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Memorandum

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Subject: 03E19000-2015-F-0183 Statewide Wildlife Habitat Management (W-65-D-13)

Please find attached a biological opinion for the subject project.

If you have any questions regarding this consultation, please contact Phil Delphey at (612) 725-3548 ext. 2206.

Enclosure

BIOLOGICAL OPINION

Effects to the

Northern Long-eared Bat

From the

Statewide Wildlife Habitat Management Grant to Minnesota Department of Natural Resources

(W-65-D-13)

TAILS No. 03E19000-2015-F-0183

Prepared by:

U.S. Fish and Wildlife Service

Twin Cities Field Office

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INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the proposed issuance of a grant under the Federal Pittman-Robertson Wildlife Restoration Grant Program (P-RWRG) and its effects on the northern long-eared bat (*Myotis septentrionalis*) in accordance with Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The Service's Wildlife and Sport Fish Restoration Program (WSFR) proposes to issue the grant to Minnesota Department of Natural Resources (MDNR) to assess habitats and to implement a variety of wildlife habitat management projects. The projects would be implemented throughout the state in Wildlife Management Areas (WMA) through June 30, 2017.

WSFR and MDNR determined that the proposed grant and the related activities are unlikely to result in adverse effects to any other federally-listed species or critical habitat. Therefore, this BO addresses one species, the northern long-eared bat.

This BO is based on information provided in the Phase I form and Project Statement completed by MDNR. A complete administrative record of this consultation is on file at the Service's Twin Cities Field Office.

Interim 4(d) for the northern long-eared bat

On April 2, 2015, the Service has published a species-specific rule pursuant to section 4(d) of the ESA for northern long-eared bat (80 FR 17974). Section 4(d) of the ESA states that:

> *Whenever any species is listed as a threatened species ... the Secretary shall issue such regulations as he deems necessary and advisable to provide for the conservation of such species* (16 U.S.C. 1533(d)).

The Service's interim 4(d) rule for northern long-eared bat exempts the take of northern long-eared bat from the section 9 prohibitions of the ESA, as follows:

(1) Take that is incidental to forestry management activities, maintenance/limited expansion of existing rights-of way, prairie management, projects resulting in minimal (<1 acre) tree removal, provided these activities:
   a. Occur more than 0.25 mile (0.4 km) from a known, occupied hibernacula;
   b. Avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31); and,
   c. Avoid clearcuts (and similar harvest methods, *e.g.*, seed tree, shelterwood, and coppice) within 0.25 (0.4 km) mile of known, occupied roost trees during the pup season (June 1–July 31).

(2) Removal of hazard trees (no limitations).

(3) Purposeful take that results from:
    a. Removal of bats from and disturbance within human structures and
    b. Capture, handling, and related activities for northern long-eared bats for 1 Year following publication of the interim rule.

Thus, any take of the northern long-eared bat resulting from activities that are implemented in compliance with the conservation measures, as necessary, is exempted from section 9 prohibitions by the interim 4(d) rule, and does not require further incidental take authorization. Note that no conservation measures are required as part of the interim 4(d) rule for forest management actions that would affect only areas with no known roost trees and no known hibernacula. MDNR will incorporate the above conservation measures into its proposed action as they are identified by survey efforts.

However, the interim 4(d) rules do not afford exemption from the ESA's section 7 procedural requirements. Therefore, consultation remains appropriate when actions (even those within the scope of the interim 4(d) rule) are funded, authorized or carried out by a federal agency. This is because the purpose of section 7 consultation is broader than the mere evaluation of take and issuance of an Incidental Take Statement; such consultations fulfill the requirements of section 7(a)(2) of the ESA, which directs that all federal actions insure that their actions are not likely to jeopardize the continued existence of any listed species, or result in the destruction or adverse modification of designated critical habitat.

Consultation History

WSFR submitted to the Twin Cities Ecological Services Field Office (TCFO) on May 14, 2015 copies of the MDNR Project Statement and the Phase I form completed by MDNR. The phase I form contained determinations of effect for each species and critical habitat in the action area. It included a determination of 'may affect, likely to adversely affect' for the northern long-eared bat. Therefore, WSFR also included a Phase 2 form in its correspondence with TCFO, which constituted its request for formal consultation. After receipt of the initial project summaries and the request to initiate consultation, TCFO requested additional clarification from the Service's Wildlife and Sport Fish Restoration Program (WSFR) and Minnesota Department of Natural Resources (MDNR) on 22 July 2015.

DESCRIPTION OF PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The "action area" is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present federal, state, or private activities, as well as the cumulative effects of reasonably certain future State or private activities within the action area.

WSFR proposes to provide funding available from the Federal Pittman-Robertson Wildlife Restoration Grant Program (P-RWRG) to MDNR to assess habitats and to implement a variety of wildlife habitat management projects. The projects would be implemented throughout the state in Wildlife Management Areas (WMA) through June 30, 2017.

Projects/Actions that Are Likely to Adversely Affect the Northern Long-Eared Bat

The actions to be implemented with funding from the P-RWRG include tree removal and the use of prescribed fire in forested and brushland habitats. Some of these actions may affect and are likely to adversely affect the northern long-eared bat and are the subject of this biological opinion. Other activities to be implemented may affect, but are not likely to adversely affect species listed as threatened or endangered under the Endangered Species Act and critical habitat (see the next section, **Projects/Actions that Will Have No Effect or Are Not Likely to Adversely Affect Listed Species and Critical Habitat**).

The proposed action will result in timber harvest, including clear cuts, vegetation clearing in brushland habitats, and implementation of prescribed fires in forest and brushland habitats in state-owned WMAs in Minnesota. The State of Minnesota has nearly 963,000 acres in state-owned WMAs in the forest landscape (Laurentian Mixed Forest and Tallgrass Aspen Parklands provinces in Minnesota's ecological classification system).

Timber harvest would be "administered primarily as a tool to achieve wildlife habitat objectives and to contribute to broader landscape multi-divisional habitat planning that is consistent with the primary purpose of WMAs." Forest habitat management would be used to maintain diverse age structure with clear cuts or selective timber harvest; natural or mechanical reforestation; improvement of hardwood mast stands through selective thinning; protection of certain white cedar (*Thuja occidentalis*) or other conifer stands as winter thermal cover; and, protection of old growth stands. Annually, 5,000 acres would be managed with clear cuts, selective harvest, or thinning. Clear cutting occurs predominantly in stands of quaking aspen (*Populus tremuloides*) during winter. MDNR will follow Site-level Forest Management Guidelines that will result in the retention of snags and leave trees and will protect riparian zones. Average size of clear cuts is expected to be about 30 acres.

Tree removal would also be carried out to maintain "an appropriate interspersion of brushland and open land habitats"; to restore, enhance, and manage habitats in WMAs in the state's farmland, prairie, and grassland landscapes; and, in wetland habitats. Brushland habitat would be maintained through a variety of vegetation clearing techniques including shearing, roller chopping, hydro-axing, and vegetative removal. This could take place on 35,000 acres annually, with 90% of this activity occurring in winter. In farmland, prairie, and grassland landscapes, tree clearing may occur on 5,000 acres annually. According to MDNR, about 90% of tree clearing in farmland landscapes takes place between October 1 and March 30, primarily during winter.

MDNR would implement prescribed fire with the proposed grant funding on 5,000 acres of brushland and 1,000 acres of forest annually. About 75% of fires would occur during the period when the northern long-

eared bats are roosting in forested habitats in the action area. Most of these fires are likely to occur during April and May.

Projects/Actions that Will Have No Effect or Are Not Likely to Adversely Affect Listed Species and Critical Habitat

Effects of the proposed action are only likely to cause adverse effects to the northern long-eared bat. The MDNR Phase 1 form for the proposed grant describes other species and critical habitat that occurs in the action area for which adverse effects are unlikely. If new information indicates that any component of the action is likely to adversely affect species other than the northern long-eared bat, WSFR should reinitiate consultation on the proposed action.

Only those components of the proposed action that are described in the previous section, **Projects/Actions that Are Likely to Adversely Affect the Northern Long-Eared Bat**, are likely to result in adverse effects to the northern long-eared bat. All other project components will have either no effect on the northern long-eared bat or may affect, but are not likely to adversely affect the species. If new information indicates that additional components of the action are likely to adversely affect the northern long-eared bat, WSFR should reinitiate consultation on the proposed action.

Conservation Measures

Conservation measures are those actions taken to minimize any adverse effects of a proposed action and to benefit or promote the recovery of the species. These actions taken by the federal agency that serve to minimize or compensate for project effects on the species under review and are included as an integral portion of the proposed action.

To be in compliance with the interim 4(d) rule for northern long-eared bat, MDNR has committed to the following conservation measures as part of the project description:

> 1) All proposed activities will occur more than 0.25 mile (0.4 km) from known, occupied hibernacula.
>
> 2) The MDNR will avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31).
>
> 3) The MDNR will avoid clearcuts (and similar harvest methods, *e.g.*, seed tree, shelterwood, and coppice) within 0.25 (0.4 km) mile of known, occupied roost trees during the pup season (June 1–July 31).

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. For the purposes of this BO, the action area includes WMA lands that are owned by the State of Minnesota and/or administered by the MDNR Division of Fish and Wildlife and shallow wildlife lakes under jurisdiction of the Section of Wildlife.

STATUS OF THE SPECIES

Refer to the final rule (80 FR 17974) for the best available information on northern long-eared bat life history and biology, threats, distribution, and overall status. The following is summarized from that rule.

Life History and Biology

The northern long-eared bat is a temperate, insectivorous, migratory bat that hibernates in mines and caves in the winter and spends summers in wooded areas. The key stages in its annual cycle are: hibernation, spring staging and migration, pregnancy, lactation, volancy/weaning, fall migration and swarming. Northern long-eared bat generally hibernate between mid-fall through mid-spring each year. Spring migration period likely runs from mid-March to mid-May each year, with timing varying depending on the portion of the range. Females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Parturition (birth) occurs in late May or early June (Caire et al. 1979, p. 406; Easterla 1968, p. 770; Whitaker and Mumford 2009, p. 213) but may occur as late as July (Whitaker and Mumford 2009, p. 213), with nursing continuing until weaning, which is shortly after young become volant in mid- to late-July. Fall migration likely occurs between mid-August and mid-October.

Summer habitat and ecology

Suitable summer habitat[1] for the northern long-eared bat 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. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure.

Many species of bats, including the northern long-eared bat, consistently avoid foraging in or crossing large open areas, choosing instead to use tree-lined pathways or small openings (Patriquin and Barclay 2003, Yates and Muzika 2006). Further, wing morphology of the species suggests that they are adapted to moving in cluttered habitats. Thus, isolated patches of forest may not be suitable for foraging or roosting unless the patches are connected by a wooded corridor.

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies (typically consisting of females and young). Northern long-eared bats actively form colonies in the summer (Foster and Kurta 1999) and exhibit fission-fusion behavior (Garroway and Broders 2007), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, northern long-eared bats switch tree roosts often (Sasse and Pekins 1996), typically every 2 to 3 days (Foster and Kurta 1999; Owen et al. 2002;

1 See the Service's current summer survey guidance for our latest definitions of suitable habitat: http://www.fws.gov/midwest/Endangered/mammals/inba/inbasummersurveyguidance.html.

Carter and Feldhamer 2005; Timpone et al. 2010). Northern long-eared bat maternity colonies range widely in size, although a maximum of 30-60 individuals may be most common early in the season, with the colony size decreasing post-lactation of young (U.S. Fish and Wildlife Service 2014). Northern long-eared bats show some degree of inter-annual fidelity to single roost trees and/or maternity areas. Male northern long-eared bats are routinely found with females and young in maternity colonies. Northern long-eared bat use networks of roost trees often centered on one or more central-node roost trees (Johnson et al. 2012). Northern long-eared bat roost networks also include multiple alternate roost trees and male and non-reproductive female northern long-eared bat may also roost in cooler places, like caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006).

Northern long-eared bats roost in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically ≥3 inches dbh). Northern long-eared bats are known to use a wide variety of roost types, using tree species based on presence of cavities or crevices or presence of peeling bark. Northern long-eared bats have also been occasionally found roosting in structures like barns and sheds (particularly when suitable tree roosts are unavailable).

Young northern long-eared bats are typically born in late-May or early June, with females giving birth to a single offspring. Lactation then lasts 3 to 5 weeks, with pups becoming volant (able to fly) between early July and early August (with timing often depending on location within the species' range).

Migration

Males and non-reproductive females may summer near hibernacula, or migrate to summer habitat some distance from their hibernaculum. The northern long-eared bat is not considered to be a long distance migrant (typically 40-50 miles). Migration is an energetically demanding behavior for the northern long-eared bat, particularly in the spring when fat reserves and food supplies are low and females are pregnant.

Winter habitat and ecology

Suitable winter habitat (hibernacula) includes underground caves and cave-like structures (e.g. abandoned or active mines, railroad tunnels). There may be other landscape features being used by northern long-eared bats during the winter that have yet to be documented. Generally, northern long-eared bats hibernate from October to April depending on local climate (November-December to March in southern areas and as late as mid-May in some northern areas).

Hibernacula for the northern long-eared bat typically have significant cracks and crevices for roosting; relatively constant, cool temperatures (0-9 degrees Celsius) and with high humidity and minimal air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible.

Northern long-eared bats tend to roost singly or in small groups (U.S. Fish and Wildlife Service 2014), with hibernating population sizes ranging from a just few individuals to around 1,000 (U.S. Fish and Wildlife Service unpublished data). Northern long-eared bats display more winter activity than other

cave species, with individuals often moving between hibernacula throughout the winter (Whitaker and Rissler 1992, Caceres and Barclay 2000). Northern long-eared bats have shown a high degree of philopatry to the hibernacula used, returning to the same hibernacula annually.

Spring Staging and Fall Swarming habitat and ecology

Upon arrival at hibernacula in mid-August to mid-November, northern long-eared bats "swarm," a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day. Swarming continues for several weeks and mating occurs during the latter part of the period. After mating, females enter directly into hibernation but not necessarily at the same hibernaculum as they had been mating at. A majority of bats of both sexes hibernate by the end of November (by mid-October in northern areas).

After hibernation ends in late March or early April (as late as May in some northern areas), most northern long-eared bats migrate to summer roosts. Females emerge from hibernation prior to males. Reproductively active females store sperm from autumn copulations through winter. Ovulation takes place after the bats emerge from hibernation in spring. The period after hibernation and just before spring migration is typically referred to as "staging," a time when bats forage and a limited amount of mating occurs. This period can be as short as a day for an individual, but not all bats emerge on the same day.

In general, northern long-eared bats use roosts in the spring and fall similar to those selected during the summer. Suitable spring staging/fall swarming habitat consists of the variety of forested/wooded habitats where they roost, forage, and travel, which is most typically within 5 miles of a hibernaculum. This includes forested patches as well as linear features such as fencerows, riparian forests and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1,000 feet from the next nearest suitable roost tree, woodlot, or wooded fencerow.

Threats

No other threat is as severe and immediate for the northern long-eared bat as the disease white-nose syndrome (WNS). Since the disease was first observed in New York in 2007 (later biologists found evidence from 2006 photographs), WNS has spread rapidly in bat populations from the Northeast to the Midwest and the Southeast. Population numbers of the northern long-eared bat have declined by 99 percent in the Northeast, which along with Canada, has been considered the core of the species' range. Although there is uncertainty about how quickly WNS will spread through the remaining portions of these species' ranges, it is expected to spread throughout their entire ranges. In general, the Service believes that WNS has significantly reduced the redundancy and resiliency of the northern long-eared bat.

Although significant northern long-eared bat population declines have only been documented due to the spread of WNS, other sources of mortality could further diminish the species' ability to persist as it experiences ongoing dramatic declines. Specifically, declines due to WNS have significantly reduced the number and size of northern long-eared bat populations in some areas of its range. This has reduced these

populations to the extent that they may be increasingly vulnerable to other stressors that they may have previously had the ability to withstand. These impacts could potentially be seen on two levels. First, individual northern long-eared bats sickened or struggling with infection by WNS may be less able to survive other stressors. Second, northern long-eared bat populations impacted by WNS, with smaller numbers and reduced fitness among individuals may be less able to recover making them more prone to extirpation. The status and potential for these impacts will vary across the range of the species.

Bats affected but not killed by WNS during hibernation may be weakened by the effects of the disease and may have extremely reduced fat reserves and damaged wing membranes. These effects may reduce their capability to fly or to survive long-distance migrations to summer roosting or maternity areas.

In areas where WNS is present, there are additional energetic demands for northern long-eared bats. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012; Warnecke et al. 2012) and have wing damage (Meteyer et al. 2009; Reichard and Kunz 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing and may experience reduced reproductive success. In addition, with wing damage, there may be an increased chance of WNS-affected bats being killed or harmed as a result of proposed action. Again, this is particularly likely if timber harvest or burns are conducted early in the spring (April – May) when bats have just returned, have damaged wings, and are exposed to colder temperatures when torpor is used more frequently.

Over the long-term, sustainable forestry benefits the northern long-eared bat by maintaining suitable habitat across a mosaic of forest treatments. However, forest practices can have a variety of impacts on the northern long-eared bat depending on the quality, amount, and location of the lost habitat, and the time of year of clearing. Depending on their characteristics and location, forested areas can function as summer maternity habitat, staging and swarming habitat, migration or foraging habitat, or sometimes, combinations of more than one habitat type. Impacts from tree removal to individuals or colonies would be expected to range from indirect impact (e.g., minor amounts of forest removal in areas outside northern long-eared bat summer home ranges or away from hibernacula) to minor (e.g., largely forested areas, areas with robust northern long-eared bat populations) to significant (e.g., removal of a large percentage of summer home range, highly fragmented landscapes, areas with WNS impacts).

Lastly, there is growing concern that bats, including the northern long-eared bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of the northern long-eared bat has been documented at multiple operating wind turbines/farms. The Service is now working with wind farm operators to avoid and minimize incidental take of bats and assess the magnitude of the threat.

Rangewide Status

The northern long-eared bat 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 (Nagorsen and Brigham 1993; Caceres and Pybus 1997; Environment Yukon 2011) (Figure 1). In the United States, the

species' range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east through the Gulf States to the Atlantic Coast (Whitaker and Hamilton 1998; Caceres and Barclay 2000; Amelon and Burhans 2006). The species' range includes the following 37 States (plus 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. 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). However, throughout the majority of the species' range it is patchily distributed, and historically was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

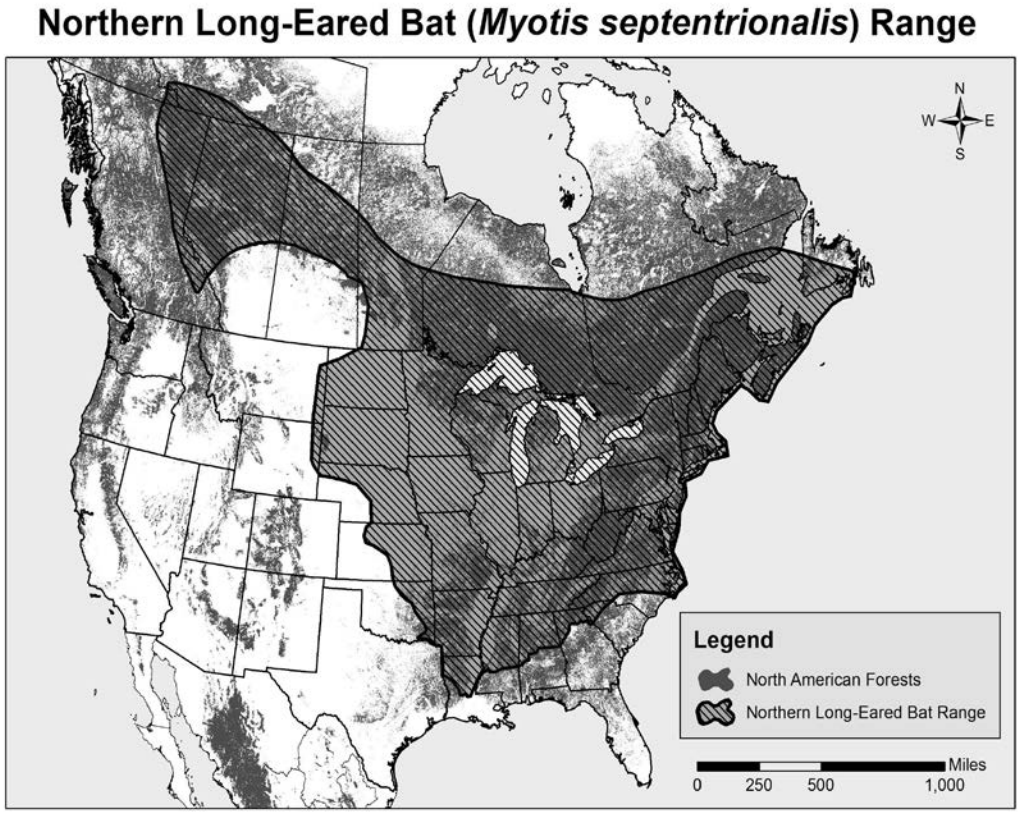

Figure 1. Northern long-eared bat range.

Although they are typically found in low numbers in inconspicuous roosts, most records of northern long-eared bat are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species' range in the United States, although many hibernacula

contain only a few (1 to 3) individuals (Whitaker and Hamilton 1998). Known hibernacula (sites with one or more winter records of northern long-eared bats) include: Alabama (2), Arkansas (41), Connecticut (8), Delaware (2), Georgia (3), Illinois (21), Indiana (25), Kentucky (119), Maine (3), Maryland (8), Massachusetts (7), Michigan (103), Minnesota (11), Missouri (more than 269), Nebraska (2), New Hampshire (11), New Jersey (7), New York (90), North Carolina (22), Oklahoma (9), Ohio (7), Pennsylvania (112), South Carolina (2), South Dakota (21), Tennessee (58), Vermont (16), Virginia (8), West Virginia (104), and Wisconsin (67). Northern long-eared bats have been documented in hibernacula in 29 of the 37 States in the species' range. 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).

The current range and distribution of the northern long-eared bat must be described and understood within the context of the impacts of WNS. Prior to the onset of WNS, the best available information on the northern long-eared bat came primarily from surveys (mostly focused on Indiana bat or other bat species) and some targeted research projects. In these efforts, the northern long-eared bat was very frequently encountered and was considered the most common myotid bat in many areas. Overall, the species was considered to be widespread and abundant throughout its historic range (Caceres and Barclay 2000).

WNS has been particularly devastating for the northern long-eared bat in the northeast, where the species was believed to be the most abundant. There are data supporting substantial declines in northern long-eared bat populations in portions of the Midwest due to WNS. In addition, WNS has been documented at more than 100 northern long-eared bat hibernacula in the southeast, with apparent population declines at most sites. WNS has not been found in any of the western states to date and the species is considered rarer in the western extremes of its range. We expect further declines as the disease continues to spread across the species' range.

Status of the Northern Long-eared Bat in Minnesota

Before 2014, there was little information on northern long-eared bat summer populations in the state. In 2014, passive acoustic surveys conducted at a new proposed mining area in central St. Louis County detected the presence of the northern long-eared bat at each of 13 sites sampled. Calls that were assigned to the northern long-eared bat accounted for approximately 14 percent of all recorded bat calls (Smith *et al*. 2014). Mist-net surveys in 2014 at 7 sites on Camp Ripley Training Center, Morrison County, resulted in capture of four northern long-eared bats (5 percent of total captures); mist-net surveys at five sites on the Superior National Forest, Lake and St. Louis Counties, resulted in the capture of 24 northern long-eared bats (55 percent of total captures) (Catton 2014). Acoustic and mist-net data were collected by a pipeline project proponent in 2014, which surveyed an approximately 125-feet wide and 300-mile-long (483-km) corridor through the northern third of the state. Positive detections were recorded in Hubbard, Cass, Crow Wing, Aitkin, and Carlton counties, and northern long-eared bats were the most common species captured by mist-net (Merjent 2014). Mist-net surveys were conducted the previous year (2013) on the Kawishiwi District of the Superior National Forest, and resulted in capture of 13 northern long-eared bats (38 percent of total captures) over 9 nights of netting at 8 sites (Grandmaison *et al*. 2013).

The northern long-eared bat is known from 25 hibernacula in Minnesota; however, the status of most is

unknown. The largest known hibernaculum in Minnesota is the Soudan Mine in St. Louis County; an estimated 3,000 northern long-eared bats are thought to hibernate within the mine. WNS has not been detected in Minnesota; however, the fungus that causes WNS was first detected in 2011–2012. Currently, only Soudan Mine and Mystery Cave in Minnesota are known to harbor the fungus that causes WNS and to our knowledge, the fungus has not actually caused WNS in bats within the state.

Critical Habitat

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

Conservation Needs of the Species

The species' conservation needs define what is needed in terms of reproduction, numbers, and distribution to ensure the species is no longer in danger of extinction. The conservation needs should be defined in the species' recovery outline or plan. Since there is no recovery plan or recovery outline available at this time, we will outline the conservation needs based on our current understanding of the species.

We find that the primary conservation need of the northern long-eared bat is to reduce the threat of WNS. This includes minimizing mortality in WNS-affected areas and slowing the rate of spread into currently unaffected areas. In addition, northern long-eared bats that continue to exist within WNS-affected areas need to be able to continue to survive and reproduce in order to stabilize and/or increase the populations. This can be done by reducing the other threats to the species, as listed above.

Therefore, efforts to protect hibernacula from disturbances need to continue. These should include restricting human access to hibernacula particularly during the hibernation period, constructing/installing suitably designed gates where appropriate and maintaining the gates, and restoring microhabitat conditions in hibernacula that have been altered. Efforts should also be made to protect and restore (in some cases) adequate fall swarming habitat around hibernacula. Known maternity habitat should be maintained, and the removal of known roost trees, particularly when pregnant females and/or young are present should be reduced. Research to identify important hibernacula and summer areas and to delineate the migratory relationship between summering and wintering populations should also be pursued.

ENVIRONMENTAL BASELINE

The Environmental Baseline analyzes the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and the ecosystem within the action area.

Action Area

Action area, as defined by the ESA's implementing regulations (50 CFR 402.02), 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 (our emphasis). Action is defined in the regulations as "…all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas. Examples include, but are not limited to: (a) actions intended to conserve listed species or their habitat; (b) the promulgation of regulations; (c) the granting of licenses, contracts, leases, easements,

rights-of-way, permits, or grants-in-aid; or (d) actions directly or indirectly causing modifications to the land, water, or air.

The action area for this consultation includes the state-owned and/or administered WMAs throughout the state (Fig. 2).

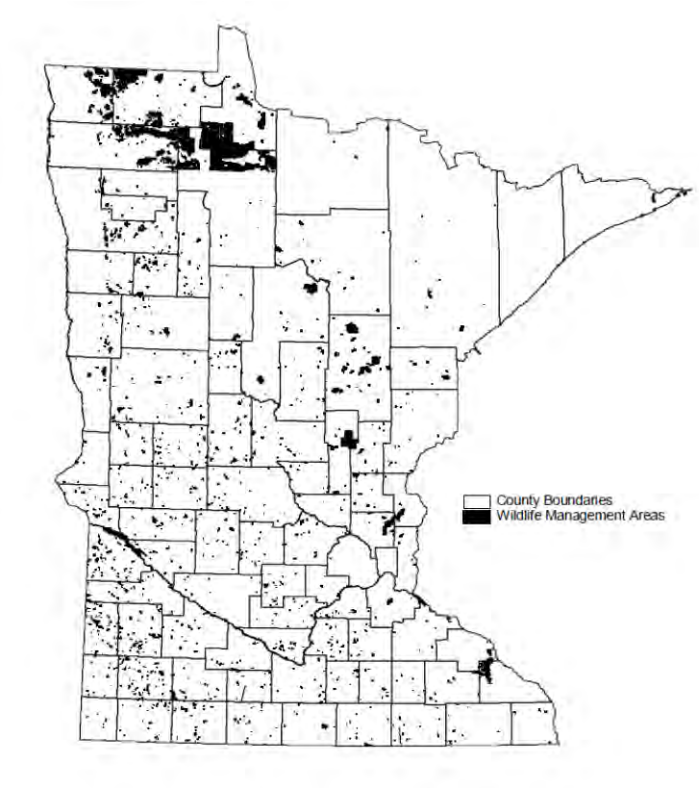

Figure 2. Locations of Minnesota state-owned wildlife management areas.

Status of the Species in the Action Area

Northern long-eared bats are assumed to be present throughout Minnesota, although the likelihood of their presence in forested areas during the presumed spring to fall roosting period is likely related directly to the extent of forest in the surrounding landscape and proximity to hibernacula. The longest distance between a known northern long-eared bat hibernaculum and a known roost tree or recorded capture of the species is about 134 miles (Merjent 2014; Minnesota Department of Natural Resources, unpubl. data). Based on this, we would expect at least most of the WMA areas in Minnesota to be within a distance that would allow northern long-eared bats to inhabit them during the spring-fall roosting period. For this BO, we will assume that all WMAs may be occupied during the presumed spring to fall roosting season – April 1 to September 30.

There are no known bat hibernacula in WMAs. Therefore, we do not expect effects to hibernacula to result from the proposed action. There are currently two known roost trees within 0.25 mile of a WMA – both near a single WMA in Aitkin County, Minnesota. Continued surveys for the northern long-eared

bat, however, are likely to yield additional roost tree locations on WMAs.

Habitat Conditions in the Action Area

The portion of the action where effects to the northern long-eared bat may occur consist of forested areas in both "farmland and transition landscapes" and in forest landscapes. Over 367,000 acres in state owned WMAs are located in farmland and transition landscapes (Prairie Parkland and Eastern Broadleaf Forest provinces in Minnesota's ecological classification system). WMAs in these landscapes serve as reservoirs for many species that ordinarily would not be able to survive the intensive agricultural landscape. In this landscape the northern long-eared bat may use forested patches of about 15 acres or more for roosting during the spring-fall roosting period. They may also use smaller patches that are within about 1000 feet of similar patches.

Minnesota has nearly 963,000 acres in state owned WMAs in the forest landscape (Laurentian Mixed Forest and Tallgrass Aspen Parklands provinces in Minnesota's ecological classification system). Forested habitats vary widely in species composition due to the widespread distribution across the state and the variety of forest types that occur in Minnesota. Brush land habitats in WMAs that will be subject to vegetation clearing activities (about 35,000 acres annually) are predominantly willow (*Salix spp.*) and alder (*Alnus spp.*). Less than 10% of brush land habitats contain trees greater than 3 inches DBH that may provide roosting habitat for the northern long-eared bat.

Conservation Needs of the Species in the Action Area

Portions of some WMAs provide habitat for the northern long-eared bat during the spring-fall periods when they roost in forest and migrate to and from hibernacula. The conservation needs of the species in the action area are similar to the needs rangewide. Therefore, within the action area the conservation needs include: 1) providing suitable habitat conditions for northern long-eared bat foraging and roosting; 2) reducing the removal of roost trees, especially during the spring-fall roosting period; 3) searching for previously unidentified areas of maternity and hibernation activity; and 4) conducting research to understand the migration patterns of northern long-eared bat that use the area during the summer or winter.

EFFECTS OF THE ACTION

This BO evaluates the anticipated effects of tree removal and prescribed fire on WMAs in Minnesota that would occur as a result of the Pittman-Robertson grant to MDNR. Tree removal in forest and farmland landscapes will together take place on about 10,000 acres annually; prescribed fire will directly affect 5,000 of brushland and 1,000 of forest annually; and, vegetation clearing will affect 35,000 acres of brushland annually. Potential effects to the northern long-eared bat include direct and indirect effects. Direct effects occur when bats are present while the activities are being conducted; indirect effects occur later in time. Effects will vary based on the type of the proposed activity.

Our analysis of effects for northern long-eared bat entails: (1) evaluating individual northern long-eared bat exposure to action-related stressors and the bats' likely responses; (2) integrating those individual effects (exposure risk and subsequent response) to discern the consequences to the populations to which those individuals belong; and (3) determining the consequences of any population-level effects to the species rangewide. If we find that the actions are unlikely to affect the rangewide numbers, reproduction, and distribution of the species in a way that can be measured or described, we conclude that the agency's actions are not likely to jeopardize the continued existence of the species.

Effects to Hibernating Bats at or Near Hibernacula

No WMA contains a known hibernaculum for the northern long-eared bat and neither direct nor indirect effects are anticipated to wintering northern long-eared bats or their hibernacula from the proposed action.

Fall swarming typically occurs within five miles of a hibernaculum. There are eleven WMAs that are within five miles of hibernaculum and that may contain sufficient forest to provide habitat for the northern long-eared bat during fall swarming (Table 1). Direct or indirect effects of tree removal in these areas could result in effects to the northern long-eared bat during fall swarming.

Table 1. Minnesota Wildlife Management Areas that are within five miles of hibernaculum for the northern long-eared bat.

Wildlife Management Area	Subunit (if any)
Espen Island WMA	
Goethite WMA	
Gores Pool #3 WMA	
John Murtaugh Memorial WMA	
John Peter Hoffman Spring Brook Valley WMA	
Old Koschak Farm WMA	
Ottawa WMA	
Perched Valley WMA	South Unit
Perched Valley WMA	Grote's Pond Unit
Sandstone WMA	Sandstone Unit, Tract 300 (Rice Lake NWR)
William Pease WMA	

Effects to Bats in Spring-Fall Habitats

Tree Removal Associated with Clear Cuts and Vegetation Clearing

Removal of trees that are greater than three inches diameter at breast height (DBH), at least in some forested areas, could result in direct effects to the northern long-eared bat. In Minnesota, northern long-eared bats could be roosting in trees between April 1 and September 30. It is during this time period that the species is likely to be adversely affected by tree removal and associated activities.

As stated above, tree removal could result in direct effects to the northern long-eared bat as a result of tree removal and clear cutting in farmland and forested landscapes and vegetation clearing in brushland landscapes. Tree removal in farmland landscapes is less likely to affect the northern long-eared bat than in forested landscapes because the species is less likely to be present in areas that are not predominantly forested. Nevertheless, the proposed action is likely to result in clearing trees from about 5,000 acres in farmland landscapes annually. The northern long-eared bat is likely to be present in at least some cases during tree removal. Where tree removal would take place in forested landscapes that are considered suitable habitat, the northern long-eared bat could occur in any of the affected areas. In brushland landscapes where vegetation removal is proposed, the northern long-eared bat could be present and roosting in trees that are greater than 3" DBH and that are within 1000 feet of forested patches that are about 15 acres or greater in extent.

Death/Injury due to Tree Removal Associated with Clear Cuts and Vegetation Clearing

Risk of death or injury of individual northern long-eared bats as a result of tree removal varies depending on the timing of activities, their location, and the extent of the area affected.

The timing of tree removal activities greatly influences the likelihood of exposure and the extent of impacts on individual bats and their populations. Female northern long-eared bats typically roost colonially, with their largest population counts occurring in the spring or early summer, presumably as one way to reduce thermal costs for individual bats (Foster and Kurta 1999). Although bats may flee their roosts during tree removal, removal of occupied roosts during the active season while bats are present is likely to cause injury or mortality to some roosting bats. Bats are likely to be injured or killed as a result of tree felling in the spring when bats often use torpor (temporary unresponsive state) to survive periods of cool weather and low prey availability. Bats are also likely to be killed or injured during early to mid-summer (approximately June-July) when flightless pups or inexperienced flying juveniles are present. Removal of trees outside these periods is less likely to result in direct injury or mortality when the majority of bats can fly and are more dispersed.

About 90% of tree removal in farmland landscapes will occur when the northern long-eared bat would not be present in the affected area – i.e., outside of the spring-fall roosting season. This will reduce the direct effects of tree removal to about 500 acres annually during the spring-fall roosting period. Stands of trees that are typically removed to restore or manage habitats in in Minnesota farmland landscapes often have only marginal suitability as roosting habitat for the northern long-eared bat. Nevertheless, we cannot describe with precision the proportion of forested patches in these landscapes that are inhabited by the northern long-eared bat during the spring-fall roosting season. Therefore, we will assume that all areas that will be affected by tree removal in farmland landscapes are inhabited by roosting northern long-eared bats. Based on this assumption, direct effects to northern long-eared bats will occur as a result of tree removal on about 500 acres of Minnesota farmland landscapes annually as a result of grant-funded activities. The likely density of northern long-eared bats in the affected areas is unknown.

About 90% of tree removal in forested landscapes also would occur during the winter when the northern long-eared bat is not present. These include clear cuts that occur primarily in stands of quaking aspen. Similar to tree removal in farmland landscapes, this will result in the felling of trees on about 500 acres annually at times when they may be inhabited by roosting northern long-eared bats. The likely density of northern long-eared bats in the affected areas is unknown.

Only about 10% of brushland habitats where vegetation clearing will occur contain trees greater than 3 inches DBH. Therefore, among the 35,000 acres of brushland that will be affected annually by this activity, only about 3,500 acres may contain maternity habitat for northern long-eared bats. In addition, about 90% of vegetation clearing in will occur during the winter when the northern long-eared bat is not present. As a result, direct effects to maternity habitat may occur in 350 acres annually as a result of vegetation clearing in brushland habitats.

Tree removal could result in direct effects to roosting northern long-eared bats on 1,350 acres annually in Minnesota as a result of the grant-funded activities. These effects will be distributed broadly among

WMAs across the State of Minnesota. Northern long-eared bat habitat is abundant and well distributed throughout the state. Minnesota contains approximately 17.3 million acres of forested habitat. The proposed action will result in tree removal from an area equivalent to about 0.008% of Minnesota's forested area during the period when the species is present in forest. Therefore, only about 0.008% of the roosting northern long-eared bats may be affected directly in Minnesota each year as a result of the grant-funded actions. This is an approximation of the effects on the number of northern long-eared bats in Minnesota, but indicative that the activities will affect only a small proportion of the species' numbers in the state.

Response to Removal or Alteration of Roosting/Foraging Habitat

The northern long-eared bat shows a varied degree of sensitivity to tree removal practices (Menzel et al. 2002, Owen et al. 2002). In central Arkansas, most roosts were in mixed pine-hardwood forest that had been partially harvested or thinned (50–99 years old overstory) or were subject to group selection harvest (Perry and Thill 2007). Forest size and continuity are also factors that define the quality of habitat for roost sites for northern long-eared bat. Lacki and Schwierjohann (2001) stated that silvicultural practices could meet both male and female roosting requirements by maintaining large-diameter snags, while allowing for regeneration of forests.

In addition to impacts on roost sites, timber harvest practices can also affect foraging and traveling habitat. Clearcut areas likely become unsuitable for the species, at least temporarily, but practices that increase diversity of forest stands may enhance areas for the species. In southeastern Missouri, the northern long-eared bat showed a preference for contiguous tracts of forest cover over fragmented or wide open landscapes for foraging or traveling, but the interspersion of different forest types on the landscape increased the likelihood of the species' occupancy (Yates and Muzika 2006). In West Virginia, female northern long-eared bats spent most of their time foraging or travelling in intact forest, in 70–90 year-old stands with 30–40 percent of basal area removed in the past 10 years, and through road corridors; they did not use areas where timber harvest similar to clearcutting had been carried out recently (Owen et al. 2003). In Alberta, Canada northern long-eared bats avoided the center of clearcuts and foraged more in intact forest than expected based on its availability (Patriquin and Barclay 2003). On Prince Edward Island, Canada, female northern long-eared bats preferred forested areas more than open areas and their foraging areas were centered along forest-covered creeks (Henderson and Broders 2008). In general, northern long-eared bats prefer intact mixed-type forests with small gaps (i.e., forest trails, small roads, or forest covered creeks) in forests with sparse or medium vegetation for foraging and traveling, rather than fragmented habitat or areas that have been clearcut.

Sustainable timber harvest activities do not typically lead to permanent losses of suitable roosting, foraging, or traveling habitat for northern long-eared bat. On the contrary, sustainable timber harvest activities are compatible with the long-term maintenance of suitable forested habitat for the species. Many sustainable timber harvest practices will result in little change in terms of the amount or quality of roosting or foraging habitat for northern long-eared bat. For example, selective harvest regimes are not anticipated to result in alterations of forest to the point where northern long-eared bat would be expected to significantly alter their normal behaviors within the affected areas. The treatment areas will still be

forested with only small openings left by the harvest treatment. Similarly, small patch cuts, wildlife openings, and forest roads would be expected to serve as foraging areas or travel corridors and not as barriers to movement. Therefore, the only impacts of concern from many forest treatments are the potential for death or injury during active season tree removal.

However, localized long-term reductions in suitable roosting and/or foraging habitat can occur from various forest practices. For example, large clearcuts (that remove a large portion of a known or assumed home range) would result in a temporary "loss" of forest for northern long-eared bat. In these cases, "temporary" would be for many years (amount of time to reproduce suitable roosting/foraging habitat). Foraging would be possible prior to roosting depending on the juxtaposition of cuts to other forest regimes.

As stated above, northern long-eared bats have been found in forests that have been managed to varying degrees and as long as there is sufficient suitable roosting and foraging habitat within their home range and travel corridors between those areas, we would expect northern long-eared bat colonies to persist in managed landscapes.

In addition to the type of timber harvest, the extent of impact from timber harvest-related habitat modifications is influenced by the amount of suitable habitat available within and nearby northern long-eared bat home ranges. Some portions of the northern long-eared bat's range are more forested than others. In areas with little forest or highly fragmented forests (e.g., western U.S. edge of the range, central Midwestern states; see Figure 1), 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 northern long-eared bat's home range is expected to vary depending on the scope of removal. Silvis et al. (2014) modeled roost loss of northern long-eared bats and Silvis et al. (2015) removed known northern long-eared bat roosts during the winter in the field to determine how this would impact the species. Once removals totaled 20–30 percent of known roosts, a single maternity colony network started showing patterns of break-up. As explained in the Status of Species section, sociality is hypothesized to increase reproductive success (Silvis et al. 2014); thus, smaller colonies are expected to have lower reproductive success.

Clearcutting and similar harvest methods that result in low density of potential roost trees may prompt the need for longer flights and increased energetic demands by northern long-eared bats at a time when they may already be energetically challenged. Northern long-eared bats emerge from hibernation with their lowest annual fat reserves and soon thereafter must return to their summer home ranges. The spring staging period precedes migration to summer habitats. During this period, northern long-eared bats remain near hibernacula. They feed and reenter hibernacula daily, where they enter torpor to minimize energy loss during the day. Individuals may increase fat reserves during this period, but are unlikely to regain the large amounts of fat lost during hibernation.

For several reasons, winter tree harvest that substantially alters summer roosting habitat for the northern long-eared bat could result in adverse effects to affected individuals. Northern long-eared bats have summer home range fidelity (Foster and Kurta 1999; Patriquin et al. 2010; Broders et al. 2013).

Activities that take place during the winter that render summer habitats unsuitable may force northern long-eared bat to rely on low energy reserves to find new roosts or foraging areas. This may put additional stress on females that are often pregnant. Hibernation and reproduction are the most energetically demanding periods for temperate-zone bats, including the northern long-eared bat (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 (state of mental or physical inactivity). Entering torpor comes at a cost of delayed parturition, which may affect the fitness of yearling northern long-eared bat. 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. 2009). 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 northern long-eared bats typically roost colonially, with their largest population counts occurring in the spring or early summer, presumably as one way to reduce thermal costs for individual bats (Foster and Kurta 1999). Therefore, similar to other temperate bats, the northern long-eared bat has 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.

In summary, tree clearing associated with the proposed action could have both adverse and beneficial effects on habitat suitability for the northern long-eared bat. The approximately 13,500 acres of habitat that will be affected by tree removal annually are scattered broadly across the State of Minnesota and will constitute only about 0.08% of forested habitat in Minnesota. This includes 5,000 acres of tree clearing in farmland landscapes. As a result, we conclude that the overall habitat suitability or availability for northern long-eared bat foraging and roosting within the action area would be minimally affected by the grant-funded activities.

Effects from Noise, Disturbance

Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities of the northern long-eared bat. Many activities may result in increased noise/vibration/disturbance that may result in effects to bats. Bats may be exposed to noise/vibration/disturbance from various MDNR activities near their roosting, foraging, or swarming areas.

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. 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.

There is limited literature available regarding impacts from noise (outside of road/traffic) on bats. Gardner et al. (1991) had evidence that a northern long-eared bat conspecific, Indiana bat, continued to roost and forage in an area with active timber harvest. Also see the timber harvest section above regarding other similar studies for northern long-eared bat. 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. 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. However, his last exit count at this roost was conducted 18 days prior to the exit count of zero. 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 of the examples above have likely become habituated to the noise/vibration/disturbance. Novel noises would be expected to result in some changes to bat behaviors.

In summary, northern long-eared bats currently present in the forest are expected to be tolerant to a certain degree of existing (prior to initiation of proposed activities) noise, vibration, and disturbance levels. However, temporary and novel noise/vibration/disturbance associated with heavy equipment operation and tree cutting may result in responses by bats that are roosting or foraging in these areas. We expect that affected bats are likely to shift their focal roosting areas further away or may temporarily abandon these roosting areas completely.

Death and Injury – Exposure to Flames, Heat, and Smoke

Prescribed fires conducted during the spring/summer roosting period could result in direct mortality or injury to northern long-eared bats by burning, heat exposure, or smoke inhalation. Bats also may be exposed to elevated concentrations of potentially harmful compounds within the smoke (e.g., carbon monoxide and irritants) (Dickinson et al. 2009). Exposure risk depends on a variety of factors including height of roosts, timing and behavior of fire, winds, and proximity of fire to roosts. Risk of direct mortality and injury to bats from prescribed fire is low as long as fire intensity and crown scorch height are low (Dickinson 2010). Northern long-eared bats may be more likely to flush from trees to avoid injury as spring progresses, temperatures increase, and less time is spent in a state of torpor (Dickinson 2010). Burning in mid-summer (e.g., July) may increase the chances that adults will have pups that may be too heavy to carry and may increase the intensity of the pups' exposure to heat and smoke. Due to the anticipated timing of the burns that are part of the proposed action, effects to torpid adults and non-volant young may be minimized and most bats may be mobile when burns are conducted. We expect minimal lethal take from the proposed prescribed fires. Northern long-eared bats may be forced to flee from roosting and foraging areas, which could increase predation risk temporarily. These adverse effects are expected to be short-term and localized.

As a result of the proposed actions, northern long-eared bats could be exposed directly to smoke and heat as a result of prescribed fire conducted in brushland and forested habitats while roosting and when foraging at night, although flame lengths for upland burns are expected to be limited to 2-4 feet, generally. Northern long-eared bats may only be infrequently exposed to flames, but males may be more

exposed due to tendency to roost in smaller trees. Non-volant pups may also be more likely to be exposed to the effects of smoke and heat because when they are too heavy to carry, they would be unable to leave the affected area – about 25% of fires in forested habitats may occur during the non-volant period. Northern long-eared bats may be present in about 750 acres of forested habitats and in about 375 acres of brushland habitats when prescribed fires are carried out. Together, this is about 0.07% of the forested habitat in Minnesota.

Smoke drift outside of the areas burned may also affect northern long-eared bats present in nearby forested habitats. We assume that prescribed burns will always be implemented when conditions for smoke dispersion are "Fair", as described in the Minnesota Smoke Management Plan (Prescribed Fire/Fuels Working Team. 2007, p. 24). Under those conditions, smoke from "landscape burns" in "Timber, slash, or piled fuels" may affect sensitive resources within 1.0 mile downwind (Prescribed Fire/Fuels Working Team. 2007, p. 22). If we assume for this analysis that each fire area is round and that only the area downwind from the burn area would be affected by smoke, then we can estimate the total area that could be affected by smoke from the proposed fires as approximately 1915 acres. This may be a conservatively high estimate of the area affected and not all of the area is likely to be suitable roosting habitat for northern long-eared bat. Therefore, smoke from the proposed fires may affect only less than about 0.01% of forested habitat in Minnesota – a rough approximation of the amount of northern long-eared bat roosting habitat that would be affected in the state.

In summary, northern long-eared bats could be exposed to burning, heat exposure, or smoke inhalation as a result of the proposed prescribed fire activities, but only a small proportion of the individuals that inhabit the action area is likely to be affected. Northern long-eared bats would be exposed to smoke, heat, and flames as a result of the grant-funded activities annually in about 0.08% of the suitable roosting habitat in the state. This includes the area that may contain maternity habitat for the northern long-eared bat and that would be burned during the roosting season in addition to the area that would be affected by drifting smoke.

Response to Removal or Alteration of Roosting/Foraging Habitat

Indirect effects to northern long-eared bats from prescribed fire may include short-term loss of roost trees and decreased prey abundance, followed by long-term increases in roost abundance and suitability and in prey abundance (Boyles and Aubrey 2006, Dickinson 2010, Dickinson et al. 2009, Johnson et al. 2009, Johnson et al. 2010, Lacki et al. 2009, Timpone et al. 2010). That is, effects of upland prescribed fires may be adverse in the short term, but beneficial in the long term.

Prescribed fire can create a greater abundance of potential roost trees for the northern long-eared bat because fires can cause bark of live trees to peel away from the sapwood creating the sloughing bark that is often used for roosting (Johnson et al. 2010). The availability of suitable roosts – including roosts with cavities and exfoliating bark – is greater in burned areas compared to unburned areas (Boyles and Aubrey 2006, Dickinson et al. 2009, Johnson et al. 2010). The northern long-eared bat roosts extensively in areas soon after they are burned and to shift from roosts beneath bark to cavities after burning (Lacki et al. 2009).

Fires can also create a more open canopy structure that can improve roost quality by increasing the amount of solar radiation reaching the roost. Canopy light penetration was higher and canopy tree density was lower in burned forest than in unburned forest (Boyles and Aubrey 2006). Additionally, canopy gaps in the burned area are associated with slightly higher maximum daily temperatures at roost trees (Johnson et al. 2009). Higher roost temperatures could facilitate more rapid growth of developing juvenile bats (Johnson et al. 2009). As a result, the abundance of trees with characteristics suitable for roosting, and the percentage of the forested area with suitable bat roosts, should be increased after fires (Boyles and Aubrey 2006).

Studies in West Virginia found that the northern long-eared bat responded favorably to prescribed fire by using new roost trees that were located in canopy gaps created as a result of the fire (Johnson et al. 2009). Conversely, fire may also destroy or accelerate the decline of existing roost trees, particularly of older snags, by burning the bases of the trees and weakening their structure, causing them to fall over sooner (Johnson et al. 2009, Dickinson et al. 2009). One study found that up to 20 percent of existing standing snags were lost post-fire, and that few new snags were created (Lacki et al. 2009).

In summary, prescribed fire may result in both adverse and beneficial effects on roosting habitat. It results in the immediate loss of some roost trees, but also creates new roosts and may enhance the suitability of affected trees that remain standing for a period after the fire. Fire likely results in long-term trends in forest composition towards a greater abundance of trees that are likely to serve as suitable roosts.

Prescribed fire may affect foraging habitat by changing the structure of the forest and by changing the abundance of prey within the affected area (Dickinson et al. 2009). The northern long-eared bat has shown a preference for foraging in heavily forested mid-slope areas, regardless of burn condition. This suggests that they feed in and around closed canopies and are likely clutter-adapted (Lacki et al. 2009). The size of female northern long-eared bat home ranges and core areas, however, did not differ among bats radio-tracked before and after fires and home ranges of the monitored bats were located closer to burned habitats after fires than to unburned habitats (Lacki et al. 2009). Northern long-eared bats may respond to the habitat alterations that result from prescribed fires by shifting the location of their foraging areas to take advantage of changes in insect prey availability (Lacki et al. 2009). Immediately after fires, insect abundance typically declines, but abundance of coleopterans (beetles), dipterans (flies), and all insects combined has been shown to increase after prescribed fires (Lacki et al. 2009). The increases among these prey taxa can occur within a year of the fire and may last for up to 16 years post-burn.

As a result of the proposed actions, fire may kill as many as 10% of overstory trees in affected stands. The death and collapse of the affected trees would likely occur over a span of several years. In the burned areas, the northern long-eared bat may have fewer trees to select for roosting, but availability of trees for roosting is likely to be only marginally affected and the overall value of the stand as roosting habitat for the species will little affected. In fact, the net effect of the prescribed burns may be to increase the suitability of the burned areas for northern long-eared bat. Overall effects to northern long-eared bat in the action area will be localized – only 0.07% of the forest in Minnesota will be burned as a result of the grant to MDNR annually based on the assumption that there are 17.3 million acres of forested area in Minnesota (Minnesota DNR website - http://www.dnr.state.mn.us/faq/mnfacts/forests.html; accessed 31

July 2015). The beneficial effects of the prescribed fires – increased thermal input to roosts and an increase in prey availability – are likely to at least offset the short-term and localized negative effects.

Cumulative Effects

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

The land management activities analyzed in this biological opinion constitute most or all of the activities that occur in the action area – state-owned WMAs in Minnesota – that would have effects on the northern long-eared bat. There is significant public use of WMAs for hunting, fishing, and other recreation, but those activities are likely to have no effects on the northern long-eared bat or only minor effects.

Summary of Effects

Impacts to Individuals

While analyzing the effects of the proposed action, we identified the life stages that would be exposed to the stressors associated with the proposed action, and analyzed how those individuals would respond upon exposure to the stressors. From this analysis, we determined that:

Neither hibernating bats nor their hibernacula will be exposed to the project stressors as there are currently no known hibernacula in the Action Area. We identified several hibernacula that are within a 5-mile radius of WMAs – the area where fall swarming may occur.

During the spring-fall period northern long-eared bats will be exposed to various project stressors and their responses to some of them are likely to be adverse.

We considered the possibility for the northern long-eared bat to be exposed to the effects of project activities at currently unknown roost sites. We anticipate that project activities will cause northern long-eared bats to flush from roosts during daylight. This could lead to permanent abandonment of roosts (which may have pups). Prescribed burning may also result in minor respiratory effects to adults. Mortality of pups is possible as a result of tree removal and inhalation of smoke. In summary, there will be impacts to individual bats in terms of either reduced survival or reproduction.

Potential effects of the action include direct effects to northern long-eared bats present within the action area when activities are being conducted and indirect effects as a result of changes in habitat suitability. The types of tree removal and land management activities that may affect habitat suitability include clear cutting in forested landscapes – primarily in quaking aspen stands; vegetation clearing in brushland habitats; tree removal in farmland landscapes; and, prescribed fire in forested and brushland habitats. Direct effects include mortality, injury, harm, or harassment as a result of removal of roost trees, noise, and general human presence.

Indirect effects from the action may result from habitat modification and primarily involve changes to roosting and foraging suitability. Tree clearing could have both adverse (such as active season tree removal of a roost tree) and beneficial effects on habitat suitability for the northern long-eared bat. Due to the minor scope of the projects in relation to the overall action area, these projects will not substantially alter the overall availability or suitability of northern long-eared bat roosting or foraging habitat in the action area.

None of the proposed actions will alter the amount or extent of mortality or harm to northern long-eared bat resulting directly from WNS. The continued implementation of monitoring efforts will provide additional information on the effect of the actions on affected bats. Minimal cumulative effects are expected.

Impacts to Populations

We have concluded that individual bats are likely to experience reductions in either their annual or lifetime survival or reproductive rates. Therefore, we need to assess the aggregated consequences of these effects to exposed individuals as they relate to the population to which these individuals belong.

There is potential for direct take of the species, but the action area will continue to provide suitable habitat conditions for northern long-eared bat foraging and roosting during the summer while the proposed activities are implemented and after they are complete. In light of the extent of the area where direct take is likely to occur relative to the entire action area and the current distribution and abundance of northern long-eared bat habitat in Minnesota, the effects of the proposed activities are unlikely to reduce the likelihood that northern long-eared bat will continue to survive and reproduce in the action area.

Impacts to the Species

Many of the proposed actions are likely to result in benefits to the species over the long term due to the maintenance of a mosaic of forest types. We recognize that the status of the species is uncertain due to WNS, but given the environmental baseline, and the anticipated intensity, frequency, and duration of the project impacts, we find that the proposed project is unlikely to have appreciable impacts on the population that inhabits the action area. Thus, no component of the proposed action is expected to reduce the reproduction, numbers, or distribution of the northern long-eared bat rangewide. Therefore, we do not anticipate a reduction in the likelihood of both survival and recovery of the species as a whole.

CONCLUSION

After reviewing the current status of this species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the northern long-eared bat. No critical habitat has been designated to date for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR § 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

On April 2, 2015, the Service published an interim species-specific rule pursuant to section 4(d) of the ESA for northern long-eared bat (80 FR 17974). The Service's interim 4(d) rule for northern long-eared bat exempts the take of northern long-eared bat from the section 9 prohibitions of the ESA, when such take occurs as follows (see the interim rule for more information):

(1) Take that is incidental to forestry management activities, maintenance/limited expansion of existing rights-of way, prairie management, projects resulting in minimal (<1 acre) tree removal, provided these activities:
    a. Occur more than 0.25 mile (0.4 km) from a known, occupied hibernacula;
    b. Avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31); and,
    c. Avoid clearcuts (and similar harvest methods, *e.g.*, seed tree, shelterwood, and coppice) within 0.25 (0.4 km) mile of known, occupied roost trees during the pup season (June 1–July 31).
(2) Removal of hazard trees (no limitations).
(3) Purposeful take that results from
    a. Removal of bats from and disturbance within human structures; and,
    b. Capture, handling, and related activities for northern long-eared bats for 1 Year following publication of the interim rule.

Incidental take that occurs as a result of activities conducted in compliance with the interim 4(d) rule does not require exemption in this Incidental Take Statement. Therefore, the following Reasonable and Prudent Measures and their implementing Terms and Conditions apply only to the activities described immediately below:

- Tree removal in farmland/grassland landscapes when it does not constitute "prairie management" – this activity is expected to occur on about 5,000 acres annually, but only 10% is expected to

occur when the northern long-eared bat may be present in the affected area and 95% would constitute prairie management. Therefore, incidental take of the species that would not be exempted by the interim 4(d) rule under this activity is expected on 25 acres annually.

- Vegetation clearing in brushland habitats – expected to occur on about 35,000 acres annually – the northern long-eared bat is expected to be present in only about 10% of the affected area (3,500 acres) and only about 10% of the clearing will occur when the species may be present in the affected area. Therefore, incidental take of the species that would not be exempted by the interim 4(d) rule under this activity is expected on 350 acres annually.

- Prescribed fire in brushland habitats – expected to occur on about 5,000 acres annually. The northern long-eared bat is likely to inhabit only 10% of the affected habitat (500 acres). About 75% of the activity is likely to take place when the northern long-eared bat may be present in the affected area. Therefore, incidental take of the species that would not be exempted by the interim 4(d) rule under this activity is expected on 375 acres annually.

The activities that are covered by the interim 4(d) rule include forest management activities. The Service considers forest management practices to include a suite of activities used to maintain and manage forest ecosystems, including, but not limited to, timber harvest and other silvicultural treatments, prescribed burning, invasive species control, wildlife openings, and temporary roads. The following groups of activities are considered forest management:

- Tree removal in farmland/grassland landscapes when it constitutes "prairie management" – this activity is expected to occur on about 5,000 acres annually and 95% of this activity constitutes prairie management; the resulting incidental take would be exempted by the interim 4(d) rule.

- Tree removal in forested areas for the purposes of forest habitat improvement and management; this may consist of clear cuts or selective timber harvest or thinning – expected to occur on 5,000 acres annually – only 10% is expected to occur when the northern long-eared bat may be present in the affected area.

- Prescribed fire in forested habitat – expected to occur in 1,000 acres annually – 75% of the activity is expected to occur when the northern long-eared bat may be present in the affected area.

AMOUNT OR EXTENT OF TAKE

If northern long-eared bats are present or utilize an area proposed for timber harvest, prescribed fire, or other disturbance, incidental take of northern long-eared bat could occur. The Service anticipates incidental take of the northern long-eared bat will be difficult to detect for the following reasons: (1) the individuals are small and occupy summer habitats where they are difficult to find; (2) northern long-eared bat form small, widely dispersed maternity colonies under loose bark or in the cavities of trees and males and non-reproductive females may roost individually, which makes finding the species or occupied habitats difficult; (3) finding dead or injured specimens during or following project implementation is unlikely; (4) the precise distribution and density of the species within its summer habitat in the action area is unknown; and, (5) in many cases incidental take will be non-lethal and undetectable.

Monitoring to determine actual take of individual bats within an expansive forested area is unlikely to produce useful information unless every individual tree that may contain suitable roosting habitat is inspected by a knowledgeable biologist when felled. To minimize or avoid take that is caused by felling trees with roosting bats, a similar tree-by-tree inspection would have to occur before trees are felled. Inspecting individual trees is not considered by the Service to be a reasonable survey method and is not recommended as a means to determine incidental take. However, the areal extent of potential roosting and foraging habitat affected can be used as a surrogate to monitor the level of take.

Other than take that is exempted by the provisions of the interim 4(d) rule, the proposed action is likely to result in incidental take as follows:

- Death, harm, and harassment of northern long-eared bats due to tree removal in farmland/grassland landscapes – take expected to occur on 25 acres annually.
- Death, harm, and harassment of northern long-eared bats due to vegetation clearing in brushland habitats – take expected to occur on 350 acres annually.
- Death, harm, and harassment due to prescribed fire in brushland habitats – take expected to occur on 375 acres annually.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to northern long-eared bat. No critical habitat has been designated for northern long-eared bat, so none would be impacted.

REASONABLE AND PRUDENT MEASURES

The incidental take of northern long-eared bats that is anticipated to occur as a result of the activities implemented during the two-year grant period (July 2015 to June 2017) is estimated based on the anticipated amount and timing of tree removal in areas where roosting northern long-eared bats may be present. The Service believes the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize take of species.

A. Ensure that known roost sites are adequately protected.

B. Ensure that MDNR monitors the amount and timing of each activity to avoid exceeding the level of take anticipated for activities for which the take is not exempted by the interim 4(d) rule.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Before activities that would cause take that is not exempted by the interim 4(d) rule begin, WSFR shall require that MDNR provide a description of the process to be used to ensure that staff involved with tree removal know the locations of any known maternity roost trees and hibernacula in Minnesota. This implements Reasonable and Prudent Measure A.

2. For each of two 12-month periods for the duration of the grant, WSFR shall provide the Twin Cities Ecological Services Field Office (TCFO) with a report summarizing the extent of area affected as a result of activities completed by MDNR in the following categories:

    - Tree removal in farmland/grassland landscapes when it does not constitute prairie management and occurs during the period, April 1 to September 30 – expected to occur on 25 acres annually.

    - Vegetation clearing in brushland habitats – expected to occur on about 35,000 acres annually and on about 3500 acres during the spring to spring-fall roosting period – reporting should describe the extent of clearing that occurred during the spring-fall roosting period, April 1 to September 30.

    - Prescribed fire in brushland habitats – expected to occur on about 5,000 acres annually. Reporting should describe the extent of clearing that occurred during the spring-fall roosting period, April 1 to September 30.

This report shall be provided to the Service no later than September 30 each year – beginning on September 30, 2016 – until all activities in these categories are completed under W-65-D-13.

2. WSFR shall require MDNR to ensure that all reasonable efforts are made to educate personnel to report any sick, injured, and/or dead bats (regardless of species) located during the implementation of project activities. All such bat encounters shall be reported to staff or researchers trained to conduct bat monitoring activities and who have the expertise to handle any live bat, regardless of its condition. If an injured bat is found, if possible, effort should be made by trained staff (with rabies vaccination) to transfer the animal to a wildlife rehabilitator. Any dead bats believed to be northern long-eared bat will be transported on ice to the TCFO or MDNR. If a northern long-eared bat is identified, TCFO will contact the appropriate Service law enforcement office. Care must be taken in handling dead specimens to preserve biological material in the best possible state. In conjunction with the care of sick and injured fish or wildlife and the preservation of biological materials from dead specimens, the WSFR should ensure that MDNR has the responsibility to ensure that information relative to the date, time, and location of northern long-eared bat, when found, and possible cause of injury or death of each is recorded and provided to the Service.

CONSERVATION RECOMMENDATIONS

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

The Service has identified the following action that, if undertaken by the MDNR, would further the conservation of the northern long-eared bat. We recognize that limited resources and other agency priorities may affect the ability of the MDNR to follow these recommendations.

- The MDNR is currently engaged in extensive efforts to study and monitor the northern long-eared bat in Minnesota. Where feasible, WSFR should use its grant programs to support and expand these efforts in cooperation with MDNR.

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

REINITIATION NOTICE

This concludes formal consultation for the proposed WSFR grant to MDNR outlined in your request dated May 14, 2015. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over an action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such a take must cease pending reinitiation.

LITERATURE CITED

Amelon, S. and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the eastern United States. Pages 69-82 *in* Thompson, F. R., III, editor. Conservation assessments for five forest bat species in the eastern United States. U.S. Department of Agriculture, Forest Service, North Central Research Station, General Technical Report NC-260. St. Paul, Minnesota. 82pp.

Barbour, R.W., and W.H. Davis. 1969. Bats of America. The University of Kentucky Press, Lexington, Kentucky. 311pp.

Barclay, R. M. R., and A. Kurta. 2007. Ecology and behavior of bats roosting in tree cavities and under bark. Pages 17-59 in Bats in forests: conservation and management. (M. J. Lacki, J. P. Hayes, and A. Kurta, eds.). Johns Hopkins University Press, Baltimore, Maryland.Benedict, R.A. and D.L. Howell. 2008. Use of building and bridges by Indiana bats (*Myotis sodalis*) and other bats in Iowa 2005-2008. Report submitted to the U.S. Fish and Wildlife Service and the Iowa Department of Natural Resources.

Boyles, J.G., and D.P. Aubrey. 2006. Managing forests with prescribed fire: Implications for a cavity-dwelling bat species. Forest Ecology and Management, 222:108-115.

Broders, H.G., L.E. Burns, and S.C. McCarthy. 2013. First Records of the Northern Myotis (*Myotis Septentrionalis*) from Labrador and Summer Distribution Records and Biology of Little Brown Bats (*Myotis lucifugus*) in Southern Labrador. The Canadian Field-Naturalist, 127:266-269.

Caceres, M.C. and M.J. Pybus. 1997. Status of the northern long-eared bat (*Myotis septentrionalis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, AB, 19pp.

Caceres, M.C. and R.M.R. Barclay. 2000. Myotis Septentrionalis. Mammalian Species, 634:1-4.

Caire, W., R. K. LaVal, M. L. LaVal, and R. Clawson. 1979. Notes on the ecology of Myotis keenii (Chiroptera, Vespertillionidae) in eastern Missouri. The American Midland Naturalist 102:404-407.Callahan, E.V. 1993. Indiana bat summer habitat requirements. M.S. Thesis, University of Missouri Columbia.

Carter, T.C., and G. Feldhamer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management, **219**: 259-268.

Catton, T. J. 2014. Summary of the 2014 Minnesota Northern Long-eared Bat Summer Habitat Use in Minnesota Project (Preliminary Report). U.S. Forest Service, USDA, Ely, MN. 9 p.

Dickinson, M.B., M.J. Lacki, and D.R. Cox. 2009. Fire and the endangered Indiana bat. Proceedings of the 3rd Fire in Eastern Oak Forests Conference GTR-NRS-P-46, p. 51-75.

Dickinson, M.B. 2010. Burning and bats: fire's effect on the endangered Indiana bat. Fire Science Brief 109:1-6.

Easterla, D. A. 1968. Parturition of Keen's myotis in southwestern Missouri. Journal of Mammalogy 49: 770.

Environment Yukon. 2011. Yukon Bats. Government of Yukon, Environment Yukon, Whitehorse, Yukon. 22pp.

Foster, R.W., and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis*) and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80(2):659-672.

Frick, W.F., D.S. Reynolds, and T.H. Kunz. 2009. Influence of climate and reproductive timing on demography of little brown myotis *Myotis lucifugus*. Journal of Animal Ecology 79(1):128-136.

Gardner, J.E., J.D. Garner, and J. Hofmann. 1991. Summer roost selection and roosting behavior of Myotis sodalis (Indiana bat) in Illinois. Final Report.

Garroway, C.J., and H.G. Broders. 2007. Nonrandom association patterns at northern long-eared bat maternity roosts. Canadian Journal of Zoology, **85**:956-964.

Grandmaison, D., K. Kirschbaum, and T. Catton. 2013. Superior National Forest Bat Monitoring: Summary of 2013 Survey Effort. Superior National Forest, Duluth, MN. 1-23 p.

Henderson, L.E., and H.G. Broders. 2008. Movements and resource selection of the northern long-eared myotis (*Myotis septentrionalis*) in a forest-agriculture landscape. Journal of Mammalogy, **89**(4):952-963.

Johnson, J.B, J.W. Edwards, W.M. Ford, and J.E. Gates. 2009. Roost tree selection by northern myotis (*Myotis septentrionalis*) maternity colonies following prescribed fire in a Central Appalachian Mountains hardwood forest. Forest Ecology and Management, 258:233–242.

Johnson, J.B, J.W. Edwards, W.M. Ford, J.L. Rodrigue, and C.M. Johnson. 2010. Roost selection by male Indiana myotis following fires in Central Appalachian Hardwood Forests. Journal of Fish and Wildlife Management 1(2):111-121.

Johnson, J.B., W.M. Ford, and J.W. Edwards. 2012. Roost networks of northern myotis (*Myotis septentrionalis*) in a management landscape. Forest Ecology and Management 266:223-231.

Lacki, M.J., and J.H. Schwierjohann. 2001. Day-roost characteristics of northern bats in mixed mesophytic forest. The Journal of Wildlife Management 65(3):482-488

Lacki, M.J., D.R. Cox, L.E. Dodd, and M.B. Dickinson. 2009. Response of northern bats (*Myotis septentrionalis*) to prescribed fires in eastern Kentucky forests. Journal of Mammalogy, 90(5):1165-1175

Menzel, M.A., S.F. Owen, W.M. Ford, J.W. Edwards, P.B. Wood, B.R. Chapman, and K.V. Miller. 2002. Roost tree selection by northern long-eared bat (*Myotis septentrionalis*) maternity colonies in an industrial forest of the central Appalachian mountains. Forest Ecology and Management, **155**:107-114.

Merjent, I. 2014. 2014 Northern Long-eared Bat Mist-net and Telemetry Survey Summary Report (Rev 0). Minneapolis, MN. 410 p.

Meteyer, C.U., E.L. Buckles, D.S. Blehert, A.C. Hicks, D.E. Green, V. Shearn-Bochsler, N.J.

Thomas, A. Gargas, and M.J. Behr. 2009. Histopathologic criteria to confirm white-nose syndrome in bats. Journal of Veterinary Diagnostic Investigation 21:411-414.

Minnesota Incident Command System (MNICS) Prescribed Fire Working Team. 2007. Minnesota smoke management plan. 39 p.

Nagorsen, D.W. and R.M. Brigham. 1993. Bats of British Columbia. Royal British Columbia Museum, Victoria, and the University of British Columbia Press, Vancouver. 164 pp.

Owen, S.F., M.A. Menzel, W.M. Ford, B.R. Chapman, K.V. Miller, J.W. Edwards, and P.B. Wood. 2003. Home-range size and habitat used by the Northern Myotis (*Myotis septentrionalis*). American Midland Naturalist, **150**(2):352-359.

Owen, S.F., M.A. Menzel, W.M. Ford, J.W. Edwards, B.R. Chapman, K.V. Miller, and P.B. Wood. 2002. Roost tree selection by maternal colonies of Northern long-eared Myotis in an intensively managed forest. USDA Forest Service. Newtown Square, Pennsylvania. 10 pp.

Patriquin, K.J. and R.M. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. Journal of Applied Ecology, 40:646-657.

Patriquin, K.J., M.L. Leonard, H.G. Broders, and C.J. Garroway. 2010. Do social networks of female northern long-eared bats vary with reproductive period and age? Behavioral Ecology and Sociobiology, 84:899-913.

Perry, R.W., and R.E. Thill. 2007. Roost selection by male and female northern long-eared bats in a pine-dominated landscape. Forest Ecology and Management **247**:220-226.

Reeder, D.M., C.L. Frank, G.G. Turner, C.U. Meteyer, A. Kurta, E.R. Britzke, M.E. Vodzak, S.R. Darling, C.W. Stihler, A.C. Hicks, R. Jacob, L.E. Grieneisen, S.A. Brownlee, L.K. Muller, and D.S. Blehert. 2012. Frequent arousal from hibernation linked to severity of infection and mortality in bats with white-nose syndrome. PLoS ONE 7(6):1-10.

Reichard, J.D. and T.H. Kunz. 2009. White-nose syndrome inflicts lasting injuries to the wings of little brown myotis (*Myotis lucifugus*). Acta Chiropterologica 11(2):457-464.

Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of northern long-eared bats *(Myotis septentrionalis)* in the white mountain national forest. Bats and Forests Symposium October 1995, Victoria, British Columbia, Canada, pp.91-101.

Silvis, A., W.M. Ford, E.R. Britzke, and J.B. Johnson. 2014. Association, roost use and simulated disruption of Myotis septentrionalis maternity colonies. Behavioural Processes 103:283-290.

Silvis, A., W.M. Ford, and E.R. Britzke. 2015. Effects of hierarchical roost removal on Northern Long-Eared Bat (Myotis septentrionalis) maternity colonies. PloS ONE 10(1):1-17.

Timpone, J.C, J.G. Boyles, K.L. Murray, D.P. Aubrey, and L.W. Robbins. 2010. Overlap in roosting habits of Indiana bats (Myotis sodalis) and northern bats (Myotis septentrionalis). The American Midland Naturalist 163(1): 115-123.

U.S. Army. 2014. Biological assessment. Ft. Drum, NY.

U.S. Fish and Wildlife Service. 2014. Northern Long-eared Bat Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, & 6. Available at http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/northern long-eared batinterimGuidance6Jan2014.pdf.

Warnecke, L., J.M. Turnera, T.K. Bollinger, J.M. Lorch, V. Misrae, P.M. Cryan, G. Wibbelt, D.S. Blehert, and C.K.R. Willis. 2012. Inoculation of bats with European *Geomyces destructans* supports the novel pathogen hypothesis for the origin of white-nose syndrome. PNAS 109(18):6999-7003.

Whitaker, J.O., and W.J. Hamilton. 1998. Mouse-eared bats, Vespertilionidae. In *Mammals of the eastern United States, Third Edition.* Comstock Publishing Associates, a Division of Cornell University Press, Ithaca, New York, pp.89-102.

Whitaker, J. O., Jr., and R. E. Mumford. 2009. Mammals of Indiana. Indiana University Press. Bloomington. 661 pp.

Yates, M.D., and R.M. Muzika. 2006. Effect of forest structure and fragmentation on site occupancy of bat species in Missouri Ozark Forests. The Journal of Wildlife Management, 70(5):1238-1248.