenditure while searching for a new roost site. This can cause harm through reduced fitness by fragmenting maternity colonies and significantly affecting behavioral patterns associated with breeding.
Forest Management, Habitat Removal, Other	Disturbance (noise, machinery exhaust, activity) associated with human activities or noise from munitions, detonations, and training vehicles, including aircraft	Active season, daytime; direct effect	Roosting areas (maternity and non-maternity)	Individuals (juveniles, adults)	Harm; Injury, mortality	This can cause harm (death or injury) of pups and adults from predation resulting from fleeing roost trees during the day. Only a subset will be harmed. In addition, studies indicate bats do not avoid active ranges or alter foraging behavior during night-time maneuvers, and NLEBs are expected to become habituated to noise disturbance.
Prescribed Burning	Heat and smoke	Active season; direct effect	Maternity roosting areas	Individuals; adults, pups, and volant juveniles	Harm; Injury, mortality	Fleeing the line of fire of a prescribed burn during daylight hours increases the likelihood of predation. A subset of individuals may be harmed by this activity
Prescribed Burning	Heat and smoke	Pup Season; direct effect	Maternity roosting areas	Individuals; adults and pups	Harm; Injury, mortality	Exposure to heat and smoke during fires can cause harm (death or injury) of pups and females caring for pups.
Prescribed Burning	Heat and smoke in areas where the NLEB is active year-round in forested wetlands during the cold winter months	Winter Season; direct effect	Winter Roosting areas	Individuals; adults and juveniles	Harm; Injury, mortality	If bats are in torpor (i.e., state of mental or physical inactivity), this can cause harm (death or injury) exposure to heat and smokle during fires can cause harm (death or injury) of adults and juveniles
Other	Use of Military Training Smoke and Obscurants	Active season, direct effect	All occupied areas except hibernacula	Individuals: adults and pups	Harm; Injury, mortality	Research indicates that prolonged dermal and respiratory exposures smokes and obsurants could have adverse effects on roosting and foraging bats.
Other	Bridge and culvert work activities affect roosting bats	Active season, direct effect	Roosting areas (maternity and non-maternity)	Individuals: adults and pups	Harm; Injury, mortality	Bats may be injured or killed if they do not exit the bridge before it is either removed or the action results in effects to portion of the bridge where the bats are roosting. This can cause harm (death or injury) of adults and pups during construction activities or from predation resulting from fleeing the structure during the day.

Table 3. Exposure-response analysis, cont.

Activity	Stressor	Exposure (time)	Exposure (space)	Resource Affected	Individual Response	Interpretation
Other	Collision through exposure to roadways	Active Season	All occupied areas except hibernacula	Individuals: adults and juveniles	Harm; Injury, mortality	Construction of new roads within 1,000-ft of documented habitat. NLEBs colliding with vehicles can cause harm (death or injury) of adults and juveniles during the active season.
Prescribed Burning	Heat and smoke	Non-volant season; direct effect	Maternity roosting areas	Individuals; non-volant juveniles	Harm; Injury, mortality	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
Other	Bats can become trapped in waste pits or tanks or drink contaminated water	Active season, direct effect	All occupied areas except hibernacula	Individuals	Harm; Injury, mortality	Bats may drink contaminated water or become trapped in waste pits and die.
Forest Management, Habitat Removal, Other	Altering the flow of air and water through hibernacula.	Winter (direct effect) and active season (indirect effect)	Near hibernacula	Individuals	Disturbance; Arousal from hibernation; reduced fitness	Response depends on proximity of tree removal to hibernacula entrances, airflow patterns, and local hydrology, roosting locations within hibernacula.
Forest Management	Removing unoccupied roost trees via the temporary removal of maternity roosting habitat	Winter; indirect effect	Maternity roosting areas	Trees	Disturbance through reduced fitness by temporarily impairing behavioral patterns associated with breeding, feeding, and sheltering	Removal of roost trees where bat colonies have demonstrated repeated use could reduce fitness through additional energy expenditure while searching for a new roost site. We do not expect harm because forest loss is not permanent and there are typically other maternity roosting areas available in forest management settings
Forest Management, Habitat Removal	Removing trees that provide habitat used for foraging, swarming, or staging	Year-round; indirect effect	All occupied areas except hibernacula	Insect prey, forest cover that supports (shelters) bat activity	Disturbance through reduced fitness; temporary energy expenditure for relocating from traditional use areas to alternative habitat	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
Prescribed Burning	Heat and smoke	Winter; direct effect	Near hibernacula	Individuals	Arousal from hibernation; reduced fitness, injury, mortality; harm	Response depends on the proximity of fire to hibernacula entrances and airflow patterns. Sufficient smoke entering hibernacula may cause injury or mortality. We do not expect this to occur due to the conservation measures
Other	Lighting	Active season, night; direct effect	All occupied areas except hibernacula	Individuals	Disturbance (fleeing), reduced fitness	Installation of new lighting sources can affect fitness by disturbing foraging patterns.
Other	Use of pesticides and herbicides for pest and vegetation control	Active season, direct and indirect effect	All occupied areas except hibernacula	Individuals; insect prey	Disturbance; sublethal exposure to toxins; reduction in prey availability	Use of pesticides can cause adverse effects by temporarily disturbing behavioral patterns associated with feeding and sheltering. Bats may drink contaminated water or forage in affected areas with the potential to eat insects exposed to chemicals. Bats may also be directly exposed to herbicides sprayed in roosting areas. Effects are reduced because all herbidices and pesticides must be used in accordance with their label.
Other	Chemical contamination from use or spills in/around bat habitat	Active season, direct and indirect effect	All occupied areas except hibernacula	Individuals; insect prey	Disturbance; temporarily reduced fitness through sublethal exposure to toxins; reduction in prey availability	Bats may drink contaminated water or forage in affected areas with the potential to eat insects exposed to chemicals.
Other	Water Quality Alteration; sedimentation	Active season, indirect effect	All occupied areas except hibernacula	Insect prey	Disturbance; temporarily reduced fitness	This could affect fitness by temporarily disturbing behavioral patterns associated with feeding and sheltering. Temporary effects on water quality could occur during construction, which could reduce local insect populations. Standard construction BMPs (e.g., silt fencing) will minimize erosion and subsequent sedimentation, thus reducing potential impacts on aquatic ecosystems.
Other	Bridge work makes it unsuitable for roosting.	Inactive season, indirect effect	Roosting areas (maternity and non-maternity)	Individuals	Increased energy exposure; temporarily reduced fitness	Removal of bridges where bat colonies have demonstrated repeated could reduce temporarily fitness through additional energy expenditure while searching for a new roost site.
Other	Subsurface drilling utility line and road installation	Winter (direct effect) and active season (indirect effect)	Near hibernacula	Individuals	Arousal from hibernation; disturbance; temporarily reduced fitness	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); however, we do not expect this to occur based on the conservation measures from the 4(d) rule.
Other	Use of explosives to remove rocks for utility line and road installation	Winter (direct effect) and active season (indirect effect)	Near hibernacula	Individuals	Arousal from hibernation; disturbance; temporarily reduced fitness	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); however, we do not expect this to occur based on the conservation measures from the 4(d) rule.

Quantifying Effects to Maternity Colonies

As described above, NLEBs are concentrated in maternity colonies during the maternity season, and the severity of the effects is expected to be highest for impacts to maternity colonies. Although overall population densities are low in relation to available summer habitat, local densities may be high within maternity colony home ranges. As a result, even small-scale summer habitat impacts could result in death, injury, or disturbance to multiple individuals simultaneously. Thus, it is useful to understand the likelihood of such a situation occurring. For pathways associated with forest management, prescribed fire, and habitat removal, we conducted a simplified cell-based probability analysis. The goal of the analysis was to predict the chances of these activities occurring within an occupied maternity roosting area when maternity colonies are present for one year until April 1, 2024, which is the time bound of this analysis.

We first determined the probability of a single maternity colony area being occupied by calculating the following:

1. Total expected population of NLEBs impacted, including the total population size and the population size by RPU. We used the maximum population size (see Population Size, above) to understand the maximum extent of impacts. This is a conservative assumption because it increases the area over which colonies are distributed.
2. Total number of maternity colonies, calculated by dividing the total number of females (estimated population size divided by 2, assuming 1:1 sex ratio) by the assumed colony size (e.g., 13 individuals for colonies in states where WNS is endemic). The total number of maternity colonies is also the number of occupied maternity core area-sized cells in the probability analysis (Steps 3 and 4, below).
3. Maternity core area was assumed to be 150 acres based on the maximum core area reported by Silvis et al. (2014), which is larger than some estimates of maternity roosting areas, but within the range of maternity roosting areas reported. This is a conservative assumption because it increases the area over which colonies are distributed. The maternity core area is also the size of the 'core area-sized cells' in the probability analysis (step 4, below).
4. Total maternity core area-sized cells in available bat habitat, calculated by dividing the available bat habitat (determined using the One Range model) by the size of one maternity core area. This assumes maternity colonies are randomly distributed across suitable habitat within the range of the NLEB.
5. Probability of a single maternity core area-sized cell being occupied, calculated by dividing the number of maternity colonies by the total maternity core area-sized cells (150 acres) in available bat habitat

We then determined the probability of a maternity core area-sized cell being impacted by forest management, prescribed fire, or habitat removal by calculating the following:

6. Total maternity core area-sized cells in the impacted area, calculated by dividing the acres of habitat impacted by the size of 1 maternity core area. We input the acres impacted annually using the maximum number of impacted acres (e.g., acres of forest management practices, prescribed fire, habitat removal) we expect to occur under this framework, which is described for each category below.
7. Probability of impacting any given cell (proportion of cells harvested, etc.), calculated by dividing the total maternity core-sized cells in the impacted area by the total maternity core-sized cells in available bat habitat.

From there we calculated the probability of any given cell being impacted by forest management practices, prescribed fire, or habitat removal and the probability of maternity core areas being impacted:

- Probability of a single cell being both occupied and impacted. This is calculated by multiplying the probability of a single maternity core-sized cell being occupied by the probability of impacting any given cell.
- Probability of a single cell miss (not impacted, not occupied, or not impacted and not occupied) = 1 minus the probability of a single cell being both occupied and impacted
- Probability of all impacted cells in one year missing all maternity core areas = the probability of a single cell miss raised to the power of the total maternity core-sized cells in the treated area
- Probability of all impacted cells over the analysis term missing all maternity core areas = the probability of all impacts in one year missing all maternity core areas raised to the power of the permit term.
- Percent chance of impacting a maternity colony. = 1 – probability of all impacted cells missing all maternity core areas multiplied by 100.

We also used these parameters to calculate the number of colonies that may be affected by these activities both range-wide and within each RPU by multiplying the probability of a single maternity core area-sized cell being occupied by the total maternity core area-sized cells in the impacted area.

Population-level Effects

We evaluate the aggregated consequences of the effects to individuals/habitat on the fitness of the population(s) to which those individuals belong. Maternity colonies are the local population unit examined, and we also analyzed effects at the scale of the representation units (RPUs) from the SSA as analogous to recovery units or regional populations. This step closes with our conclusions on the likely fate or ultimate response of the population(s) and is couched in terms of population fitness (i.e., persistence and reproductive potential, long and short-term).

Species Range-wide

This step determines whether the anticipated reductions in population fitness will reduce the likelihood of survival and recovery of the species by reducing its range-wide reproduction, numbers, or distribution (RND). If the Service and other action agencies have insured that the population-level risks do not noticeably, detectably, or perceivably reduce the likelihood of progressing towards or maintaining the RND needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species.

Effects of Forest Management

Literature Review

Beneficial Effects

Active forest management can result in the creation, enhancement, and conservation of bat habitat over broad areas and time scales (Silvis et al. 2012). Forest management practices (harvest, thinning, etc.) can reduce clutter and 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 NLEB 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 forest management practices could meet both male and female roosting requirements by maintaining large-diameter snags, while allowing for regeneration of forests.

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.

Tree Felling

The impacts from tree felling are expected to vary depending on location, time of year, and extent/intensity. If a bat is roosting in a tree that is felled, it may remain in the tree and be crushed or flush and become more vulnerable to predation (e.g., by diurnal raptors). It is unlikely that all bats present in a stand during covered activities will be disturbed and flush, and not all disturbance will constitute harm.

While bats can flee during forest management practices, felling of occupied roosts has been shown to result in direct injury and death of Indiana bat adults and pups in three instances (Cope et al 1974; Bellwood 2002; J. Whitaker, Indiana State University, pers. comm. 2005). Indiana bats and NLEB are closely related and have similar behavior (i.e., forest-dwelling, forming maternity colonies, roosting in trees in the summer). These three instances did not occur during forest management operations, but available evidence indicates that both adults and pups can be killed when an occupied roost tree is felled.

Based on these reports, the risk of injury or death from being crushed when a tree is felled is most likely to impact non-volant pups. The risk is also greater to adults during cooler weather when bats periodically enter torpor and may be unable to arouse quickly enough to respond. The likelihood of potential roost trees containing larger numbers of covered species is greatest during pregnancy and lactation (April-July), with exit counts falling dramatically after this time. For example, two studies found little brown and northern long-eared bats' use of certain trees appears to be highest in spring, when females were pregnant, with colonies breaking into smaller groups before parturition (Foster and Kurta 1999, Sasse and Pekins 1996).

Habitat Loss

Silvis et al. (2014a) modeled the effects of roost-loss on NLEBs, and Silvis et al. (2015) actually removed known roosts during the winter to investigate the effects. 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. However, once removals exceeded 20–30% of documented roosts (ample similar roosts remained), a single maternity colony network started showing patterns of break-up. Sociality is believed to increase reproductive success (Silvis et al. 2014a), and smaller colonies could experience reduced reproductive success, providing less thermoregulatory benefits for adults in cool spring temperatures and/or for non-volant pups. Fitness benefits of colonial roosting include minimizing the physiological stress of lactation, creation of more favorable thermal conditions, and cooperative rearing of young (Olivera-Hyde et al. 2019).

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 over fragmented forest 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). A preference for riparian habitats was also reflected in the relative probability of acoustic detections of NLEB in riparian vs non-riparian areas in four eastern states and the District of Columbia (Gorman et al. 2022). 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.

Amount of Forest Management Anticipated

For the purposes of this Standing Analysis, we estimate the maximum amount of forest management we expect to occur under this framework (500,000 acres) as follows:

To estimate how much forest management could occur over the next year, we started by reviewing the timber harvest estimated in the 2016 PBO analyses. *Refer to the 2016 PBO for more information about the assumptions, limitations, and methods, in estimating timber harvest.* We estimated an average of 3,669,077 acres would be harvested annually (affecting 1.3% of the available forested habitat).

We used the 2016 PBO timber harvest estimates to calculate how much forest management likely occurred annually within each RPU since 2016. There were no RPUs at the time of the 2016 PBO, so we used the data and analyses in the 2016 PBO to estimate acres of forest management practices by RPU post-hoc. We calculated that 27.8% of the estimated forest management practices occurred in the Southeast RPU, 2.9% in the East Coast RPU, 6.5% in the Midwest RPU, and 62.8% in the Eastern Hardwoods RPU. These calculations are based on the percent of forested acres in each RPU and the estimated harvest in each state where data were available. Some states have multiple RPUs, and some RPUs cover multiple states, therefore we determined the proportion of each RPU in each state, summed the total acres in each RPU and calculated the proportion of harvest using overall annual total. We assumed forest management treatment rates do not vary by location within a given state/RPU.

We reviewed timber harvest reported through the 4(d) Rule Consistency Determination Key to estimate the amount of forest management practices that occurred in NLEB habitat since the 2016 PBO. A total of 4,098 projects reported timber harvest using the 4(d) Rule Consistency Determination Key from March 28, 2019, through November 3, 2022. Reported cumulative timber harvest was 1,345,402 acres and averaged 336,350 acres/year. The reported timber harvest was 9% of the anticipated annual timber harvest estimated and analyzed in the 2016 PBO (336,350 acres reported vs 3,669,077 acres in the 2016 PBO). We accept that average annual timber harvest reported under-represents the annual timber harvest because some users did not report annual updates for incomplete projects.

Although the average annual timber harvest reported is not inclusive of all harvest activities, these data provide an indication of the magnitude of forest management practices annually within the NLEB range. We determined that 500,000 acres is a reasonable maximum estimate of forest management practices that could occur over the next year. Given the uncertainty in our estimates, we assumed 250,000 acres (50% of the 500,000 acres) of forest management would occur during the maternity season to be conservative to the species. Without more information to better understand unreported harvested acres, or the anticipated acres of forest management practices over the next year, we used this reasonable maximum to set the bounds of our analysis and indicate when this analysis should be revised, and individual consultations may need to be re-initiated.

Based on the RPU estimates extrapolated from state totals in the 2016 PBO, we estimate the following acres of forest management practices by RPU:

- Southeast RPU: 69,500 acres total (27.8%)
- East Coast RPU: 7,250 acres total (2.9%)
- Midwest RPU: 16,250 acres total (6.5%)
- Eastern Hardwoods RPU: 157,000 acres total (62.8%)

Quantifying the Effects of Forest Management

Forest management practices result in increased fitness (i.e., positive response) through the improvement of roosting, foraging, swarming/staging, and travel and migration habitat by reducing clutter, creating canopy, growing larger diameter trees, maintaining larger diameter snags, creating snags, allowing for regeneration, increasing heterogeneity, and removing non-native species. Forest management maintains forested habitat, and NLEBs use actively managed forests. However, forest management practices also remove roost trees and harvest may reduce foraging, spring staging, fall swarming, or travel and migration habitat. Table 3 shows the pathways we identified for NLEB negative responses to forest management and the range of individual responses expected. Removing occupied trees is likely to kill or injure pups and adults. The disturbance (noise, exhaust from machinery, etc.) that accompanies harvest activities could result in harm or death because fleeing during daylight increases the likelihood of predation. The species' responses to these stressors depends on the type of harvest (e.g., thinning, salvage, even-aged management, clear cut, etc.) and its timing (i.e., more likely to be beneficial when bats are not present).

Removing occupied roost trees can cause harm from death and injury when the tree falls or from predation that could occur when bats flee the roost. We expect this to occur when NLEBs are more concentrated during the maternity season (pups and adults) and the swarming/staging season (adults and juveniles). It is also possible during cold temperatures (<4.5ºC or 40ºF) in areas where NLEBs are active year-round when adults and juveniles experience bouts of torpor, which makes them less likely to escape. As described above, the vast majority of winter roosts occur within forested wetlands, so we do not anticipate effects outside of forested wetland habitat. We do not predict precise numbers of individuals affected, but the likelihood of harm and death is very low. The chance of felling an occupied roost tree is low because there are many trees on the landscape in most forest management settings, only a handful of which are maternity roost trees or roost trees used during swarming and staging or winter (in areas where they are active year-round). In addition, tree harvests in the eastern U.S. are almost always live trees, and dead trees (which are more likely to be roosts) are of little commercial value aside from salvage harvests or firewood. The likelihood of noise or exhaust resulting in fleeing is also low because it would have to occur in close proximity to an occupied roost tree. The chance of a fleeing bat being predated is low.

Although the likelihood of felling an occupied roost tree is low, the consequences can be severe. As described above, severity is expected to be low for swarming/staging populations because these individuals that are able to fly and escape impacts, individuals are more likely roosting singly or in smaller groups during this time, and the 0.25 mile buffer around known hibernacula will further reduce the likelihood of this occurring. The consequences for adult NLEBs in torpor in areas where the species is active year-round may be greater than for swarming/staging populations; however, the likelihood of it occurring is even lower because there are not many days with temperatures <4.5ºC, and available data indicate the NLEBs are roosting in forested wetlands in these areas (Jordan 2020), and these areas are not typically subjected to forest management treatments due to best management practices.

The likelihood and severity of effects is greatest for maternity colonies because NLEBs are pregnant and caring for non-volant pups. We used the simplified cell-based probability analysis to predict the chances of forest management practices occurring within an occupied maternity roosting area when NLEBs are present. We analyzed a reasonable worst-case scenario by assuming 500,000 acres of forest management practices would occur during the maternity season over the next year. Results indicate that the chance of impacting any given maternity colony is extremely unlikely (<5%), and a maximum of 7 colonies could be affected over the range of the NLEB (Table 4).

Table 4. Maximum Impact of Forest Management Activities on Maternity Colonies

FOREST MANAGEMENT					
Population	Maximum Treated (acres)	% of Modeled Habitat Affected	% Chance of Impacting Maternity Colony	# of Maternity Colonies Affected	% of Maternity Colonies Affected
Rangewide (USA)	250,000	0.1%	1.0%	7	0.1%
Southeast RPU	69,500	0.1%	0.7%	4	0.1%
East Coast RPU	7,250	0.1%	0.0%	<1	<0.1%
Midwest RPU	16,250	0.1%	0.1%	<1	<0.1%
Eastern Hardwoods RPU	157,000	0.1%	0.4%	3	0.1%

In addition to the pathways that result in direct effects, forest management practices could alter the flow of air and water through unknown hibernacula, which could also harm NLEBs. We expect the likelihood of this occurring will be low because the range-wide determination key asks if the action area for individual projects contains caves, karst, or other hibernacula features and requests a hibernacula habitat assessment. In addition, the hibernacula often selected by NLEB are "large, with large passages" (Raesly and Gates 1987), and may be less affected by relatively minor surficial micro-climatic changes that might result from forest management around unknown hibernacula. Further, bats rarely hibernate near the entrances of structures (Grieneisen 2011). Davis et al (1999) reported that partial clearcutting "appears not to affect winter temperatures deep in caves.". We anticipate very little, if any, impact based on the widely dispersed (i.e., not concentrated in a given area) nature of forest management activities and the nature of typical hibernacula.

We also do not quantify the potential reductions in fitness that may result as indirect effects from loss of habitat, and we do not expect the reductions in fitness to significantly impair essential behavioral patterns or result in harm. We anticipate that less than 0.2% (500,000 acres of 245,157,764 acres) of available habitat will be harvested by April 1, 2024. In addition, the NLEB does not appear to be limited by habitat in most locations, as demonstrated by a great deal of plasticity within its environment (e.g., living in highly fragmented forest habitats to contiguous forest blocks from the southern United States to Canada's Yukon Territory) in the absence of WNS. According to the SSA, adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat. However, there is less than 0.1% chance that these activities will affect colonies in the Midwest RPU (which covers the western and central MW states), and <1 maternity colony may be affected in the Midwest RPU. In addition, habitat losses from forest management practices are temporary, and forest management occurs in areas with sufficient forested habitat on the landscape, which would allow for NLEBs to find alternate maternity roosting areas nearby. Therefore, reductions in fitness from habitat loss due to forest management are anticipated to uncommon and localized. Further, many forest management practices benefit NLEB habitat and may increase fitness of local NLEB populations.

Effects of forest management in undocumented areas

As described above, we conclude take is not reasonably certain to occur in areas of suitable habitat where presence has not been documented. Because the forest management practices are extremely unlikely (<5%) to impact an undocumented colony, individual federal actions are not likely to adversely affect[5] NLEBs in areas outside of known locations. However, because the analysis indicates that 7 maternity colonies will be affected range-wide, it is reasonable to conclude there will be some impacts to some individual NLEBs in areas where they have yet to be documented (i.e., specific areas where they are not reasonably certain to occur). Given the nature of forest management and overlap with suitable habitat, the best available science indicates that forest management practices are anticipated to have at least some negative impact on some individual NLEBs in unknown locations, as opposed to the assumption that forest management will have a large impact on all of the or most NLEBs. Forest management will also positively affect NLEBs in unknown locations. This relative quantification of impacts, even if somewhat qualitative, is essential to determining the magnitude of the importance of the impacts on the population and to the species. The low probability of forest management practices impacting a given colony, coupled with the low levels of harm and death anticipated shows that severe, localized effects to NLEBs in unknown locations are not likely.

Effects of forest management in known occupied areas

If action agencies are conducting forest management activities and formally consulting under the Interim Consultation Framework, they are conducting activities in areas where NLEBs are reasonably certain to occur and may be within a known colony area, known swarming or staging area, or known winter habitat in areas where the species is active year-round. Although the impacts to unknown populations are discountable across the range (1% chance of impacting a colony), the best available commercial and scientific information shows that conducting forest management practices in known areas is likely to adversely impacts individuals and populations.

As described above, the conservation measures prevent impacts to known hibernacula, known hibernating bats. The conservation measures also prevent impacts to known, occupied maternity roost trees during the pup season. However, we do expect impacts to some pups and adults during the maternity season, swarming/staging, and during cold temperatures in areas where bats are active year-round if NLEBs are in torpor and the activity occurs in a forested wetland. We anticipate that 10 maternity colonies may be impacted by forest management practices. However, the low levels of harm and death anticipated provides evidence that severe, localized effects to northern long-eared bats in known locations are also unlikely. The low levels or harm and death predicted are further supported by other analyses of forest management on the NLEB. For example, the Service recently issued Incidental Take Permits for forest management activities in Michigan, Minnesota, and Wisconsin (ICF 2023). Harvest activities were expected to occur on over 500,000 acres per year, and less than 3 NLEBs were anticipated to be killed and 74 disturbed (a fraction of these would be harmed). Therefore, we do not expect more than 3 individuals to be harmed within a colony. In addition, forest management practices will benefit NLEB habitat.

---

[5] "Not likely to adversely affect" is the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Discountable effects are extremely unlikely to occur. Exremely unlikely is generally accepted as a <5% chance.

Effects of Prescribed Fire

Literature Review

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 to the habitat types that resulted from fire suppression in many parts of the eastern U.S. The impact of fire suppression on populations of NLEBs is unclear, but it is apparent that fire may affect individual bats adversely through exposure to heat, smoke, and carbon monoxide, and positively through habitat modifications and resulting changes in their food base.

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 fire. Dickinson et al. (2009) monitored two NLEBs (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. It was presumed that roosting sites (e.g. exfoliating bark, crevices) used by bats offer little protection from hot gases released by fire (Dickinson et al. 2009, p. 59; Guelta and Balbach 2005). By extrapolating from other species, carbon monoxide exposure would cause incapacitation at concentrations of >1000 PPM for 25 minutes or more (Dickinson et al. 2009, p. 59; Spietel 1996). 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 can arouse from short-term torpor quickly. Most adult bats are quick, flying at speeds > 30 km/hour (Patterson and Hardin 1969) and able to escape to unburned areas. NLEB use multiple roosts, switching roost trees often, and could likely use alternative roosts in unburned areas should fire destroy the current roost. Silvis et al. (2016) noted NLEBs aroused from torpor in late April during prescribed fires; however, the authors acknowledged how non-volant bats and adults with pups respond to fire is unknown. Non-volant pups are likely the most vulnerable to death and injury from prescribed fire.

At least some NLEBs roosting in burned areas may be harmed by carbon monoxide or heat. 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. Their research suggested that blood carboxyhemoglobin concentrations from CO exposure only approach critical levels just above flame heights in the most intense prescribed burns. However, if bats are in torpor during a fire and cannot arouse quickly enough to escape, thermal injury could occur up to the height of at which crown scorch occurs. Most prescribed fires for forest management are planned to avoid significant tree scorch.

Direct and Indirect Effects – Winter Roosting

Fires conducted during the winter could affect hibernating NLEBs if they generate gases that drift or are blown into hibernacula. Whether this occurs depends on local airflow characteristics and weather conditions (Carter et al. 2002; Perry 2011). Smoke from may not reach toxic levels in caves and mine, but 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 also 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 availability of roosting sites (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 other intense wildfires may create large areas of snags, the effects of multiple, low-intensity prescribed burns on snag density is less obvious, especially for forests consisting mostly of fire-adapted tree species. Low-intensity, ground-level fire may injure large 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 to roost 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 NLEBs before and after prescribed fire, finding a greater percentage (74.3 percent) of roosts in burned habitats than in unburned habitats. NLEB behavior is consistent with being fire tolerant – that is, they frequently forage and roost in live trees and snags in early stages of decay in post-burn sites (Lacki et al. 2009a, p. 1172). NLEB post-burn roost selection was based on bole condition – they selected trees with higher number of cavities and a higher percentage of bark cover on the bole than random snags, likely due to a wider range of roosting options within a tree (Lacki et al. 2009a, p. 1172). 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. The extent to which preferred roosts are limiting in forested habitats is unclear (Lacki et al. 2009a, p. 1172; Crampton and Barclay 1998, p. 1355; Kunz and Lumsden et al. 2003, p. 16). There is evidence, however, for competition for roost availability among syntopic (similar and closely related) species of tree-roosting bats (Lacki et al. 2009a, p. 1172; Boonman 2000, p. 385; Lumsden et al. 2002, p. 207).

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. 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.

Indirect Effects – Summer Foraging

Adult insects are the predominant prey of NLEB. 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 related to the insects' ability to use regrowth of ground vegetation stimulate by the burns (Swengel 2001, p. 1141). In NLEB fecal samples, lepidopterans (moths), coleopterans, and dipterans were the three most important groups of insect prey, with dipteran consumption increasing in the year after burning. NLEB appeared to track the observed changes in insect availability – home ranges were closer to burned habitats than to unburned habitats after fires, but home range size did not change.

<u>Amount of Prescribed Fire Anticipated</u>

For the purposes of this Standing Analysis, we estimate the maximum amount of prescribed fire we expect to occur under this framework (650,000 acres) as follows:

To estimate how much prescribed fire could occur over the next year, we started by reviewing the prescribed fire estimated in the 2016 PBO analyses. *Refer to the 2016 PBO for more information about the assumptions, limitations, and methods, in estimating prescribed fire.* We estimated 648,908 acres of forested NLEB habitat would be burned annually (0.2% of the available forested habitat).

These estimations were based on data from the 2012 National Prescribed Fire Use Survey Report, and we assumed the mean annual use of prescribed fire from 2002-2014 would be consistent annually. The use of prescribed fire likely varies among years, but to estimate the proportion of prescribed fire that could occur during the active season of 2023, we assumed prescribed fire in forested habitat will be similar; the most recent national report indicates that the extent of prescribed fire in both the northeastern and southeastern U.S. fluctuated between 2011 and 2019 with no clear trends up or down (2020-Prescribed-Fire-Use-Report.pdf (prescribedfire.net)).

We used the state prescribed fire data from the 2016 PBO prescribed fire estimates to calculate how much prescribed fire likely occurred annually within each RPU since 2016. There were no RPUs at the time of the 2016 PBO, so we used the data and analyses in the 2016 PBO to estimate burned acres by RPU post-hoc. We calculated that 43.4% of the projected prescribed fire from the 2016 PBO would have occurred in the Southeast RPU, 5.2% in the East Coast RPU, 16.1% in the Midwest RPU, and 35.3% in the Eastern Hardwoods RPU. These calculations are based on the percent of forested acres in each RPU and the estimated acres of prescribed fire in each state where data were available. Some states have multiple RPUs, and some RPUs cover multiple states, therefore we determined the proportion of each RPU in each state, summed the total acres in each RPU and calculated the proportion of prescribed burns using overall annual total. We assumed forest management treatment rates do not vary by location within a given state/RPU.

We reviewed prescribed fire reported through the 4(d) Rule Consistency Determination Key to estimate the amount of prescribed fire that may have occurred in NLEB habitat since the 2016 PBO. A total of 365 projects reported 1,468,562 acres of prescribed fire from March 28, 2019 through November 3, 2022. The mean annual total amount of prescribed fire was 367,138 acres (range 188,665 – 727,570 acres), and the average project size was 4,023 acres (range 2,285 – 7,740 acres). If the self-reporting in the 4(d) Rule Consistency Determination Key is accurate, only about 57% of the anticipated annual prescribed fire estimated in the 2016 PBO occurred on average annually. However, reported prescribed fire exceeded 2016 PBO estimates in 2021 (727,570 acres vs 648,908 acres predicted in the 2016 PBO). Significant fluctuations in extent of prescribed burning among years seems typical for regions of the U.S. occupied by the NLEB (Coalition of Prescribed Fire Councils, Inc. 2020). We accept that reported average acres of annual prescribed fire underrepresents the actual acreage of prescribed fires because some users did not report annual updates for incomplete projects.

Although the average annual acreage of prescribed burns is not inclusive of all prescribed burn activities, these data provide an indication of the magnitude of the actual burned area annually within the NLEB range. We determined that 650,000 acres is a reasonable maximum estimate of prescribed burned area that could occur over the next year (between now and April 1, 2024). Given the uncertainty in our estimates, we assumed 325,000 acres (50% of the 650,000 acres) of prescribed fire would occur during the maternity season to be conservative to the species. We did not assume all of this would occur during the pup season because most prescribed burning happens during the dormant season. Without more information to better understand unreported acres, or the anticipated acres of prescribed fire over the next year, we used this reasonable maximum to set the bounds of our analysis and indicate when this analysis should be revised.

Based on the RPU estimates extrapolated from state totals in the 2016 PBO, we estimate the following acres of prescribed fire by RPU:

- Southeast RPU: 141,050 acres total (43.4%)
- East Coast RPU: 16,900 acres total (5.2%)
- Midwest RPU: 52,325 acres total (16.1%)
- Eastern Hardwoods RPU: 114,725 acres total (35.3%)

Quantifying Effects of Prescribed Fire

Table 3 shows the pathways we identified for NLEB negative responses to prescribed fire and the range of individual responses expected. Prescribed fire also results in increased fitness (i.e., positive response) likely through the increases in roosting habitat quality and insect abundance.

Prescribed fire creating snags, creates roost features in live trees, removes mid-story clutter, and stimulates growth of ground cover and insect populations. Exposure to prescribed burning can cause direct adverse responses (fleeing, injury, death). Stressors are 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.

Exposure to heat and smoke can cause harm from death or injury directly or from predation that could occur when NLEBs flee prescribed burns. We expect this to occur when NLEBs are more concentrated during the maternity season and the swarming/staging season, but we only anticipate direct harm from heat and smoke during the pup season or during cold temperatures (<4.5ºC or 40ºF) in areas where NLEBs are active year-round. As described above, the vast majority of winter roosts occur within forested wetlands, so we do not anticipate effects outside of forested wetland habitat. We do not predict precise numbers of individuals affected, but the likelihood of harm and death is low. The chance of burning near an occupied roost tree is low because there are many trees on the landscape in most forest settings, only a handful of which are maternity roost trees or roost trees used during swarming and staging or winter (in areas where they are active year-round). The likelihood of heat, smoke, and disturbance resulting in fleeing or causing harm or death is low because it would have to occur in close proximity to an occupied roost tree. In addition, the chance of a fleeing bat being predated is low.

Although the likelihood of burning an occupied roost tree is low, the consequences can be severe. The consequences for NLEBs in torpor in areas where the species is active year-round may be high; however, the likelihood of it occurring is even lower because there are not many days with temperatures <4.5ºC, and available data indicate the NLEBs are roosting in forested wetlands in these areas (Jordan 2020), and these areas are not typically subjected to high intensity burns.

The likelihood and severity of effects is greatest for maternity colonies because NLEBs are pregnant and caring for non-volant pups. We used the simplified cell-based probability analysis to predict the chances of prescribed burns occurring within an occupied maternity roosting area when NLEBs are present for one year. We analyzed a reasonable worst-case scenario by assuming 650,000 acres of burning would occur during the active season. Results indicate that the chance of impacting any given maternity colony is extremely unlikely (<5%), and a maximum of 13 colonies could be affected over the range of the NLEB (Table 5).

The heat and smoke from burning could also harm hibernating bats if a hibernaculum is exposed to smoke. Although the conservation measures avoid impacts to known hibernaculum, prescribed burns may impact unknown hibernacula. However, we expect the likelihood of this occurring will be low because the range-wide determination key asks if the action area for individual projects contains caves, karst, or other hibernacula features and requests a hibernacula habitat assessment. Based on the assessment burn activities can be modified to avoid the effects of smoke on potentially hibernating bats (e.g., burning when wind directions do not cause smoke to inundate potential hibernacula). In addition, prescribed fires may have little or no effects to NLEBs in unknown hibernacula. Caviness (2003), for example, reported that prescribed burns were found had no notable influence on bats hibernating in various caves in the Ozark National Forest. All bats present in caves at the beginning of the burn were still present and in “full hibernation” when the burn was completed, and bat numbers increased in the caves several days after the burn. There were minute changes in relative humidity and temperature during the burn and elevated short-term levels of some contaminants from smoke were noted.

Table 5. Maximum Impact of Prescribed Fire Activities on Maternity Colonies

PRESCRIBED FIRE					
Population	Maximum Treated (acres)	% of Modeled Habitat Affected	% Chance of Impacting Maternity Colony	# of Maternity Colonies Affected	% of Maternity Colonies Affected
Rangewide (USA)	325,000	0.1%	1.8%	13	0.2%
Southeast RPU	141,050	0.3%	3.2%	9	0.3%
East Coast RPU	16,900	0.2%	0.2%	<1	<0.1%
Midwest RPU	52,325	0.3%	0.7%	2	0.3%
Eastern Hardwoods RPU	114,725	0.1%	0.2%	2	0.1%

Effects of prescribed burning in undocumented areas

As described above, we conclude take is not reasonably certain to occur in areas of suitable habitat where presence has not been documented. Because the prescribed fire is extremely unlikely (<5%) to impact an undocumented colony, individual federal actions are not likely to adversely affect NLEBs in areas outside of known locations. However, because the analysis indicates that 13 maternity colonies will be affected range-wide, it is reasonable to conclude that there will be some impacts to some individual NLEBs in areas where they have yet to be documented (e.g., specific areas where they are not reasonably certain to occur). It is also possible that some impacts could occur to NLEBs that may be hibernating in undocumented hibernacula. Given the nature of prescribed fire and overlap with suitable habitat, the best available science indicates that prescribed fire is anticipated to have at least some negative impact on some individual NLEBs in unknown locations, as opposed to the assumption that it will have a large impact on all of the or most NLEBs. Prescribed fire will also positively affect NLEBs in unknown locations. This relative quantification of impacts is essential to determining the magnitude of the importance of the impacts on the population and to the species. The low probability of prescribed fire impacting a given colony, coupled with the low levels of harm and death anticipated provides evidence that severe, localized effects to NLEBs in unknown locations are unlikely.

Effects of prescribed burning in known occupied areas

If action agencies are conducting controlled burns and formally consulting under the Interim Consultation Framework, they are conducting activities in areas where NLEBs are reasonably certain to occur and may be within a known colony area, known swarming or staging area, or known winter habitat in areas where the species is active year-round. Although the impacts to unknown populations are discountable across the range (<5% chance of impacting a colony), controlled burning in areas of known colonies is likely to adversely impact individuals and populations.

As described above, the conservation measures prevent impacts to known hibernacula and known hibernating bats. The conservation measures also prevent impacts to known, occupied maternity roost trees during the pup season. However, we do expect impacts to some pups and adults during the maternity season, swarming/staging, and during cold temperatures in areas where bats are active year-round if NLEBs are in torpor and activities occur in forested wetlands. We anticipate that 13 maternity colonies may be impacted by prescribed burning. However, the low levels of harm and death anticipated provides evidence that severe, localized effects to northern long-eared bats in known locations are also unlikely. The low levels or harm and death predicted are further supported by other analyses of prescribed fire on the NLEB. For example, the Service recently issued Incidental Take Permits for forest management activities in Michigan, Minnesota, and Wisconsin (ICF 2023). Prescribed fire was expected to occur on over 77,000 acres per year, and less than 1 NLEB was anticipated to be killed and <4 disturbed (a fraction of these would be harmed). Therefore, we do not expect more than 1 individual to be harmed within a colony. In addition, prescribed fire will benefit NLEB habitat.

Effects of Habitat Removal

In the final listing rule for the NLEB, we note that habitat removal could result in the following impacts: (1) loss of suitable roosting or foraging habitat; (2) fragmentation of remaining forest patches, leading to longer flights between suitable roosting and foraging habitat; (3) removal of travel corridors fragmenting colonies/networks; and (4) direct injury or mortality from the removal of occupied roosts during active season clearing. Habitat removal could also alter the flow of air and water through unknown hibernacula and impact NLEBs. The literature review for forest management (above) describes the loss of suitable roosting or foraging habitat, direct injury or mortality from removal of occupied roost, and alteration of hibernacula, and all of these effects and studies apply to habitat removal as well. In addition, fragmentation of forests patches and travel corridors may result in longer flights to find alternative suitable habitat and result in colonial disruption.

NLEBs emerge from hibernation with their lowest annual fat reserves and return to their summer home ranges. Because NLEBs have summer home range fidelity (Foster and Kurta 1999; Patriquin et al. 2010; Broders et al. 2013), loss or alteration of forest habitat may put additional stress on females when returning to summer roost or foraging areas after hibernation. Females (often pregnant) have limited energy reserves available for use if forced to seek out new roosts or foraging areas. Hibernation and reproduction are the most energetically demanding periods for temperate-zone bats, including the NLEB (Broders et al. 2013). Bats may reduce metabolic costs of foraging by concentrating efforts in areas of known high prey profitability, a benefit that could result from the bat's local roosting and home range knowledge and site fidelity (Broders et al. 2013). Cool spring temperatures provide an additional energetic demand, as bats need to stay sufficiently warm or enter torpor. Entering torpor comes at a cost of delayed parturition; bats born earlier in the year have a greater chance of surviving their first winter and breeding in their first year of life (Frick et al. 2010). Delayed parturition may also be costly because young of the year and adult females would have less time to prepare for hibernation (Broders et al. 2013). Female NLEBs typically roost colonially, with their largest population counts occurring in the spring (Foster and Kurta 1999), presumably as one way to reduce thermal costs for individual bats (Foster and Kurta 1999). Therefore, similar to other temperate bats, NLEBs have multiple high metabolic demands (particularly in spring) and must have sufficient suitable roosting and foraging habitat available in relatively close proximity to allow for successful reproduction.

Amount of Habitat Removal Anticipated

For the purposes of this Standing Analysis, we estimate the maximum amount of habitat removal that we expect to occur under this framework (536,000 acres) as follows:

To estimate how much habitat removal could occur over the next year, we started by reviewing the forest conversion estimated in the 2016 PBO analyses. *Refer to the 2016 PBO for more information about the assumptions, limitations, and methods, in estimating forest conversion.* We estimated an average of 914,237 acres would be converted from forested habitat annually (affected 0.3% of the available forested habitat). This estimation was based on the average annual acres of forest conversion by state using the National Land Cover Database by subtracting the total acres of forest in 2011 from the total acres of forest in 2001 and calculating the annual loss over the 10-year period.

We used the 2016 PBO forest conversion estimates to calculate how much habitat removal likely occurred annually within each RPU since 2016. There were no RPUs at the time of the 2016 PBO, so we used the data and analyses in the 2016 PBO to estimate habitat removal acres by RPU post-hoc. We estimated that 44.5% of the projected conversion from the 2016 PBO occured in the Southeast RPU, 6.6% in the East Coast RPU, 5.6% in the Midwest RPU, and 43.3% in the Eastern Hardwoods RPU. These estimations are based on the percent of forested acres in each RPU and the estimated conversion in each state where data were available. Some states have multiple RPUs, and some RPUs cover multiple states, therefore we determined the proportion of each RPU in each state, summed the total acres in each RPU and calculated the proportion of conversion using overall annual total. We assumed conversion rates do not vary by location within a given state/RPU.

We reviewed forest conversion reported through the 4(d) Rule Consistency Determination Key to estimate the amount of habitat removal that occurred in NLEB habitat since the 2016 PBO. A total of 16,649 projects reported 825,996 acres of converted forest from March 28, 2019 through November 3, 2022. The mean annual total amount of forest conversion was 206,499 acres (range 95,163 – 517,998 acres), and the average project size was 49.6 acres (range 23.8 – 105 acres). If the self-reporting in the 4(d) Rule Consistency Determination Key is accurate, only about 39% of the anticipated annual forest conversion estimated in the 2016 PBO occurred on average annually, but reported acres were close to the estimated average in 2021. We accept that reported average acres of annual forest conversion underrepresents the actual acreage of habitat removal because some users did not report annual updates for incomplete projects.

Although the average annual acreage of forest conversion reported is not inclusive of all habitat removal activities, these data provide an indication of the magnitude of habitat removal occurring annually within the NLEB range. We determined that 520,000 acres of habitat removal is a reasonable maximum estimate that could over the next year. Given the uncertainty in our estimates, we assumed 260,000 acres (50% of the 520,000 acres) of habitat removal would occur during the maternity season to be conservative to the species. Without more information to better understand unreported converted acres, or the anticipated acres of conversion over the next year, we used this reasonable maximum to set the bounds of our analysis and indicate when this analysis should be revised.

Based on the RPU estimates extrapolated from state totals in the 2016 PBO, we estimate the following acres of habitat removal by RPU:

- Southeast RPU: 115,700 acres total (44.5%);
- East Coast RPU: 17,160 acres total (6.6%)
- Midwest RPU: 14,560 acres total (5.6%)
- Eastern Hardwoods RPU: 112,580 acres total (43.3%)

Quantifying Effects of Habitat Removal

Table 3 shows the pathways we identified for NLEB negative responses to habitat removal and the range of individual responses expected. Many of the pathways are similar to forest management; however, there are no beneficial effects anticipated from habitat removal. The primary alteration of the environment associated with habitat removal that is relevant to the NLEB is the removal of trees that provide roosts or serve as foraging, spring staging, or fall swarming habitat. Removing occupied trees is likely to kill or injure pups and adults. Fragmentation and loss of forest habitat decreases opportunities for growth and successful reproduction. Alteration of hibernacula can harm NLEBs. The disturbance (noise, exhaust from machinery, etc.) that accompanies habitat removal activities may result in harm or death because fleeing during daylight increases the likelihood of predation. A small subset of disturbed individuals may be harmed. The species' responses to these stressors depend on the timing, location, and extent of the removal. In areas with little forest or highly fragmented forests (e.g., western U.S. edge of the range, central Midwestern states; see Figure 1), the impact of forest loss would be disproportionately greater than similar-sized losses in heavily forested areas (e.g., Appalachians and northern forests). Also, the impact of habitat loss within a NLEB's home range is expected to vary depending on the scope of removal.

Removing occupied roost trees can cause harm from death and injury when the tree falls or from predation that could occur when bats flee the roost. We expect this to occur when NLEBs are more concentrated during the maternity season and the swarming/staging season. It is also possible during cold temperatures (<4.5ºC or 40ºF) in areas where NLEBs are active year-round when they experience bouts of torpor, which makes them less likely to escape. As described above, the vast majority of winter roosts occur within forested wetlands, so we do not anticipate effects outside of forested wetland habitat. We do not predict precise numbers of individuals affected, but the likelihood of harm and death is low. The chance of felling an occupied roost tree is low because there are many trees on the landscape in most forested settings, only a handful of which are maternity roost trees or roost trees used during swarming and staging or winter (in areas where they are active year-round). The likelihood of disturbance (noise, exhaust, etc.) resulting in fleeing is also low because it would have to occur in close proximity to an occupied roost tree. The chance of a fleeing bat being predated is low.

Although the likelihood of felling an occupied roost tree is low, the consequences can be severe. As described above, severity is expected to be low for swarming/staging populations because these individuals are able to fly and escape impacts, individuals are more likely roosting singly or in smaller groups during this time, and the 0.25 mile buffer around known hibernacula will further reduce the likelihood of this occurring. The consequences for NLEBs in torpor in areas where the species is active year-round may be greater than for swarming/staging populations; however, the likelihood of it occurring is even lower because there are not many days with temperatures <4.5ºC, and available data indicate the NLEBs are roosting in forested wetlands in these areas (Jordan 2020), and these areas are not typically subjected to forest management treatments due to best management practices.

The likelihood and severity of effects is greatest for maternity colonies because NLEBs are pregnant and caring for non-volant pups. We used the simplified cell-based probability analysis to predict the chances of forest management practices occurring within an occupied maternity roosting area when NLEBs are present. We analyzed a reasonable worst-case scenario by assuming 536,000 acres of forest management practices would occur during the maternity season over the next year. Results indicate that the chance of impacting any given maternity colony is extremely unlikely (<5%), and a maximum of 9 colonies could be affected over the range of the NLEB (Table 6).

Table 6. Maximum Impact of Habitat Removal Activities on Maternity Colonies

HABITAT REMOVAL					
Population	Maximum Treated (acres)	% of Modeled Habitat Affected	% Chance of Impacting Maternity Colony	# of Maternity Colonies Affected	% of Maternity Colonies Affected
Rangewide (USA)	260,000	0.1%	1.1%	9	0.1%
Southeast RPU	115,700	0.2%	2.2%	7	0.2%
East Coast RPU	17,160	0.2%	0.2%	<1	<0.1%
Midwest RPU	14,560	0.1%	0.1%	<1	<0.1%
Eastern Hardwoods RPU	112,580	0.1%	0.2%	2	0.1%

In addition to these two pathways, habitat removal could alter the flow of air and water through unknown hibernacula, which could also harm NLEBs. We expect the likelihood of this occurring will be low because the range-wide determination key asks if the action area for individual projects contains caves, karst, or other hibernacula features and requests a hibernacula habitat assessment. In addition, the hibernacula often selected by NLEB are “large, with large passages” (Raesly and Gates 1987), and may be less affected by relatively minor surficial micro-climatic changes that might result from forest management around unknown hibernacula. Further, bats rarely hibernate near the entrances of structures (Grieneisen 2011). Davis et al (1999) reported that partial clearcutting “appears not to affect winter temperatures deep in caves.” We anticipate very little, if any, impact based on the widely dispersed (i.e., not concentrated in a given area) nature of habitat removal and the nature of typical hibernacula.

Unlike forest management, we do anticipate adverse effects from the reduction in habitat, even if it occurs during the inactive season when NLEBs are not on the landscape. This results from reductions in fitness that may result as indirect effects from loss of habitat because habitat loss can result in fragmentation of maternity colonies. Although we anticipate that less than 0.2% (536,000 acres of 245,157,764 acres) of available habitat will be removed by April 1, 2024, the SSA states that adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat. There is less than 0.2% chance that these activities will affect colonies during the active season in the Midwest RPU (which covers the western and central MW states). However, habitat removal is permanent, and the effects can be felt from habitat removal that occurs at any time of the year. We anticipate that the removal of 29,120 acres (500,000 acres total; 5.6% in Midwest RPU) could occur in the Midwest RPU, and this would affect about 1 maternity colony. Therefore, reductions in fitness from habitat loss is anticipated to be uncommon in most of the range, but it will cause local effects to affect two maternity colonies in the Midwest RPU.

Effects of habitat removal in undocumented areas

As described above, we conclude take is not reasonably certain to occur in areas of suitable habitat where presence has not been documented. Because the habitat removal is extremely unlikely (<5%) to impact an undocumented colony, individual federal actions are not likely to adversely affect NLEBs in areas outside of known locations. However, because the analysis indicates that 9 maternity colonies will be affected range-wide, it is reasonable to conclude that there will be some impacts to some individual NLEBs in areas where they have yet to be documented (e.g., specific areas where they are not reasonably certain to occur). It is also possible that some impacts could occur to NLEBs that may be hibernating in undocumented hibernacula. Given the nature of habitat removal and overlap with suitable habitat, the best available science indicates that habitat removal is anticipated to have at least some negative impact on some individual NLEBs where data shows occurrence but where information that identifies species locations is absent. We do not conclude that it will have a large impact on all or most NLEBs. This relative qualitative assessment of impacts is essential to determining the magnitude of the importance of the impacts on the population and to the species. The low probability of habitat removal impacting a given colony, coupled with the low levels of harm and death anticipated provides evidence that severe, localized effects to NLEBs in unknown locations are unlikely. However, habitat removal is expected to be more impactful than forest management and prescribed fire because it does not benefit NLEB habitat.

Effects of habitat removal in known occupied areas

If action agencies are removing habitat and formally consulting under the Interim Consultation Framework, they are removing habitat in areas where NLEBs are reasonably certain to occur and may be within a known colony area, known swarming or staging area, or known winter habitat in areas where the species is active year-round. Although the impacts to unknown populations are discountable across the range (<5% chance of impacting a colony), we conclude that the best available information shows that removing habitat in areas supporting known colonies is likely to adversely impact individuals and populations.

As described above, the conservation measures prevent impacts to known hibernacula, known hibernating bats. The conservation measures also prevent impacts to known, occupied maternity roost trees during the pup season. However, we do expect impacts to some pups and adults during the maternity season, swarming/staging, and during cold temperatures in areas where bats are active year-round if NLEBs are in torpor and activities occur in a forested wetland. We anticipate that 9 maternity colonies may be impacted by habitat removal, and we do not expect more than 3 individuals to be harmed within a colony. The low levels of harm and death anticipated provides evidence that severe, localized effects to NLEBs in known locations are also unlikely except in the Midwest RPU where 1 colony may be affected. Habitat removal is expected to be more impactful than forest management and prescribed fire because it does not benefit NLEB habitat.

Other Activity Types that May Affect the NLEB

The NLEB may be affected by a variety of other activities beyond those associated with forest management, prescribed fire and habitat removal. These activities include, but may not be limited to:

- Disturbance/noise from with human activities
- Lighting
- Use of pesticides for pest and vegetation control
- Water quality alteration
- Collision
- Noise from munitions, detonations, and training vehicles
- Use of military training smoke and obscurants
- Bridge and culvert maintenance, repair, or replacement
- Subsurface drilling or blasting for utility line and road installation

We do not have enough information to estimate the potential effects of these activities as we did for the effects associated with forest management, prescribed fire, and habitat removal. As a result, the Standing Analysis provides a general analysis of potential exposure pathways and effects for these other activities. Some of these affects are likely to be captured by the analysis of activities such as forest conversion, which are expected to occur in association with the other activities such increased noise, increased lighting, etc. In addition, as with the activities of forest management, prescribed fire and habitat removal, only a very small number of individuals are likely to be affected.

<u>Disturbance/Noise</u>

Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities of the NLEB. Many activities may result in increased noise/vibration/disturbance that may result in effects to bats. Significant changes in noise levels in an area may result in temporary to permanent alteration of bat behaviors. The novelty of these noises and their relative volume levels will likely dictate the range of responses from individuals or colonies of bats. At low noise levels (or farther distances), bats initially may be startled, but they would likely habituate to the low background noise levels. At closer range and louder noise levels (particularly if accompanied by physical vibrations from heavy machinery and the crashing of falling trees) many bats would probably be startled to the point of fleeing from their day-time roosts and in a few cases may experience increased predation risk. For projects with noise levels greater than usually experienced by bats, and that continue for multiple days, the bats roosting within or close to these areas are likely to shift their focal roosting areas further away or may temporarily abandon these roosting areas completely.

NLEBs may continue to roost and forage in areas with increased noise unless it is severe or intense or close to a roost. Gardner et al. (1991) had evidence that an NLEB conspecific, Indiana bat, continued to roost and forage in an area with active forest management (see the Forest Management Section above regarding other similar studies for NLEB). They suggested that noise and exhaust emissions from machinery could possibly disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment.

Indiana bats have also been documented roosting within approximately 300 meters of a busy state route adjacent to Fort Drum Military Installation (Fort Drum) and immediately adjacent to housing areas and construction activities on Fort Drum (US Army 2014). Bats roosting or foraging in all the examples above may have become habituated to the noise/vibration and disturbance. Intense noise and vibration close to a roost tree, however, may cause NLEBs to abandon the roost. Callahan (1993) noted that the likely cause of the bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree.

Noise/disturbance may disturb NLEBs – see Table 3 for the pathway identified for NLEB responses to noise/disturbance. Although some adverse effects to NLEBs are likely to occur from noise or disturbance, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of activities and occupancy rates that are typically less than 5%. In addition, the potential for noise disturbance to harm NLEBs is more probable when new sources of noise and disturbance occur within suitable habitat. We anticipate than any new sources of noise within suitable habitat are likely to occur associated with habitat removal, which is addressed in the effects analysis for Habitat Removal section above. Therefore, we do not anticipate additional take beyond that estimated for habitat removal throughout the range.

Lighting

Bat behavior may be affected by lights when traveling between roosting and foraging areas. Foraging in lighted areas may increase risk of predation or it may deter bats from flying in those areas. Bats that significantly alter their foraging patterns may increase their energy expenditures resulting in reduced reproductive rates. This depends on the context (e.g., duration, location, extent, type) of the lighting.

Some bats seem to benefit from artificial lighting, taking advantage of high densities of insects attracted to light. For example, 18 species of bats in Panama frequently foraged around streetlights, including slow-flying edge foragers (Jung and Kalko 2010). However, seven species in the same study were not recorded foraging near streetlights. Bat activity differed among color of lights with higher activity at bluish-white and yellow-white lights than orange. Bat activity at streetlights varied for some species with season and moonlight (Jung and Kalko 2010). In summary, this study suggests highly variable responses among species to artificial lighting.

Some species appear to be averse to lights. Downs et al. (2003) found that lighting of *Pipistrellus pygmaeus* roosts reduced the number of bats that emerged. In Canada and Sweden, *Myotis* spp. and brown long-eared bat (*Plecotus auritus*) were only recorded foraging away from street lights (Furlonger et al. 1987, Rydell 1992). Stone et al. (2009) found that commuting activity of lesser horseshoe bats (*Rhinolophus hipposideros*) in Britain and was reduced dramatically and the onset of commuting was delayed in the presence of high pressure sodium (HPS) lighting. Stone et al. (2012) also found that light-emitting diodes (LED) caused a reduction in lesser horseshoe bat (*Rhinolophus hipposideros*) and *Myotis* spp. activity. In contrast, there was no effect of lighting on several other bat species.

Although there is limited information regarding potential neutral, positive, or negative impacts to NLEB from increased light levels, slow-flying bats such as *Rhinolophus*, *Myotis*, and *Plecotus* species have echolocation and wing-morphology adapted for cluttered environments like the NLEB (Norberg and Rayner 1987), and emerge from roosts when light levels are low, probably to avoid predation by diurnal birds of prey (Jones and Rydell 1994). Therefore, we would generally expect that NLEB would avoid lit areas. In Indiana, Indiana bats avoided foraging in urban areas and Sparks et al. (2005) suggested that it may have been in part due to high light levels. Using captive bats, Alsheimer (2012) also found that the little brown bat (*M. lucifugus*), was more active in the dark than light.

Table 3 shows the pathway that was identified for NLEB responses to lighting, and it is possible that NLEBs will experience reduced fitness from lighting. Although some adverse effects to NLEBs are likely to occur from lighting, it is anticipated that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of activities and occupancy rates that are typically less than 5%. Adoption of voluntary conservation measures associated with lighting, although not required, are anticipated to further reduce the likelihood that adverse effects are reasonably certain to occur. As with sources of noise disturbance, many new sources of lighting within areas of suitable habitat are likely to be associated with habitat removal, which is captured by the effects analysis in the Habitat Removal section above. New lighting sources not associated with habitat removal, but adjacent suitable habitat are expected to have minimal effects on individuals.

Pesticides and other Environmental Contaminants

Pesticides, including herbicides may be used to control pests and weed species including noxious or invasive plants in or near areas of suitable NLEB habitat. Treatments typically occur in spring, early summer, or fall. Treatments can be applied either by hand, from a truck mounted boom sprayer with spray heads designed to minimize drift, or aerially. Herbicide and other pesticide applications typically occur during the day when bats are roosting, and often in the morning to avoid and minimize wind-induced drift.

Long-term sublethal effects of environmental contaminants, such pesticides, on bats are largely unknown; however, environmentally relevant exposure levels of pesticides have been shown to impair nervous system, endocrine, and reproductive functioning in other wildlife (Yates et al. 2014, Köhler and Triebskorn 2013, Colborn et al. 1993). Moreover, bats' high metabolic rates, longevity, insectivorous diet, migration-hibernation patterns of fat deposition and depletion, and immune impairment during hibernation, along with potentially exacerbating effects of WNS, likely increase their risk of exposure to and accumulation of pesticide-related toxins (Secord et al. 2015, Yates et al. 2014, Geluso et al. 1976, Quarles 2013, O'Shea and Clark 2002), although these risks are highly dependent on the toxicity of the specific compound bats may be exposed to.

Table 3 shows the pathway we identified for NLEB responses to the use of pesticides, and it is possible that NLEBs will experience reduced fitness and harm depending on the specific circumstances. NLEBs may drink contaminated water or eat contaminated insects. Bats may also be directly exposed to herbicides or other pesticides sprayed in roosting areas. Any potential effects, however, are highly dependent on the toxicity of the particular compound and the potential routes of exposure, which can vary widely. Although some adverse effects to NLEBs may occur from pesticide use, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of activities, their use in areas outside of suitable habitat and occupancy rates that are typically less than 5%. In addition, all pesticides must be used in accordance to their label instructions, which are designed to minimize water contamination and adverse effects to wildlife as well as avoidance of areas known to support federally listed threatened and endangered species. We acknowledge the potential for pesticide use to harm NLEBs, but given the high degree of uncertainty associated with pesticide risk, we are unable to estimate the level of harm, beyond the very low level of potential exposure based on current occupancy rates. Broad-scale aerial applications of pesticides over suitable forested habitat are not included in this analysis.

Spills/Chemical Contamination

Accidents during project operation could result in the leakage of hazardous chemicals into the environment which could affect water quality resulting in reduced densities of aquatic insects that bats consume. Table 3 shows the pathway we identified for NLEB responses to spills and chemical contamination, and it is possible that NLEBs will experience reduced fitness and harm depending on the specific circumstances. Bats may drink contaminated water or forage in affected areas with the potential to eat insects exposed to chemicals. Although some adverse effects to NLEBs are reasonably certain to occur from spills and chemical contamination, we anticipate most accidents and spills, by their nature are unlawful activities. The exemption to the prohibition of incidental take provided by the incidental take statement of a biological opinion can only be provided for "otherwise lawful activities". Many spills and or leaks of hazardous substances are often in violation of state and federal laws. These projects, therefore, will not qualify for consultation under section 7 of the ESA.

Water Quality Alteration

Some projects may result in permanent loss of wetland and/or streams from fill or temporarily reduce water quality from sedimentation. Table 3 shows the pathway we identified for NLEB responses to water quality alteration. Activities that reduce quantity or quality of water sources and foraging habitat may impact bats, even if conducted while individuals are not present. Standard construction BMPs (e.g., silt fencing) will minimize erosion and subsequent sedimentation, thus reducing potential impacts on aquatic ecosystems. Since potential impacts from sedimentation are expected to be localized, foraging bats should have alternative drinking water and foraging locations. The surrounding landscape will continue to provide an abundant prey base of both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential direct effects to bats from a reduction in water quality are anticipated to be minimal. In addition, as described in Table 3, most water quality alterations are anticipated to be associated with new construction activities. Many water quality alterations that have the potential to impact NLEBs would also involve habitat removal, which is captured by the effects analysis in the Habitat Removal section above. Therefore, we do not anticipate additional take beyond that estimated for habitat removal throughout the range.

Collision

Actions that facilitate vehicle traffic in areas where NLEBs are likely to fly at or below vehicle height pose a risk of collision for the species, especially where traffic volume is high and roads are near NLEB habitat. There is only sporadic evidence of NLEBs being killed by cars, but documenting roadkill is difficult due to short carcass persistence times (see next paragraph) and there are few studies focused on this topic in the U.S. Russell et al. (2009) assessed the level of mortality from road kills on a bat colony in Pennsylvania and collected 27 road-killed little brown bats and 1 Indiana bat and cited unpublished data from the Pennsylvania Game Commission documenting NLEB mortality. Curtis et al. (2014) indicates that a dead NLEB was found along a road in Kansas and was thought to have collided with a vehicle. Collision has been documented for other *Myotis* in Europe (Lesinski et al. 2011). Collision risk of bats varies depending on time of year, location of road in relation to roosting/foraging areas), species' flight characteristics of their flight, traffic volume, and whether young bats are dispersing (Lesinski 2007, Lesinski 2008, Russell et al. 2009, Bennett et al. 2011). Among European studies where comparisons could be made, bat roadkill was higher at locations with greater traffic volume (Fensome and Mathews 2016, p. 319).

Loud and busy roads may repel NLEBs and function more as a barrier to movement than a collision risk. Many studies suggest that roads may serve as a barrier to bats (Bennett and

Zurcher 2013, Bennett et al. 2013, Berthinussen and Altringham 2011, Wray et al. 2006), but roads with few vehicles (less than about 2,800 vehicles/day) and only two lanes had little effect on Indiana bat movement (Bennett et al. 2013, p. 988). Roads with this amount of traffic, however, may still cause roadkill if they are near NLEB habitat – bat roadkill has been detected on roads with as few as 1,100 vehicles per day, for example, in Europe (Vuk et al. 2015, p. 90). Traffic noise likely repels bats from at least some roads. During foraging, greater mouse-eared bats (*Myotis myotis*) avoid areas exposed to sources of "intense broadband noise", like vehicle traffic (Schaub et al. 2009, p. 3179). The repelling effect of noise lessens with distance – for example, two studies found no or insignificant effects of traffic noise when bats were more than 50-150 meters (m) from the noise source (Schaub et al. 2009, p. 3179, Bonsen et al. 2015, p. 355). In most cases, we expect there will be a decreased likelihood of bats crossing roads of increasing size (lanes).

Table 3 shows the pathway we identified for NLEB responses to the risk of collision and to a barrier effect of roads, and we anticipate that NLEBs will be killed from collisions with vehicles when roads are within approximately 1,000 feet of NLEB habitat when traffic is light enough to not simply function as an outright barrier. The Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana and Northern Long-eared Bat (USFWS 2018) indicates that this is particularly important for new multi-lane highways or road projects that raise the road profile above the tree canopy. We anticipate most road and highway projects will use the programmatic consultation for transportation projects instead of this Standing Analysis, which could include many if not most road projects large enough to function as a barrier. Some mortality due to roadkill on road projects is expected, although, we anticipate that relatively small numbers of bats will be impacted per year in each state because of the decreased likelihood of bats crossing major roads. We anticipate the likelihood of mortality will be further reduced by the wide dispersal of new road construction and NLEB occupancy rates that are typically less than 5%.

Noise from Munitions, Detonations, and Training Vehicles from Military Operations

Recent studies have indicated that anthropogenic noise can alter foraging behavior and success of bats, including some gleaning species like the NLEB (Bunkley et al. 2015; Schaub et al. 2008; Siemers and Schaub 2011). Table 3 shows the pathway we identified for NLEB responses to noise from military training operations, and it is possible that NLEBs will be disturbed. A small subset of disturbed individuals may be harmed. However, studies indicate that indicate bats do not avoid active ranges or alter foraging behavior during night-time maneuvers, and NLEBs are expected to become habituated to noise disturbance (Whitaker & Gummer 2002; Service 2010; USFWS 2009). Although some adverse effects to NLEBs may occur from noise from military operations, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of activities and occupancy rates that are typically less than 5%. In addition, several military installations have adopted conservation measures to help reduce the potential adverse effects on Indiana bats which would also serve limit effects to NLEBs from routine operations.

Use of Military Training Smoke and Obscurants

Smoke/obscurants are used to conceal military movements and help protect troops and equipment in combat conditions. Although they would be primarily used during the day, smoke/obscurants may be deployed at night. Training on military installations may include, but is not limited to, smokes and obscurants such as fog oil, colored smoke grenades, white phosphorous, and graphite smoke. Research indicates that prolonged dermal and respiratory exposures to these items, except for the graphite smoke, could have adverse effects on roosting and foraging Indiana bats (Service 1998; Service 2012; Driver et al. 2002; USWFS 2009; NRC 1999). Given the similar roosting behavior and foraging locations of the NLEB, it is likely they will also be adversely affected by these smokes and obscurants.

Table 3 shows the pathway we identified for NLEB responses to the use of smokes and obscurants, and it is possible that NLEBs will be harmed depending on the specific circumstances. Although some adverse effects to NLEBs are reasonably certain to occur, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the limited use of these chemicals and occupancy rates that are typically less than 5%. In addition, many military installations already limit the use of smokes and obscurants in areas that may affect the Indiana bat, further reducing the impact to NLEBs. As indicated above, several military installations have adopted conservation measures to help reduce the potential for adverse effects of their actions on Indiana bats, which would also serve to conserve NLEBs.

Bridge and Culvert Maintenance, Repair, or Replacement

NLEBs have been found using bridges for day and night roosts in Illinois, Louisiana, Iowa, and Missouri (Feldhamer et al. 2003; Ferrara and Leberg 2009; Kiser et al. 2002; Benedict and Howell 2008; Droppelman 2014). Bridge and culvert characteristics have been studied to help determine bat roosting potential. Keeley and Tuttle (1999) describe the ideal day roost bridge characteristics for crevice-dwelling bat species to be bridges with a roost height of 10+ ft (3+ m) above the ground and culverts between 5 and 10 ft (1.5 and 3 m) tall and 300 ft (100 m) or more long. Culverts with day roosting bats to range from 1.3 ft (0.4 m) (Boonman, 2011) to 10 ft (0.4m – 3m) (Keeley and Tuttle, 1999) in height. Altering or removing bridges when occupied by NLEBs is expected to result in adverse effects. Bridge or culvert alteration refers to any bridge or culvert repair, retrofit, maintenance, and/or rehabilitation work activities that modifies the bridge to the point that it is no longer suitable for roosting.

Table 3 shows the two pathways we identified for NLEB responses to bridge and culvert work and it is possible that NLEBs will experience reduced fitness and harm depending on the specific circumstances. We expect that NLEBs may be killed or injured bats during activities conducted while bats are present, and the removal of roosts can reduce fitness. Although some adverse effects to NLEBs are reasonably certain to occur from bridge or culvert maintenance, repair, or replacement, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of activities and occupancy rates that are typically less than 5%. We also expect that the majority of adverse effects associated with bridge or culvert work will be covered by the Programmatic Biological Opinion for

Transportation Projects in the Range of the Indiana and Northern Long-eared Bat (USFWS 2018).

Subsurface Drilling or Blasting

Surface-disturbing activities (such as drilling or blasting) 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).

Table 3 shows the two pathways we identified for NLEB responses to drilling and blasting, and it is possible that NLEBs will be harmed. We do not expect any adverse effects to known hibernacula or known hibernating bats due to the conservation measures. These activities can alter the flow of air and water through unknown hibernacula, as well as cause arousal during hibernation. Although the alteration of unknown hibernacula may occur, we anticipate that relatively small numbers of bats will be impacted per year in each state based on the widely dispersed nature of these activities and their likely occurrence during the non-hibernating period. Take is not reasonably certain is not reasonably certain to occur in areas of suitable habitat where presence has not been documented.

Summary of Impacts

Impacts to individuals

Forest management, prescribed fire, and habitat removal activities are likely to result in injury and mortality of pups and adults through the removal of occupied roost trees. We expect impacts during the maternity season, especially the pup season, swarming/staging seasons, and during the winter in areas where NLEBs are active year-round if NLEBs are in torpor and the activity occurs in a forested wetland. Individual bats from 32 different maternity colonies are expected to be exposed to these activities, and of those, a small number are expected to be directly harmed. We anticipate no more than three bats will be harmed in each maternity colony. We do not anticipate the loss of any colonies, but we do anticipate one maternity colony could be fragmented by permanent maternity roosting habitat removal, which would cause a reduction in reproductive fitness. We also anticipate additional beneficial and adverse effects to NLEBs as a result of these activities, but none of these other adverse effects meet the definition of take. Additional harm is anticipated for unquantified effects from "other" activities that may affect the NLEB. We are unable to quantify the effects due to the programmatic nature of this standing analysis; however, we do not expect the additional impacts to substantially increase the number of individuals affected or number of maternity colonies affected due to the low likelihood of activities impacting maternity colonies (occupancy rates are typically <5%) the widely dispersed nature of activities across the landscape. We expect projects that qualify for the Interim Consultation Framework to reduce the number of NLEBs and reduce reproductive success.

Impacts to populations

Because we expect impacts to individuals, we assess how the potential adverse effects to individuals affect the overall health and viability of NLEB populations. Therefore, we analyzed effects to RPUs to better understand whether these local effects could affect the species' resilience, redundancy, and representation. Our analysis predicts that there is a low likelihood that individual activities within these categories will intersect NLEBs and that few NLEBs will be affected within each RPU (Table 4, Table 5, and Table 6). Less than 1% of all maternity colonies will be affected in each RPU. Even if the impacts were severe enough to result in the loss of a maternity colony, the resilience, redundancy, and representation would not be significantly affected in any RPU.

Where the species has substantially declined as a result of WNS, the surviving members of the population may be resilient or resistant to WNS. These surviving populations are particularly important to the persistence of the populations. The individual effects analysis indicates that some additional impacts will occur as a result this action. We do not know at this time if the impacts from this action are additive to the effects of WNS; however, even if the potential mortality from these activities is additive to the impacts from WNS, our analysis suggests that the proportion of maternity colonies that will be affected in each RPU is small and would not significantly affect the species' likelihood of persisting in any these RPUs. Reproduction, numbers, and distribution (RND) changes at the RPU level are not likely. Based on the relatively small numbers affected annually compared to the RPU population sizes, we do not anticipate population-level effects to the NLEB. Based on this Standing Analysis, we conclude that adverse effects from forest management, prescribed fire, and habitat removal, and other activities will not significantly affect the species' RND at the population-level.

WNS is the primary factor causing the declines of NLEBs. Our analysis of the effects of activities that may occur between March 2023 and April 2024 indicates that the additional loss of individual NLEB resulting from these activities would not exacerbate the effects of WNS at the scale of the RPUs within its range.

OTHER ACTIVITIES CAUSED BY THE ACTION

Within a biological opinion, all consequences to species or critical habitat caused by the proposed Federal action are evaluated, including the consequences of other activities caused by the proposed action, that are reasonably certain to occur (see definition of "effects of the action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed action (but not part of the proposed action) are reasonably certain to occur.

Because this is a Standing Analysis, not a Federal action, we are unable to list a complete set of all the other activities caused by the qualifying federal actions at this time. Other activities caused by the proposed federal action will be documented in the project-specific BAs and BOs; however, we expect that any effects of these other activities caused by the federal action on the NLEB will be within the scope of the effects of the Interim Consultation Framework evaluated in this Standing Analysis.

CUMULATIVE EFFECTS

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

Because this is a Standing Analysis that considers the effects of certain federal and non-federal activities across the range of the NLEB, the Standing Analysis' area of consideration is identical to the range of the species within the U.S. We expect that the cumulative effects that are reasonably certain to occur within the qualifying project action areas will be considered in the project-specific BAs and BOs will fall within those that this Standing Analysis contemplated across the range of the species. This will be an important step of project-specific consultation because the Service must consider the aggregate effects of the factors analyzed under "environmental baseline," "effects of the action," and "cumulative effects" in the action area, when viewed against the status of the species, to determine if the federal action is likely to jeopardize the continued existence of the species. This Standing Analysis considers the status of the species and the effects of the potential actions that may be conducted under the Interim Consultation Framework across the entire range of the NLEB. The Standing Analysis also considers the total amount of forest management, prescribed fire, and habitat removal that may occur until April 1, 2024. The methods used to derive those estimates do not distinguish between federal and non-federal causes; therefore, the aggregate effects of those activities do not need to be evaluated as separately cumulative effects because they are already considered.

The following is a list of potential State or private activities that could result in cumulative effects within the Action Area and may need to be considered during project-specific consultation: wind facility development or operation; activities that may impact known hibernacula or hibernating bats; use of pesticides; chemical contamination; water quality alteration; road or communication tower construction that could result in collision risk; bridge maintenance, repair, or replacement; subsurface drilling or blasting for utility line and road installation; purposeful take; or other activities that may affect NLEBs not listed here.

CONCLUSION

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. "Jeopardize the continued existence of" 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 that species (50 CFR 402.02).

The jeopardy analysis in this Standing Analysis relies primarily on 2 components: (1) Status of the Species, which evaluates the NLEB range-wide condition, the factors responsible for that condition, and its survival and recovery needs; and (2) Effects of the Action, which determines the impacts of potential federal actions that qualify for formal consultation in the Interim Consultation Framework. In accordance with policy and regulation, there are two other components that we are to rely upon to make a jeopardy determination: (3) the Environmental Baseline, which evaluates the status of the NLEB in the Action Area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the NLEB; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the NLEB.

The Service adds the effects of the action and the cumulative effects to the status of the species and to the environmental baseline to determine if the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the RND of that species. As described above, the environmental baseline for the Standing Analysis is reflected by the status of the species. Therefore, we have enough information to now make a determination that the effects of the potential actions conducted under the Interim Consultation Framework are not likely to jeopardize the continued existence of the northern long-eared bat for the following reasons:

1. Adverse impacts all have a low likelihood of occurrence, and severe, localized effects are not expected.
2. Less than 1% of all maternity colonies will be affected in each RPU. Even if the impacts were severe enough to result in the loss of a maternity colony, the resilience, redundancy, and representation would not be significantly affected in any RPU.
3. While impacts could occur to individuals or populations, we do not consider these impacts to affect the survival or recovery of NLEBs in the RPUs or range-wide.
4. WNS is the primary factor causing the declines of NLEBs. Our analysis of the effects of activities that may occur over the next year indicates that the additional loss of individual NLEB resulting from these activities would not exacerbate the effects of WNS at the scale of the RPUs within its range.
5. When the Service issues a project-specific BO under the Interim Consultation Framework, we will describe the environmental baseline within the action area of the individual project and evaluate cumulative effects within the Action Area. At that time, we will verify our conclusion that the individual project is not likely to jeopardize the continued existence of the northern long-eared bat unless the status or role of the action area or the cumulative effects within the action area are significant enough to warrant a jeopardy determination.

LITERATURE CITED

Literature cited throughout the Standing Analysis is available upon request from the Midwest Regional Office, Ecological Services Program.