

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION

PROGRAMMATIC BIOLOGICAL OPINION

on the
Revised Forest Plan for the
Pisgah and Nantahala National Forests

Log No. 22-399



Agency:

U.S. Forest Service
Pisgah and Nantahala National Forests
Asheville, North Carolina

Consultation Conducted by:

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Table of Contents

CHAPTER 1 - INTRODUCTION.....	1
A. Introduction.....	1
B. Consultation History	3
C. Description of the Proposed Action.....	3
1. Description of the Project Area	3
2. Species in the Project Area.....	4
3. Description of the Proposed Action.....	6
4. Implementing the Revised Forest Plan (Proposed Action)	18
D. Summary of Plan Components for Federally Listed and At-Risk Species Discussed in this BO	20
CHAPTER 2 – CONTEXT OF THE PROPOSED ACTION	21
1. Relationship of the Project Area to Bats	21
2. Relationship of Proposed Action to Existing Management.....	21
3. Description of the Proposed Action.....	21
4. Conservation Measures.....	24
CHAPTER 3 – STATUS OF BAT SPECIES	29
A. Forest-Dwelling Bat - Indiana Bat.....	29
1. Listing Status	29
2. Species Description	29
3. Life History.....	29
4. Population Dynamics/Status and Distribution.....	32
5. Conservation Needs and Threats	32
B. Forest-Dwelling Bat – Northern Long-eared Bat	35
1. Listing Status	35
2. Species Description	35
3. Life History.....	36
4. Population Dynamics/Status and Distribution.....	37
5. Conservation Needs and Threats	39
C. Forest-Dwelling Bat – Little Brown Bat.....	39
1. Listing Status	39
2. Species Description	39
3. Life History.....	39
4. Population Dynamics/Status and Distribution.....	41

5.	Conservation Needs and Threats	42
D.	Forest Dwelling Bat – Tricolored Bat.....	42
1.	Listing Status	42
2.	Species Description	42
3.	Life History.....	42
4.	Population Dynamics/Status and Distribution.....	44
5.	Conservation Needs and Threats	45
E.	Cave-Obligate Bat – Gray Bat	45
1.	Listing Status	45
2.	Species Description	45
3.	Life History.....	45
4.	Population Dynamics/Status and Distribution.....	48
5.	Conservation Needs and Threats	48
F.	Cave-Obligate Bat – Virginia Big-eared Bat	50
1.	Listing Status	50
2.	Species Description	50
3.	Life History.....	50
4.	Population Dynamics/Status and Distribution.....	51
5.	Conservation Needs and Threats	51
	CHAPTER 4 – JEOPARDY ANALYSIS	53
A.	Analytical Framework for Jeopardy and Adverse Modification Determinations.....	53
1.	Jeopardy Determination.....	53
2.	Adverse Modification Determination.....	53
B.	Environmental Baseline	54
1.	Status of Bats in the Action Area	54
C.	Effects of the Action	57
1.	Factors to be Considered	58
2.	General Discussion of Potential Effects	59
D.	Cumulative Effects.....	60
E.	Jeopardy Determination	60
F.	Incidental Take Statement.....	62
G.	Conservation Recommendations	62
H.	Reinitiation Notice	62
I.	References	63

Figure	Description
1	Map of the Pisgah and Nantahala National Forests.

Table	Description
1	Summary of consultation.
2	Species within or bordering the Forests.
3	Potential forest management activities that could temporarily negatively affect bats (assuming no implementation of conservation measures).
4	Plan components specifically addressing habitat conditions for bats.
5	General suitable habitat descriptions for bats.
6	Suitable or potentially suitable habitat for bats as modeled by the USFS.
7	Summary of status and trends for forest-dwelling and cave-obligate bats.
8	Potential forest management activities with proposed acreage that could temporarily negatively affect bats at a project-specific level (assuming no implementation of conservation measures).
9	Potential forest management activities and potential effects to bats and bat habitat at a project-specific level (assuming no implementation of conservation measures).
10	Description of potential effects.
11	Change in condition over time and tiers for ecozones identified as (or that would contain) suitable bat habitat.

Abbreviation	Description
°C	degrees Celsius
°F	degrees Fahrenheit
ac	acre(s)
ATC	Appalachian Trail Conservancy
BA	Biological Assessment
BO	Biological Opinion
cm	centimeter(s)
DBH	diameter at breast height
E	endangered
EIA	Ecological Interest Areas
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESE	Ecological Sustainability Evaluation
FHWA	Federal Highway Administration
Forests	Pisgah and Nantahala National Forests
ft	feet, foot
GA	geographic area(s)
ha	hectare(s)
ITS	Incidental Take Statement
km	kilometer(s)
m	meter(s)
MA	Management Areas
mi	mile(s)
mm	millimeter(s)
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System

Abbreviation	Description
NHTs	National Historic Trails
NLEB	northern long-eared bat
NPS	National Park Service
ORVs	Outstanding Remarkable Values
Pd	<i>Pseudogymnoascus destructans</i>
Revised Forest Plan	revised Land and Resource Management Plan
RNAs	Research Natural Areas
RPMs	Relative and Prudent Measures
Service	U.S. Fish and Wildlife Service
SIAs	Special Interest Areas
T	threatened
TCs	Terms and Conditions
US	United States
USFS	U.S. Forest Service
VBEB	Virginia big-eared bat
Wilderness	Congressionally Designated Wilderness
WSAs	Wilderness Study Areas

CHAPTER 1 - INTRODUCTION

A. Introduction

The U.S. Fish and Wildlife Service (Service) has prepared this Biological Opinion (BO) on the effects of the U.S. Forest Service (USFS) revised Land and Resource Management Plan (Revised Forest Plan) for the Pisgah and Nantahala National Forests (Forests) on listed species (identified in Table 2), in accordance with the Endangered Species Act, as amended (ESA), (16 U.S.C. 1531 et seq.). For ease of discussion throughout this document, the Pisgah and Nantahala National Forests will be referred to as the Forests when referencing the single administrative unit, the staff that administers the unit, or the National Forest System (NFS) lands within the unit.

The USFS submitted a Biological Assessment (BA) documenting that the Revised Forest Plan is likely to adversely affect the following listed species:

- gray bat (*Myotis grisescens*), endangered (E)
- Indiana bat (*Myotis sodalis*), E
- northern long-eared bat (NLEB) (*Myotis septentrionalis*), threatened (T), proposed endangered (PE)
- Virginia big-eared bat (VBEB) (*Corynorhinus townsendii virginianus*), E

Further, the BA determined that the Revised Forest Plan is not likely to adversely affect the following listed species:

- Appalachian elktoe (*Alasmodonta raveneliana*), E
- Blue Ridge goldenrod (*Solidago spithamea*), T
- bunched arrowhead (*Sagittaria fasciculata*), E
- Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*), E
- Heller's blazing star (*Liatris helleri*), T
- little-wing pearl mussel (*Pegias fabula*), E
- mountain golden heather (*Hudsonia montana*), T
- mountain sweet pitcher plant (*Sarracenia rubra* spp. *jonesii*), E
- noonday globe snail (*Patera clarki nantahala*), T
- Roan Mountain bluet (*Hedyotis purpurea* var. *montana*), E
- rock gnome lichen (*Gymnoderma lineare*), E
- rusty-patched bumblebee (*Bombus affinis*), E
- small whorled pogonia (*Isotria medeoloides*), T
- spotfin chub (*Erimonax monachus*), T
- spreading avens (*Geum radiatum*), E
- spruce-fir moss spider (*Microhexura montivaga*), E
- swamp pink (*Helonias bullata*), T
- Virginia spiraea (*Spiraea virginiana*), T

The BA also determined that the Revised Forest Plan may affect, but is not likely to jeopardize the following at-risk species (petitioned for listing or proposed):

- little brown bat (*Myotis lucifugus*), petitioned for listing
- longsolid (*Fusconaia subrotunda*), proposed threatened (PT)

- mountain purple pitcher plant (*Sarracenia purpurea* var. *montana*), petitioned for listing
- tricolored bat (*Perimyotis subflavus*), petitioned for listing

The Service has concluded that the Revised Forest Plan, as proposed, is not likely to jeopardize the continued existence of longsolid and mountain purple pitcher plant due to the geographical extent of each species and minimal adverse impacts associated with implementation of the Revised Forest Plan.

The longsolid is a freshwater mussel found in Alabama, Kentucky, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. There are currently 60 extant management units (populations) of the species, two of which are in North Carolina (Service 2018). Approximately 27% of watersheds known to support longsolid in North Carolina are at least partially owned by the USFS (USFS 2022a). Often, ownership is in the headwaters or upper reaches of the watersheds and not necessarily immediately adjacent to streams suitable for longsolid. Although not anticipated, loss of the North Carolina management units or degradation of occupied watersheds would not lead to species jeopardy. In fact, analysis in the BA shows that conditions of these watershed should improve or stay the same over time and tiers of Revised Forest Plan implementation.

The mountain purple pitcher plant is a carnivorous plant found in southern Appalachian bogs or cataract seeps in Georgia, North Carolina, and South Carolina. It is uncertain how many populations are present; however, there may be less than a few dozen (Weakley 2020). Within North Carolina there are 13 populations, two of which are on the Forests. Although not anticipated, loss of the Forests' populations or degradation of occupied bogs would not lead to species jeopardy. In fact, analysis in the BA shows that conditions of wetlands supporting mountain purple pitcher plant should improve or stay the same over time and tiers of Revised Forest Plan implementation.

The BA and letter requesting formal consultation under section 7 of the ESA was received by the Service on January 19, 2022. As described in this BO, and based on the BA and other information collected during the consultation process, the Service has concluded that the Revised Forest Plan, as proposed, is not likely to jeopardize the continued existence of the following species:

- gray bat (*Myotis grisescens*), E
- Indiana bat (*Myotis sodalis*), E
- little brown bat (*Myotis lucifugus*), petitioned for listing
- NLEB (*Myotis septentrionalis*), T, PE
- tricolored bat (*Perimyotis subflavus*), petitioned for listing
- VBEB (*Corynorhinus townsendii virginianus*), E

This BO does not provide an analysis for effects of specific actions. Rather, the effects analysis is a broad-scale examination of the types of projects and activities conducted under the Revised Forest Plan that could potentially occur in listed species habitat and result in effects on listed species. This broad-scale analysis will then be used to determine the potential for the Revised Forest Plan direction to jeopardize the affected populations of listed species.

The Forests retain their responsibility under the ESA to consult on future projects (conducted under the Revised Forest Plan) that may affect listed species regardless of the project's consistency with the Proposed Action considered in this BO. Future projects and their potential to adversely affect a listed species, or critical habitat, will be analyzed at the project level and a separate jeopardy/adverse modification determination will be made at that time.

This BO is based on information provided in the Forests' BA (USFS 2022a) for the Proposed Action, the draft Revised Forest Plan (USFS 2022b) and the draft Environmental Impact Statement (EIS) (USFS 2022c), personal communications, scientific literature, unpublished reports, field investigations, and other sources of information cited herein.

B. Consultation History

The Forests have a history of frequent and effective communication with the Service in North Carolina. The history of ESA section 7 consultation on the Proposed Action is summarized chronologically in Table 1.

Table 1. Summary of consultation.

Date	Event
October 2013	Informal consultation on the Revised Forest Plan began when the Forests initiated an assessment of the existing forest conditions. From these initial discussions, a list of species to be considered during consultation was determined.
March 2014	The Notice of Intent to revise the Land and Resource Management Plan.
February 2020	A 90-day public comment period on the draft Revised Forest Plan and associated draft EIS was initiated.
May 2020	Extension of the proposed comment period.
June 2020	Comments provided by the Service were reviewed by USFS staff and addressed through updates to Revised Forest Plan and EIS.
June 2021	The Forests shared a list of species on which they would be consulting with the Service.
May – November 2021	Forest planning and biological staff met with Service staff weekly to discuss plan components associated with listed and at-risk species and the potential effects to species at the programmatic level.
January 2022	Formal consultation with the Service was initiated via submittal of a BA.
March 2022	After receiving comments from the Service, the Forests submitted a revised BA.

C. Description of the Proposed Action

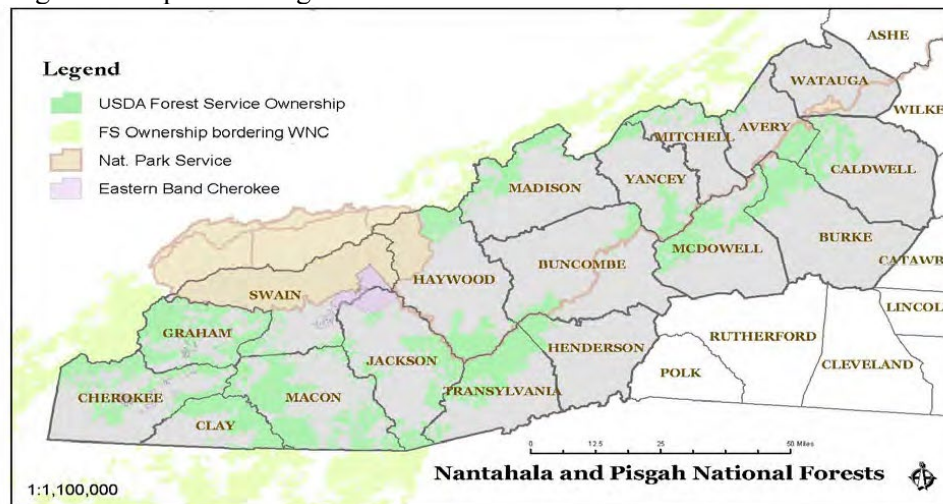
This section describes the project area, provides background on the development of the Revised Forest Plan, describes implementation, and summarizes the key elements of the Revised Forest Plan providing forest-wide, management area, and geographic area direction on forest management.

1. Description of the Project Area

The Forests lie within a geological area known as the Blue Ridge province of the Appalachian Mountains. These mountains form a southwest to northeast range through western North Carolina and contain many peaks over one mile (mi) in elevation. The total land area of the 18-county assessment area is approximately 4,795,098 acres (ac), with over 77% forest land. The

Forests are within a much larger matrix of forest land, predominantly privately owned forest land. Figure 1 displays the Forests across the 18-county area in western North Carolina.

Figure 1. Map of the Pisgah and Nantahala National Forests.



Management of the Forests is organized into six Ranger Districts:

- Nantahala National Forest
 - Cheoah District based in Robbinsville, North Carolina
 - Nantahala District based in Franklin, North Carolina
 - Tusquitee District based in Murphy, North Carolina
- Pisgah National Forest
 - Appalachian District based in Mars Hill, North Carolina
 - Grandfather District based in Nebo, North Carolina
 - Pisgah District based in Pisgah Forest, North Carolina

The Forests include large, designated wilderness areas, such as the Linville Gorge Wilderness and the Joyce Kilmer-Slickrock Wilderness, in concert with other special areas such as Wild and Scenic River Systems, other undeveloped backcountry areas, lands managed for production of timber, and other special use areas, such as gamelands and recreational facilities.

2. Species in the Project Area

Table 2 lists species with listed or at-risk federal designations found within or bordering the Forests.

Table 2. Species within or bordering the Forests.

Common Name	Scientific Name	ESA Status	Designated Critical Habitat	Range on the Forests
Appalachian Elktoe	<i>Alasmodonta raveneliana</i>	E	Yes	Appalachian, Cheoah, Nantahala, and Pisgah Districts. Designated critical habitat occurs on the Appalachian,

Common Name	Scientific Name	ESA Status	Designated Critical Habitat	Range on the Forests
				Nantahala, and Pisgah Districts.
Blue Ridge goldenrod	<i>Solidago spithamea</i>	T	No	Appalachian District.
bunched arrowhead	<i>Sagittaria fasciculata</i>	E	No	Not known to occur on the Forests.
Carolina northern flying squirrel	<i>Glaucomys sabrinus coloratus</i>	E	No	Appalachian, Cheoah, Grandfather, and Nantahala Districts.
gray bat	<i>Myotis grisescens</i>	E	No	Appalachian, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
Heller's blazing star	<i>Liatris helleri</i>	E	No	Appalachian and Grandfather Districts.
Indiana bat	<i>Myotis sodalis</i>	E	Yes, but not on the Forests.	Cheoah, Pisgah, Nantahala, and Tusquitee Districts.
little brown bat	<i>Myotis lucifugus</i>	Petitioned for listing.	N/A	Appalachian, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
little-wing pearlymussel	<i>Pegias fabula</i>	E	No	Nantahala District.
longsolid	<i>Fusconaia subrotunda</i>	PT	Proposed critical habitat, but not on the Forests.	Nantahala and Tusquitee Districts.
Roan Mountain bluet	<i>Hedyotis purpurea</i> var. <i>montana</i>	E	No	Appalachian and Grandfather Districts
mountain golden heather	<i>Hudsonia montana</i>	T	Yes	Grandfather District. Designated critical habitat occurs on the Grandfather District.
mountain purple pitcher plant	<i>Sarracenia purpurea</i> var. <i>montana</i>	Petitioned for listing.	No	Nantahala and Pisgah Districts.
mountain sweet pitcher plant	<i>Sarracenia rubra</i> spp. <i>jonesii</i>	E	No	Not known to occur on the Forests.
noonday globe snail	<i>Patera clarki nantahala</i>	T	No	Nantahala District.
NLEB	<i>Myotis septentrionalis</i>	T, PE	No	Appalachian, Cheoah, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
rock gnome lichen	<i>Gymnoderma lineare</i>	E	No	Appalachian, Cheoah, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
rusty-patched bumblebee	<i>Bombus affinis</i>	E	No	Not known to occur on the Forests. Historic in the Appalachian, Cheoah,

Common Name	Scientific Name	ESA Status	Designated Critical Habitat	Range on the Forests
				Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
small whorled pogonia	<i>Isotria medeoloides</i>	T	No	Appalachian, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
spotfin chub	<i>Erimonax monachus</i>	T	Yes	Appalachian (historic), Cheoah and Nantahala Districts. Designated critical habitat occurs on the Nantahala District.
spreading avens	<i>Geum radiatum</i>	E	No	Appalachian, Grandfather, and Pisgah Districts.
spruce-fir moss spider	<i>Microhexura montivaga</i>	E	Yes	Appalachian, Grandfather, Nantahala, and Pisgah Districts. Designated critical habitat occurs on the Appalachian District.
swamp pink	<i>Helonias bullata</i>	T	No	Pisgah and Nantahala Districts.
tricolored bat	<i>Perimyotis subflavus</i>	Petitioned for listing.	N/A	Appalachian, Cheoah, Grandfather, Nantahala, Pisgah, and Tusquitee Districts.
VBEB	<i>Corynorhinus townsendii virginianus</i>	E	No	Appalachian and Grandfather Districts.
Virginia spiraea	<i>Spiraea virginiana</i>	T	No	Appalachian, Cheoah, Nantahala, and Pisgah, Districts.

Endangered - Any species that is in danger of extinction throughout all or a significant portion of its range.

Threatened - Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Petitioned for listing - Petitions are formal requests to list a species as endangered or threatened under the ESA.

Proposed - Once a species is proposed, a year-long review period commences at the end of which the Service will make a final listing determination. ESA regulation 50 C.F.R. 402.10(a) states: "Each federal agency shall confer with the Secretary on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed." Conferencing is not required for anything less than a jeopardy call, but conferencing or concurrence may be requested by the action agency.

Critical Habitat - The specific area within the geographic area occupied by a listed species, at the time it is listed, on which are found those physical or biological features essential to conserve the species and that may require special management considerations or protection and specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species.

3. Description of the Proposed Action

The Proposed Action is the revision the Land and Resource Management Plan by the Forests. The original Land and Resource Management Plan for the Forests was signed in 1987. There have been 26 amendments to the Land and Resource Management Plan since 1987 addressing

new land acquisitions, management of Wild and Scenic Rivers, and plan direction which needed updating to account for new scientific information.

The Forests are proposing to revise their Land and Resource Management Plan based on legal requirements, changed conditions and resource demands, topics identified in the 2014 Need for Change (79 FR 13984), and promulgation of new policy, including the 2012 Planning Rule (77 FR 21161). Revision is needed because the 1987 plan is beyond the 10- to 15-year duration provided by the National Forest Management Act (NFMA, 16 U.S.C. 1606(e)(5)(A)). Like the 1987 plan, the Revised Forest Plan provides forest-wide management direction, and describes desired conditions, objectives, standards, guidelines, goals, and management approaches meant to aid in the implementation of future land management decisions. The purpose of the Revised Forest Plan is to guide management of the Forests so that they are ecologically sustainable and contribute to social and economic sustainability; consist of ecosystems and watersheds with ecological integrity and diverse plant and animal communities; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future. These benefits include clean air and water; habitat for fish, wildlife, and plant communities; and opportunities for recreational, spiritual, educational, and cultural benefits. The Revised Forest Plan will serve as the principal mitigation tool to avoid, minimize, rectify, or compensate any adverse environmental impacts associated with management on the Forests.

Purpose of Proposed Action

The purpose of the Revised Forest Plan is to provide land management direction for the Forests by guiding programs, practices, uses, and projects. The Revised Forest Plan provides guidance for project and activity decision-making on the Forests for the next 15 years. The guidance includes:

- Forest-wide components to provide for integrated social, economic, and ecological sustainability, and ecosystem integrity and diversity, while providing for ecosystem services and multiple uses. Components must be within USFS authority and consistent with the inherent capability of the plan area.
- Recommendations to Congress (if any) for lands suitable for inclusion in the National Wilderness Preservation System and/or rivers eligible for inclusion in the National Wild and Scenic Rivers System.
- The plan area's distinctive roles and contributions within the broader landscape.
- Identification or recommendation (if any) of other designated areas.
- Identification of suitability of areas for the appropriate integration of resource management and uses, including lands suited and not suited for timber production.
- Identification of the maximum quantity of timber that may be removed from the plan area.
- Identification of geographic area- or management area-specific plan components.
- Identification of watersheds that are a priority for maintenance or restoration.
- Plan monitoring program.

The Revised Forest Plan would guide natural resource management activities on the Forests and address changed conditions and direction that have occurred since the 1987 Land and Resource Management Plan was prepared and amended while meeting the objectives of federal law,

regulation, and policy. It is important to note that the Revised Forest Plan does not authorize site-specific prohibitions or activities; rather, it establishes broad direction, similar to zoning in a community. Project or activity decisions will be made following appropriate procedures and site- or project-specific analyses would still need to be conducted to assess compliance with federal regulations (e.g., ESA, National Environmental Policy Act (NEPA)).

Development of the Revised Forest Plan

The Revised Forest Plan was developed with guidance from the 2012 Planning Rule (77 FR 21161). Within the requirements set forth in the 2012 Planning Rule, land management plans provide a programmatic framework and the sideboards to guide decisions for all natural resource management activities on their respective NFS units. Plans include plan components (desired conditions, objectives, standards, guidelines, suitability of lands, and goals) that influence the design and choice of future proposals for projects and activities in a plan area, and also include monitoring items. They provide additional definition of resource management activities needed to implement and achieve desired conditions and objectives, including constraints upon the decision space for on-the-ground management decisions.

A Land and Resource Management Plan provides the framework and text guiding day-to-day resource management. It is strategic and programmatic and does not provide project-level decisions or result in irreversible or irretrievable commitments of resources. The purpose of the Revised Forest Plan is to guide management toward the attainment of long-term desired conditions. Given the multiple resource nature of land management, the many types of projects, and the various activities that can occur over the life of the Revised Forest Plan, it is not likely that a project or activity would maintain or contribute to the attainment of all desired conditions. Additionally, not all desired conditions are relevant to every activity (e.g., recreation desired conditions may not be relevant to a fuels treatment project). Most projects and activities are developed specifically to maintain or move conditions toward one or more of the desired conditions of the Revised Forest Plan. It should not be expected that each project or activity would contribute to all desired conditions in a plan. Instead, a project or activity will typically contribute to one, or a subset, of desired conditions.

The Revised Forest Plan is the result of public engagement efforts dating back to 2013. During the development of the Revised Forest Plan, a variety of scoping efforts, public informational and comment meetings, field trips, invited group presentations, and workgroup meetings were conducted. Additionally, the Revised Forest Plan was developed with input from tribal partners, agency partners, and elected officials at various communities in and around the Forests.

Programmatic Nature of the Revised Forest Plan

The Revised Forest Plan is programmatic in scope, meaning it provides the framework for future site-specific actions but does not authorize, fund, or carry out future site-specific actions. Future project-level activities must be consistent with the direction in the Revised Forest Plan and must undergo separate project-level analyses, including NEPA planning and decision-making procedures, and ESA section 7 consultation if appropriate. The management direction contained in the Revised Forest Plan will go into effect once the final record of decision is signed by the Forest Supervisor. Project-level environmental analysis will still need to be completed for proposals that would implement the direction in the Revised Forest Plan.

Management Areas

Every forest plan must have management areas (MAs) or geographic areas (GAs) or both. A forest plan may identify designated or recommended designated areas as MAs or GAs. These areas are assigned sets of plan components such as desired conditions, objectives, and in some areas standards and/or guidelines. GA desired conditions describe what the Forests wants to achieve in specific GAs that are not necessarily covered by forest-wide desired conditions. While all resources have been considered for forest-wide direction, plan components have been developed for GAs to further refine plan direction within each respective GA. GAs in the Revised Forest Plan include:

- Bald Mountain
- Black Mountains
- Eastern Escarpment
- Fontana Lake
- Great Balsam
- Highland Domes
- Hiwassee
- Nantahala Gorge
- Nantahala Mountains
- North Slope
- Pisgah Ledge
- Unicoi Mountains

Designated areas or features are identified and managed to maintain their unique special character or purpose. Some categories of designated areas may be designated only by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are national heritage areas, national recreational areas, national scenic trails, inventoried roadless areas, wild and scenic rivers, wilderness areas, and wilderness study areas. Examples of administratively designated areas are experimental forests, research natural areas, scenic byways, botanical areas, and significant caves.

MAs ensure consistent approaches to achieving desired conditions and objectives among the multiple Ranger Districts that will administer the Revised Forest Plan. Most of the MAs are not spatially contiguous but instead are distributed among the 12 GAs list above. The Revised Forest Plan designates five general MAs across the Forests: Interface, Matrix, Backcountry, Ecological Interest Areas, and Administrative Sites. These are areas of the Forests that have similar management intent and a common management strategy. Other MAs are administrative or congressionally designated areas which will not change during the revision. These are allocated based on unique or special characteristics including: Research Natural Areas, Experimental Forests, Appalachian National Scenic Trail Corridor, National Scenic Byways, Heritage Corridors, Wild and Scenic River Systems, Congressionally Designated Wilderness, Recommended Wilderness and Wilderness Study Areas, forest identified Special Interest Areas, Roan Mountain, and the Cradle of Forestry in America.

Allocation to a specific MA does not mandate or direct the USFS to propose or implement any action; rather, the MAs provide direction on desired conditions and allowable activities and uses,

including timber harvest/production, commercial and personal use of special forest products and firewood, the use of prescribed and natural (unplanned) fire, livestock grazing, recreation (including wheeled, motorized vehicle use), road construction and reconstruction, and minerals development (leasable and materials). The MAs are characterized into four groups as follows:

MA Group 1: Interface and Matrix

This MA group would include the most active management. Here, timber harvest and prescribed fire augment natural disturbance to provide greater resiliency for ecosystems and wildlife habitat by emphasizing composition, structure, function, or connectivity. To accomplish this work, road building may occur, and timber production and stand improvement activities complement the ecological restoration desired conditions and objectives.

- **Interface** - This MA contains the most concentrated recreation use on the Forests, including developed and dispersed recreation locations, as well as National Recreation Trails and some heavily used roads that bring visitors to these locations. Interface provides both corridors and distinct locations where the public either travels through or specifically recreates. As such, this MA becomes the interface by which most forest visitors begin their interaction with the Forests. Here, visitors have easy access to a variety of forest activities, including visitor facilities, and access to some trailheads that make hiking, biking, horseback riding, climbing, hunting, and gathering possible. This MA also includes all off highway vehicle trail systems, and the developed areas surrounding reservoirs. While recreation on the Forests is not confined to this MA, use is concentrated in these areas because of recreation infrastructure. Recreation opportunities and settings in the Interface emphasize experiences that consider the comfort and convenience of visitors more than in other MAs.
- **Matrix** - Matrix is the largest MA in the Forests and functions as large patch landscape providing connections between Interface, Backcountry, and other special designations. The Matrix provides open, edge, and interior wildlife habitat with a diversity of sizes and shapes, as well as providing multiple uses sustained by lower levels of motorized and non-motorized access, in comparison to Interface. Matrix is comprised of diverse vegetation, ranging from young forest to old growth and includes stream and river corridors, unique habitats, and common communities. The Matrix also contains smaller isolated patches of NFS land surrounded by private ownerships. These patches contribute to maintaining a broader forested landscape in conjunction with adjacent landowners. Recreational opportunities emphasize moderately secluded habitats for hiking, biking, horseback riding, hunting, fishing, and watersports. Interactions with other visitors are of low to moderate frequency.

The greatest amount of active management is expected to occur in the Matrix MA, which would have the most acres managed annually. Active management in the Interface MA would have the same tools available as in the Matrix, but the total number of acres treated in Interface would be substantially less, and treatments would be designed with consideration of high concentration of forest users and heavy public use. In both MAs, passive management would occur where actions are limited by steep slopes, riparian areas, the designated old growth network, or accessibility.

MA Group 2: Appalachian Trail Corridor, Cradle of Forestry in America, Ecological Interest Areas, Experimental Forests, Heritage Corridors, National Scenic Byways, Wild and Scenic Rivers

In this MA group, active management is allowed consistent with the desired conditions of the MA but is expected to be less active than MA Group 1, with fewer tools available. This MA group is not suitable for timber production. Timber harvest is typically only allowed when it contributes to the recognized features of the area. For example, in the Ecological Interest Areas MA, timber harvesting, and prescribed fire could be used to restore community composition, while in the Cradle of Forestry, silvicultural tools can only be used to demonstrate historical practices and provide educational opportunities. Road building is also limited to specific circumstances that are compatible with the unique features of the MA. As a result, active management in this group is a moderate to low level of activity, compared to MA Group 1.

- **Appalachian National Scenic Trail Corridor (ANST)** - The ANST was established by Congress in the National Trails System Act of 1968. The ANST is administered by the Secretary of the Interior in consultation with the Secretary of Agriculture and managed as a partnership among the USFS, the National Park Service (NPS), the Appalachian Trail Conservancy (ATC), and local ATC-affiliated maintainer clubs. Management is in accordance with the National Trails System Act and the Appalachian Trail Comprehensive Plan utilizing the cooperative management system. Along with the USFS, the NPS and the ATC plan and carry out management actions and programs to protect, enhance, and ensure that uses do not substantially interfere with the nature and purposes of the ANST. On the Forests, the ANST crosses the Appalachian, Cheoah, Nantahala, and Tusquitee Ranger Districts. Except where it passes through MAs with more restrictive direction, this corridor MA consists of those lands mapped as the visible foreground from the ANST footpath and associated features such as shelter and privy sites, designated overnight sites, water sources, vistas, and spur trails.
- **Cradle of Forestry in America** - The Cradle of Forestry in America is a 6,500-ac site within the Pisgah National Forest which was designated in 1968 to commemorate the beginning of forest conservation in the United States (US). Congress recognized this site as the birthplace of forestry and forestry education in America to promote, demonstrate, and stimulate interest in scientific forest management under the principles of multiple use, and showcase partnership opportunities. The Cradle of Forestry tells the story of the first forestry school and the beginnings of scientific forestry in America. Once home to the Biltmore Forest School, the site includes a visitor center; amphitheater; a collection of historic and reconstructed buildings; picnic areas; trails; and camping opportunities. This MA contains areas of rich ecological diversity such as southern Appalachian bogs and swamp forests.
- **Ecological Interest Areas (EIAs)** – EIAs are places where active management is desired to improve ecological species composition. Generally, these locations have fewer roads than the Matrix MA and contain some concentrations of high-quality natural communities or high quality current old growth, but these areas are not as biologically exceptional as Special Interest Areas. EIAs benefit from a management style that is focused on restoring and improving the unique values present, including perpetuating or enhancing plant or animal species and communities that are of national, regional, or state significance. Top priorities in this MA would be to restore community composition by treating stands with uncharacteristic vegetation. The need for balancing successional age

classes at the landscape scale would not drive stand-level prescriptions. Ecological restoration would result in a mix of forest habitats of various ages, sizes, and configurations. Timber harvest, prescribed fire, non-native invasive treatments, and road construction are tools for achieving desired conditions.

- **Experimental Forests** - Experimental Forests provide the USFS and other researchers with real-world laboratories in which to conduct long-term science and management studies aimed at enhancing the health, productivity, and diversity of the nation's forests and improving forestry practices. Even though many management activities take place on these lands, they are not a part of usual USFS programs. These lands are dedicated to experimentation and education and are designated for national and international research programs. The Forests have three experimental forests – Bent Creek in Buncombe County near Asheville, Coweeta Hydrologic Laboratory, and Blue Valley in Macon County.
- **Heritage Corridors** - This MA consists of congressionally designated National Historic Trails (NHTs), National Millennium Trails, and other historic routes eligible for listing on the National Register of Historic Places. Historic trails are administered through guidelines developed by the NPS in conjunction with partners including the USFS, Native American tribes, state parks, non-profits, and private landowners. Associated landscapes of cultural significance are managed to maintain and restore their inherent cultural values through consultation with Native American tribes and Tribal Historic Preservation Officers, the State Historic Preservation Officer, the NPS, and other partners. There are two NHTs located on the Forests: the American Revolution Overmountain Victory Trail and the Trail of Tears.
- **National Scenic Byways** - Driving for pleasure and sightseeing is one of the most popular outdoor-recreation pursuits in the nation and state of North Carolina. National Scenic Byways are administrative designations recognized by the Federal Highway Administration (FHWA) and are part of a larger network of scenic routes that exist throughout the country. This MA includes the scenic corridors along the Blue Ridge Parkway, Cherohala Skyway, and portions of the Forest Heritage National Scenic Byway recognized by the FHWA. These byways are nationally designated because of their scenic beauty and the opportunity they provide to view the scenic, natural, and cultural landscapes of western North Carolina.
- **Wild and Scenic Rivers** - This MA includes management direction for Wild and Scenic Rivers and the adjacent lands that make up the river corridors on NFS lands. The Wild and Scenic Rivers Act (16 U.S.C. 1271-1287) and its amendments provide for the protection of selected rivers and their immediate environments. Congressionally designated Wild and Scenic Rivers are managed to maintain the free-flowing status, maintain Outstanding Remarkable Values (ORVs), and maintain or enhance the wild, scenic, and riparian features of the river and to provide water-oriented recreational opportunities in a natural setting. Rivers that are eligible for Wild and Scenic River designation are afforded a set of interim protections to assure that the free-flowing characteristics and the ORVs are maintained until a decision is made on the future use of the river and adjacent lands through an Act of Congress or a change in eligibility or suitability status from a future study. There are 21 congressionally designated, eligible, or suitable streams or rivers on the Forests.

MA Group 3: Backcountry, Roan Mountain, and Special Interest Areas

MA Group 3 involves primarily passive management where natural processes such as floods, storms, insects, disease, and fire shape the landscape. Prescribed fire is assumed to be the primary method of active restoration, occurring over large landscapes where possible and at varying intensities. Some timber management may occur, creating variable-sized gaps of young forest through tree cutting, though the cutting, removal, and sale of timber is expected to be infrequent. Existing roads needed for general forest access are maintained, but new permanent road construction and reconstruction are limited. Overall, these MAs will experience a low level of active management.

- **Backcountry** - The Backcountry MA contains large blocks of remote and unroaded forest primarily shaped by natural processes, except where active management is utilized to restore ecosystem composition, structure, function, and to provide resiliency against insects and disease. Sections of the Forests within this MA are generally 2,500 ac or greater in size; however, some areas may be smaller if they are adjacent to other semi-primitive non-motorized management. These areas are primarily shaped by natural processes such as floods, storms, insects, diseases, and fires. Fire is present on the landscape and is managed to benefit natural resources and reach desired conditions. Existing system roads are maintained, but new road construction and reconstruction are limited. Unneeded system roads are prioritized for decommissioning, while unauthorized roads are prioritized for obliteration. The landscape features are predominantly mid- and late-successional forest communities as well as old growth with a continuous forested canopy that changes in density based on ecozone desired conditions. The Backcountry MA emphasizes habitat for species that thrive in large blocks of older forests. These areas provide large tracts of Backcountry recreation opportunities, emphasizing a semi-primitive non-motorized setting with limited recreational facilities. Hiking, backpacking, mountain bike riding, horseback riding, climbing, nature study, hunting, fishing, boating, and watersports are typical activities that may be available in a setting where freedom from the sights and sounds of modern civilization is important.
- **Roan Mountain** - The Roan Mountain MA protects one of the most unique landscapes in the eastern US. Roan Mountain and the greater Roan Highlands encompass a 20-mi massif stretching along the North Carolina and Tennessee border. The mountain's elevation reaches 6,285 feet (ft) at the summit, making it one of the highest mountains in the eastern US. The MA includes 9,200 ac of the mountain and mountain-top balds and protects the scenic integrity and unique wildlife and plant communities in the area, including the summer Catawba rhododendron gardens and stands of spruce-fir and northern hardwoods. Roan Mountain represents one of the richest repositories of temperate zone diversity, including numerous rare communities, four federally listed plants, two federally listed animals, and more than 80 southern Appalachian endemic or regionally rare species. It possesses several unique geological features, including some of the highest and most prominent sheer cliffs and granite rock outcrops in the Blue Ridge, which support a rich mix of species. The MA is one of the only places on the Forests where grazing can be used as a tool to manage the landscape. The Appalachian Trail crosses the mountain's summit, and the USFS maintains a recreation area on the mountain.
- **Special Interest Areas (SIAs)** – SIAs are the most exceptional ecological communities that serve as core areas for conservation of the most significant and rare elements of

biological diversity on the Forests. They represent communities of plants and animals that occupy a small portion of the landscape but contribute significantly to biological diversity. These areas are generally resilient and are not in need of active restoration, although maintenance activities may be needed to maintain their integrity.

MA Group 4: Congressionally Designated Wilderness; Recommended Wilderness and Wilderness Study Areas; Research Natural Areas

MA Group 4 is dominated by passive management, except for minor instances where active management using prescribed burning would be desired for specific fire-adapted restoration priorities (e.g., Linville Gorge Wilderness). Although it is possible to employ active management methods in this group, the tools that would be used are limited, such as restrictions on motorized equipment. Therefore, it is assumed that lands in this group would have the lowest priority for active management, especially since many opportunities in other MA groups are available.

- Congressionally Designated Wilderness (Wilderness) - Wilderness is managed to perpetuate or enhance the natural, untrammeled, and undeveloped character of the area while providing opportunities for primitive and unconfined recreation and/or solitude and preserving other features of value such as scenery, geology, or cultural/historic sites. Wilderness is also available for scientific research or educational opportunities which are related to, and compatible with, Wilderness resources and attributes. Wilderness provides for the greatest degree of protection from human intrusion among lands of the Forests. Many acres of Wilderness on the Forests also contain old growth, critical habitats, and natural heritage areas where preservation of natural conditions is favored. As of 2018, Wilderness designations extend to more than 107 million acres nation-wide, including approximately 66,388 ac on the Forests. There are three Congressionally Designated Wildernesses wholly within the Forests and three Wildernesses which are partly on adjacent National Forests.
- Recommended Wilderness and Wilderness Study Areas (WSAs) - WSAs on the Forests are lands designated by Congress to study their potential for inclusion in the National Wilderness Preservation System. These WSAs are managed to preserve their wilderness characteristics until Congress designates them as Wilderness or releases them from further consideration. In addition to WSAs, other NFS lands evaluated and found to have strong Wilderness characteristics are recommended for inclusion in the National Wilderness Preservation System, and like WSAs, are managed to protect and maintain the ecological and social characteristics that provide the basis for their suitability for Wilderness designation. The Forests contain five WSAs and 14 recommended Wilderness Areas.
- Research Natural Areas (RNAs) – RNAs represent current natural conditions, and designation of these areas allows natural physical and biological processes to prevail without human intervention. They will be managed for scientific research. They are managed in an undisturbed state as a baseline for comparison with other forest environments; however, under unusual circumstances, management may be used to maintain the unique features that the RNAs were established to maintain. The two existing RNAs are Black Mountain and Walker Cove. Both are located on the Appalachian Ranger District of the Pisgah National Forest.

Components of the Revised Forest Plan

By regulation, the Revised Forest Plan must include plan components. Plan components guide future project and activity decision-making and include desired conditions, objectives, standards, guidelines, suitability of lands, and goals. The following are the definitions and, where necessary, a description of the context of the required plan components.

Desired Condition

A desired condition is a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined but must not include completion dates.

Desired conditions are not commitments or final decisions approving projects and activities. The desired condition for some resources may currently exist, but for other resources they may only be achievable over a long time period.

Objective

An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Inclusion of objectives does not guarantee funding for these actions; however, objectives should be based on reasonably foreseeable budgets.

Objectives describe the focus of management in the plan area within the plan period. Not every action the Forests may take is included as an objective, and objectives are not intended to be limiting as planned activities may be exceeded. Objectives that are defined as occurring “over the life of the plan” are referring to the first 15 years of plan implementation.

The Revised Forest Plan contains Tier 1 and Tier 2 objectives. Tier 1 objectives are based on a continuation of recent USFS budgets and capacity, while Tier 2 objectives reflect additional outcomes that may be possible with added capacity of partners and partner resources. Any individual objective may proceed to Tier 2 when additional capacity and resources are available for that action.

Standards

A standard is a mandatory constraint on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Standards can be developed for forest-wide application or specific areas. Additionally, they may be applied to all management activities or selected activities.

Guidelines

A guideline is a constraint on project or activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

A guideline can be developed for forest-wide application or specific areas. Additionally, they may be applied to all management activities or selected activities.

Suitability of Lands

Specific lands within the Forests are identified as suitable for various multiple uses or activities based on the desired conditions applicable to those lands. The Revised Forest Plan also identifies lands within the Forests as not suitable for uses that are not compatible with desired conditions for those lands. Suitability of lands are not identified for every use or activity.

Identifying suitability of lands for a particular use in the Revised Forest Plan indicates that the use may be appropriate but does not make a specific commitment to authorize that use. Final suitability determinations for specific authorizations occur at the project or activity level decision making process. Generally, lands on the Forests are suitable for uses and management activities appropriate for National Forests, such as outdoor recreation or timber, unless identified as not suitable.

Goals

Goals are broad statements of intent, other than desired conditions, usually related to process or interaction with the public. Goals are expressed in broad, general terms but do not include completion dates.

Other Required Plan Content

In addition to requiring that a plan have components, the 2012 Planning Rule requires that a plan have “other required content” addressing priority watersheds, the distinctive roles and contributions of the plan area, a plan monitoring program, and proposed and possible actions.

Revised Forest Plan Direction

Based on discussions with the public, the revised planning effort centers around four themes: connecting people to the land, sustaining healthy ecosystems, providing clean and abundant water, and partnering with others. These themes are described below and apply forest-wide across all resource areas.

Connecting People to the Land

The Forests in western North Carolina have been recognized for their importance to people. The rich cultural mosaic of people who have called this region their home depend on the Forests for scenic beauty, year-round outdoor play and exercise, spiritual renewal, traditional uses like hunting, fishing, and gathering, and economic opportunity. The Revised Forest Plan:

- Establishes a framework for sustainable recreation, including standards for new trail construction built on modern design and collaboration.
- Calls for developing trail loop opportunities, a strategy for climbing opportunities, an operations and maintenance guide for dispersed campsites, and more.
- Supports economic development and tourism in local communities, the forest product industry and non-timber forest product collection, maintains the Forests’ scenic integrity and access, and sustains our cultural and historic resources.

- Honors and redeems our trust responsibility to tribes, recognizing tribes and tribal members as partners in managing the National Forests, and valuing traditional ecological knowledge and places of tribal significance.

Sustaining Healthy Ecosystems

The Forests support a diversity of forest communities from southern pine to northern hardwood forests. When compared to the southern Appalachian Region, the Forests contain a proportionally greater number of high-elevation forests and southern Appalachian balds, rare plant and animal communities, and headwater streams than the greater region. The Revised Forest Plan:

- Establishes a clear vision for each ecological community on the Forests.
- Accelerates the development of young forest and open forest, which are currently underrepresented habitats, while also ensuring that development of old growth characteristics will be prioritized:
 - Doubles annual young forest creation practices (from 650 to 1,200 ac) and accomplishes even more with the help of partners (up to 3,200 ac annually).
 - Emphasizes using fire and mechanical harvest to restore open forest conditions in tiered objectives.
 - Increases the designated old growth network by more than 50,000 ac.
 - Increases prescribed fire up to 20,000 annual ac and up to 45,000 annual ac with additional resources.
- Restores and maintains rare habitats, including wetlands and southern Appalachian bogs, Carolina hemlock bluffs, balds, spruce-fir, and more.
- Provides overall habitat diversity for all wildlife, including habitats to support recovery of federally threatened and endangered species.
- Increases non-native invasive species treatments, habitat restoration, and watershed projects.

Providing Clean and Abundant Water

Water is a life-sustaining resource for the Forests and the natural and local communities that depend on it. Beyond ecological communities, Forest waters also support municipal water supplies, tribal lands, agriculture, and industry. The Revised Forest Plan:

- Identifies priority watersheds for watershed restoration activities during the life of the Revised Forest Plan, spread across the Forests.
- Emphasizes aquatic organism passage, stream channel improvement projects, maintaining and expanding the range of brook trout, freshwater mussels, and other aquatic species.
- Establishes streamside zones where activities contribute to improving the stream ecosystems.
- Includes an objective to develop a forest-wide road maintenance plan to promote public safety, prevent erosion, and protect water quality while maintaining access.
- Provides the flexibility to adapt to changing conditions in the face of climate change.

Partnering with Others

The USFS collaborates with partners to enhance its mission to sustain the Forests in North Carolina. Forest managers work with other federal agencies, state and local governments, tribes,

and diverse partners across boundaries to achieve shared objectives. Working collaboratively allows for more work on the ground than any one agency could do alone. The Revised Forest Plan:

- Builds on thousands of ideas that citizens, organizations, and governments shared during plan development.
- Ensures that all interests benefit from the implementation of the multiple use mission.
- Identifies Tier 2 goals for nearly all objectives if additional capacity in the form of resources or help from others is available during implementation; and identifies ways to work with others to accomplish shared goals.
- Positions the Forests to become a partner of choice for volunteers and local communities as well as local and national organizations.

4. Implementing the Revised Forest Plan (Proposed Action)

The Revised Forest Plan provides a framework and text that guides day-to-day resource management options. It is a strategic, programmatic document and does not make project-level decisions or irreversible or irretrievable commitments of resources. These decisions will be made during a more detailed, site-specific analysis of any proposed future action.

Project/Activity Consistency with the Revised Forest Plan

The NFMA requires that all projects and activities authorized by the USFS be consistent with an associated forest plan. A project or activity approval document must describe how the action is consistent with applicable plan components by meeting the following criteria:

- **Desired Conditions, Objectives, and Goals:** The project or activity contributes to the maintenance or attainment of one or more desired conditions, objectives, or goals, or does not foreclose the opportunity to maintain or achieve any desired conditions, objectives, or goals over the long-term.
- **Standards:** The project or activity complies with applicable standards if it is designed in exact accordance with the standard.
- **Guidelines:** The project or activity should:
 - Comply with applicable guidelines as set out in the plan; or
 - Be designed in a way that is effective in achieving the purpose of the applicable guidelines.
- **Suitability of Lands:** A project or activity would occur in an area:
 - That the plan identifies as suitable for that type of project or activity; or
 - The plan is silent with respect to its suitability for that type of project or activity.

Because of the many types of projects and activities that can occur over the life of a forest plan, it is not likely that a project or activity can contribute to the attainment of all desired conditions. Further, it is unlikely that all desired conditions will be relevant to every activity (e.g., recreation desired conditions may not be relevant to a fuels treatment project). Most projects and activities will be developed to maintain or move conditions toward one or more of the desired conditions in a forest plan. Each project or activity is not expected to contribute to all desired conditions in a plan, but usually to one or a subset.

Projects or Activities Not Consistent with the Revised Forest Plan

Where a proposed project or activity would not be consistent with Revised Forest Plan direction, the responsible official has the following options:

- Modify the proposed project or activity to make it consistent with the applicable Revised Forest Plan components.
- Reject the proposal or terminate the project or activity.
- Amend the Revised Forest Plan so that the project or activity will be consistent with the plan as amended; or
- Amend the Revised Forest Plan contemporaneously with the approval of the project or activity so that the project or activity will be consistent with the Revised Forest Plan as amended. This amendment may be limited to apply only to the project or activity.

Monitoring Program and Adaptive Management

Monitoring and evaluation requirements have been established through the NFMA, and additional direction is provided by the USFS in Chapter 30 (Monitoring) of the Land Management Handbook. The monitoring program will provide monitoring questions and measures, which will assist managers in evaluating the degree to which on-the-ground actions are making progress toward desired conditions presented in the Revised Forest Plan. Further, the monitoring program will facilitate an adaptive management approach that will serve as the basis for continual improvement. Among the monitoring requirements, the Forests will monitor and report to the Service information pertinent to listed species. The monitoring program will answer the following questions:

- Is the USFS implementing the Revised Forest Plan properly? Is the USFS meeting the management objectives and project guidelines? (Implementation monitoring.)
- Is the Revised Forest Plan effective? Is the USFS achieving management goals and desired outcomes? (Effectiveness monitoring.)
- Does hypothesis testing indicate need to change the Revised Forest Plan? (Validation monitoring.)

Implementation monitoring tracks progress and accomplishments; however, it is effectiveness and validation monitoring that drive and support the adaptive management process. Effectiveness monitoring evaluates condition and trends relative to desired conditions, and validation monitoring tests hypotheses and provides information that might necessitate changes to desired conditions in the Revised Forest Plan.

Monitoring will provide information needed to address adaptive management by:

- Detecting changing conditions, risks, and uncertainties that require adaptive responses; and
- Identifying if a change to the monitoring program is warranted based on new information. Monitoring questions and indicators may be modified through the adaptive management approach over time as determined in the biennial reports and evaluations.

D. Summary of Plan Components for Federally Listed and At-Risk Species Discussed in this BO

Below is a summary of the management direction from the Revised Forest Plan. The bat species discussed in this BO can be grouped into two categories based on considerable overlap in the life history. The two species groups are:

- Forest-dwelling bats – The four forest-dwelling bats included in the BA are Indiana bat, little brown bat, NLEB, and tricolored bat. Forest-dwelling bats are dependent upon caves and cave-like structures for winter hibernation and primarily use trees for summer roosts. These species share general life history characteristics and are discussed together in this BO where appropriate.
- Cave-obligate bats – The two cave-obligate bats included in the BA are gray bat and VBEB. These bat species are cave dependent and with very few exceptions, in which cave-like conditions are created in man-made structures, only inhabit caves. No known hibernacula for cave-obligate bats occur on the Forests. Cave-obligate bats use the Forests for foraging and commuting. These species share general life history characteristics and are discussed together in this BO where appropriate.

Although their specific niches vary, forest-dwelling and cave-obligate bats have the same needs to persist on the landscape - foraging habitat and proximity to water, roosting habitat, and hibernacula – and the Revised Forest Plan direction can be broken down into components that directly or indirectly address each need for the species groups. Currently, there are approximately 539 plan components that are directly or indirectly related to maintaining, restoring, or enhancing habitat for bats. Those that are directly related can be summarized as plan components that provide the framework for:

- The management and maintenance of old growth, mature, open, and young forests.
- The management and maintenance of desired forest structure and composition.
- The location and positioning of wildlife openings.
- Protecting hibernacula and surrounding habitat.
- Mitigating white-nose syndrome (WNS).

CHAPTER 2 – CONTEXT OF THE PROPOSED ACTION

The Forests determined in their BA that activities conducted under the Proposed Action will be likely to adversely affect forest-dwelling bats (Indiana bat, little brown bat, NLEB, and tricolored bat) and cave-obligate bats (gray bat and VBEB) (USFS 2022a). Unless otherwise noted, topics discussing both forest-dwelling bats and cave-obligate bats will refer to “bat” or “bats”. When discussing a bat group (forest-dwelling or cave-obligate) or a specific bat species, that group or species will be noted.

This section describes the spatial context in which the Service conducts its ESA section 7 consultation, jeopardy, and adverse modification analysis; describes the relationship of the project area to bat occurrences; explains the relationship of the Proposed Action to existing management; and describes the desired condition for bats under the Revised Forest Plan, as well as the guidelines and standards applied at the project level to achieve desired conditions.

This BO will consider the effects of implementation of the proposed framework of the Revised Forest Plan. However, this BO does not provide a detailed analysis for effects of specific projects. Future projects undertaken by the USFS will undergo detailed, site-specific analysis for effects on listed species and critical habitat, and subsequent section 7 consultation when appropriate.

1. Relationship of the Project Area to Bats

The Proposed Action (implementation of the Revised Forest Plan) would occur across the Forests, and bats or potentially suitable habitat occurs in each of the Ranger Districts across the Forests.

2. Relationship of Proposed Action to Existing Management

The Revised Forest Plan will provide similar land management direction to the original plan but is based on updated scientific information and data on development pressure adjacent to the Forests; unprecedented increases in recreation; the growth of wildland urban interface; the spread of insects, disease, and invasive species; and the escalating impacts from climate change.

3. Description of the Proposed Action

An overall description of the Proposed Action is described in Chapter 1, Section C. The description here is focused on those actions (collectively known as timber management) that may adversely affect bats if the Revised Forest Plan is implemented. The Revised Forest Plan components discussed here would be applied forest-wide as well as across the MAs and GAs. No other Revised Forest Plan components are expected to adversely affect bats during plan implementation.

Timber management includes a diversity of silvicultural treatments that are used to achieve desired conditions, objectives, and goals of forest resources. While historically the emphasis was on commodity production to support and strengthen the country during wartime, it has evolved through the passage of the Multiple Use-Sustained Yield Act in 1960, the NFMA of 1976, and the advancement of ecosystem management concepts embodied in the 2012 Planning Rule.

Today timber harvest is a tool used primarily to manage for healthy forests and wildlife habitat as well as to support local communities.

Timber management includes both commercial and non-commercial tree harvest as well as reforestation treatments that are used to establish desired forests after disturbances such as harvest, fire, wind events, or insect infestations. Reforestation treatments include site preparation for natural regeneration and site preparation in advance of tree planting, which is done to ensure that desired tree species are regenerated. Release treatments are implemented after the young forest is established to guide species composition and the health and longevity of the remaining trees. Non-native and invasive species treatments and prescribed fire are also tools integrated into timber management.

Fire plays an important role in shaping the vegetation and landscape in western North Carolina. Recurring fire has been a part of the landscape for thousands of years. Aggressive fire suppression, coupled with an array of other disturbances (e.g., logging and chestnut blight), has changed the historic composition and structure of the Forests. Periodic prescribed burning and other vegetation management can recreate the ecological role of fire in a controlled manner. While fires may have been frequent on the landscape, the intensity and effects of fire vary within and between vegetation types.

Fire and fuels management supports a variety of desired conditions and objectives across the Forests (e.g., community protection, hazardous fuels reduction, native ecosystems restoration, historic fire regimes restoration, wildlife openings, open woodland creation, etc.). Managers can influence the effects of fire by proactive measures, such as thinning, prescribed fire, fuel break construction, or by responding to wildfires or unplanned ignitions when they occur.

Timber management and prescribed fire are often used in combination to meet forest plan objectives and desired conditions. For example, in fire-adapted forest communities, prescribed fire and timber management are used in the same silvicultural prescription to achieve open structural conditions or woodlands that are typical on xeric sites and sites of moderate moisture potential.

Timber management activities that disturb forested areas adjacent to or in occupied habitat have the greatest potential to result in adverse effects to bats. Those activities that have the greatest potential to affect bats include timber harvest, forest stand improvement, thinning, thin/burn, and prescribed burning (plan components ECO-O-02 through 06). Table 3 summarizes potential forest management activities with the potential to affect bat habitat.

Table 3. Potential forest management activities that could temporarily negatively affect bats (assuming no implementation of conservation measures).

Plan Component	Activity	Description
ECO-O-02 (objective)	Timber harvest	<p>Tier 1: Increase new young forest conditions by using silvicultural practices on 650 to 1,200 ac annually.</p> <p>Tier 2: Increase new young forest conditions by using silvicultural practices on 1,200 to 3,200 ac annually.</p>

Plan Component	Activity	Description
		<i>Management approach: young forest creation will be accomplished using both timber harvest and prescribed fire. Timber harvest will account for most (approximately 80% or more) of young forest creation during the life of the plan.</i>
ECO-O-03 (objective)	Forest stand improvement	<p>Tier 1: Conduct stand and forest community improvement practices on 3,800 ac to approximately 6,000 ac annually.</p> <p>Tier 2: Conduct stand and forest community improvement practices on 6,000 ac to approximately 12,000 ac annually.</p> <p><i>Management approach: This objective includes mechanical and chemical site preparation and release treatments in seedling and sapling stands across all disturbance types. It also includes midstory treatments to assist with developing advanced competitive regeneration and treatments to improve ecosystem composition and density.</i></p>
ECO-O-04 (objective)	Thinning	<p>Tier 1: Annually apply intermediate thinning treatments on 150 to 400 ac to address forest health, future composition, and structure desired conditions.</p> <p>Tier 2: Annually apply intermediate thinning treatments on 400 to 600 ac to address forest health, future composition, and structure desired conditions.</p>
ECO-O-05 (objective)	Thin/burn	<p>Tier 1: Annually thin and burn 300 to 600 ac to advance open forest woodland conditions.</p> <p>Tier 2: Annually thin and burn 600 to 900 ac to advance open forest woodland conditions.</p> <p><i>Management approach: Open Forest woodland conditions are restored and maintained using a combination of both timber harvest and prescribed fire and both commercial and non-commercial treatments. This will include regeneration in a portion of the woodland during the maintenance phase. The maintenance phase requires repeated prescribed fire treatments.</i></p>
ECO-O-06 (objective)	Prescribed burn	<p>Tier 1: Apply prescribed fire on 10,000 ac to 20,000 ac annually to restore and maintain fire-adapted ecozones, create woodlands, and reduce hazardous fuels.</p> <p>Tier 2: Apply prescribed fire on 20,000 ac to 45,000 ac annually to restore and maintain fire-adapted ecozones, create woodlands, and reduce hazardous fuels.</p> <p><i>Management approach: Annually, determine a planned level of prescribed fire based on resource availability, weather conditions, and other factors. The priority fire-adapted ecozones include shortleaf pine, pine-oak/heath, dry oak, and dry-mesic oak ecozones. Prescribed fire would be prioritized</i></p>

Plan Component	Activity	Description
		<i>where federally listed species and species of conservation concern habitat requires frequent burning.</i>

4. Conservation Measures

Conservation measures are proposed actions meant to minimize incidental take and benefit or promote the recovery of the species under review. The Revised Forest Plan proposes plan components to specifically protect bats on the Forests. Generally, these measures are intended to reduce the intensity and probability of impacts to bats or their habitats caused by management activities. The Revised Forest Plan includes approximately 539 plan components that directly or indirectly support healthy and resilient habitat conditions associated with bats. These plan components range from very broad direction applicable to the whole forest or ecozone to specific direction for habitat elements associated with bats. Nineteen of these components specifically address and prioritize habitat conditions for bats. Table 4 identifies these plan components. For the purposes of this review, these components are considered conservation measures.

Table 4. Plan components specifically addressing habitat conditions for bats.

Plan Component	Language
WLF-DC-02 (desired condition)	Permanent grass, forb, and shrub openings are positioned within forested habitats to ensure nesting and foraging areas are within proximity of each other for many animals. These openings are located to minimize conflict with recreationists and to ensure streams and native plant communities near these openings are not affected (i.e., stream temperature and channel integrity are not negatively affected). These areas are important to the life histories of many wildlife species but especially to bobwhite quail, wild turkey, white-tailed deer, elk, black bear, golden-winged warblers, and many other birds, bats, and pollinators.
WLF-DC-04 (desired condition)	Mature forests, including late seral stages and old growth conditions, provide habitat and forage for species such as black bear, wild turkey, white-tailed deer, cerulean warbler, wood thrush, other species of migratory and resident birds, terrestrial salamanders, bats, and reptiles.
WLF-DC-05 (desired condition)	Woodlands and other open forest types provide open understory conditions across all elevations that enhance nesting and foraging opportunities for many bird and bat species, suitable areas for butterflies, bees, and other pollinators, as well as optimal foraging for browsers such as white-tailed deer and elk. Larger native trees with exfoliating bark provide roosting habitat for bats.

Plan Component	Language					
WLF-DC-06 (desired condition)	<p>Habitat components at finer scales provide for wildlife occupancy, are present in sufficient amounts, and distributed across all ecozones. For example, snags provide roosting and nesting habitat for bats and cavity nesting birds, especially along the edge of openings, and foraging habitat for insectivores such as woodpeckers. Larger diameter live or dead trees provide habitat for black bear and other species requiring cavity or denning conditions, while smaller live or dead trees with crevices provide critical nesting and roosting habitat for flying squirrels and bats. Coarse wood on the forest floor, in a variety of sizes and shapes, provides habitat for salamanders and other cover- and moisture-associated wildlife, nesting areas for some migratory birds (e.g., black and white warbler), as well as drumming logs for ruffed grouse.</p>					
	<p>These habitat components that are retained during young forest restoration perpetuate to later successional stage, either through natural succession or through forest stand improvement practices. Over time, they contribute to the development of old growth characteristics such as large, downed woody debris; abundant snags; variable gap sizes; and tip up mounds.</p>					
	<p>The table below provides desired amounts of finer-scale habitat components retained during young forest restoration.</p>					
	<p>Finer-Scale Habitat Desired Conditions for Young Forests</p> <table><tr><th>Snags</th><th>Den Trees</th><th>Coarse Woody Debris</th></tr><tr><td>An average of ≥ 4 snags/ac > 9 inches (in) diameter at breast height (DBH) is present within young forest habitats across the forest, including naturally occurring and those created incidentally or intentionally during restoration activities. In areas known to be or potentially occupied by federally listed bats, snag recruitment and retention should also include snags ≥ 3 in DBH.</td><td>Trees > 9 in DBH exhibiting crevices and other suitable denning characteristics are present across the landscape.</td><td>Density will vary by surrounding forest type and age, but some pieces of downed wood that are ≥ 10 in diameter and ≥ 10 ft long are present on the forest floor across the landscape.</td></tr></table>	Snags	Den Trees	Coarse Woody Debris	An average of ≥ 4 snags/ac > 9 inches (in) diameter at breast height (DBH) is present within young forest habitats across the forest, including naturally occurring and those created incidentally or intentionally during restoration activities. In areas known to be or potentially occupied by federally listed bats, snag recruitment and retention should also include snags ≥ 3 in DBH.	Trees > 9 in DBH exhibiting crevices and other suitable denning characteristics are present across the landscape.
Snags	Den Trees	Coarse Woody Debris				
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WLF-S-01 (standard)	<p>When identifying wildlife habitat diversity elements for retention during vegetation management activities:</p> <ul style="list-style-type: none">Maintain an average of four snags (≥ 9 in DBH) per ac across the project area to contribute to landscape scale wildlife habitat diversity for species such as bats, woodpeckers, and other cavity nesting birds, except where such snags pose a threat to human health or safety. Retain snags exhibiting suitable wildlife habitat characteristics (e.g., exfoliating or sloughing bark, cavities, or crevices) along the edge of openings or combined with other leave trees to extend the life of ephemeral wildlife habitat elements in the project area and reduce threats to human health and safety during vegetation management activities. To minimize the risk of incidental take, in areas known to be or potentially occupied by federally listed bats, snag					

Plan Component	Language				
	<p>recruitment and retention should also include snags or live trees with more than 25% exfoliating bark ≥ 3 in DBH.</p> <ul style="list-style-type: none"> Emphasize hard and soft mast producing species, including mast-bearing trees, berries, and fruit trees, to enhance foraging opportunities for species such as white-tailed deer, wild turkey, ruffed grouse, black bear, songbirds, and small mammals. <p>Emphasize the following:</p> <ul style="list-style-type: none"> Native trees with exfoliating bark and natural crevices, including, but not limited to, shagbark hickory, white oaks, yellow pines, yellow birch, and black locust, to provide roosting and denning habitat for bats and Carolina northern flying squirrels. Consider current research, such as Service, North Carolina Wildlife Resources Commission, North Carolina Bat Working Group, the USFS bat conservation strategy, or other relevant guidance to determine appropriate roost and den tree species and condition for retention during project implementation. Whenever possible, snags susceptible to windthrow should be identified in clumps and/or buffered by live trees. Standing live and dead trees > 9 in DBH that exhibit cavities and other denning conditions, except where human safety is of concern. Leave eastern hemlock where possible to preserve the gene pool and food source for birds and small mammals. Downed woody debris of various sizes should be emphasized for retention, where available, and include pieces that are ≥ 10 in DBH and 10 ft long to provide habitat for salamanders and other cover- and moisture-associated wildlife and drumming logs for ruffed grouse. Consider leaving new logging slash. 				
WLF-G-02 (goal)	Open understory conditions should be enhanced to provide the natural range of variation through a reduction in ericaceous shrubs, such as deciduous azaleas and mountain laurel, to benefit many species of birds, bats, and other animals.				
PAD-DC-06 (desired condition)	<p>Desired conditions for canopy cover and shrub and herbaceous cover of unique habitats are shown in table below. These conditions may also be enhanced by active management techniques.</p> <p>Desired Conditions of Unique Habitats</p> <table> <tr> <th>Unique Habitat</th><th>Desired Conditions for Canopy Cover (Other Primary Characteristics)</th></tr> <tr> <td>Caves/Mines</td><td>Not trampled or impacted by recreationists, habitat free from white nose syndrome for a diversity of bats. Caves/mines retain characteristics important to bats (e.g., microclimate, airflow) and are surrounded by healthy forests providing quality spring staging and fall swarming habitat.</td></tr> </table>	Unique Habitat	Desired Conditions for Canopy Cover (Other Primary Characteristics)	Caves/Mines	Not trampled or impacted by recreationists, habitat free from white nose syndrome for a diversity of bats. Caves/mines retain characteristics important to bats (e.g., microclimate, airflow) and are surrounded by healthy forests providing quality spring staging and fall swarming habitat.
Unique Habitat	Desired Conditions for Canopy Cover (Other Primary Characteristics)				
Caves/Mines	Not trampled or impacted by recreationists, habitat free from white nose syndrome for a diversity of bats. Caves/mines retain characteristics important to bats (e.g., microclimate, airflow) and are surrounded by healthy forests providing quality spring staging and fall swarming habitat.				
PAD-S-08 (standard)	Coordinate with the Service to ensure that protection of potential and known hibernacula and maternity habitat is consistent with the most recent conservation measures, recovery plans, BOs or USFS bat conservation strategy. This includes delineating appropriate fall swarming and spring emergence buffers and applying appropriate conservation measures (e.g. activity type, timing, etc.).				
PAD-S-09 (standard)	Identify caves, abandoned mines, and large rock shelters supporting bat populations as smoke-sensitive targets where and when bats are present.				

Plan Component	Language
PAD-S-10 (standard)	Post and enforce the regional cave and abandoned mine closure order at all biologically significant caves and other known bat hibernacula (e.g., abandoned mines, large rock shelters, talus slopes, cliff faces) to control human disturbance and prevent the spread of WNS in cave-associated bats, including, but not limited to, the federally endangered Indiana bat and threatened NLEB.
PAD-S-11 (standard)	If cave and mine closure orders are found to be ineffective at protecting hibernating bats from human disturbance, construct and maintain gates or other structures that allow for entrance and egress by bats.
PAD-S-12 (standard)	Follow all Service direction concerning mitigation efforts for the effects of WNS on susceptible bat species, including decontamination protocols for people permitted to enter caves and mines for purposes identified in the closure.
OGN-DC-02 (desired condition)	Old growth characteristics shift over time, and disturbances are a natural part of the system. High quality old growth characteristics, such as large, downed woody debris, abundant snags, variable gap sizes, tip-up mounds, and undisturbed soils, etc., develop over time and are present.
OGN-S-01 (standard)	In patches identified as part of the designated old growth network, allow vegetation manipulation, including thinning, woodland creation and prescribed burns and limited soil disturbance, for the following purposes and with project specific analysis: <ul style="list-style-type: none"> a) To enhance old growth values and characteristics, including: <ul style="list-style-type: none"> • Downed logs in all stages of decay. • Old trees. • Standing snags. • Uneven-aged structure of canopy species. • Single and multiple tree-fall gaps. • Abundant fungal component. • Large trees. • Appropriate density and basal area of canopy trees. • Approximate composition of native forest species including trees, shrubs, and herbs. b) To improve forest health or prevent the spread of disease when the integrity (including characteristics) of the old growth patch or adjacent lands are threatened from conditions within the patch.
MAT-DC-03 (desired condition)	Young forest habitat occurs in greater proportions in Matrix than other MAs, providing proportionally more edge habitats that provide early seral conditions, and supporting species (such as bats, pollinators, ruffed grouse, and golden-winged warblers) that depend on grass and shrub habitat and soft mast.
CDW-DC-03 (desired condition)	Natural processes shape habitat and determine the selection, distribution, and population of wildlife species, although the recovery of threatened and endangered species may be promoted. Where present, rare communities and associated species continue to exist. Cavity trees, standing snags, and downed logs are common throughout the area as a result of natural mortality and successional progression.
MIN-DC-04 (desired condition)	Abandoned mine lands are reclaimed to provide for public safety and to minimize impacts to cultural and natural resources.
BLM-GLS-03 (guidelines)	At mid-elevations accessible by existing roads, emphasize restoration of structural and compositional diversity within rich cove ecozones for species such as ruffed grouse, American woodcock, bats, and many salamander species.

Plan Component	Language
NG-GLS-01 (guidelines)	Protect cave habitats within Nantahala Gorge, including Blowing Springs, for all species with a focus on Indiana bat, NLEB, and gray bats, and the lost Nantahala cave spider.

CHAPTER 3 – STATUS OF BAT SPECIES

A. Forest-Dwelling Bat - Indiana Bat

This section provides information about the Indiana bat's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

The Indiana bat was listed as an endangered species via notice in the Federal Register on March 11, 1967 (32 FR 4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U. S. C. 668aa(c)). The reasons for listing the species are summarized in the 2019 5-Year Review and include destruction/degradation of hibernation habitat, loss/degradation of summer habitat, migration habitat, and swarming habitat, disturbance of hibernating bats, disturbance of summering bats, disease and parasites, predation, and various anthropogenic factors (Service 2007). Critical habitat was designated for Indiana bat on September 24, 1967 (41 FR 14914); however, the specific caves and mines that have been designated do not occur in the action area and therefore, will not be adversely affected by the Proposed Action.

2. Species Description

Indiana bat is an insectivorous, temperate, medium-sized bat in the genus *Myotis* that migrates annually from winter hibernacula to summer habitat in forested areas. Adults weigh about 0.25 ounce (oz) and have a wingspan of 9-11 in. The species closely resembles the little brown bat and NLEB. It is distinguished from these two species by its distinctly keeled calcar (a small, triangular protrusion of membrane at the base of the tail membrane near the heel) and the hind feet of the Indiana bat tend to be small and delicate, with fewer, shorter hairs. Furthermore, NLEB has long, pointed, symmetrical tragus (projection of skin in front of the external ear). The ears and wing membranes of Indian bat have a dull appearance and flat coloration that does not contrast with the fur, and the fur lacks luster compared with that of little brown bats (Barbour and Davis 1969). The nose of an Indiana bat is lighter in color than that of a little brown bat.

3. Life History

Indiana bat average life span is 5-10 years, but recapture of banded individuals has documented Indiana bats up to 15 years old (Humphrey and Cope 1977). Hall (1962), Myers (1964), and LaVal and LaVal (1980) report sex ratios of 1:1 for Indiana bat.

Indiana bat is migratory species that hibernates in caves and mines during winter and forages in wooded areas, particularly riparian areas (LaVal et al. 1977), during summer. Foraging activity and travel is mostly nocturnal.

The key phases in the Indiana bat annual life cycle are:

- hibernation;
- spring staging and migration;
- pregnancy and lactation;
- pup volancy; and
- fall migration and mating (swarming).

Although the timing varies with latitude and weather conditions, Indiana bats generally hibernate from mid-fall to mid-spring each year. The area around a winter hibernaculum necessarily serves as the location for the spring emergence from hibernation. Upon emerging from hibernation, bats forage for a few days or weeks near their hibernaculum (spring staging). During spring staging, Indiana bats roost in trees and forage in habitats that are similar to their summer habitats.

Males and non-reproductive females may remain near hibernacula or migrate immediately to summer habitat some distance from their hibernaculum. Female Indiana bats commonly migrate hundreds of miles from their hibernacula (Service 2007). Long-distance migration is energetically demanding. Spring migration occurs when fat reserves are depleted from hibernation, prey abundance is low, WNS-induced wing damage is healing, and gestation starts; therefore, spring migration is possibly the most stressful period in the Indiana bat's life cycle. Spring migration occurs from late-March to late-May. Females depart shortly after emerging from hibernation and are pregnant when they reach summer areas. Non-reproductive females and males may stay close to hibernacula (Whitaker and Brack 2002) or migrate to their summer habitat (Kurta and Rice 2002).

Adult females give birth to a single pup in late-May to early-June (Humphrey et al. 1977). Pups are weaned from nursing shortly after becoming volant in mid- to late-July. Fall migration occurs following months of summer foraging and building fat reserves from mid-August to mid-October. Upon arriving at their winter hibernaculum from summer habitats, the species exhibits swarming behavior in the vicinity of the hibernaculum. Indiana bats roost in trees and forage in habitats that are similar to their summer habitats, typically within 5 mi of their hibernaculum. Fall swarming continues for several weeks and mating occurs during the latter part of the period. After mating, females enter hibernation, but not necessarily at the same hibernaculum where mating occurred. Most individuals of both sexes are hibernating by the end of November (by mid-October in northern areas).

The following subsections discuss in greater detail the aspects of the Indiana bat's life history that are most relevant to this consultation.

Summer Habitat and Ecology

Summer habitats for Indiana bat consists of a wide variety of forested areas where they roost, forage, and travel. These habitats may include portions of adjacent and interspersed non-forested areas such as wetlands, the edges of agricultural fields, old fields, and pastures. Areas containing potential roosts include forests and woodlots, as well as linear features such as fencerows, riparian forests, and other wooded corridors. Tree density and canopy cover in areas used for roosting or foraging is variable.

While wing morphology of Indiana bat suggests that the species is adapted to moving in and tolerating some cluttered habitats (Norberg and Rayner 1987), it is more often detected along forest edges, forest openings, and corridors (Sparks et al. 2005). Many species of bats, including Indiana bat, consistently avoid crossing or foraging in large open areas, choosing instead to use tree-lined pathways or small openings (Patriquin and Barclay 2003; Yates and Muzika 2006).

Therefore, small, isolated patches of trees are unlikely to provide suitable foraging or roosting habitat unless connected to other patches by a wooded corridor.

Many male Indiana bats appear to remain at or near the hibernacula in summer with some fanning out in a broad band around the hibernacula (Whitaker and Brack 2002). Because males typically roost individually or in small groups, the average size of their roost trees is generally smaller than the roost trees used by female maternity colonies. Males may occasionally roost in caves. Males exhibit summer site fidelity and have been recaptured in foraging areas from prior years (Service 2007).

Maternity Colonies and Roosts

Following a variable-length period of foraging near hibernacula in the spring, females seek suitable habitat for maternity colonies, which appear essential for reproductive success. Most documented maternity colonies contained 100 or fewer females (Service 2007). Indiana bat maternity colonies in Indiana averaged 50-80 adult females (Whitaker and Brack 2002).

The species exhibits a high degree of inter-annual fidelity to particular roost trees and/or maternity areas (Humphrey et al. 1977; Gardner et al. 1991a, 1991b, 1996; Callahan et al. 1997). Males are rarely found roosting with females in Indiana bat maternity colonies. Maternity colonies use networks of roost trees often centered around one or more primary roost trees. Indiana bat maternity colonies use a minimum of 8–25 roost trees per season (Callahan et al. 1997; Kurta et al. 2002) and have been reported to switch between roosts every 2-3 days (Foster and Kurta 1999; Kurta et al. 2002; Carter and Feldhamer 2005; Kurta 2005). Bats using familiar foraging and roosting areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002).

Indiana bats are known to use a wide variety of tree species ≥ 5 in DBH that have cracks, crevices, or peeling bark for roost trees. A typical Indiana bat primary roost is located under the exfoliating bark of dead ash (*Fraxinus spp.*), elm (*Ulmus spp.*), hickory (*Carya spp.*), maple (*Acer spp.*), oak (*Quercus spp.*), or poplar (*Populus spp.*), but any live or dead tree that has large, thick slabs of peeling bark is potentially suitable. Primary roosts are usually in trees that are in early- to mid- stages of decay (Gardner et al. 1991a).

A study by O’Keefe and Loeb (2017), documenting southern Appalachian roost trees, suggested that Indiana bats usually roosted in small groups, although some roost tree emergence counts were relatively large (75–126 bats). Further, bats primarily used yellow pine snags, which is a departure from what has been observed for Indiana bat maternity colonies in the midwest and northeast. Bats likely selected for pines because pine snags were more available than hardwood snags and because they provide optimal roosting structure (tall, solar-exposed) for Indiana bats in the southern Appalachian Mountains. Britzke et al. (2003) and O’Keefe and Loeb (2017) reported that pine snag roosts in the southern Appalachian region only lasted for one, or rarely two, maternity seasons and sometimes lost all their bark in one season. However, the degree of roost switching (2-3 days) was similar to that reported elsewhere in the range of the Indiana bat (Foster and Kurta 1999; Kurta et al. 2002; Carter and Feldhamer 2005; Kurta 2005, O’Keefe, and Loeb 2017).

Winter Habitat and Ecology

Suitable winter habitat (hibernacula) for Indiana bat species includes underground caves and cave-like structures (e.g., abandoned or active mines, railroad tunnels, and other locations where bats hibernate in winter). Generally, Indiana bats hibernate from October to April depending on local weather conditions (November-December to March in southern areas and as late as mid-May in some northern areas).

Caves that meet temperature requirements for Indiana bats are rare. Most Indiana bats hibernate in caves or mines where the ambient temperature remains below 50 degrees Fahrenheit (°F), but infrequently drops below freezing (Hall 1962, Myers 1964, Henshaw 1965, Humphrey 1978). Caves that historically sheltered the largest populations of hibernating Indiana bats were those that provided the largest volumes and structural diversity, thus ensuring stable internal temperatures over wide ranges of external temperatures, with a low likelihood of freezing (Tuttle and Kennedy 2002).

Indiana bats generally hibernate in large clusters, sometimes with other species, with densities of 300-484 bats per square ft (Service 2007). Indiana bats have shown a high degree of philopatry to the hibernacula used, returning to the same hibernacula annually.

4. Population Dynamics/Status and Distribution

Indiana bats are concentrated in relatively few hibernacula during the winter. Biennial winter surveys in 2019 estimated a total of 537,297 Indiana bats in 223 hibernacula in 16 states (Service 2019a). Four states accounted for 95.7 % of the total population estimate: Missouri (36.3%), Indiana (34.4 %), Illinois (14.6%), and Kentucky (10.4%).

Emerging from hibernation, Indiana bats disperse across a broad range in 19 states. The Draft Recovery Plan (Service 2007) indicates 269 known extant maternity colonies in 16 states. Of these, 54% were discovered between 1997-2007, mostly using mist-netting surveys and radio-tracking. Surveys continue to discover maternity colonies, but the Service has not compiled a range-wide tally since 2007. Using a 1:1 female/male sex ratio and an average maternity colony size of 50 adult females, the 2019 winter survey population estimate yields an estimate of $537,000 \text{ total bats} \div 2 = 268,500 \text{ females}$, $\div 50 \text{ females/colony} = 5,370 \text{ colonies}$ (Service 2019c). The 269 Indiana bat maternity colonies known as of 2007 represent only 5% of this possible total.

The 2019 range-wide population estimate of 537,297 Indiana bats is a 4% decrease from the 2017 estimate of 559,412 bats. The most dramatic declines in the number of occupied hibernacula have occurred in the Northeast and Appalachia Recovery Units (Service 2019c). The biennial population estimates had been increasing from 2001-2007, suggesting that the species' long-term decline had been reversed (Service 2017). The decline since 2007 is likely attributable to WNS.

5. Conservation Needs and Threats

The conservation needs of and threats to Indiana bat are discussed in detail in the 2007 Draft Recovery Plan (Service 2007) and the most recent 5-year review (Service 2019c). These documents describe habitat loss and degradation, forest fragmentation, hibernacula disturbance

and alteration, and environmental contaminants as the greatest threats to Indiana bats. The Draft Recovery Plan also identified collisions with wind turbines as an emerging threat. The 2019 5-year review includes an extensive discussion on WNS and the effects to the Indiana bat population.

White-nose Syndrome

In recent years, no other threat is more severe and immediate for Indiana bat than WNS. WNS was first documented in North Carolina in 2011. Since first observed in New York in 2006, WNS has spread rapidly in bat populations throughout the US and Canada. As of summer 2019, the causative WNS fungal pathogen, *Pseudogymnoascus destructans* (Pd), has spread to 33 states and seven Canadian provinces, and WNS currently affects 12 species of bat (Service 2019c). The range-wide Indiana bat population has decreased by 19.2% from 2007 (i.e., since arrival of WNS in New York State) to 2019 (Service 2019c). States with the largest net loss (percent decline) of Indiana bats since 2007 include: Missouri = -18,157 (-9%), Kentucky = -15,220 (-21%), Indiana = -53,220 (-22%), Ohio = -4,739 (-62%), Tennessee = -6,509 (-73%), New York = -39,367 (-75%), West Virginia = -14,125 (-96%), and Pennsylvania = -1,027 (-99%) (Service 2019c). Cheng et al. (2021) estimates range-wide declines of 28% from 1995 to 2018 and a 93% overlap of species and WNS occurrence ranges. It appears likely that WNS is spreading throughout most of the range of the Indiana bat and addressing the threat of WNS is the first and foremost conservation need.

WNS is the clear cause of the recent declines in Indiana bat numbers. In areas with WNS, there are additional energetic demands for Indiana bats. For example, WNS-affected bats have fewer 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.

Other stressors that had no discernable population-level impacts previously, combined with the impact of the disease, could become factors influencing Indiana bat probability of persistence in particular areas or regions. In general, smaller populations are more vulnerable to extirpation resulting from direct impacts or adverse habitat changes than larger populations, especially those that rely on colonial behaviors for critical life history functions. For example, a single bat maternity colony reduced in size by WNS-related mortality and with the remaining individuals weakened by the disease, would be less likely to adapt to the loss or reduction of suitable roosting trees and foraging habitat in its traditional home range than a larger and healthier colony. Repeating this scenario with multiple colonies across a landscape could accelerate the population-level declines caused by WNS alone.

Forest Fragmentation and Habitat Modifications

Forests used by foraging and roosting Indiana bats during spring, summer, and fall have changed dramatically from pre-settlement conditions (Service 1999). The USFS summary of forest trends (USFS 2014b) reported a decline in forest acreage from 1850 to the early 1900s, when forests were converted to other land cover types or many native plant communities were altered. Over the next century, other land cover types (mostly cropland) were converted to forest through tree

planting or pioneer-field succession. From 2001-2006, the US lost 1.2% of its total forest acreage, mostly in the southeast and west. Interior forest (40-ac parcels comprised of at least 90% forest cover) experienced a net loss of 4.3%. Although it is difficult to quantify the resultant impacts, this forest fragmentation has resulted in modifications to Indiana bat habitat, especially summer habitat, and is suspected in contributing to the decline of Indiana bat populations (Service 1999).

Summer habitat can include extensive forests or small woodlots connected by hedgerows. The removal of such habitats is occurring rapidly in some portions of the Indiana bat's range due to residential and commercial development, mining, oil and gas development, and infrastructure development, including roadways and utility corridors. Even in areas of relatively abundant habitat, permanent and temporary impacts to forest habitat pose mortality risks to Indiana bats during tree felling activities. Furthermore, the ongoing, permanent loss of forests and woodlots may have a significant cumulative effect on the species, as habitat is lost, fragmented and/or degraded, and as maternity colonies are displaced from habitat to which they exhibit fidelity (Service 2012).

Disturbance of Hibernating Bats

From 1965-2001, there was an overall decline in Indiana bat populations, with winter habitat modifications having been linked to changes in populations at some of the most important hibernacula (Service 2007). Improper gating and other structures have rendered many historical hibernacula unavailable to Indiana bats. Other documented threats, involving hibernacula, include human disturbances, cave commercialization, vandalism, flooding of caves during reservoir creation, destruction from quarrying limestone, and indiscriminate collecting, handling, and/or banding of hibernating bats. Natural alterations of hibernacula include flooding, entrance and passage collapses and blocked sinkholes, all of which can alter the temperature regime within a cave and potentially, prevent entry by Indiana bats. Both natural and human-induced changes to hibernacula can alter the climate required by Indiana bats, which in turn adversely affects the population (Service 2012).

Wind Turbines

The construction and operation of wind turbines are estimated to kill close to a million bats (various species, including the Indiana bat) per year and can present a significant local threat to populations (<https://www.mdpi.com/1424-2818/12/2/84/htm>). Bats are vulnerable to mortality and injury associated with the rotating turbine blades, either by collision or barotrauma (pressure-change injury). Indiana bat mortality has been documented at multiple wind turbine installations. The Service continues to coordinate with the wind industry to develop and implement measures that avoid and minimize take of bats incidental to turbine operations, and to continue to assess this threat.

Environmental Contaminants

With the restrictions on the use of organochlorine pesticides in the 1970s, this significant threat to Indiana bats was reduced. However, cholinesterase-inhibiting insecticides, organophosphates, and carbamates have now become the most widely used insecticides (Grue et al. 1997), and the impact of these chemicals on Indiana bats is not known. Because of the unique physiology of bats in relation to reproduction, high energy demands and sophisticated thermoregulatory

abilities, much more research needs to be done with these pesticides and their effects on bats. These and other contaminants likely remain a significant and poorly understood threat to Indiana bats. The Service (2007) summarizes known and suspected contaminant threats to bats.

Climate Change

The capacity of climate change to result in changes in the range and distribution of wildlife species is recognized, but detailed assessments of how climate change may affect specific species, including Indiana bats, are limited. Bats are sensitive to changes in temperature, humidity, and precipitation (Adams and Hayes 2008). During winter, for example, only a small proportion of caves provide the right conditions for hibernating Indiana bats because of the species' very specific temperature and humidity requirements.

Climate change may affect bats through changes in food availability, timing of hibernation and reproductive cycles, frequency and duration of torpor, rates of energy expenditure, and rates of juvenile bat development (Sherwin et al. 2013). Surface temperature is directly related to cave temperature, so climate change that involves increased surface temperatures may affect the suitability of hibernacula. Climate change may, therefore, shift Indiana bats from southern to northern hibernacula (Clawson 2002). Loeb and Winters (2013) noted that while areas suitable for Indiana bat summer maternity colonies have been forecasted to decline significantly due to climate change, the northeastern and Appalachian regions of the US have the potential to serve as climate refugia for Indiana bats and are predicted to continue to support the species. Impacts on the availability and/or timing of insect prey are also likely. Currently, however, the Service has no evidence demonstrating climate change impacts at a population-level to Indiana bats. The rapid spread of WNS across the range of the species is likely to mask any effects of climate change on their status.

B. Forest-Dwelling Bat – Northern Long-eared Bat

This section provides information about NLEB's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

The NLEB was proposed for listing as endangered on October 2, 2013, via a notice in the Federal Register (78 Fed. Reg. 191) and was formally listed as threatened on April 2, 2015. The primary reason for listing is the recent severe and ongoing decline of the species due to WNS. An interim 4(d) rule providing measures necessary and advisable to provide for the conservation of the species was proposed at listing. The 4(d) rule was finalized on January 14, 2016 (81 FR 1900). On April 27, 2016, the Service determined that designating critical habitat for the NLEB under the ESA was not prudent (81 FR 24707). A proposed rule to reclassify NLEB to endangered was published on March 23, 2022 (87 FR 16442).

2. Species Description

NLEB is an insectivorous, temperate, medium-sized bat that migrates annually from winter hibernacula to summer habitat in forested areas. Adults are 3-3.7 in long have a wingspan of 9-10 in. The fur is medium to dark brown on the back; dark brown, but not black on the ears and wing membranes; and tawny to pale-brown fur on the ventral side (Nagorsen and Brigham 1993;

Whitaker and Mumford 2009). As indicated by its common name, the NLEB is distinguished from other *Myotis* species by its relatively long ears (average 0.7 in) that, when laid forward, extend beyond the nose up to 0.2 in (Whitaker and Mumford 2009; Caceres and Barclay 2000). The tragus (projection of skin in front of the external ear) is long, pointed, and symmetrical (Nagorsen and Brigham 1993, Whitaker and Mumford 2009).

3. Life History

NLEB has a very similar life history to Indiana bat. The life history of NLEB is summarized here and significant differences in life history between the two species are noted. For more detailed information, see Chapter 3, Section A3 (Status of Bat Species – Forest-Dwelling Bat - Indiana Bat; Life History).

The NLEB is a 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 and lactation, pup volancy, and fall migration and mating. NLEBs generally hibernate between mid-fall through mid-spring each year. Spring migration period likely runs from mid-March to mid-May each year. Females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Young are born between mid-May and early-June, 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.

NLEB pups are typically born mid-May to early-June, with females giving birth to a single offspring. Lactation then lasts 3-5 weeks, with pups becoming volant between early-July and early-August.

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

Summer Habitat and Ecology

Suitable summer habitat for NLEBs consists of a wide variety of forested/wooded habitats where they roost, forage, and commute 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 NLEB, 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 NLEB suggests that they are adapted to moving in cluttered habitats. Thus, small, isolated patches of forest may not be suitable for foraging or roosting unless the patches are connected by a wooded corridor.

Maternity Colonies and Roosts

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies. Coloniality is a requisite behavior for reproductive success. NLEB maternity colonies range widely in size, although 30-60 bats may be most common (Service 2014). NLEBs show fidelity to summer roosting and foraging areas and may show fidelity to individual roost trees. Unlike Indiana bats, male NLEBs are routinely found with females in maternity colonies. NLEBs use networks of roost trees often centered around one or more central-node roost trees. NLEB roost networks also include multiple alternate roost trees and male and non-reproductive female NLEBs may also roost in cooler places, like caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006).

NLEBs roost in cavities, underneath bark, crevices, or hollows of both live and dead trees or snags (typically ≥ 3 in DBH). NLEBs are known to use a wider variety of roost types than Indiana bats, using tree species based on presence of cavities or crevices or presence of peeling bark. NLEBs have also been found roosting in structures like barns, sheds, and bridges.

Winter Habitat and Ecology

As with Indiana bat, suitable winter habitat (hibernacula) for NLEB includes underground caves and cave-like structures (e.g., abandoned or active mines, railroad tunnels, and other locations where bats hibernate in winter). There may be other landscape features being used by NLEBs during the winter that have yet to be documented. Generally, NLEB hibernates from October to April depending on local weather conditions (November-December to March in southern areas and as late as mid-May in some northern areas).

Hibernacula for NLEB typically have significant cracks and crevices for roosting; relatively constant, cool temperatures 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.

NLEB tend to roost singly or in small groups (Service 2014), with hibernating population sizes ranging from a just few individuals to around 1,000 (Service unpublished data). NLEBs display more winter activity than other cave species, with individuals often moving between hibernacula throughout the winter (Griffin 1940, Whitaker and Rissler 1992, Caceres and Barclay 2000). NLEBs have shown a high degree of philopatry to the hibernacula used, returning to the same hibernacula annually.

4. Population Dynamics/Status and Distribution

In the US, the species' range reaches from Maine 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 and in the 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 was historically less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

Although typically found in low numbers in inconspicuous roosts, most records of NLEBs are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species' range in the US, although many hibernacula contain only a few (1-3) individuals (Whitaker and Hamilton 1998). Known hibernacula (sites with one or more winter records of NLEB) include: Alabama (2), Arkansas (41), Connecticut (8), Delaware (2), Georgia (7), 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). NLEBs 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 NLEB must be described and understood within the context of the impacts of WNS. Prior to the onset of WNS, the best available information on NLEBs came mainly from surveys (primarily focused on Indiana bat or other bat species) and some targeted research projects. In these efforts, NLEBs were frequently encountered and considered the most common myotis 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 NLEBs. Multiple hibernacula that once supported populations of hibernating NLEBs have been heavily impacted by WNS and species presence is no longer documented. Cheng et al. (2021) estimates range-wide declines of > 90% from 1995 to 2018 and a 79% overlap of species and WNS occurrence ranges.

Frick et al. (2015) documented the local extinction of NLEBs from 69% of sites included in their analyses (468 sites where WNS had been present for at least four years in Vermont, New York, Pennsylvania, Maryland, West Virginia, and Virginia).

Available evidence, including both winter and summer data, indicates NLEB abundance has and will continue to decline substantially over the next 10 years under current demographic conditions (Service 2021). Winter abundance (from known hibernacula) has declined range-wide (by 49%), and the number of extant winter colonies also declined range-wide (by 81%). By 2030, as modeled in the Species Status Assessment for the Northern Long-eared Bat (2022), range-wide abundance declines by 95% and the spatial extent declines by 75% are expected. There has also been a noticeable shift towards smaller winter colony sizes, with a 96-100% decline in the number of large hibernacula (≥ 100 individuals). Declining trends in abundance and occurrence are also evident across much of the NLEB summer range. Range-wide summer

occupancy has declined by 80% from 2010-2019. Data collected from mobile acoustic transects found a 79% decline in range-wide relative abundance from 2009–2019 and summer mist-net captures declined by 19% compared to pre-WNS capture rates. Further declines are expected as the disease continues to spread across the species' range.

5. Conservation Needs and Threats

NLEBs have the same conservation needs and threats as Indiana bat; however, NLEB is the species most impacted by WNS. For more detailed information, see Chapter 3, Section A5 (Status of Bat Species – Forest-Dwelling Bat - Indiana Bat; Conservation Needs and Threats).

C. Forest-Dwelling Bat – Little Brown Bat

This section provides information about little brown bat's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

The little brown bat is not currently listed under the ESA. The Service has undertaken a discretionary status review of the species and expects to determine if listing of this species is warranted in fiscal year 2023 (National Listing Workplan, <https://www.fws.gov/media/national-listing-workplan-fiscal-years-2022-2027>, accessed 12 May, 2022).

2. Species Description

The little brown bat is a medium sized bat, weighing 7-14 grams (g) with a wingspan of 22-27 centimeters (cm) (Harvey et al. 1999), with a body length of 76-95 millimeters (mm) (Laubach et al. 2004) and a forearm measurement of 33-41 mm (Fenton and Barclay 1980). Its fur is glossy and ranges in color from dark brown to a yellowish brown (Fenton and Barclay 1980). The little brown bat is similar to the Indiana bat but can be distinguished by its calcar that is not keeled, and the presence of toe hairs that extend beyond its claws. The little brown bat is also similar to the NLEB, but the NLEB has ears that extend beyond the nose up to 0.2 in when laid forward and a tragus that is longer and more pointed when compared to the little brown bat (Whitaker and Mumford 2009; Caceres and Barclay 2000).

3. Life History

Little brown bat has a very similar life history to Indiana bat and NLEB. The life history of little brown bat is summarized here and significant differences in life history between the species are noted. For more detailed information, see Chapter 3, Section A3 (Status of Bat Species – Forest-Dwelling Bat - Indiana Bat; Life History) and Chapter 3, Section B3 (Status of Bat Species – Forest-Dwelling Bat – Northern Long-eared Bat; Life History).

Summer Habitat and Ecology; and Maternity Colonies and Roosts

After emerging from their hibernacula in the spring, little brown bats roost in a variety of sites, including trees, buildings, under rocks, wood piles, and occasionally caves (Fenton and Barclay 1980). Maternity colonies of little brown bats have been found in a variety of man-made structures including bridges, attics, basements, under sheet metal roofs, in barn rafters, in bat houses, and in hollow trees if temperature conditions are right (Davis and Hitchcock 1965, Fenon and Barclay 1980). A maternity colony of 6,700 little brown bats, discovered in an abandoned

barn in Indiana, is the largest maternity colony ever documented (Whitaker and Hamilton 1998). Roost fidelity of females to summer roosts tends to be high with adult females typically returning to their natal roosts (Frick et al. 2010a; Reynolds 1998). Female little brown bats typically give birth to one pup between May, June, and July (Harvey et al. 2011). Less is known about where most male little brown bats spend their summer, but it is thought that they likely spend the summer roosting period scattered in a variety of roost types (Harvey et al. 2011). Randall et al. (2014) found that data collected during their telemetry study in 2007 agreed with Broders and Forbes (2004), who reported that all female little brown bats captured in forests were found to roost in nearby buildings, whereas the males roosted in nearby trees.

Little brown bats are opportunistic in selecting roost sites, “taking shelter in any sites with appropriate microclimates, and quickly locating and exploiting new roosts” (Fenton and Barclay 1980). Flexible behavior may have led to the overall success of this species in exploiting fragmented agricultural landscapes (Henderson et al. 2009) and suburban areas with buildings that are frequently occupied during warm months, yet continued fragmentation of landscapes into smaller patches and reduced availability of buildings for roosting are certain to have adverse effects on little brown bat populations.

In the late summer and fall, individual little brown bats depart from summer roosts and migrate to a variety of transient roosts (Fenton and Barclay 1980) before arriving at winter hibernacula, between September and October (Saunders 1988), located up to 300 kilometers (km) from summer roosts (Davis and Hitchcock 1965; Fenton 1970; Griffin 1970; Humphrey and Cope 1976), or perhaps as far as 1,000 km (Wilson and Ruff 1999). Caves and mines serve as swarming sites during the fall mating period and as hibernacula during the cold months. Swarming behavior in little brown bats occur from August through early-October, which also coincides with the pre-hibernation fattening period (Kunz et al. 1998; McGuire et al. 2009). Hibernacula (or winter roosts) appear to be selected by bats for their high humidity and relatively stable, cool temperatures that are above freezing (Fenton 1970; Hitchcock 1949; Humphrey and Cope 1976). The duration of hibernation in little brown bats depends largely on climate and the length of the hibernal period for a given sector of its range. Although fidelity to hibernacula may differ between males and females (Thomas et al. 1979), little brown bats often return annually to swarm, mate, and hibernate at the same site (Davis and Hitchcock 1965; Humphrey and Cope 1976).

Winter Habitat and Ecology

Little brown bats hibernate in a variety of suitable sites throughout their range, mostly consisting of caves and abandoned mines, with no records of the bats hibernating in buildings (Fenton and Barclay 1980). Studies found that high levels of humidity (> 90%) and temperatures above freezing, most often characterize sites used as hibernacula by little brown bats (Hitchcock 1949, Davis and Hitchcock 1965; Fenton 1970; Humphrey and Cope 1977), but Fenton (1970) found that there are hibernacula used by little brown bats where the ambient temperature is below freezing. Hibernacula are rarely used as day roosts by little brown bats in the summer (Fenton and Barclay 1980), but near the end of August in Ontario, some individuals (usually adult males) spend the day in hibernacula (Fenton and Barclay 1980).

Populations of little brown bats at the southern part of their range may enter hibernacula around November and not exit until May, while at the northern part of the range in Ontario, individuals start to enter hibernacula in September and exit early- to mid-May (Fenton and Barclay 1980). Exiting the hibernacula is dependent upon local weather conditions and the frequency of arousal from torpor (Fenton and Barclay 1980). The hibernacula sites act as the focal points for swarming activity, which dependent upon location, lasts from late-August into October (Fenton and Barclay 1980).

The swarming period begins when the bats arrive at their hibernacula, approximately an hour after sunset (Fenton and Barclay 1980). Little brown bats typically feed before arriving at their hibernacula and upon entering, spend variable time flying around inside (Davis and Hitchcock 1965; Fenton and Barclay 1980; Fenton 1969). Bats that swarm at a particular site may not hibernate there (Fenton and Barclay 1980). The recovery rate of individuals banded from swarming to hibernation, or season to season, at any site is usually low (Fenton and Barclay 1980; Fenton 1969). During the swarming period, individual bats may travel significant distances, (Fenton 1970) resulting in mixing of the population of bats from different areas (Fenton and Barclay 1980). Historical migration distances appear to vary widely, ranging from a few miles to greater than 500 km (Davis and Hitchcock 1965). Comparably, in Canada, Norquay et al. (2013) found migration distances to vary widely, from 10-647 km.

4. Population Dynamics/Status and Distribution

The historic and current range of the little brown bat covers large portions of North America from the Alaska-Canada boreal forest south through most of the contiguous US, though the species is generally absent from the southern Great Plains region. Southwestern populations formerly assigned to this species have now been assigned to *M. occultus* (Piaggio et al. 2002; Wilson and Reeder 2005), so the southwestern boundary of the range includes southern California (except extreme southeast), Nevada, northern Utah, northern Colorado, and perhaps northeastern New Mexico (Piaggio et al. 2002; NatureServe 2022). The core of the range, based on historical abundance, appears to be the northeastern United States and boreal Canada, with smaller populations in the southern and western United States (Davis et al. 1965).

Long-term monitoring of 22 prominent hibernacula for the species in the core range in the northeastern US provided the basis for cave survey data from 1985 to predict a population of 6.5 million little brown bats as of 2006 (Frick et al. 2010b) – which is presumed to account for the vast majority of the species’ overall population. As of 2006, regional mean growth suggested that the northeastern core population of this species was stable or slightly increasing (Frick et al. 2010b). Thus, the pre-WNS population of this species – both throughout its range and within its core northeastern range – was viable and did not face imminent risk of extinction. The appearance of WNS in 2006 dramatically altered the population balance, which in turn has substantially impaired the ability of little brown bats to adapt to other cumulative threats looming against a rapidly declining species baseline. In only four years, this lethal fungal pathogen has summarily killed at least one million little brown bats in the northeastern core range, and all efforts undertaken thus far to contain its westward spread and rate of infection have proven ineffective. Of 38 winter hibernacula examined where WNS has been confirmed or suspected for two or more years, survey data indicates that winter populations at 36 sites had declined compared to their 10-year pre-WNS average estimates (Kuntz and Reichard 2010). Of

hibernaculum that averaged greater than 50 little brown bats prior to the discovery of WNS, four hibernacula (North Carolina [3], Tennessee [1]) declined to zero little brown bats in the most recent post-WNS surveys (Kuntz and Reichard 2010). Moreover, 16 hibernacula (42%; 23 in total but 7 were smaller on average than 50 individuals prior to WNS) declined below 50 individuals in the most recent post-WNS survey estimate (Kuntz and Reichard 2010). Cheng et al. (2021) estimates range-wide declines of > 90% from 1995 to 2018 and a 36% overlap of species and WNS occurrence ranges.

5. Conservation Needs and Threats

Little brown bats have the same conservation needs and threats as Indiana bat. For more detailed information, see Chapter 3, Section A5 (Status of Bat Species – Forest-Dwelling Bat - Indiana Bat; Conservation Needs and Threats).

D. Forest Dwelling Bat – Tricolored Bat

This section provides information about tricolored bat's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

A petition to list the tricolored bat as threatened was received by the Service on June 16, 2016. On December 20, 2017, the Service found that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted. The Service commenced a review (known as a 12-month finding) to determine if listing of the tricolored bat is warranted (82 C. F. R. 60362 December 20, 2017).

2. Species Description

The tricolored bat was classified as *Pipistrellus subflavus* and was often called the eastern pipistrelle or “pips” in literature, surveys, and guidebooks predating its reclassification in 2006. It is currently classified as *Perimyotis subflavus* per Hooper et al. (2006). The bat is generally smaller in size compared to the other *Myotis* described above, with a weight of 4-8 g, forearm length of 31-35 mm and a total length generally between 81-89 mm (Laubach et al. 2004). The species' most distinguishing characteristics are the reddish forearm contrasting with the black wing membrane and the fur that shades from a dark grey base to a yellowish brown to a dark brown tip (Laubach et al. 2004).

3. Life History

Tricolored bat has a very similar life history to Indiana bat and NLEB. The life history of tricolored bat is summarized here and significant differences in life history between the species are noted. For more detailed information, see Chapter 3, Section A3 (Status of the Species – Indiana Bat; Life History) and Chapter 3, Section B3 (Status of the Species – Northern Long-eared Bat; Life History).

Summer Habitat and Ecology; and Maternity Colonies and Roosts

Tricolored bats are known to roost mostly in foliage and specifically, clusters of dead leaves (65%), live foliage (30%), and squirrel nests (5%; Veilleux et al. 2003). The species can occasionally be found in man-made structures (Whitaker 1998) and can be found in culverts

during the summer and winter. Tricolored bats accounted for only 12 (2.9%) of 401 bat colonies in buildings in Indiana (Cope et al. 1991), suggesting that most colonies are roosting in forests (Veilleux 2003). In Indiana, female tricolored bat maternity roosts occurred mostly in upland habitats (9.4%) as opposed to riparian (0.8%) and bottomland (0.2%) habitats (Veilleux et al. 2003). Preferred upland habitat by this species could be related to the greater availability of preferred roost tree species: white oak (*Quercus alba*), bur oak (*Quercus macrocarpa*), and red oak (*Quercus rubra*) (Veilleux et al. 2003).

Tricolored bats appear to exhibit site fidelity for summer roosting habitat. Veilleux (2003) found site fidelity for 18 tricolored bats in Indiana. The bats were monitored for 9 days and during that time bats used 1-3 roost trees and changed roost trees 1-2 times, on average. Tricolored bats remained at single roost trees for 2.5-6 consecutive days on average. Four individuals late in pregnancy or lactation remained at a roost for 2.5-4 days. Eight of 18 individuals (~44%) returned to previously used roosts trees after initially changing to a new roost (Veilleux et al. 2003). Tricolored females have their pups in late spring and early summer, and usually have twins (Harvey et al. 2011).

Roost areas for individuals and maternity colonies are relatively small. In Indiana, Veilleux and Veilleux (2004) radio-tracked four tricolored bats to their respective roosts trees and found that minimum and maximum distances from roosts trees were between 21 meters (m) and 926 m. Minimum roost area for all four individuals containing all roosts used during both years (1999-2000) ranged from 0.1-2.3 hectares (ha). A comparable study in Nova Scotia found that the average roosting area of maternity colonies varied from 1.6-77.4 ha, with a mean of 22.8 ha (56.3 ac) A study conducted in the Ouachita Mountains of central Arkansas radio-tagged 28 male and nine female tricolored bats and found that roosts trees varied from 1-3 roost trees for males and 1-5 roost trees for females (Perry and Thill 2007b). Seven of 14 female roosts were considered to be colonies and based on exit counts and visible pups, the estimated number of bats (adults and pups) in colonies was 3-13, with an average of 6.9 (± 1.5) (Perry and Thill 2007b). Perry and Thill (2007b) found males roosting in forested habitats also occupied by females, but primarily in solitary roosts.

Winter Habitat and Ecology

Tricolored bats are known to hibernate in caves, mines, rock crevices, and culverts during the winter months (Harvey et al. 1999). Although tricolored bats are considered one of the most common and widely distributed species in North America (Briggler and Prather 2003), little information has been published on seasonal use and site selection for this species (Briggler and Prather 2003; Raesley and Gates 1987; Sandel et al. 2001). LaVal and LaVal (1980) noted the large number of individuals captured at a hibernacula in Missouri, in late-April and May and then again in late-July and August, suggesting that tricolored bats are among the first to arrive at hibernacula in the fall, and among the last to exit in the spring (Fujita and Kunz, 1984).

During hibernation, males and females are not segregated (Griffin 1940) and are noted to roost singly, as opposed to in clusters (Fujita and Kunz 1984). Although tricolored bats primarily hibernate singly, clusters of bats comprising of 2-3 individuals have been documented on numerous occasions (Sandel et al. 2001). Because of the small size and tendency to hibernate singly, McNab (1974) noted that tricolored bats had successfully hibernated in a cave in Florida,

where the relatively high ambient temperatures excluded other bat species (Fujita and Kunz 1984). Briggler and Prather (2003) found that cave temperature had a strong influence of site selection by tricolored bats.

A presence/absence survey resulted in data that showed tricolored bats were more likely to be found in caves with higher temperatures (11.4-10.5 degrees Celsius [$^{\circ}\text{C}$]) in the winter of 2000 and lower temperatures (12.6-13.9 $^{\circ}\text{C}$) during spring 2000 (Briggler and Prather 2003). As a result of the 54 caves surveyed over six seasons in Arkansas, Briggler and Prather (2003) noted that tricolored bats showed a preference for cave openings with east-facing aspects and avoided caves on steep slopes during winter hibernation; the preferences seemed to be a result of the influence of ambient temperature. East-facing aspects on shallow slopes were larger than those on steep, west-facing slopes; larger caves had a greater buffer capacity from weather conditions for hibernating bats (Briggler and Prather 2003).

As previously noted, there is little information about tricolored bat movements, but the species is currently believed to be a regional migrant (Fraser et al. 2012; Fujita and Kunz 1984). Species engaging in regional migration travel annually from hibernacula to summer roosting sites, and then moving among swarming locations in the fall (Fenton 1969; Fraser et al. 2012; Hitchcock 1965). Recent research has led to some speculations that some individuals migrate farther distances than previously suspected, and that migratory behavior may differ between males and females (Davis 1959; Fraser et al. 2012). Fraser et al. (2012) investigated tricolored bat migration by conducting stable hydrogen isotope analyses of 184 museum specimen fur samples and compared the results to published values of collection site growing season precipitation. Their results suggested that 33% of males and 16% of females collected during the postulated non-molt period were south of their location of fur growth. Fraser et al. (2012) also noted that if tricolored bats only engaged in regional migration, then evidence would be expected to show equal numbers of bats migrating north and south during the non-molt period. Respectively, Fraser et al. (2012) concluded that at least some tricolored bats, of both sexes, engage in latitudinal migration.

4. Population Dynamics/Status and Distribution

WNS has recently decimated tricolored bat populations in several states, but before the onset of WNS, the tricolored bat was generally believed to be common and secure throughout most of its range in the eastern US. Historically, little research and monitoring of this species were conducted. However, an analysis of survey data suggests that even prior to WNS, the tricolored bat, along with several other WNS-affected species, was in a state of gradual decline in the eastern US (Ingersoll et al. 2013). Correcting for biases inherent in hibernacula counts, Ingersoll et al. (2013) found that from 1999-2011, (i.e., both pre and post-WNS), the tricolored bat declined by 34% in the multi-state study area (New York, Pennsylvania, West Virginia, and Tennessee). Further, while WNS has been assumed to be the sole driver of bat population declines, new research indicates that many factors are likely acting synergistically (Ingersoll et al. 2016). Bats are subject to a suite of severe threats (Hutson and Mickleburgh 1992 and 2001, Pierson 1998), including disturbance and altered microclimates of critical hibernacula and day roosts (Tuttle 1979, Neilson and Fenton 1994, Thomas 1995), loss and modification of foraging areas (Pierson 1998, Hein 2012, Jones et al. 2009), toxicity and changed prey composition and abundances from pesticide use and other chemical compounds (Shore and Rattner 2001, Clark

1988), climate change (Frick et al. 2010, Rodenhouse et al. 2009), and in-flight collisions with vehicles, buildings, and wind turbines (Russell et al. 2009, Arnett et al. 2008, Kunz et al. 2007). In addition, an important emerging threat to bats in eastern North America (Frick et al. 2010) with potential to spread across the continent (Foley et al. 2011), is WNS (Lorch et al. 2011). Bats are often subject to more than one of these threats simultaneously; such co-occurring threats may result in synergistic or interacting effects, with impacts more severe than from any single threat in isolation (Crain et al. 2008, Kannan et al. 2010, Laurance and Useche 2009, Harvell et al. 2002). Cheng et al. (2021) estimates range-wide declines of > 90% from 1995 to 2018 and a 59% overlap of species and WNS occurrence ranges.

5. Conservation Needs and Threats

Tricolored bats have the same conservation needs and threats as Indiana bat. For more detailed information, see Chapter 3, Section A5 (Status of Bat Species – Forest-Dwelling Bat - Indiana Bat; Conservation Needs and Threats).

E. Cave-Obligate Bat – Gray Bat

This section provides information about gray bat's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

Gray bat was listed under the Endangered Species Preservation Act on October 15, 1966 (80 Stat. 926; 16 U. S. C. 668aa(c)) and as an endangered species under the ESA via notice in the Federal Register on April 28, 1976 (41 FR 17736). The reasons for listing the species are summarized in the 1982 Recovery Plan and include human disturbance, environmental disturbance, impoundment of waterways, cave commercialization and improper gating, and natural calamities (Service 1982). Critical habitat is not designated for gray bat.

2. Species Description

Gray bat is the largest member of its genus in the eastern US. Its forearm measures from 40-46 mm, and it weighs 7-16 g, but more typically 8-11 g (Service 1982). It is distinguished from all other bats within its range by its uni-colored dorsal fur; all other eastern bats have distinctly bi- or tricolored fur on their backs (Service 1982). Following molt in July or August, gray bats are dark gray, but they often fade to chestnut brown or russet between molts, which is especially apparent in reproductive females during May and June (Service 1982). The wing membrane connects to the foot at the ankle unlike in most *Myotis* where the membrane connects at the base of the first toe (Service 1982). The presence of a notch on the nails of the claws of the feet and thumbs and longer and forearm length are the most reliable methods of identifying the species (Sasse et al. 2019).

3. Life History

Gray bats are found throughout karst areas of the southeastern US where they primarily roosts in caves, and occasionally in human-made structures such as concrete box culverts, dams, abandoned mines, and bridges (Timmerman and McDaniel, 1992; Johnson et al. 2002; Powers et al. 2016; Sasse et al. 2019). Males and females hibernate together in large colonies for approximately 6-7 months in a few caves throughout Alabama, Arkansas, Kentucky, Missouri,

and Tennessee. Gray bats are considered regional migrants with average migrations of 200 km (124 mi) (Gerdes 2016). However, some bats have been known to migrate as far as 775 km (481 mi). In the spring, gray bats migrate to caves used as separate bachelor and maternity colonies (Decher and Choate 1995). Spring migration typically takes place between mid-March to late-May, which may vary based on latitudinal gradients and annual weather patterns (Tuttle 1976b). Fall migration usually occurs from early-August to mid-November (Tuttle 1976b; Gerdes 2016). Very few studies have attempted to document spring and fall migratory pathways, and little is known about bat movements between summer and winter caves (LaVal et al. 1977; Thomas and Best 2000; Moore et al. 2017). Gray bats show strong philopatry to both summering and wintering sites (Tuttle 1976a, Tuttle 1979, Tuttle and Kennedy 2005, Martin 2007). Because of their highly specific roost and habitat requirements, only about 5% of available caves are suitable for occupancy by gray bats (Tuttle 1979, Harvey 1994).

Winter Habitat and Ecology, Staging, and Spring Migration

The annual activity period of gray bats is April to October (Best et al. 1997), mid-March to mid-November in western North Carolina. Adult female gray bats emerge from their winter hibernating caves (hibernacula) in late-March or early-April, followed by juveniles of both sexes and adult males. Ovulation in females occurs soon after their emergence from hibernation (Guthrie and Jeffers 1938). Juveniles and adult males typically emerge between mid-April and mid-May (Tuttle 1976b). This period following hibernation, but prior to spring migration, is typically referred to as "staging". Most gray bats migrate seasonally between their hibernacula and maternity caves. Spring migration is hazardous because gray bats that do not have sufficient fat reserves have difficulties surviving the stress and energy-intensive migration period. Consequently, adult mortality is highest in late-March and April (Tuttle and Stevenson 1977, Service 1982). The distance traveled by an individual colony during migration (spring and fall) varies depending on geographic location (Service 1982).

Summer Habitat and Ecology; and Maternity Colonies and Roosts

Gray bat summer foraging is strongly correlated with open water of rivers, streams, lakes, or reservoirs, where insects are abundant (Tuttle 1976b, LaVal et al. 1977). Results of surveys conducted in Tennessee indicate that wetland depressions are also important foraging sites for gray bats (Lamb 2000). Although the species may travel up to 35 km between prime feeding areas over lakes and rivers and occupied caves, (LaVal et al. 1977, Tuttle and Kennedy 2005, Moore et al. 2017), most maternity colonies are usually located between 1-4 km from foraging locations (Tuttle 1976b). At foraging sites, Tuttle (1976b) estimated that gray bats forage within roughly 3 m of the water's surface. Abbreviated instances of bad weather in early spring and late fall are generally the only times gray bats deviate from primarily feeding along local bodies of water, and then they are found foraging in forest canopies (LaVal et al. 1977, Stevenson and Tuttle 1981).

Colony members are extremely loyal to their colony home range, with males and non-reproductive females dispersing and congregating in smaller groups in more peripheral caves within that area (Tuttle 1976b). Most young take flight in late-June to mid-July by 4 weeks of age (at 20-25 days of age) (Service 1982, Mitchell and Martin 2002). Where colonies have been reduced in size as a result of roost disturbance, days to volancy (flight) in young are sometimes increased up to 35 days following birth, and in severely reduced colonies, the young sometimes

die before learning to fly (Service 1982). For newly volant young, growth rates and survival are inversely proportional to the distance from their roost to the nearest aquatic (over a river or reservoir) foraging habitat (Tuttle 1976a). Although females continue to nurse their young for a brief period after they learn to fly, juveniles must learn how and where to hunt independently (Tuttle and Stevenson 1982).

Each summer colony occupies a traditional home range that often contains several roosting caves scattered over up to a 70 square km (43.5 square mi) area. Gray bat summer caves are usually located along large bodies of water and have temperatures ranging from 57-77 °F (Mitchell and Martin 2002). Summer caves typically contain structural heat traps (including domed ceilings, small chambers, and porous rock surfaces) that capture metabolic heat from clustered gray bats, allowing the nursery populations to succeed. Preferred summer colony caves are within 1 km (approximately 0.6 mi) of a body of water and are rarely more than 4 km (2.5 mi) from a lake or major river (Mitchell and Martin 2002). The average roosting density of gray bats is 1,828 bats/square m (10.8 square ft) (Sherman and Martin 2006). Gray bats are also known to use a variety of human-made structures including bridges, culverts, dams, mines, and buildings during the spring, summer, and fall. The species readily uses bridges and culverts, and concrete structures seem to be preferred due to their tendency to retain heat longer than other materials; however, metal and wood structures may also be used with less frequency. Gray bats have been observed using bridges and culverts as both day and night roosts. Bridges used as day roosts are typically constructed of concrete and contain vertical crevices, expansion joints, or other locations that allow bats to retreat into the bridge deck or superstructure (Keeley and Tuttle 1999, Feldhamer et al. 2003, Cleveland and Jackson 2013). Bridges with a concrete deck and concrete or metal girders seem to be preferred as night roosts (Keeley and Tuttle 1999, Kiser et al. 2002). This bridge type retains heat into the night, and the chambers between the girders trap heat rising from under the bridge and provide protection from wind, weather, and predators. Night-roosting bats are typically found on the vertical surface of the girder at the intersection with the underside of the deck, often near the bridge abutments. Areas over land seem to be preferred more than the central portion of the bridge and areas spanning water. Bridges that lack crevices/expansion joints or girders are rarely used as day or night roosts (Adam and Hayes 2000, Feldhamer et al. 2003, Ormsbee et al. 2007); however, structures with cave-like areas or other unique features that provide suitable roosting locations can also provide suitable roosting habitat. There are a few exceptions to cave or cave-like roosts. Weber et al. (2020) found 293 gray bats roosting in a building and tracked two gray bats to sycamore trees in which they roosted (Samoray et al. 2020). Wetzel and Samoray (2022) also tracked a gray bat to a shagbark hickory tree roost in Tennessee in April. Notably, gray bat had not previously been documented using trees as roost sites.

Fall Migration

Gray bats often migrate in large groups (Whitaker and Hamilton 1998). Fall migration for gray bats occurs in approximately the same order as spring emergence, with females departing first (early-September) and juveniles leaving last (mid-October). Gray bats have been documented to regularly migrate 17-437 km (10.6-271.6 mi) between summer maternity sites and winter hibernacula (Tuttle 1976b, Hall and Wilson 1966), with some individuals moving as much as 689-775 km (428.1-481.6 mi) (Tuttle 1976b, Tuttle and Kennedy 2005). Gray bats reach their hibernacula between August and October, with the females arriving first.

4. Population Dynamics/Status and Distribution

The gray bat is a monotypic species that occurs in limited geographic range in limestone karst areas of the southeastern US. Gray bats are known to occur in 13 states, Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, North Carolina, Missouri, Oklahoma, Tennessee, and Virginia. The species' range has expanded in some states (e.g., Georgia, Indiana, Kansas, and North Carolina), and gray bats are using many caves where use had not been documented prior to completion of the 1982 Recovery Plan (NatureServe 2022). The primary range of gray bats is concentrated in the cave regions of Alabama, Arkansas, Kentucky, Missouri, and Tennessee, with smaller populations found in adjacent states (Harvey et al. 1981, Brack et al. 1984, Harvey 1992, Harvey 1994, Mitchell 1998). Overall, gray bat numbers have increased significantly in many areas (Service 2009). Range-wide, gray bats have been documented in a few hundred caves (Service 1982). Martin (2007) reported nearly 500,000 gray bats at eight hibernacula, where there had only been about 25,000 recorded historically. In other areas (e.g., Florida) the species has declined significantly at both hibernacula and maternity sites (Service 2009). Based on recent surveys of Priority 1 hibernacula, the current range-wide population estimate for the gray bat is approximately 5.3 million individuals (Service 2021). The major gray bat hibernacula, where approximately 95% of gray bats hibernate in 17 caves, occur primarily in Alabama, Arkansas, Kentucky, Missouri, and Tennessee (Harvey et al. 2005, Martin 2007). There is only one record of a single gray bat hibernating in Pendleton County, West Virginia. Wide population fluctuations of gray bat numbers have been documented at many maternity sites across the species' range, but there have been significant population increases in some of the major hibernacula (Service 2009).

5. Conservation Needs and Threats

The conservation needs of and threats to gray bat are discussed in detail in the 1982 Recovery Plan (Service 1982) and the most recent 5-year review (Service 2009). Tuttle (1979), Service (1982), Mitchell (1998), Shapiro and Hohmann (2005), and Martin (2007) listed multiple factors that contributed to the initial decline of gray bats, including human disturbance, natural flooding, impoundment of waterways, and contamination from pesticides.

Human disturbance, natural and man-made flooding

Although human disturbance remains the number one reason for the continued decline of some populations of gray bat (Tuttle 1979, 1987; Rabinowitz and Tuttle 1980; Service 1982; Mitchell 1998; Martin et al. 2000; Shapiro and Hohmann 2005; Martin 2007; Elliott 2008) natural and man-made flooding remains a secondary threat at some gray bat sites. Cave flooding is a particular concern, as gray bats retreat further back into caves and roost over water to avoid disruption from humans. Flash flooding in caves can also adversely affect gray bats by damaging gates at cave entrances that were constructed to protect roosting bats (Elliott 2008).

Contamination

Although pesticide contamination has been well documented in some populations of gray bats (Clark et al. 1978, 1980; Clawson and Clark 1989; Clawson 1991; Sasse 2005), Elliott (2008) suggested that the continued increase of gray bats coincided with the reduced use of pesticides in southern Missouri where the landscape was mostly covered in forest, pasture, and hay fields. Sasse (2005) noted that gray bats at four maternity caves in Arkansas remain exposed to

pesticide residues but at lower levels than previously reported by others (Clark et al. 1988; Clawson and Clark 1989; Clawson 1991). Nonetheless, Sasse (2005) recommended that there should be continued periodic monitoring of pesticide residues in guano and carcasses of dead bats.

Insecticide use historically had a detrimental impact on gray bat populations (Clark et al. 1978, Clark et al. 1988), though many of the toxic substances are now banned from the market. The longevity, high metabolic rate, and insectivorous diet of bats increases their likelihood of exposure to bioaccumulating chemicals in the environment. While modern pesticides (e.g., organophosphates, neonicotinoids, pyrethroids, carbonates) aren't expected to bioaccumulate in tissues, they are still a concern, are highly toxic, and may kill bats from direct exposure (Shapiro and Hohmann 2005). The presence of other contaminants of concern that can bioaccumulate (e.g., pharmaceuticals, flame retardants) has been documented in bats (Secord et al. 2015), though additional research is needed to understand impacts.

Siltation and nutrient loading of waterways where bats forage and drink may negatively affect the species. As previously stated, a large portion of the gray bat diet is comprised of adult aquatic insects such as mayflies, stoneflies, and caddisflies. These groups of aquatic insects are especially susceptible to degraded water quality. Any substantial declines in the populations of these insects may have a detrimental effect on gray bat populations as well (Service 1982). Tuttle (1979) presented a correlation between a decline in gray bat numbers and an increase in sedimentation in several Alabama and Tennessee waterways.

Climate change

Climate change could have a significant impact on gray bats. Bogan (2003) predicted that climate changes could impact bats by adversely affecting their food supply or the internal roosting temperature of caves. In Australia, Hughes (2003) demonstrated that the ranges of different species of flying foxes (*Pteroptus spp.*) had shifted due to recent rises in ambient temperature on that continent. Humphries et al. (2002) investigated the hibernation energetics of little brown bat and predicted that global warming would cause climate-mediated energetic constraints on the distribution of this and other hibernating bats. It is projected that a rise in ambient temperature could make traditional and currently occupied hibernacula and maternity sites unsuitable for roosting gray bats and cause a shift in the species' range northward. This could adversely affect the species' food supply or affect the ability of bats to adequately deposit important fat reserves which are critical for gray bats to survive the hibernation season.

White-nose syndrome

In 2012, the Service confirmed the first instance of WNS in gray bats (USFWS 2012a). The full impact of WNS on overall gray bat populations is still being determined. It seems plausible that WNS would pose a serious threat to a species like the gray bat, where individuals overwinter in few high-density hibernacula, should it infect those colonies. However, some studies have found that Pd may not spread through gray bat colonies as quickly as once expected, nor be as substantial a threat to the species as initially suspected (Flock 2014). As of spring 2017, the species has yet to experience any WNS-related declines and their populations appear to have remained stable within Tennessee (Bernard *et al.* 2017) and Virginia (Powers *et al.* 2016). Several behavioral traits, such as preferred microclimates within hibernacula and sustained

activity and foraging throughout winter (Bernard and McCracken 2017) may enable this species to prevent or minimize the colonization of Pd during torpor.

F. Cave-Obligate Bat – Virginia Big-eared Bat

This section provides information about VBEB's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This information provides the background for analyses in later sections of the BO.

1. Listing Status

VBEB is one of two federally endangered subspecies of Townsend's big-eared bat that were jointly listed as endangered under the ESA on December 31, 1979 (44 FR 69206). At listing the threats were initially attributed to the small population size, limited distribution, and vulnerability to human disturbance (44 FR 69206). The apparent vulnerability to human disturbance was due to the population concentrations in only a small number of caves. More recently, the revised Recovery Plan considers the primary threats to be vandalism and increased human visitation to maternity roosts and hibernacula (Service 2019a). Critical habitat was designated concurrent with the listing and consists of five caves, all in West Virginia. No critical habitat occurs within or near the action area and therefore, will not be adversely affected by the Proposed Action.

2. Species Description

VBEBs are medium-sized with forearms measuring 39-48 mm long and weighing 7-12 g. Total body length is 98 mm, the tail is 46 mm, and the hind foot is 11 mm long. They are distinguishable by having long ears (over 2.5 cm) and facial glands on either side of the snout. VBEBs closely resemble the Ozark big-eared bat (*Corynorhinus townsendii ingens*), but the subspecies do not have overlapping ranges.

3. Life History

VBEB is a cave-obligate that roosts in caves and cave-like habitats year-round. These bats prefer caves in karst regions dominated by oak-hickory or beech-maple-hemlock forest. Foraging tends to occur near forest/edge interfaces and along forested and riparian corridors in areas that have abrupt changes in vertical structure as well as both vertical and horizontal surface area for gleaning (Lacki and Dodd 2011). VBEB has been observed foraging over corn fields, old pastures, and hay fields; along cliff lines; and in small woodlots, and large forested tracts. They do not appear to use livestock pastures or clear cuts (Service 2019d). Moths make up the largest part of their diet with beetles, flies, wasps, and hoppers adding to their prey (VADWR 2022). Woody plant species diversity is important for maintaining moth species richness for VBEBs (Service 2019d). During the night the bats punctuate feeding bouts with periods of inactivity when they digest their food. During these periods of rest, the bats often roost near their foraging areas. They have been observed night-roosting in rock shelters, buildings, and occasionally under bridges. Foraging areas are generally located within a few miles (less than 7 mi) of cave/mine roost sites (Service 2019d). VBEB is non-migratory, but does make seasonal movements of up to 57 km (40 mi) between winter hibernacula and summer maternity caves, though shorter distance movements of 32 km (20 mi) or less are more common (Stihler 1994, Service 2019b).

These bats usually hibernate in tight clusters near entrances of caves and mines that are well-ventilated and where temperatures range from 32-54 °F. As with other bat species, mating occurs in fall and winter, and females store sperm over winter. Ovulation and fertilization take place in spring shortly after females arouse from hibernation. In late spring or summer, females congregate in the relatively warm parts of caves to form maternity colonies where they bear a single pup in May or June. The gestation period for this species varies from 56-100 days depending on the ambient temperature (the young develop quicker during warm springs). The young are capable of flight at three weeks old, and by six weeks they are weaned. It is not known where most males spend the summer; although there have been bachelor colonies discovered (KDFWR, u.d.). There is evidence that bachelor sites are important to the breeding behavior of this species (Stihler et al. 1997). Some bats begin to return to the hibernation site in September, but they continue to feed each warm evening. By December, the bats have entered hibernation (UK, u.d.).

4. Population Dynamics/Status and Distribution

VBEs are distributed in isolated populations in the Appalachian Mountains in Kentucky, North Carolina, Virginia, and West Virginia. There are ten known major hibernacula and 18 known major maternity roosts and the majority of bats occur in just a few caves. Range-wide the population was estimated to be 19,574 based on hibernacula counts (Service 2019d). This represents a 30% increase from the last 5-year review though it's important to note that increases are not consistent across sites and recent declines have been observed at a number of the major VBE sites.

In the southeast region, there are two major hibernacula. Both are gated and considered protected. There are eight other minor hibernacula. The total number of hibernating VBEs in this population based on the last 2 years of data is 526 (Service 2019d). The number of VBEs at the main known hibernaculum in North Carolina has fluctuated since discovery in 1981 when 34 bats were found. Subsequent surveys indicated an initial trend of increasing numbers in the first decade, but since the mid-1990s there have been some dramatic drops on several occasions (as low as 31 and 55 bats). At the time of the previous status review (2008), there were 376 VBEs documented in this cave, which was the highest number recorded. The most recent survey conducted in 2018 documented 179 VBEs. One other minor hibernaculum has seen similar fluctuations of between 70 and 4 bats over a 10-year period, with the most recent count in 2018 documenting 42 VBEs (Service 2019d). These fluctuations may be due to factors negatively affecting the species, or due to the complexity of the habitat. It is suspected that there are other areas where the bats overwinter as the surrounding mountain landscape is very rocky, with a multitude of crevices and openings yet unexplored or inaccessible to humans. Overall population trends for this region are unclear due to the history of fluctuations at primary sites; however, the status may be declining since numbers at both major hibernacula have recently decreased, and as have numbers at two of three maternity sites (Service 2019d).

5. Conservation Needs and Threats

The conservation needs of and threats to VBE are discussed in detail in the most recent 5-year review (Service 2019d). They are summarized below and include human disturbance, habitat loss, small population size, and mining and energy development. The potential threat of WNS is also discussed below.

Human disturbance

Disturbance and vandalism at cave and roost sites is one of the primary threats to this species. VBEs are extremely sensitive to human disturbance. Even slight disturbances can cause adults to abandon caves, abandon young, and force bats to use valuable energy reserves needed to survive hibernation. Many of the largest roost sites are located on private land and are not protected and even when sites are protected, they are frequently entered illegally.

Habitat loss

The species is also threatened by the degradation and fragmentation of foraging areas, activities that could damage or degrade surface or subsurface areas of caves, barriers to migration and activities that reduce connectivity between roosting and foraging areas. Although the primary maternity colony in North Carolina is considered protected, the areas where many of the secondary roosts and foraging areas are concentrated are popular for second home development and are being rapidly developed. This development and associated projects (e.g., road creation/widening) could impact foraging habitat, travel corridors, and roosting locations. It could also result in increased predation from cats and other species adapted to human presence. Protection and management of foraging and roosting habitat around primary roost sites is needed.

Small population size

The small size of colonies in this region is also a concern. Regional populations are disjunct with no connectivity between them. Given the isolation of this and other regional populations, genetic drift and inbreeding could be issues. While the numbers of VBEs at sites in North Carolina appears stable, populations in Virginia are declining and some sites have been abandoned. However, there may also be additional sites that haven't been discovered.

Mining and Energy Development

Quarry mining, oil and gas development, coal mining, and wind energy are all listed as threats to VBEs (Service 2019d). However, these threats are not impacting the species in the southeastern management unit and largely occur in other parts of the range.

White-nose syndrome

VBEs are considered a suspect species for WNS due to detection of Pd on the species. However, to date there have been no signs of the disease affecting VBEs and no known population impacts from WNS to this species.

CHAPTER 4 – JEOPARDY ANALYSIS

A. Analytical Framework for Jeopardy and Adverse Modification Determinations

This BO only considers programmatic direction by the action agency that has undergone consultation. Effects to the species and/or designated critical habitat from programmatic direction that has not been consulted on are not included in the jeopardy or adverse modification determination. In situations where programmatic consultation has been completed for one but not the other, this BO provides an independent analysis for the species or designated critical habitat that does not rely on effects of the programmatic consultation to the other.

This BO does not provide an analysis for effects of specific actions. Rather, the effects analysis is a broad-scale examination of the types of projects and activities conducted under the Revised Forest Plan that could potentially occur in listed species habitat and result in effects on listed species. This broad-scale analysis will then be used to determine the potential for the Revised Forest Plan direction to jeopardize the affected populations of listed species.

The Forests retains its responsibility under the ESA to consult on future projects (conducted under the Revised Forest Plan) that may affect listed species regardless of the project's consistency with the Proposed Action considered in this BO. Future projects and their potential to adversely affect a listed species, or critical habitat, will be analyzed at the project level and a separate jeopardy/adverse modification determination will be made at that time.

1. Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: (1) Status of the Species, which evaluates the bats' range-wide conditions, the factors responsible for these conditions, and the bats' survival and recovery needs; (2) Environmental Baseline, which evaluates the condition of bats in the action area, the factors responsible for those conditions, and the relationship of the action area to the survival and recovery of bats; (3) Effects of the Action, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on bats; and (4) Cumulative Effects, which evaluates the effects on bats of future non-federal activities reasonably certain to occur in the action area. In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the bats' current status, taken together with cumulative effects, to determine if implementation of the Proposed Action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of bats in the wild.

2. Adverse Modification Determination

There are no designated critical habitats for NLEB, little brown bat, tricolored bat, or gray bat. Critical habitat was designated for Indiana bat on September 24, 1967 (41 FR 14914) and VBEB on December 31, 1979 (44 FR 69206); however, the specific caves and mines that have been designated do not occur in the action area and therefore, will not be adversely affected by the Proposed Action. Therefore, potential adverse modification to critical habitat is not discussed further in this BO. Additionally, projects following the Revised Forest Plan, which may occur within 0.5 mi of a known hibernaculum, are limited to types that would not affect bats within the hibernaculum or alter the environment of the hibernaculum.

B. Environmental Baseline

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

1. Status of Bats in the Action Area

Bats have been documented (mist-net captures or acoustic surveys) using the Forests, and suitable habitat for bats is prevalent throughout each Ranger District. The forest-dwelling bats addressed in this BO could be considered habitat generalists, benefiting from suitable habitat elements across the landscape. No hibernacula for the cave-obligate bats addressed in this BO are known to occur on the Forests. However, cave-obligate bats are known to use the Forests for commuting and foraging. General suitable habitat descriptions are summarized in Table 5 below.

Table 5. General suitable habitat descriptions for bats.

Bat	Suitable Habitat Description
Indiana bat	Suitable summer habitat for Indiana bats 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 (i.e., live trees and/or snags ≥ 5 in DBH (12.7 cm) that have exfoliating bark, cracks, crevices, and/or hollows), 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.
NLEB	Suitable summer habitat for NLEB consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥ 3 in DBH that have exfoliating bark, cracks, crevices, and/or cavities), 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.
little brown bat	In summer, little brown bats commonly roost in human-made structures, but have also been found under tree bark, in rock crevices, and in tree hollows. Male and female little brown bats both prefer old-growth and mature trees because they provide more crevices and cavities. Reproductive females form maternity colonies in buildings, bat houses, and tree hollows and select sites based on ambient temperature and shelter. Maternity colonies are usually located near water where little brown bats prefer to forage. These colonies do not occur in caves or mines (reproductive females and their young need warmer temperatures), but larger maternity colonies tend to be close to hibernacula, presumably because the bats do not need to travel very far to reach them after hibernation. Males often roost alone, and do not share maternity colonies' high-temperature needs. Males may use tree crevices, buildings and occasionally caves and mines as day roosts.

Bat	Suitable Habitat Description
tricolored bat	In the summer, tricolored bats generally roost singly in habitats including open woods near water and they may select roosts in buildings, crevices of cliffs and rocks, or in or below the canopy of live or recently dead trees that retain some dead or live leaves. Some males and non-reproductive females also roost in their winter hibernaculum. Maternity colonies have been found in trees (including in clusters of dead leaves in oaks or pines), rock crevices, and barns or other buildings. Tri-colored bats tended to select roosts that were away from roads, in unharvested woods with high habitat heterogeneity, or in the unharvested riparian buffer of a partially harvested stand. Perry and Thill (2007) found tri-colored bats in mature forest stands with a hardwood component and a complex vertical structure and dense midstory. However, Yates and Muzika (2006) found that tri-colored bats favored open habitats with less dense midstory vegetation and a dense understory.
forest-dwelling bats	Although a few species hibernate in leaf litter or in hollow trees, most forest-dwelling bats spend winters hibernating in caves, cave-like structures, and mines (hibernacula). They use areas in various sized caves or mines with constant temperatures, high humidity, and no air currents. Roost temperature and humidity needs vary by species. Some species roost singly either on the walls and ceiling or in cracks and crevices and other species tend to roost in clusters.
gray bat	<p>Suitable summer foraging and commuting habitat for gray bats consists of a wide variety of forested/wooded habitats strongly correlated with open water of rivers, streams, lakes, or reservoirs.</p> <p>In spring, summer, and fall, gray bats are known to use man-made structures such as bridges, culverts, and buildings as roosting habitat. Gray bats have been observed using bridges and culverts as both day and night roosts. Areas closer to land seem to be preferred over the central portion of the bridge. Bridges that lack crevices/expansion joints or girders are rarely used as day or night roosts; however, structures with cave-like areas or other unique features that provide suitable roosting locations can also provide suitable roosting habitat.</p>
VBEB	<p>Suitable summer foraging and commuting habitat for VBEBs consists of a wide variety of forested/wooded habitats. The species will also forage over old fields and small woodlots.</p> <p>In summer, VBEBs are known to night-roost in old buildings (houses, barns, etc.), under bridges, and in rock shelters. Maternity roosts are located in caves and cave-like features with suitable thermal conditions for raising young.</p>
cave-obligate bats	The two cave-obligate bats listed above spend winters hibernating in caves and mines (hibernacula) and types of sites used vary by species. Hibernacula for these species are not known to occur on the Forests.

The USFS used the Ecological Sustainability Evaluation (ESE) tool to evaluate potential effects of the Revised Forest Plan on bats. The ESE tool is a strategic conservation planning tool used by the USFS Southern Region for forest planning. Ecological sustainability in this context is defined as the capability of ecosystems to maintain ecological integrity (36 CFR 219.19). This analysis tool is based on the structure of the Open Standards for the Practice of Conservation (CMP 2018) planning tool and utilizes a standardized process that is adaptable to forest specific priorities and needs. The ESE tool employs prioritization algorithms utilizing rank, importance rating, attributes and indicators, stressors and threats, scope, and severity.

The USFS identified key characteristics and indicators (canopy composition; young, old [mature and old growth], and open woodland conditions; snag density, etc.) of the following ecosystems within the ESE tool that include one or more of the forest-dwelling¹ or cave-obligate² bats species discussed in this BO:

- Acidic Cove Forest¹
- Dry Oak Forest^{1, 2}
- Dry-Mesic Oak Forest^{1, 2}
- Floodplain Forest¹
- High Elevation Red Oak Forest^{1, 2}
- Mesic Oak Forests^{1, 2}
- Northern Hardwood Forest^{1, 2}
- Pine-Oak Heath Forest¹
- Rich Cove Forest¹
- Shortleaf Pine Forest¹
- Spruce-Fir Forest^{1, 2}

For the purposes of this BO, the ecozones listed above are assumed to be or contain suitable habitat for bats as described in Table 5. It is noted that all areas in a particular ecozone may not be suitable; however, in the absences of more refined data, this is the best available data. The USFS determined, through modeling, the total number of acres in each ecozone across the Forests. The amount of suitable or potentially suitable habitat is summarized in Table 6 below.

Table 6. Suitable or potentially suitable habitat for bats as modeled by the USFS.

Ecozone	Forest-wide Acres	% of Forests
Acidic Cove Forest	249,253	24%
Dry Oak Forest*	49,260	5%
Dry-Mesic Oak Forest*	103,187	10%
Floodplain Forest	2,342	0.2%
High Elevation Red Oak Forest*	40,188	4%
Mesic Oak Forests*	177,270	17%
Northern Hardwood Forest	53,564	5%
Pine-Oak Heath Forest*	103,844	10%
Rich Cove Forest	199,477	19%
Shortleaf Pine Forest*	46,479	4%
Spruce-Fir Forest	15,529	1%
Total	1,040,393	100%

*fire-adapted forest communities.

The ecozones above statistically account for 100% of USFS lands in the Forests. Other modeled habitats not considered suitable habitat for bats including grassy balds, heath balds, and lakes account for less than 0.5% of the Forests and do not appreciably change the percentages in Table 6.

Comprehensive survey data to determine status and trends of bats on the Forests are unavailable; however, there is no data to contradict the expectation that status and trends on the Forests would

be consistent with status and trends of bats range-wide for the species. Range-wide status and trend for each bat species is discussed in Chapter 3, Sections A4, B4, C4, D4, E4, and F4 and summarized in Table 7 below.

Table 7. Summary of status and trends for bats.

Bat	Status and Trends
Indiana bat	<ul style="list-style-type: none"> • Range-wide decrease of 4% from 2017-2019. • Biennial population estimates had been increasing from 2001-2007, suggesting that the species' long-term decline had been reversed; however, there has been decline since 2007 (likely attributable to WNS). • Range-wide declines of 28% from 1995 to 2018.
NLEB	<ul style="list-style-type: none"> • Winter abundance has declined range-wide by 49%, and the number of extant winter colonies also declined range-wide by 81%. • Noticeable shift towards smaller colony sizes, with a 96-100% decline of the number of large hibernacula (≥ 100 individuals). • Range-wide summer occupancy has declined by 80% from 2010-2019. • Data collected from mobile acoustic transects found a 79% decline in range-wide relative abundance from 2009–2019 and summer mist-net captures declined by 19% compared to pre-WNS capture rates. • Range-wide declines of $> 90\%$ from 1995 to 2018.
little brown bat	<ul style="list-style-type: none"> • Range-wide declines of $> 90\%$ from 1995 to 2018.
tricolored bat	<ul style="list-style-type: none"> • Range-wide declines of $> 90\%$ from 1995 to 2018.
gray bat	<ul style="list-style-type: none"> • Overall, gray bat numbers have increased significantly in many areas. • Wide population fluctuations of gray bat numbers have been documented at many maternity sites across the species' range, but there have been significant population increases in some of the major hibernacula.
VBEb	<ul style="list-style-type: none"> • Surveys indicated an initial trend of increasing numbers in the first decade since listing, but since the mid-1990s there have been some dramatic drops on several occasions (as low as 31 and 55 bats). • Overall population trends for the southeast region are unclear due to the history of fluctuations at primary sites; however, the status may be declining since numbers at both major hibernacula have recently decreased, as have numbers at two of three maternity sites.

C. Effects of the Action

Effects of the action are defined as “...the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline” (50 CFR 402.02). These effects are considered along with the predicted cumulative effects to determine the overall effects to the species for purposes of preparing a BO on the Proposed Action. Direct effects are defined as those that result from the Proposed Action and directly or immediately impact the species or its habitat. Indirect effects are those that are caused by, or will result from, the Proposed Action and are later in time, but still reasonably certain to occur.

1. Factors to be Considered

Plan components will affect subsequent project design when implementing forest management activities in the future. These forest-wide desired conditions, objectives, standards, guidelines, and goals affect future management decisions, but authorize no immediate activities or changes to ongoing activities. Therefore, no direct effects occur to bats as a result of the Proposed Action (revising the Land and Resource Management Plan). Additionally, because the Revised Forest Plan does not describe specific actions and is programmatic in scale, direct and indirect effects from implementation are unknown and cannot be evaluated. The same is true for beneficial effects. Upon proposal, future project-level activities that result from implementation of the Revised Forest Plan direction will undergo individual site-specific environmental review and section 7 ESA consultation.

Although there are no direct effects associated with revising the Land and Resource Management Plan and indirect and beneficial effects from Revised Forest Plan implementation are unknown, the Service can generally describe effects that may result from project-level implementation. Management activities described within the different MA categories in the Revised Forest Plan have the potential to affect bats where they overlap with occupied habitat. Depending on implementation, those activities that have the greatest potential to affect bats include timber harvest, forest stand improvement, thinning, thin/burn, and prescribed burning (plan components ECO-O-02 through 06). Potential effects would be project specific and temporary (i.e., there is no anticipated permanent loss of forest habitat on the Forests), and often short-term negative effects contribute to long-term beneficial effects.

Table 8 summarizes forest management activities with the potential to affect bat habitat at project-specific levels in the future. Other forest activities (e.g. road and trail construction, facility construction and maintenance, etc.) are proposed in relatively small amounts and could affect bat habitat in very small, practically immeasurable, amounts. Activities at this scale are analyzed specifically at the project level.

Table 8. Potential forest management activities with proposed acreage that could temporarily negatively affect bats at a project-specific level (assuming no implementation of conservation measures).

Plan Component	Activity	Tier 1 (ac)	Tier 2 (ac)
ECO-O-02	Timber harvest	1,200	3,200
ECO-O-03	Forest stand improvement	6,000	12,000
ECO-O-04	Thinning	400	600
ECO-O-05	Thin/burn	600	900
ECO-O-06	Prescribed burn	20,000	45,000

Under Tier 1 (based on a continuation of recent USFS budgets and capacity), if the upper end of the range of activities described in objectives is accomplished in a given year, that would equate to 28,200 ac of timber harvest and prescribed fire implemented in a single year. Note that this is not likely to be new areas each year; some areas will receive repeated burns, particularly where prescribed fire or timber stand improvement activities are occurring. Further, it is not anticipated that reaching the upper end of both activities would occur regularly, as this represents a large increase in the pace and scale compared to current activity levels. However, for purposes of the most conservative estimation of potential effects of forest management on bats, if one assumes 28,200 ac of annual activity, then approximately 2.7% of the Forests could experience temporary

changes in bat habitat quantity and quality. This percentage is not additive as management activities could occur in the same areas during subsequent years (i.e. it is not a correct assumption that 40.5% of the Forests would be affected over the life of the Revised Forest Plan [2.7% each year x 15 years]).

Similarly, under Tier 2 (additional outcomes that may be possible with added capacity of partners and partner resources), approximately 6% of the Forests could experience temporary changes in bat habitat quantity and quality. As noted above, this percentage is not additive.

2. General Discussion of Potential Effects

The Proposed Action represents a programmatic decision that describes no specific project-level action and authorizes no specific action, and therefore, would have no direct, indirect, or beneficial effects on listed species or their habitats. The Revised Forest Plan provides the direction under which future management decisions would be made. Any effects would occur later, during individual project implementation when site-specific decisions are made based on Revised Forest Plan direction. All project-level activities may be subject to consultation, as appropriate, under the ESA prior to implementation.

Table 9 summarizes potential forest management activities and potential effects to bats and bat habitat at a project-specific level, and Table 10 provides a brief description of the potential effects.

Table 9. Potential forest management activities and potential effects to bats and bat habitat at a project-specific level (assuming no implementation of conservation measures).

Plan Component	Activity	Potential Project-Level Effects		
		Noise and Vibration	Alteration of Forest Habitat	Heat and Smoke
ECO-O-02	Timber harvest	x	x	
ECO-O-03	Forest stand improvement	x	x	
ECO-O-04	Thinning	x	x	
ECO-O-05	Thin/burn	x	x	x
ECO-O-06	Prescribed burn	x	x	x

Table 10. Description of potential effects.

Potential Effect	Description
Noise and vibration.	Tree removal and prescribed burning generate noise and/or vibrations that could disturb bats. The novelty of these noises and their relative volume levels may dictate the range of responses from individuals or colonies of bats.
Alteration of forest habitat.	The alteration of forested habitat can occur as a result of tree removal and prescribed burning. These alterations can adversely affect bats directly when they are present on the landscape, indirectly, or beneficially. The alteration of forested habitat may result in the removal and/or fragmentation of summer habitat (commuting, roosting, and foraging habitats).
Heat and Smoke	Bats that remain in trees could be injured or killed by heat. Bats could also flush from trees due to smoke or heat. Burning conducted too close to hibernacula or under certain conditions could cause smoke to enter hibernacula and smother bats.

Potential Effect	Description
Habitat Improvement	Many of the activities proposed in summer habitat may benefit bats over the long-term by improving, restoring, or maintain habitat; or increasing insect abundance and diversity.

D. Cumulative Effects

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

For the purpose of this consultation, cumulative effects are primarily the effects attributable to state and private landowners with adjacent lands or inholdings on the Forests, or to the actions of state and local governments when no federal nexus (e.g., permit, funding) is present. Future non-federal activities will occur within and surrounding the action area. Such activities could include state highway maintenance and improvement projects, utility corridor construction and maintenance, residential and recreational development and use, timber harvest, fuel reduction around private developments, livestock grazing, and other actions. Future non-federal activities will continue and presumably increase as population densities rise and demand for development and maintenance increase. However, at this time, specific future actions being considered or proposed that could have cumulative effects with the Proposed Action are not known.

Additionally, since the Proposed Action is programmatic in nature, it does not in itself mandate or approve future implementation of activities on the Forests. Therefore, any future actions would undergo separate analysis and consultation related to the effects to listed species and/or critical habitat. Any site-specific information of future activities with no federal nexus that may contribute to cumulative effects would be considered at that time.

E. Jeopardy Determination

After reviewing the current status of bats, the environmental baseline for the action area, the effects of the Proposed Action, and cumulative effects, it is the Service's BO that the Revised Forest Plan, as proposed, is not likely to jeopardize the continued existence of forest-dwelling (Indiana bat, NLEB, little brown bat, and tricolored bat) or cave-obligate (gray bat and VBEB) bats. This conclusion is based on the magnitude of the project effects to reproduction, distribution, and abundance in relation to the listed population. Implementing regulations for section 7 defines "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." Our conclusion is based on, but not limited to, the information presented in the 2022 BA (USFS 2022a), the 2021 EIS (USFS 2022c), correspondence during the consultation process, information in our files, and informal discussions between the Service and the USFS.

The Revised Forest Plan includes plan components that would directly or indirectly enhance and/or restore habitat for federally listed species, including bats on the Forests. The ESE tool used by the USFS, and described in Chapter 4, Section B1, was also used to evaluate ecozone

condition over time and tiers to predict effectiveness of the Revised Forest Plan once implemented (Table 11). An overall positive increase in ecozone condition is also interpreted here as an overall positive increase in condition of suitable habitat for bats (should the Revised Forest Plan be implemented) which would in turn reflect species' health and resilience on the Forests.

Table 11. Change in condition over time and tiers for ecozones identified as (or that would contain) suitable bat habitat. Red = poor, yellow = fair, light green = good, and dark green = very good.

Ecozones	Existing Condition	Tier 1 10 yrs	Tier 1 50 yrs	Tier 2 10 yrs	Tier 2 50 yrs
Acidic Cove Forest ¹	1.92	1.75	2.42	1.75	2.14
Dry Oak Forest ^{1,2}	2.06	2.19	2.88	2.63	3.50
Dry-mesic Oak Forest ^{1,2}	1.53	2.06	2.24	1.94	2.71
Floodplain Forest ¹	1.00	1.21	1.93	1.21	1.64
High Elevation Red Oak Forest ^{1,2}	1.85	1.85	1.85	2.08	3.15
Mesic Oak Forest ^{1,2}	1.53	1.88	2.76	1.76	2.59
Northern Hardwood Forest ^{1,2}	1.63	1.38	2.63	1.88	2.38
Pine Oak-Heath Forest ¹	1.72	2.28	1.94	2.33	2.06
Rich Cove Forest ¹	1.61	1.83	2.06	2.11	2.17
Shortleaf Pine Forest ¹	1.89	2.11	2.06	2.44	2.11
Spruce-fir Forest ^{1,2}	2.67	2.87	3.27	2.87	3.27

¹forest-dwelling bats

²cave-obligate bats

The ESE tool predicts that ecozone conditions for bats generally improve or stay the same compared to existing conditions with implementation of the Revised Forest Plan for each combination of tier and timeframe. There are no predicted decreases in ecozone conditions. This is thought to be a result of maintenance and restoration of forest health and resilience, the major tenant of the Revised Forest Plan.

At finer scales, the ESE tool can analyze characteristics (indicators and elements) of each ecozone. This finer-scale analysis includes estimates of edge habitat availability, old growth forest condition, open forest condition, and snag density over time and tiers should the Revised Forest Plan be implemented. Acres of transitional edge habitat and miles of forest edge (edge habitat availability) are expected to improve or stay the same over time and tiers of the Revised Forest Plan. Elements contributing to old growth forest conditions and open forest conditions are also expected to improve or stay the same. Snag density is expected to decline with natural forest aging; however, active management will create new snags to replace those lost from natural aging or even increase density over time. Conditions within caves and abandoned mines are predicted to improve under implementation of the Revised Forest Plan because mitigating WNS is addressed through several plan components.

Loss of bats and their suitable habitats on the Forests would not lead to species jeopardy. In fact, analysis in the BA shows that conditions of these species should improve or stay the same over time and throughout the tiers of Revised Forest Plan implementation.

F. Incidental Take Statement

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 this incidental take statement (ITS).

This BO analyzes management direction that allows for future activities that may adversely affect bats but does not authorize these activities. The mere potential for future take from these actions is not a legitimate basis for providing an exemption for take. The Service is not issuing an ITS for this BO or identifying associated Reasonable and Prudent Measures (RPMs) and Terms and Conditions (TCs) in accordance with the 2015 guidelines outlined in the “Interagency Cooperation—Endangered Species Act of 1973, as Amended; Incidental Take Statements” which amends regulations associated with ITSs for programmatic actions (50 CFR 402.14(i)). The amendment states, “for a framework programmatic action, an incidental take statement is not required at the programmatic level; any incidental take resulting from any action subsequently authorized, funded, or carried out under the program will be addressed in subsequent section 7 consultation, as appropriate.” Subsequent consultation on the site-specific actions developed pursuant to the Revised Forest Plan will serve as the basis for determining if an exemption from the section 9 take prohibitions is warranted. If so, the Service will provide RPMs and TCs, as appropriate, to minimize the impacts of the take on bats in accordance with 50 CFR 402.14(i).

G. Conservation Recommendations

Sections 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a Proposed Action on listed species or critical habitat, to help implement recovery plans or to develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the Forests. In general, our recommendations are to continue and expand the various programs the Forests already undertake to contribute to bat conservation.

- Continue to collaborate with partners to learn more about how bats are using habitats on the Forests (e.g., spring migration radio tagging and tracking, location and assessment of roost trees).
- Continue coordinating with the Service on the region-wide Bat Conservation Strategy for the benefit of forest-dwelling bats.

H. Reinitiation Notice

This concludes formal consultation for forest-dwelling and cave-obligate bats and the effects of the revised Land and Resource Management Plan for the Pisgah and Nantahala National Forests. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if:

- (1) 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;

- (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or
- (3) a new species is listed or critical habitat designated that may be affected by the action.

The Service retains the discretion to determine whether the conditions listed in (1) through (3) have been met and reinitiation of formal consultation is required.

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