

Biological Opinion

Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats

FWS Log #: 04ET1000-2018-F-0017



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A handwritten signature in black ink, appearing to read "Robert Tawes", is written over a horizontal line.

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A handwritten date "4/12/18" is written in black ink above a horizontal line.

Date

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CONSULTATION HISTORY

This section lists key meetings and correspondence (events) during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Tennessee Ecological Services Field Office (TNFO).

Date	Event	Participants	Discussion Topic
Sept. 23, 2014	TVA Office, Knoxville, TN/Conference call	Staff from TVA, Service SE Region Office (RO), and TN FO	Discussion on development of a region-wide programmatic consultation (e.g., pros/cons, components, limitations, time frame).
Jan. 23, 2015	TVA office, Knoxville, TN	Staff from TVA and TN FO	Initiation of informal programmatic consultation
Feb. 10, 2015	Conference call	TVA staff; Service SE and Midwest ROs and TN FO staff	Framework and aspects in development of modeling approach to determine potential presence of Indiana bat and northern long-eared bat within TVA's Action Area.
Apr. 22, 2015	Conference call	Staff from TVA and TN, NC, KY, AL, MS, GA, and VA FOs	TVA shared focus and framework, discussion on what to focus on moving forward.
July 22, 2015	TN FO, Cookeville, TN/Conference call	Staff from TVA, Service SE RO, and TN, AL, KY, and MS FOs	Status Meeting (discussed routine actions, acreage estimates, data/modeling, avoidance and minimization measures).
Aug. 20, 2015	TVA Office, Knoxville, TN	TVA staff; Geographic information system (GIS) staff from TN and NC FOs	GIS Modeling and Analysis.
Dec. 16, 2015	GA FO, Athens, GA	TVA staff; staff from GA FO	Overview, status, and questions and answers regarding consultation with GA FO staff.
Jan. 6, 2015	TN FO, Cookeville, TN	TVA staff; TN FO staff	Checkpoint.
Jan. 14, 2016	Service SE RO, Atlanta, GA	TVA staff; staff from Service SE RO and TN FO	Overview and status.
Jan. 22, 2016	E-mail correspondence	TVA staff; TN FO staff	Provided BA Chapters 1-2 for Service review.
Feb. 1, 2016	TVA Office, Chattanooga, TN	TVA staff; AL FO staff	Overview, status, and questions and answers regarding consultation with AL FO staff.

Date	Event	Participants	Discussion Topic
Feb. 16, 2016	MS FO, Jackson, MS / Conference call	TVA staff; MS FO staff	Overview, status, and questions and answers of consultation with MS FO staff.
Feb. 22, 2016	KY FO, Frankfort, KY / Conference call	TVA staff; KY FO staff	Overview, status, and questions and answers of consultation with KY FO staff.
June 18, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, AL, GA, TN, MS, KY, NC, and VA FOs	TVA provided draft BA for final review and comments to the Service SE RO and AL, GA, TN, MS, KY, NC, and VA FOs.
June 30, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs	TN FO forwarded request to staff in Service SE RO, and AL, GA, MS, KY, NC, and VA FOs by July 19, 2017.
July 17, 2017	E-mail correspondence	TN FO staff; TVA staff	TN FO sent e-mail to TVA indicating that additional time was needed for Service SE RO, and AL, GA, MS, KY, NC, TN and VA FOs review and comments of draft BA; the RO and FOs agreed to provide comments to the TN FO by August 4, 2017. The TN FO indicated to TVA that comments would be provided to TVA by August 21, 2017.
Aug. 11, 2017	E-mail correspondence	TVA staff; staff in Service SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs	TVA sent e-mail to SE RO, and AL, GA, MS, KY, NC, TN, and VA FOs indicating that they would hold a conference call from the TN FO on September 15, 2017, to address comments submitted on draft BA.
Sept. 7, 2017	TN FO, Cookeville	TVA staff, TN FO staff	TVA held meeting with TN FO staff to discuss comments provided by KY, NC, TN, and VA FOs review of draft BA.
Sept. 15, 2017	Conference call	TVA staff, staff in Service SE RO, AL, GA, TN, MS, KY, NC, and VA FOs	TVA addressed comments submitted by FOs regarding the draft BA.
Sept. 15 – Oct. 1, 2017	E-mail correspondence, Phone calls	TVA staff, staff in KY, NC, and VA FOs	TVA continued coordinating with KY, NC, and VA FOs to further address their questions and comments on the draft BA.

Date	Event	Participants	Discussion Topic
Oct. 2, 2017	Mail	TVA staff, TN FO staff	TVA provided hard copy of final BA to TN FO.
Oct. 13, 2017	E-mail correspondence	TVA staff, TN FO staff	TVA provided electronic copy of final BA to TN FO.
Oct. 13, 2017	Mail	TN FO staff, TVA staff	The TN FO initiated formal consultation and indicated that the final subject programmatic biological opinion would be provided to TVA no later than Feb. 28, 2018.

BIOLOGICAL OPINION

1. INTRODUCTION

A Biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act (ESA) of 1973, as amended, as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the Tennessee Valley Authority's (TVA) proposed programmatic strategy for routine actions that may affect endangered and threatened bats (the Action). TVA provided a Biological Assessment (BA) for the Action, which described how 10 overarching actions and 96 routine activities that TVA authorizes, funds, or carries out, may affect ESA-listed bats and their designated critical habitat during the next 20 years. The BA does not address the effects of the 96 routine activities on other listed species and critical habitats, and these activities are subject to the consultation requirements of ESA §7(a)(2). As necessary, TVA must consider the effects of these activities on other listed species and critical habitats through additional programmatic or project-level consultations.

The TVA determined that 21 of the 96 routine activities have no effect on the listed bat species or their critical habitat. Unless these activities may affect other listed species and critical habitat, consultation is not required. The TVA determined that the other 75 routine activities may affect, but are not likely to adversely affect, the gray bat, Virginia big-eared bat, and designated critical habitat for the Indiana bat (Ibat). Of these 75 activities, TVA determined that 72 (all but 3) may affect, but are not likely to adversely affect, the Ibat and northern long-eared bat (NLEB). By letter dated March 8, 2018, the Service concurred with TVA's "not likely to adversely affect" determinations, which concluded the consultation relative to these species, critical habitats, and activities. Until new information warrants a reinitiation of the consultation that supported these activity-specific findings, projects that are fully consistent with the activity description in the BA do not require further consultation with the Service regarding the species and critical habitats for which the Service provided programmatic concurrence. TVA proposes to report annually all project-level activities that complied with ESA §7(a)(2) by relying on the programmatic consultation.

Accordingly, this BO is limited in scope to evaluating the effects of the three proposed routine activities that TVA determined are likely to adversely affect the Ibat and the NLEB. The Action does not affect, or is not likely to adversely affect, any designated critical habitat for listed bat species; therefore, this BO does not further address critical habitat.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce

appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

2. PROPOSED ACTION

TVA proposes a Bat Programmatic Strategy (the Action) to streamline the manner in which the agency fulfills its responsibilities under ESA §7 relative to ESA-listed bat species. TVA's BA for the Action describes various routine activities that may affect listed bat species and the conservation measures that TVA will apply to avoid and minimize adverse effects. The BA also describes various ongoing activities, such as monitoring, habitat enhancement, and public education, that promote the recovery of one or more listed bat species. Addressing these activities programmatically is intended to promote consistency, predictability, and efficiency of project-level consultations, and to more effectively address the conservation needs of listed bats at local and landscape scales.

The Action is comprised of 96 routine activities under the following 10 general action categories that TVA authorizes, funds, or carries out:

- 1) manage for biodiversity and public use;
- 2) protect cultural resources;
- 3) manage land use and disposal;
- 4) manage permitting under section 26a of the TVA Act;
- 5) operate, maintain, retire, construct, and expand power plants;
- 6) maintain existing transmission line assets;
- 7) convey electric transmission property;
- 8) expand or construct new transmission assets;
- 9) promote economic development; and
- 10) promote solar sites.

The Action does *not* include activities associated with:

- construction of, or purchase of power from, a wind farm;
- utility-scale solar projects (*i.e.*, projects that generate and feed solar power directly into the grid, supplying a utility with energy);
- TVA's ownership of mineral reserves; and
- nuclear power plant relicensing (the Nuclear Regulatory Commission typically serves as lead agency).

Of the 96 routine activities that occur under the 10 general action categories listed above, TVA determined that 75 may affect listed bats or their designated critical habitats. Of these 75 activities, only three are likely to adversely affect the Ibat or NLEB:

- 1) removal of hazardous trees or tree branches (Activity #33);
- 2) mechanical vegetation removal that includes trees or tree branches 3 inches or greater in diameter (Activity #34); and
- 3) prescribed burns (Activity #23);

In this BO, we do not further address the 93 activities described for the Action that TVA determined have no effect on, or are not likely to adversely affect, listed bats or their critical

habitat. The scope of the BO is limited to the three activities listed above that are likely to adversely affect the Ibat and NLEB, and to the proposed conservation actions that are relevant to these species. Because the effects of hazardous tree removal and other tree removal on bats are similar, we combine these two activities in our description of the proposed action in section 2.2 and in our effects analyses.

The BA estimates the spatial extent of tree removal and prescribed burning activity during a calendar year and cumulatively over the next 20 years (2018–2037), but does not identify the location or timing of such activity at the project level. In the context of consultation under ESA §7(a)(2), the Action is consistent with the regulatory definition at 50 CFR §402.02 of a “framework programmatic action,” which is a Federal action that approves a framework for the development of future actions that are authorized, funded, or carried out at a later time, and are subject to further consultation.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 CFR §402.02). The 96 activities of the programmatic Action will occur on lands associated with the 10 general action categories listed in the previous section. Table 2-1 reports the ownership, approximate total acreage, and estimated annual acreage affected by project activity on these lands.

Table 2-1. Ownership, total acreage, and annual affected acreage of the 96 activities described for the Action (source: BA Table 3-1).

Ownership	Acres	Annual Affected Acres
TVA Retained Land: Reservoir Land	293,000	12,782
TVA Retained Land: Power Property	38,000	1,089
TVA Transmission Easements: Existing ROW^a & Maintenance Buffer	545,201	79,186–80,935
TVA Transmission Easements: New ROW	23,800	1,190
Public Land: Economic Development Sites	75,220	3,761
Private Land: Solar Sites	40,000	2,000
Total	1,015,221	100,008–101,757

^a Right-of-Way

The 1.015-million acres reported in Table 2-1 are distributed throughout the 82.8-million acre TVA Region (Figure 2-1) in Tennessee, northern Alabama, northern Georgia, southern Kentucky, eastern Mississippi, western North Carolina, and southwestern Virginia. The BA does not provide maps delineating Action lands within the TVA Region, because some are not yet identified (e.g., future solar sites on private land, new transmission substations), and many are difficult to display effectively at a regional scale (e.g., the existing transmission ROW network). Although the Action Area is large, it represents only 1.23 percent of the total area within the TVA Region.

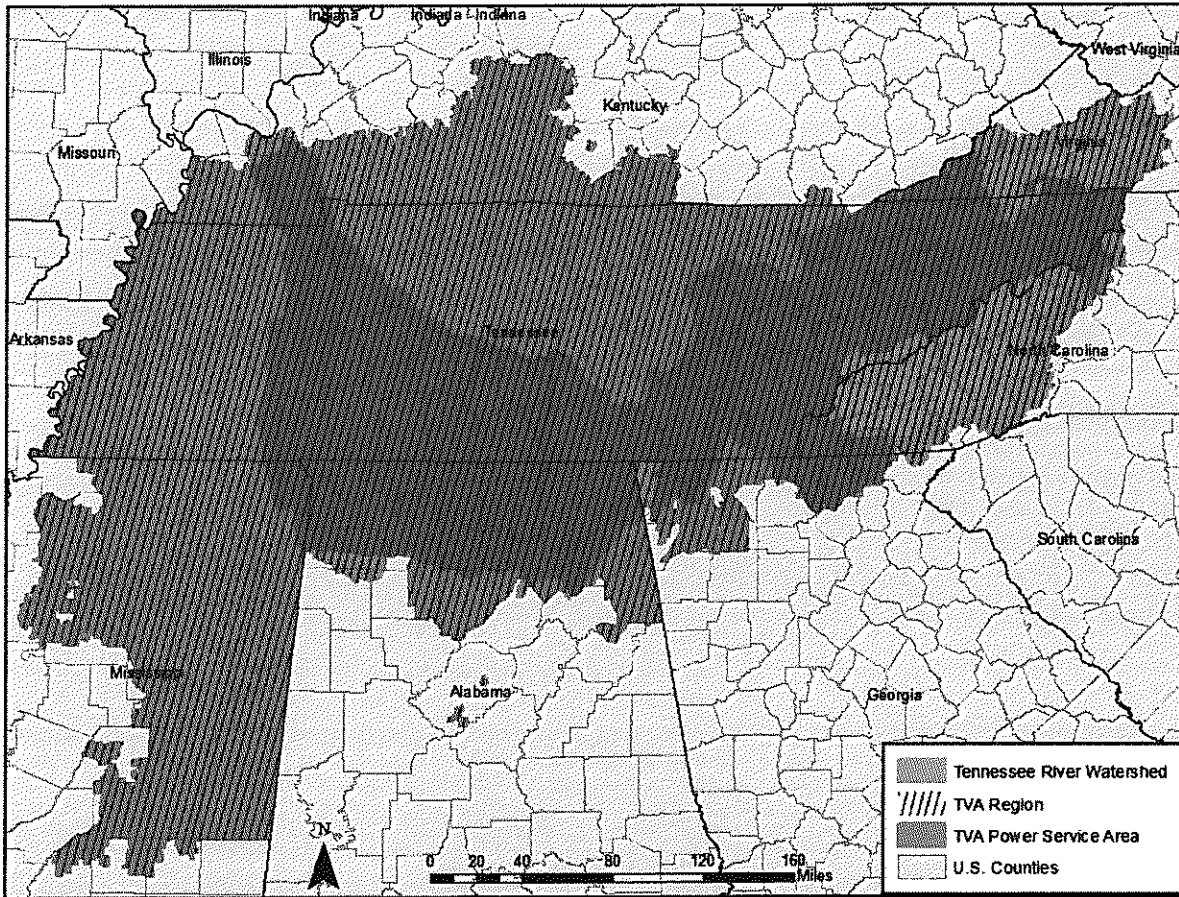


Figure 2-1. The 1.015-million acre Action Area is distributed throughout the 82.8-million acre TVA Region, which is comprised of the Tennessee River Watershed and the TVA Power Service Area (source: BA Figure 2-1).

The BA does not provide a project-specific schedule or map of activities over the 20-year Action duration. Annually, TVA estimates that about one-tenth (100,008–101,757 acres) of the lands for which the programmatic Action is formulated will receive direct and indirect effects from project activity. Cumulatively over 20 years, TVA estimates that the routine activities described for the Action will affect about 45.5 percent of the Action lands; therefore, more than half of the 1.015-million acres will receive no effects. Some lands may receive project activity on multiple occasions (*e.g.*, prescribed burning, ROW vegetation management). Recognizing the variable and uncertain distribution of the routine activities, TVA describes the 1.015-million acres of lands that may receive effects of project activity at any time during the next 20 years as the “Action Area” for this consultation. Although it includes areas that the Action will not affect, the Service adopts the TVA definition of the Action Area for the purposes of this programmatic consultation.

Chapter 2 of the BA, “Description of the Action Area,” provides data about land cover and other characteristics of the 82-million-acre TVA Region, which contains the 1-million-acre Action

Area distributed in patches (e.g., TVA reservoirs, power plants) and linear corridors (e.g., transmission ROWs) throughout the region. About 36 million acres (44 percent) of the Region has forest cover that is potentially suitable habitat for tree-roosting bats (BA pg. 24). The Action Area is proportionally less forested than the Region as a whole, with 240,103 acres (23.65 percent) of forest cover (H. LeGrand, pers. comm., 2017).

2.2. Tree Removal Activities

Eight of the ten of the general TVA action categories identified in section 2 routinely involve a need to remove trees, either to eliminate a hazard to human life or property (Activity #33) or to manage the structure and composition of the plant community on a site (Activity #34). Action category #2, “protect cultural resources,” and category #7, “convey electric transmission property,” do not involve tree removal.

The BA described three general sideboards for TVA’s anticipated routine tree removal activity. First, TVA estimated the total acreage of routine tree removal annually and cumulatively over the next 20 years (2018–2037). Second, TVA estimated the proportion of tree removal that would result in a permanent alteration of local habitat conditions, *i.e.*, the percentage of the acreage in which trees are not planted or allowed to regenerate following tree removal. Third, TVA estimated the temporal distribution of tree removal acreage (either permanent or temporary) relative to three functional seasons of the bat life cycle:

- Inactive season, hibernation (mid-November to mid-March or April)
- Active season, all bats are volant (able to fly).
- Active season, bat pups are non-volant (June and July).

Table 2-2 summarizes these estimates of tree removal activity by action category.

The 20-year cumulative estimates in Table 2-2 are exactly or approximately 20 times a single annual acreage estimate reported for each action category except #6, “maintain existing transmission line assets,” for which TVA provided two annual estimates. TVA anticipates a substantial reduction in tree removal from 1,835 to 86 acres per year beginning in the year 2022, when TVA expects it will have removed taller trees from the border zones along the majority of existing ROWs. Thereafter, TVA plans to maintain its ROWs in an early-successional state on a 3-year maintenance rotation. Removing trees from 1,835 acres per year for 4 years and from 86 acres per year for 16 years results in a 20-year cumulative estimate of 8,716 acres for existing transmission line maintenance. The cumulative acreage of tree removal for all action categories is 47,204 acres, of which 92 percent is permanent removal.

2.2.1. Tree Removal Settings and Methods

Section 3.2 of the BA describes two of the 96 activities included under the programmatic Action as tree removal:

Activity #33, “Removal of hazardous trees or tree branches,” occurs as necessary throughout the year to address immanent threats to public safety, facilities, or private property. Settings for hazardous tree removal include, but are not limited to, campgrounds, day use areas, access

Table 2-2. Extent (acres) of TVA tree removal activity (annual, permanent, seasonal, and cumulative) for 2018–2037 (data source: BA Table 3-2). Percentages are relative to values in the same row under “Annual Total Tree Removal,” except in the last row, where the percentages are relative to 47,204 acres (“Total Cumulative Tree Removal”).

Action Category		Annual Total Tree Removal	Permanent Tree Removal	Seasonal Distribution			Cumulative Total Tree Removal 2018-2037
				Inactive Season	Active Season; All Bats Volant	Active Season; Pups Non-Volant	
1. Manage for Bio-diversity, Public Use		59	35 (60%)	12 (20%)	30 (50%)	18 (30%)	1,186
3. Manage Land Use, Disposal		630	504 (80%)	315 (50%)	189 (30%)	126 (20%)	12,600
4. Manage 26a Permitting (Shoreline)		104	73 (70%)	83 (80%)	10 (10%)	10 (10%)	2,080
5a. Operate and Maintain Plants		35	35 (100%)	28 (80%)	5 (15%)	2 (5%)	700
5b. Retire, Construct, Expand Plants		75	75 (100%)	60 (80%)	11 (15%)	4 (5%)	1,500
6. Maintain Existing TL ^a Assets:	2018–2021	1,835	1,835 (100%)	734 (40%)	459 (25%)	642 (35%)	8,716
	2022–2037	86	86 (100%)	34 (40%)	22 (25%)	30 (35%)	
8. Expand or Construct New TL Assets		595	595 (100%)	357 (60%)	119 (20%)	119 (20%)	11,900
9. Promote Economic Development		376	376 (100%)	338 (90%)	38 (10%)	0 (0%)	7,522
10. Promote Solar Generation		50	50 (100%)	40 (80%)	10 (20%)	0 (0%)	1,000
Annual Total	2018–2021	3,759	3,578 (95%)	1,967 (52%)	871 (23%)	921 (25%)	N/A ^b
	2022–2037	2,010	1,829 (91%)	1,267 (63%)	434 (22%)	309 (15%)	
Cumulative Total 2018–2037		N/A	43,576 (92%)	28,140 (60%)	10,428 (22%)	8,628 (18%)	47,204

^a TL = transmission line

^b N/A = not applicable

corridors between private property and TVA reservoirs, and transmission line ROWs. Hazardous tree removal may involve the use of a feller buncher, bulldozer, bush-hog, chainsaw, and other hand tools.

Activity #34, “Mechanical vegetation removal, includes trees or tree branches three inches or greater in diameter,” serves a variety of purposes and occurs during daylight hours throughout the year, with a possible duration of days to weeks at a particular location. The physical settings for non-hazardous tree removal include, but are not limited to, public/recreational use areas, natural areas (*e.g.*, to create openings for wildlife habitat enhancement), lawn maintenance, and areas for the construction of new buildings, roads, transmission lines, or substations. TVA removes trees along existing ROWs and access roads to ensure the integrity of operations and reduce risks to human safety. The equipment employed may include a feller buncher, bulldozer, track or bucket hoe, scraper, bush-hog, mower, logging and boom trucks, chainsaw, and hand tools.

2.2.2. Conservation Measures for Tree Removal

To avoid or reduce adverse effects to bats resulting from tree removal, TVA proposes to apply several conservation measures when conducting Activities #33 and #34. Generally, these measures are intended to reduce the intensity of, or the probability of exposure to, stressors caused by tree removal that may affect bats or their habitat resources, including the elimination of roost trees (while currently occupied or not), and the introduction of sediment or other pollutants to waters that bats drink or that support bat prey resources.

The BA also identifies noise as a stressor caused by tree removal activity. The “noise/vibration” conservation measure that TVA assigns to tree removal (labeled as NV1; BA pg. 114) states:

NV1 = Noise is expected to be short-term, transient, and not significantly different from urban interface or natural events (*i.e.*, thunderstorms) that bats are frequently exposed to when present on the landscape; bats thus are unlikely to be disturbed.

This statement suggests that the noise associated with tree removal activity is unlikely to disturb bats due to its brief duration and similarity to ambient noise. However, TVA indicates that Activity #34 may include the use of various large or loud equipment (*e.g.*, bulldozer, chainsaw) “with [a] possible duration of days to weeks” (BA pg. 44). Because this measure does not specify actions or conditions that will have any effect on when, where, or how noise associated with tree removal will occur, it is not relevant to the analysis in this BO.

General Measures

TVA proposes nine conservation measures (TR1–TR9; BA section 5.2.4) for tree removal activity. Some deal with the timing and location of tree removal activity relative to the seasonal life cycle and known occurrences of the listed bats. The proposed measures are (copied from the BA):

- TR1 = Removal of potentially suitable summer roosting habitat during time of potential occupancy has been quantified and minimized programmatically. TVA will track and document alignment of activities that include tree removal (*i.e.*, hazard trees, mechanical vegetation removal) with the programmatic quantitative cumulative estimate of seasonal

removal of potentially suitable summer roost trees for Indiana bat and northern long-eared bat.

- TR2 = Removal of suitable summer roosting habitat within 0.5 mile of Priority 1/Priority 2 Indiana bat hibernacula, or 0.25 mile of Priority 3/Priority 4 Indiana bat hibernacula or any northern long-eared bat hibernacula will be prohibited, regardless of season, with very few exceptions (e.g., vegetation maintenance of TL ROW immediately adjacent to Norris Dam Cave, Campbell County, TN).
- TR3 = Removal of suitable summer roosting habitat within documented habitat (*i.e.*, within 10 miles of documented Indiana bat hibernacula, within 5 miles of documented northern long-eared bat hibernacula, within 2.5 miles of documented Indiana bat summer roost trees, within five miles of Indiana bat capture sites, within one mile of documented northern long-eared bat summer roost trees, within three miles of northern long-eared bat capture sites) will be tracked, documented, and included in annual reporting.
- TR4 = Removal of suitable summer roosting habitat within potential habitat for Indiana bat or northern long-eared bat hibernacula will be tracked, documented, and included in annual reporting.
- TR5 = Removal of any trees within 150 ft of a documented Indiana bat or northern long-eared bat maternity summer roost tree during non-winter season, range-wide pup season or swarming season (if site is within known swarming habitat), will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with the USFWS to determine how to minimize impacts to pups to the extent possible. This may include establishment of artificial roosts before loss of roost tree(s).
- TR6 = Removal of a documented Indiana bat or northern long-eared bat roost tree that is still suitable and that needs to occur during non-winter season, range-wide pup season, or swarming season (if site is within known swarming habitat) will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with the USFWS to determine how to minimize impacts to pups to the extent possible. This may include establishment of artificial roosts before loss of roost tree(s).
- TR7 = Tree removal within 100 ft of existing transmission ROWs will be limited to hazard trees as defined in Section 3-2.
- TR8 = Requests for removal of hazard trees on or adjacent to TVA reservoir land are inspected by staff knowledgeable in identifying hazard trees per International Society of Arboriculture and TVA's checklist for hazard trees. Approval is limited to trees with a defined target.
- TR9 = Internal controls will be in place to further reduce potential for site-specific direct adverse effects to Indiana bat and northern long-eared bat associated with tree removal. This includes promoting presence/absence surveys (mist netting or emergence counts) that allows for positive detections but without resulting in increased constraints in cost and project schedule. Internal controls are intended to facilitate willingness and financial feasibility to conduct surveys amidst increasing budget constraints without the risk for increased financial penalty if Indiana bat or northern long-eared bat individuals are caught. This enables TVA to

contribute to increased knowledge of bat presence on the landscape while continuing to carry out TVA's broad mission and responsibilities.

Sedimentation, Spills, Pollutants, and Contaminants (SSPC)

Six conservation measures (SSPC1–5, and SSPC7) deal with protecting water quality while conducting tree removal activities, which are described in section 5.2.6 of the BA. These measures are standard TVA best management practices (BMPs) that avoid or minimize inputs of sediment and other pollutants into waterways and cave/cave-like entrances. Although TVA determined that tree removal activity under the programmatic Action is likely to adversely affect the Ibat and NLEB, TVA concluded that the stressors causing such adverse effects do not include sediments and contaminants (BA pg. 123). The Service agrees that implementing SSPC1–5 and SSPC7 during tree removal activities will limit any adverse effects to bats via changes in water quality to an insignificant scale or discountable probability. Therefore, we do not further address the SSPC conservation measures in this BO.

2.3. Prescribed Burning

Of the ten general TVA action categories listed in the introduction to section 2 of this BO, only “manage for biodiversity and public use” involves prescribed burning (Activity #23). This activity is limited to portions of TVA Reservoir Lands. TVA uses fire to maintain and establish high quality wildlife habitat, reduce the risk of wildfires, stimulate growth of targeted vegetation, and recycle nutrients back into the soil.

During the last 5 years, TVA has burned about 750 to 1,000 acres each year, of which 60 percent was on open lands and 40 percent on forested lands. The annual extent of burning will rarely exceed 1,500 acres. TVA estimates that 26,247 acres of its reservoir lands could use prescribed fire over the next 20 years. Of this total, 17,677 acres (86 parcels that range in size from 2–4,649 acres) are identified for prescribed burning (potential burn sites), but are not currently included in a burn plan due to budget and staff limitations. The remaining 8,570 acres (66 parcels that range in size from 2–1,659 acres) are currently managed with fire (active burn sites) or are slated for fire management within the next 5 years (planned burn sites).

2.3.1. Prescribed Burning Methods

TVA intends to conduct most burns in early winter to early spring (approximately November–April). Weather conditions that are not conducive to controlled burning generally preclude burns during September and October. Burn season and frequency on a parcel ranges from 1–5 years, depending on site-specific objectives. Table 2-3 provides examples of the objectives associated with burns conducted at various times of year.

Table 2-3. Seasonality and example objectives of prescribed burning on TVA lands (source: BA Table 3-3).

SEASON	OBJECTIVES
Fall-Winter-Spring; Spring	Invasive control - conversion to native early successional - maintain early successional (in partnership with state agency at some locations)
Fall-Winter; Winter-Spring; Spring	Maintain early successional seral stage (e.g., dam safety level protection; hay/row crop production; Native warm season grass production; research partnership with local university, state agency or non-profit organization; reduce encroaching canopy - expanding barrens habitat; reduction of density coverage; understory maintenance- shortleaf pine initiative)
Fall-Winter	Maintain Pine-savannah - early successional seral stage
Winter-Spring	Mix upland hardwood selective thinning and understory control- Partnership research with Mississippi State University
Fall-Winter-Spring	Mixed hardwood-pine local wildfire suppression-understory maintenance-Shortleaf Initiative
Spring	Pine-Cedar local wildfire suppression-invasive and woody suppression-revert to early succession
Fall-Winter-Spring	Pine-hardwood local wildfire suppression-understory maintenance-hardwood regeneration
Fall-Winter-Spring; Fall-Winter	Pine-Oak local wildfire suppression (invasive understory control; early succession maintenance; shortleaf initiative; afforestation preparation)
Fall-Winter-Spring	Planted shortleaf (understory maintenance; maintain early successional seral stage)
Winter-Spring	Site prep (conversion to native, early successional stage; maintain early successional seral stage)
Fall-Winter-Spring	Undesirable woody suppression - desirable woody regeneration maintenance; early-successional conversion and maintenance)
Fall-Winter; Spring	Upland hardwood local wildfire suppression (undesirable woody control; understory maintenance; invasive control)

TVA has previously established BMPs for conducting prescribed burns, which are appended to the BA as Appendix C (“BMPs for Silviculture Activities on TVA Lands”), and which apply to this Action. The description of Activity #23 in section 3-2 of the BA lists the following guidance (conditions and considerations) for prescribed burning that specifically deal with caves and bats (paraphrased from BA pg. 40):

- 1) Caves are smoke-sensitive environments. TVA assumes that federally listed bats use a cave until surveys show otherwise.
- 2) Considering relevant site-specific conditions, prescribed burn managers must ensure that smoke does not enter caves or cave-like structures when bats are present.

- 3) Where feasible, burn larger acreages in smaller units at a time to reduce the risk of smoke entering sensitive sites.
- 4) Tractor-constructed fire breaks, mechanical site preparation, vegetation cutting, and construction of new roads (including temporary roads) are prohibited within 200 feet of cave portals, cave collapse areas, mines and sinkholes. Use site-specific data to determine whether wider buffers are necessary to protect water and air quality in caves and mines.
- 5) Use existing barriers (*e.g.*, streams, lakes, wetlands, roads, and trails) as fire lines whenever possible.
- 6) Prescribed burning in known and potential maternity roosting habitat is prohibited from June 1–July 31, except where site-specific data indicate that Ibats and NLEBs are not likely present.

TVA has provided a seasonal breakdown of the 20-year cumulative extent of prescribed burning relative to the three bat life-cycle seasons: inactive season (winter), non-volant pups (June and July), and the remainder of the active season (H. LeGrand, pers. comm., 2018a). Although not listed as an avoidance and minimization measure applicable to burning, this breakdown specifies no burning during June and July, 90 percent during the inactive season, and 10 percent in the remainder of the active season.

2.3.2. Conservation Measures for Prescribed Burning

In addition to the burning BMPs and the methods described in section 2.3.1, TVA proposes nine conservation measures to avoid and minimize the adverse effects of smoke and heat from prescribed burning on bats. Some of these measures, listed below (copied from BA section 5.2.3), overlap with the proposed methods.

- SHF1 = Fire breaks are used to define and limit burn scope.
- SHF2 = Site-specific conditions (*e.g.*, acres burned, transport wind speed, mixing heights) are considered to ensure smoke is limited and adequately dispersed away from caves so that smoke does not enter cave or cave-like structures.
- SHF3 = Acreage is divided into smaller units to keep the amount of smoke at any one time or location to a minimum and reduce risk for smoke to enter caves.
- SHF4 = Planned timing for prescribed burns minimally overlaps with time of potential occupancy by bats (See BA Table 3-3). If burns need to be conducted during April and May, when there is some potential for bats to present on the landscape and more likely to enter torpor due to colder temperatures, burns will only be conducted if the air temperature is 55° or greater, and preferably 60° or greater.
- SHF5 = Fire breaks are plowed immediately prior to burning, are plowed as shallow as possible and are kept to minimum to minimize sediment.
- SHF6 = Tractor-constructed fire lines are established greater than 200 ft from cave entrances. Existing logging roads and skid trails are used where feasible to minimize ground disturbance and generation of loose sediment.
- SHF7 = Burning will only occur if site specific conditions (*e.g.* acres burned, transport wind speed, mixing heights) can be modified to ensure that smoke is adequately dispersed away from caves or cave-like structures. This applies to prescribed burns and burn piles of woody vegetation.

- SHF8 = Brush piles will be burned a minimum of 0.25 mile from documented, known, or obvious caves or cave entrances and otherwise in the center of newly established ROW when proximity to caves on private land is unknown.
- SHF9 = A 0.25-mile buffer of undisturbed forest will be maintained around documented or known gray bat maternity and hibernation colony sites, documented or known Virginia big-eared bat maternity, bachelor, or winter colony sites, Indiana bat hibernation sites, and northern long-eared bat hibernation sites. Undisturbed forest is important for gray bats to regulate temperatures at the mouth of the cave, and provide cover for bats as they emerge from the cave. Prohibited activities within this buffer include cutting of over-story vegetation, construction of roads, trails or wildlife openings, and prescribed burning. Exceptions may be made for maintenance of existing roads and existing ROW, or where it is determined that the activity is compatible with species conservation and recovery (*e.g.*, removal of invasive species).

The BA (pg. 39) reports that 74 caves occur within 1 mile of the active, planned, and potential burn sites on TVA reservoir lands. Of these, 11 have documented bat occupancy (current or historic), 25 are within 500 feet of active burn sites, and 15 are within the boundaries of potential burn sites (3 of the 15 have documented bat occurrence). TVA determined that prescribed burning conducted in a manner consistent with the proposed Action, which includes the BMPs and the conservation measures listed above, is not likely to adversely affect listed bats while they inhabit caves.

The Service previously concurred with this TVA determination relative to the gray bat and Virginia big-eared bat (see Consultation History), which roost in caves year-round. We agree also that the BMPs and proposed conservation measures will limit any adverse effects of burning on I bats and NLEBs while they inhabit caves to an insignificant scale or discountable probability. Therefore, we do not further address in this BO the effects of burning on these two species while they inhabit caves, which is during their inactive winter (hibernation) season. Further analysis of the effects of prescribed fire is limited to burns conducted during the active season of these two bat species.

2.4. Additional Conservation Measures

In addition to the impact avoidance and minimization measures specified for each of the 96 activities, section 5.3 of the BA describes various ongoing TVA efforts that promote the recovery of listed bats in the TVA Region. These efforts include:

- monitor gray bat caves on TVA-managed lands;
- collaborate with partners to survey bridges and potential summer use (*e.g.*, maternity colonies) areas;
- support bat ecology research (*e.g.*, spring migration radio tagging and tracking, location and assessment of roost trees);
- monitor bat use following habitat enhancement and artificial roost projects on TVA lands;
- install, monitor, and maintain gates and signage at bat caves on TVA lands;
- serve on State white-nose syndrome planning committees (*e.g.*, AL, TN);

- maintain a database of listed bat occurrences within the TVA Region (*i.e.*, mist net captures, cave, bridge, and tree roosts, *etc.*) to inform project-specific environmental reviews and BAs;
- manage invasive plants that threaten rare species habitats (*e.g.*, cave entrances); and
- conduct bat habitat identification workshops for TVA staff.

TVA also addresses listed bat conservation needs to some extent in the following plans and policies:

- 2015 Integrated Resource Plan (IRP), which guides TVA’s electricity generation planning;
- 2011 Natural Resource Plan (NRP), which guides management and stewardship activities on TVA lands;
- 2006 Land Policy, which guides management of the reservoir system and surrounding reservoir lands; and
- 1999 Shoreline Management Policy (SMP), which guides the protection of shoreline and aquatic resources while allowing reasonable access to the water by adjacent property owners.

Lastly, the BA expresses TVA’s commitment to a rigorous environmental review process at multiple levels to ensure compliance with the National Environmental Policy Act, ESA, and other environmental laws. The Action of this consultation is an example of such review at a regional programmatic level for ESA compliance purposes with respect to listed bats. The programmatic Action addresses multiple routine activities that are common components of actions funded, authorized, or carried out with additional project-level environmental review as necessary and appropriate.

The BA does not provide data about the various additional conservation measures listed above that would inform an analysis of their beneficial effects on listed bat numbers, reproduction, or distribution. The Service recognizes the inherent value of these efforts to the recovery of listed bats. Several provide information that is critical to formulating effective conservation actions, but do not improve directly the status of listed bats. Therefore, lacking data that would allow us to determine the scale of their beneficial effects relative to those of the proposed activities that are likely to adversely affect the Ibat and NLEB, we do not further address the “additional conservation measures” in this BO.

2.5. Project-Level Process

Chapter 6 of the BA describes the procedures TVA proposes for activities funded, authorized, or carried out under the programmatic Action to rely on this programmatic consultation for ESA compliance with respect to the listed bats that such activities may affect. These procedures specify a sequence of TVA project-specific determinations using best available data, and the documentation, notification, and reporting processes that are associated with these determinations. Table 2-4 reiterates these procedures.

Table 2-4. Proposed steps to document and report alignment of TVA activities with the bat programmatic consultation (source: BA Table 6-1).

#	Step
1.	Site-specific project will be screened via TVA's environmental review process.
2.	Project will be reviewed to determine if associated activities are within the scope of TVA's bat programmatic consultation (BPC).
3a.	Projects with activities that are outside BPC scope will be subject to project-specific consultation if warranted. END
3b.	Projects with activities that are within BPC scope will be reviewed for potential to impact covered species. Go to 4.
4a.	Project-specific activities that are determined in the BPC to have No Effect will be documented as aligning with the BPC and documented in TVA's environmental management system. END
4b.	Project-specific activities determined in the BPC to have potential to NLAA ^a covered species will be reviewed further to determine if project exposes covered species to stressors. If so, conservation measures identified in the BPC will be implemented and documented. If no exposure to stressors will occur as part of the project, activity will be documented as having no effect on covered species. In either case, TVA will notify the appropriate USFWS FO (via email or letter) of proposed project, alignment with BPC, and project-specific determination. This notification will serve as documentation in the TVA's administrative record. All projects with effects determinations of these types will be summarized in annual reporting associated with the BPC. END
4c.	Project-specific activities determined in the BPC to have potential to LAA ^b covered species will be reviewed further to determine if project exposes covered species to stressors. Go to 5.
5a.	If no exposure to stressors will occur as part of this project-specific activity, activity will be documented as aligning with the BPC, having no effect on covered species, and will be included in annual reporting associated with the BPC. END
5b.	If project-specific activity aligns with LAA determination, project conducts presence/ absence surveys, and detections are negative, TVA will document a NLAA determination and alignment with BPC. TVA will notify the appropriate USFWS FO (via email or letter) of the proposed project, alignment with BPC, survey outcome, and determination. This notification will serve as documentation in TVA's administrative record. All projects with effects determinations of these types will be summarized in BPC annual reporting. END
5c.	If project-specific activity aligns with LAA determination, project assumes presence, or project conducts presence/absence surveys and detections are positive, TVA will document a LAA determination and alignment with BPC. TVA will notify the appropriate USFWS FO (via email or letter) of the proposed project, alignment with BPC, survey outcome (if surveys conducted), and determination. This notification will serve as documentation in TVA's administrative record. All projects with effects determinations of these types will be summarized in annual reporting associated with the BPC. END

^a NLAA = may affect; not likely to adversely affect.

^b LAA = may affect; likely to adversely affect.

2.6. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed Federal action. For purposes of consultation under ESA §7, the effects of a Federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions.

“Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration” (50 CFR §402.02).

The 96 activities addressed in this programmatic Action are routine components of projects that serve one or more of the 10 general action categories listed in section 2 of this BO. Projects authorized, funded, or carried out under these 10 action categories may or may not involve interrelated or interdependent actions. Section 5.1 of the BA indicates that TVA will consider in project-level environmental review whether interrelated or interdependent activities associated with one or more of the activities covered under this programmatic Action may affect listed bats and other listed species, and if so, enter a project-specific consultation with the Service. We agree with TVA that any assessment of interrelated and interdependent activities at the program level of this Action would be speculative, given its activity-level focus. Therefore, we do not further address the topic of interrelated or interdependent actions in this BO.

3. STATUS OF THE SPECIES

This section summarizes best available data about the biology and current condition of the Indiana bat (*Myotis sodalis*) (Ibat) and the northern long-eared bat (*Myotis septentrionalis*) (NLEB) throughout their range that are relevant to formulating an opinion about the Action.

The Ibat was among several animals identified in 1967 (32 FR 4001) as threatened with extinction under the Endangered Species Preservation Act of 1966, and subsequently classified as endangered when the ESA of 1973 superseded the earlier statute. The Service approved a recovery plan for the Ibat on October 14, 1983 (USFWS 1983), and issued a draft first revision, on April 13, 2007 (USFWS 2007). Critical habitat is designated for the Ibat, but is not relevant to this consultation.

The Service has issued the following decisions regarding ESA protections for the NLEB:

<u>Date</u>	<u>Federal Register</u>	<u>Decision</u>
04/02/2015	80 FR 17973–18033	Threatened species status with interim 4(d) rule
01/14/2016	81 FR 1900–1922	Final 4(d) rule
04/27/2016	81 FR 24707–24714	Determination that designation of critical habitat is not prudent

The Service has not yet approved a recovery plan for the NLEB.

3.1. Species Description

The Ibat is a medium-sized bat that closely resembles the little brown bat (*Myotis lucifugus*), but has a darker brown to black pelage. Adults weigh about one-quarter of an ounce (the weight of three pennies), and have a wingspan of 9 to 11 inches.

The NLEB is also a medium-sized bat, also weighing about one-quarter of an ounce. As indicated by its common name, the NLEB is distinguished from other *Myotis* species by its large ears, which extend beyond the nose when laid forward.

3.2. Life History

The Ibat and NLEB are both insectivorous migratory species that hibernate in caves and mines during winter and forage in wooded areas during summer. Foraging activity and travel is mostly nocturnal. Ibat average life span is 5–10 years, but recapture of banded individuals has documented Ibats up to 15 years old (Humphrey and Cope 1977). NLEB longevity is up to 18.5 years (Hall *et al.* 1957). Prior to the arrival of white-nose syndrome, Caceres and Pybus (1997) attributed the highest age-specific annual mortality rates for the NLEB and many other species of bats to the juvenile stage. Hall (1962), Myers (1964), and LaVal and LaVal (1980) report sex ratios of 1:1 for the Ibat. NLEB sex ratios at the population level are not reported in the literature, but as a species similar to the Ibat in many other respects, a 1:1 ratio is likely.

The key phases in the Ibat and NLEB annual life cycle are:

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

Although the timing varies with latitude and weather conditions, both bat species generally hibernate from mid-fall to mid-spring each year. Upon emerging from hibernation, bats forage for a few days or weeks near their hibernaculum (spring staging). Spring migration occurs from mid-March to mid-May. Females depart shortly after emerging from hibernation and are pregnant when they reach summer areas. Males tend to stay closer to hibernacula during summer. Adult females give birth to a single pup in late May to early June. Pups are weaned from nursing shortly after becoming volant in mid- to late-July. Fall migration occurs from mid-August to mid-October. Upon arriving at hibernacula, both species exhibit the “swarming” behavior. Large numbers of bats fly in and out of hibernacula entrances from dusk to dawn, roosting during the day in trees, but occasionally within the hibernacula. 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 Ibat and NLEB life history that are most relevant to this consultation. We do not further discuss hibernation or hibernacula, because the Action is not likely to affect this life stage or habitat.

3.2.1. Summer Habitat and Ecology

Summer habitats for Ibat and NLEB 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. NLEBs are typically associated with upland forests with generally greater cover than Ibats, and appear to favor mature upland forests (Caceres and Pybus 1997), but occasionally forage over forest clearings, water, and along roads. However, most NLEB hunting occurs on forested hillsides and ridges, rather than along riparian areas preferred by the Ibat (Brack and Whitaker 2001; LaVal *et al.* 1977).

Wing morphology of both species suggests they are adapted to moving in cluttered habitats. Many species of bats, including the Ibat and NLEB, 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 patches of trees are unlikely to provide suitable foraging or roosting habitat unless connected to other patches by a wooded corridor.

Many male Ibats 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, which we discuss in the following subsection. Males may occasionally roost in caves. Males exhibit summer site fidelity and have been recaptured in foraging areas from prior years (USFWS 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. The size of NLEB maternity colonies is variable, but most are comprised of 30-60 females (USFWS 2014). Ibat maternity colonies are generally larger, but most contain fewer than 100 adult females (USFWS 2007). The mean maximum emergence count from Ibat maternity roosts after young began to fly (measured in 12 studies) was 119 bats (Kurta 2005), suggesting a colony size of 60-70 adult females (assuming that most adult females successfully raise one pup to volancy).

For purposes of this programmatic BO, we use 60 adult Ibat females per colony as the basis for estimating the number of Ibat colonies on the summer landscape. For each colony, we assume the local Ibat population is comprised of 60 adult females, 60 sympatric adult males, and 60 juveniles following parturition. Similarly, we use 45 adult NLEB females (the mid-point of the 30-60 range), and assume that the local population is comprised of 45 adult females, 45 sympatric adult males, and 45 juveniles following parturition.

Both species exhibit a degree of inter-annual fidelity to particular roost trees and/or maternity areas (Ibat: Humphrey *et al.* 1977; Gardner *et al.* 1991a, 1991b; Gardner *et al.* 1996; Callahan *et al.* 1997) (NLEB: Perry 2011; Johnson *et al.* 2009; Jackson 2004; Foster and Kurta 1999). Males are occasionally found with females in NLEB maternity colonies, but only rarely in Ibat maternity colonies. Maternity colonies of both species use networks of roost trees often centered around one or more primary (Ibat) or central-node (NLEB) roost trees. Ibat maternity colonies use a minimum of 8–25 roost trees per season (Callahan *et al.* 1997; Kurta *et al.* 2002). NLEB roost networks also include multiple alternate roost trees. Male and non-reproductive female NLEBs may also roost in caves and mines (Barbour and Davis 1969; Amelon and Burhans 2006).

Roost tree preferences vary between the two species. Ibats are known to use a wide variety of tree species ≥ 5 inches diameter at breast height (dbh) that have cracks, crevices, or peeling bark. A typical Ibat primary roost is located under the exfoliating bark of a dead ash, elm, hickory, maple, oak, or poplar, but any tree that retains large, thick slabs of peeling bark is potentially suitable. Primary Ibat roosts are usually in trees that are in early-to-mid stages of decay. NLEBs use a wider variety of trees for roosts. NLEBs roost in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags that are ≥ 3 inches dbh. Ibats and NLEBs (more frequently) occasionally roost in barns and sheds, particularly when suitable tree roosts are unavailable.

3.2.2. Migration

Males and non-reproductive females may remain near hibernacula, or migrate to summer habitat some distance from their hibernaculum. Female Ibats commonly migrate hundreds of miles from their hibernacula (USFWS 2007), whereas NLEBs typically migrate 40-50 miles (USFWS 2014). Long-distance migration is energetically demanding. Fall migration occurs following months of summer foraging and building fat reserves. Spring migration occurs when fat reserves are depleted from hibernation, prey abundance is low, and females are pregnant; therefore, spring migration is possibly the most stressful period in the Ibat and NLEB life cycle.

3.2.3. Fall Swarming/Spring Emergence Habitat

The area around a winter hibernaculum necessarily serves as the location for the spring emergence from hibernation and the fall return from summer habitats. During spring staging and fall swarming, Ibat and NLEB roost in trees and forage in habitats that are similar to their summer habitats (see section 3.2.1), typically within 5 miles of their hibernaculum. Fall swarming activity lasts for several weeks. The duration of spring staging is more variable. Individual bats may spend a few days or a few hours around their hibernacula following emergence, or may migrate immediately to summer habitat.

3.2.4. Home Range

Ibats and NLEBs are migratory species that establish seasonal residency within a distinct home range. Summer home range includes roosting, foraging, and drinking areas, and the travel

pathways between those habitats for a duration of several months. Fall home range includes the hibernaculum entrance for swarming behavior, but must also include roosting, foraging, and drinking areas for a duration of several weeks. For individuals (most females) that migrate to more distant summer habitats, spring home range is likely a subset of the areas used in the fall, but only for a few hours or days.

Studies using radio telemetry tagging and various analysis methods (e.g., mean convex polygons, 95% adaptive kernel, 95% fixed kernel) have estimated average individual Ibat summer home range sizes of 205–917 acres (Jachowski *et al.* 2014; Kniowski and Gehrt 2014; Menzel *et al.* 2005; Sparks *et al.* 2005; Watrous *et al.* 2006). One study near a hibernaculum during spring and fall (Rommé *et al.* 2002), and two during fall (Brack 2006; Kiser and Elliot 1996), estimated average home range sizes of 156–3,825 acres. Average individual NLEB summer home range size appears smaller than Ibat, with estimates of 161 and 179 acres (Owen *et al.* 2003, Lacki *et al.* 2009, respectively). No published studies have examined spring or fall home range sizes of NLEB. The average home range sizes reported in the studies cited above are each associated with substantial variability among the sample of individuals tracked in a particular study area. The sample size ranges from 3–32 bats. None reported the collective spatial extent of bat activity of all individuals tracked, and none attempted to track all members of a maternity colony or all bats engaged in fall swarming at a hibernaculum.

Depending on local habitat conditions, the home ranges of members of a maternity colony may or may not overlap substantially outside of the immediate area around shared roost trees. Some studies have documented summer habitat movements exceeding 1 mile (e.g., NLEB travel between roost tree and foraging area of 5,640 feet, Sasse and Pekins 1996), which imply a home range larger than a few hundred acres. For these reasons, the Service conservatively advises using a radius of 2.5 miles (Ibat) and 1.5 miles (NLEB) around a summer survey detection to delineate the area in which foraging and roosting activity of a maternity colony may occur. The area of a circle with a 2.5-mile radius is 12,566 acres, which is about 14 times larger than the largest Ibat individual summer home range reported in the literature. Similarly, a 1.5-mile circle (4,524 acres) is 25 times larger than the largest NLEB individual summer home range reported in the literature. A radius of 2.5 and 1.5 miles is likely to encompass all the roosts and foraging areas associated with a summer Ibat and NLEB detection, which is the purpose of this guidance, but likely exceeds the area on the landscape that a maternity colony actually uses regularly, which is not its purpose.

Likewise, the home ranges of very large numbers of individuals swarming at a hibernaculum probably do not overlap substantially much beyond the hibernaculum entrance, unless suitable habitat in the vicinity is very limited. To delineate potential foraging and roosting activity around known Ibat hibernacula, the Service uses a 10-mile radius for Priority 1 and 2 hibernacula, and a 5-mile radius for Priority 3 and 4 hibernacula. This recognizes the importance of these areas in bat conservation, and the variability associated with larger (P1 and P2) and smaller (P3 and P4) numbers of bats. For all known NLEB hibernacula, the radius is 5-miles, because NLEB winter aggregations are comparable to or less than Ibat numbers at P3 and P4 hibernacula.

Ibat males and females generally roost separately in the summer, but NLEB males are known to roost with females in maternity colonies to some extent. Some of the studies cited above suggest

differences in summer home range size between males and females, both Ibat and NLEB. Despite some differences, male and female NLEB may share a large fraction of their foraging habitat within the occupied forested landscape. An analysis of mist net survey data in Kentucky (USFWS 2015a) shows that most NLEB males and non-reproductive females are captured in the same locations as reproductively active females (1,712 of 1,825 capture records, or 94 percent), suggesting substantial overlap in the summer home range of reproductive females and other individuals.

3.3. Numbers, Reproduction, and Distribution

3.3.1. Indiana Bat

Ibats are concentrated in relatively few hibernacula during the winter. Biennial winter surveys in 2017 estimated a total of 530,705 Ibats in 229 hibernacula in 17 states (USFWS 2017). Four states accounted for 96 percent of the total population estimate: Missouri (41.1%), Indiana (34%), Kentucky (11%), and Illinois (9.9%).

Emerging from hibernation, female Ibats disperse across a broad range in 19 States (Figure 3-1). Males are found during the summer throughout the range of the species, but most commonly in areas near known hibernacula (Gardner and Cook 2002). Males typically roost alone in the summer, but occasionally with maternity colonies. The Recovery Plan (USFWS 2007) reports 269 known extant maternity colonies in 16 states. Of these, 54 percent were discovered between 1997 and 2007, mostly using mist-netting surveys. 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 60 adult females (see section 3.2.1), the 2017 winter survey population estimate yields an estimate of $530,705 \div (2 \times 60) = 4,423$ extant maternity colonies. The 269 Ibat maternity colonies known as of 2007 represents only 6 percent of this possible total.

The 2017 range-wide population estimate of 530,705 Ibats is a 3.5 percent decrease from the 2015 estimate of 550,224 bats (Figure 3-2). The biennial population estimates had been increasing from 2001 to 2007, suggesting that the species' long-term decline had been reversed (USFWS 2017). The decline since 2007 is likely attributable to WNS (see section 3.4 under "Threats"), especially in the Northeast Recovery Unit.

3.3.2. Northern long-eared bat

The range of the NLEB extends across much of the eastern and north central US (37 states), and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Figure 3-3). Before the onset of WNS, the species was most frequently observed in the northeastern US and the Canadian Provinces of Quebec and Ontario. The species was less common in the southern and western portions of the range. The NLEB still occurs across much of the historical range, but with many gaps where the species is apparently extirpated or sparse due to WNS.

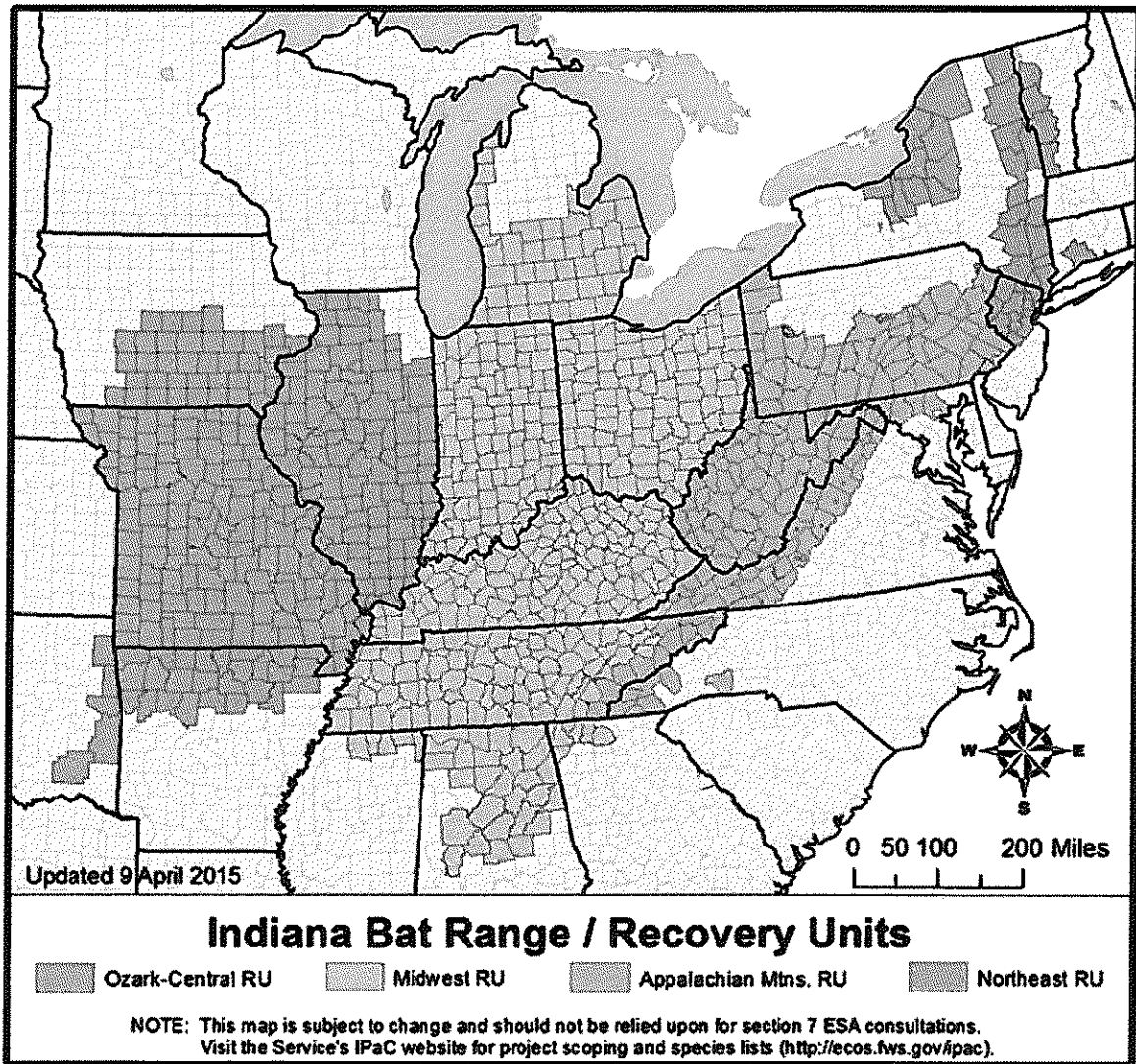


Figure 3-1. Range of, and Recovery Units for, the Indiana bat.

Most historical records of NLEBs are from winter hibernacula surveys (Caceres and Pybus 1997). The Service's "Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions" (USFWS 2016) reported 1,508 known hibernacula in the United States, most in the eastern and mid-western portions of the US range. Even prior to WNS, surveys of many these hibernacula detected only a few individuals (Whitaker and Hamilton 1998). There are likely many more unknown hibernacula. The 2016 Biological Opinion also reported 1,744 known NLEB maternity roost trees in 19 US states. Prior to the introduction of WNS, the NLEB was considered common in the northern portion of its range, uncommon in the south, and rare in the west. Recent surveys in upland areas have revealed that this species is more common in Arkansas, Kentucky, Missouri, and Tennessee than indicated by previous work, which was focused primarily on detecting Ibats, and also more common in the Piedmont and Coastal Plain of North Carolina (NatureServe Explorer 2017).

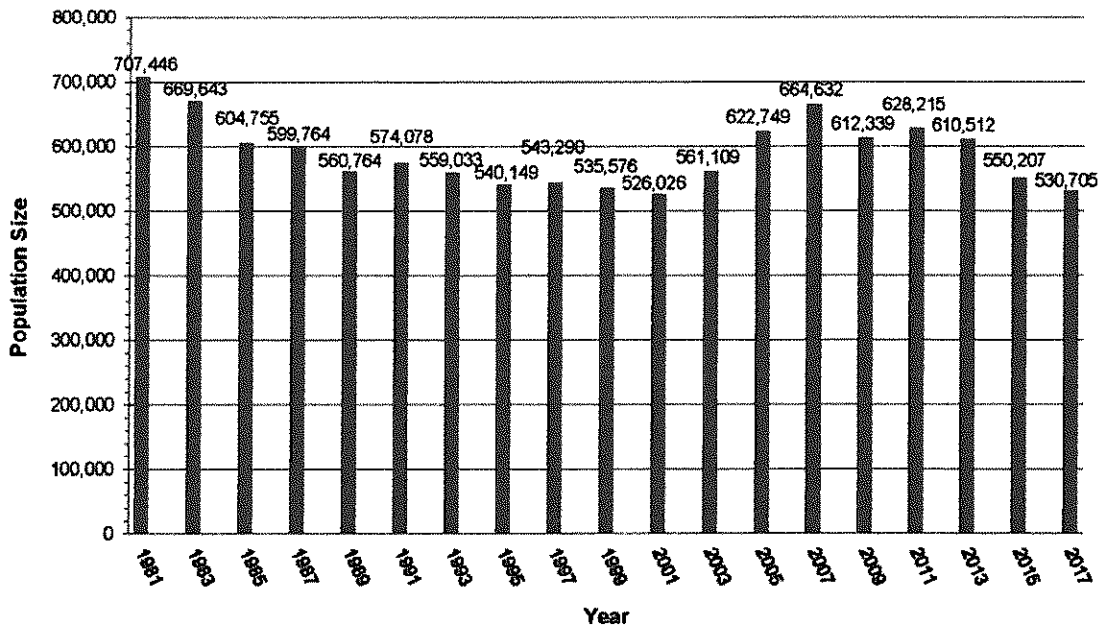


Figure 3-2. Indiana bat range-wide population estimates from 1981–2017 (source: USFWS 2017)

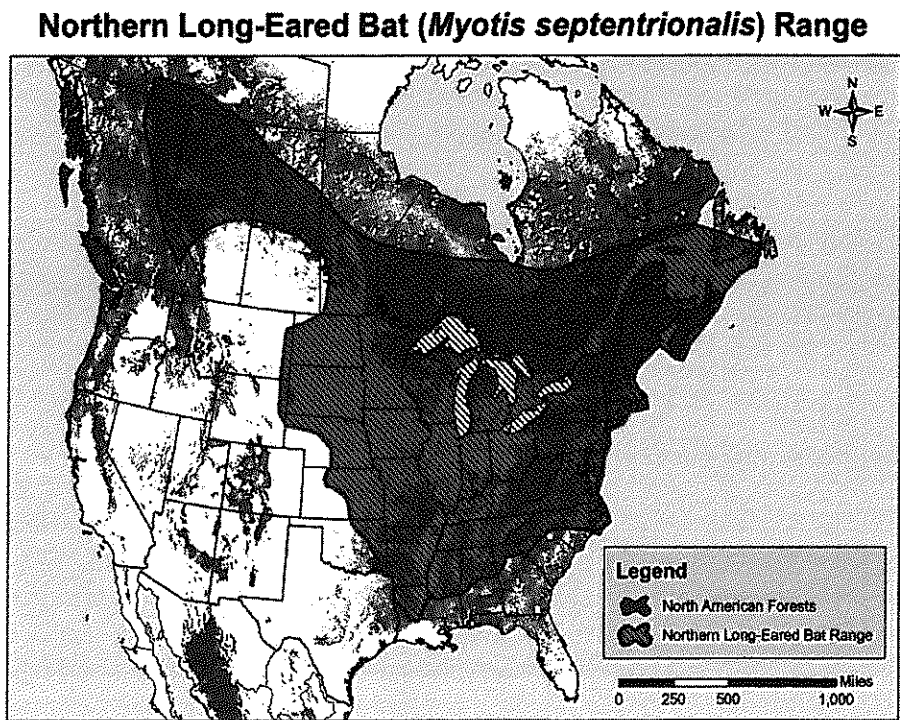


Figure 3-3. Range of the NLEB (Source: 80 FR 17976).

Hibernacula counts are the preferred census method for bats that hibernate. However, the NLEB uses many hibernacula, rarely in numbers greater than 300, is difficult to detect in hibernacula, moves between hibernacula during the winter, and most of its hibernacula are likely not known. Therefore, hibernacula counts are unlikely to provide a reliable metric for the species' range-wide abundance.

The 2015 final listing rule for the NLEB (80 FR 17979) summarized the limited abundance data available for each major region within the range, and noted that a range-wide population estimate for the species was not available at that time. The Service calculated a rough range-wide population estimate of about 6.5 million NLEB in the intra-Service BO for the final 4(d) rule that excepted various activities from take prohibitions (USFWS 2016). The Service based this estimate on the extent of forested habitat in the species range, observed detection rates in summer surveys, and the characteristics of summer NLEB colonies (e.g., home range size, number of individuals per colony). Although WNS continues to kill and weaken individuals in most of the species' range, NLEB populations may still number in the millions.

3.4. Conservation Needs and Threats

The conservation needs of and threats to the Ibat are discussed in detail in the 2007 Draft Recovery Plan (USFWS 2007) and the most recent 5-Year Review (USFWS 2009). These documents describe habitat loss and degradation, forest fragmentation, hibernacula disturbance and alteration, and environmental contaminants as the greatest threats to Ibats. The Draft Recovery Plan also identified collisions with wind turbines as an emerging threat. The Service has not yet approved a recovery plan for the NLEB.

In recent years, no other threat is more severe and immediate for the both the Ibat and NLEB than the disease known as white-nose syndrome (WNS). It is unlikely that NLEB populations would be declining so dramatically without the impact of WNS. Since first observed in New York in 2006, WNS has spread rapidly in bat populations from the Northeast to the Midwest and Southeast. NLEB numbers have declined by 99 percent in the Northeast, which along with Canada, was considered the core of the species' range. WNS-related declines in Ibat populations are estimated at up to 75 percent, with the disease recently moving into the Midwest core of the species' range. It appears likely that WNS will spread throughout most of the range of both species, and addressing the threat of WNS is their first and foremost conservation need. Additional information on WNS, which is constantly evolving, is available at <http://whitenosesyndrome.org/>.

The coastal plain of North Carolina is a possible refuge from the WNS epidemic for the NLEB. Studies using radio telemetry are revealing seasonal behavior that is different from other portions of the species' range. These coastal plain bats are not migrating to hibernacula in the fall (caves do not occur in this part of North Carolina), are active during most of the winter, and do not yet show any symptoms of WNS.

WNS is the clear cause of significant NLEB population declines and the recent downturn in Ibat numbers. However, other stressors that had no discernable population-level impacts previously, combined with the impact of the disease, could become factors influencing Ibat and NLEB

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. A single bat maternity colony, for example, reduced in size by WNS-related mortality and with the remaining individuals weakened by the disease, is much 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.

The USDA Forest Service summary of forest trends (USFS 2014) reported a decline in forest acreage from 1850 to the early 1900s. Thereafter, the conversion from forest to other land cover types was balanced with the conversion of other land cover types (mostly cropland) to forest through tree planting or old-field succession until 2001. From 2001 to 2006, the U.S. lost 1.2 percent of its total forest acreage, mostly in the southeast and west. Interior forest (40-acre parcels comprised of at least 90% forest cover) experienced a net loss of 4.3 percent.

The construction and operation of wind turbines represent an emerging concern for bat conservation, as bats appear particularly vulnerable to mortality and injury associated with the rotating turbine blades, either by collision or barotrauma (pressure-change injury). Ibat and NLEB mortality has been documented at multiple wind turbines installations. The Service is working with the wind industry to develop and implement measures that avoid and minimize the take of bats incidental to turbine operations, and to assess the magnitude of this threat.

Bats are sensitive to changes in temperature, humidity and precipitation (Adams and Hayes 2008), especially in their hibernacula. 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). Clawson (2002) suggested that climate change may shift Ibat from southern to northern hibernacula. At this time, however, the Service has no evidence linking climate change to any population-level changes for either Ibat or NLEB. The rapid spread of WNS across the range of both species is likely to mask any effects of climate change on their status.

4. ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Ibat and the NLEB, their habitats, and ecosystem within the Action Area. The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

4.1. Action Area Numbers, Reproduction, and Distribution

4.1.1. Indiana Bat

Figure 4-1 shows the outline of the TVA Region on a map of the range of the Ibat. About 64 percent of the 82-million acre TVA Region (52,947,795 acres) is within the Ibat’s range, and that portion represents about 17 percent of the Ibat range. The 1.015-million acre Action Area is

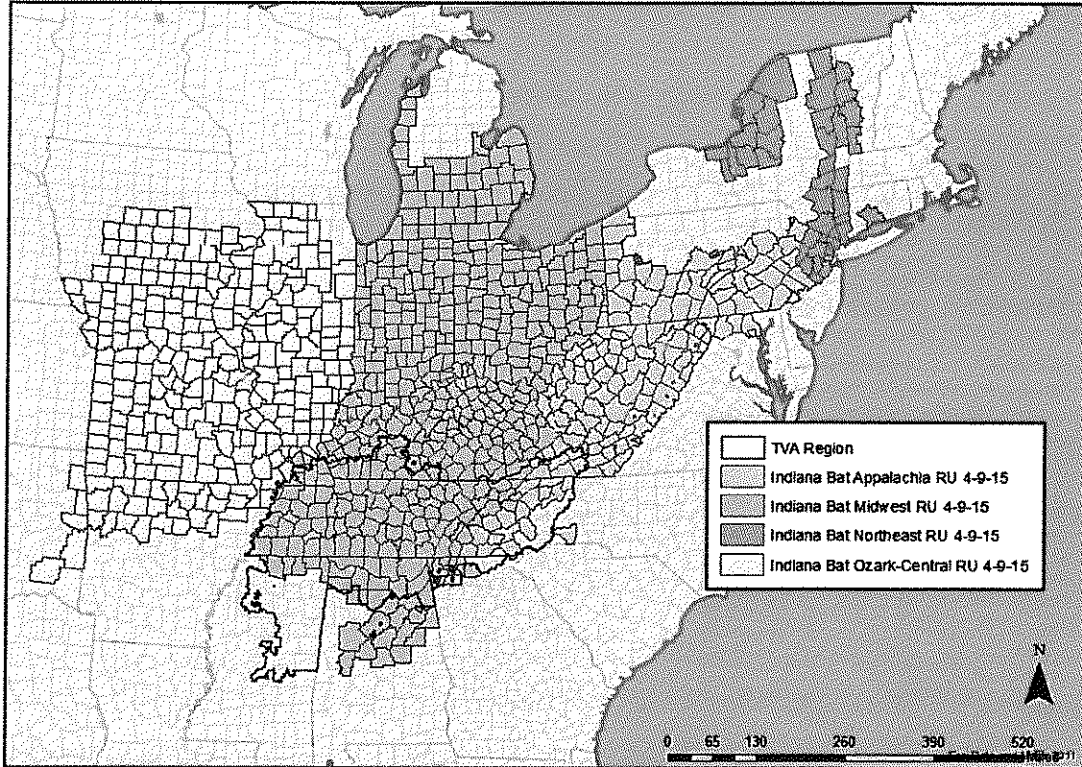


Figure 4-1. Range of the Indiana bat showing the TVA Region (source: BA Figure 4-1).

distributed throughout the TVA Region (see section 2.1); however, the BA does not partition the Action Area relative to the range of the Ibat. For purposes of describing the Ibat baseline and analyzing action-caused effects to Ibat in this BO, TVA proposes that we use the proportion of the TVA Region that is within the Ibat range (63.93 percent) as the proportion of the Action Area that is within the Ibat range (H. LeGrand, pers. comm., 2018b). We agree. This is a conservative approach that errs on the side of overestimating effects, because TVA anticipates that a disproportionate share of Action activity during the next 20 years will occur in portions of Mississippi that are outside the Ibat range.

TVA reports that 240,103 acres of the Action area are forested (see section 2.1). We assume that this forest cover is distributed uniformly or nearly so both within and outside the range of the Ibat; therefore, the distribution of forest cover within and outside the Ibat range is the same as the distribution of the Action Area as a whole within (63.93 percent) and outside the Ibat range. Forested acreage of the Action Area within the Ibat range is $0.6393 \times 240,103 \text{ acres} = 153,498 \text{ acres}$.

Figure 4-2 shows documented Ibat occurrence records within and near the TVA Region, including numerous hibernacula. Based on the 2013 winter surveys of hibernacula within the TVA Region, TVA reported (BA Table 4-2) that 25,434 Ibat (4.4 percent of the 2013 range-wide population) hibernated within the TVA region. Hibernacula counts provide the best census method for Ibat numbers (see section 3.3.1). Although adults disperse widely from hibernacula,

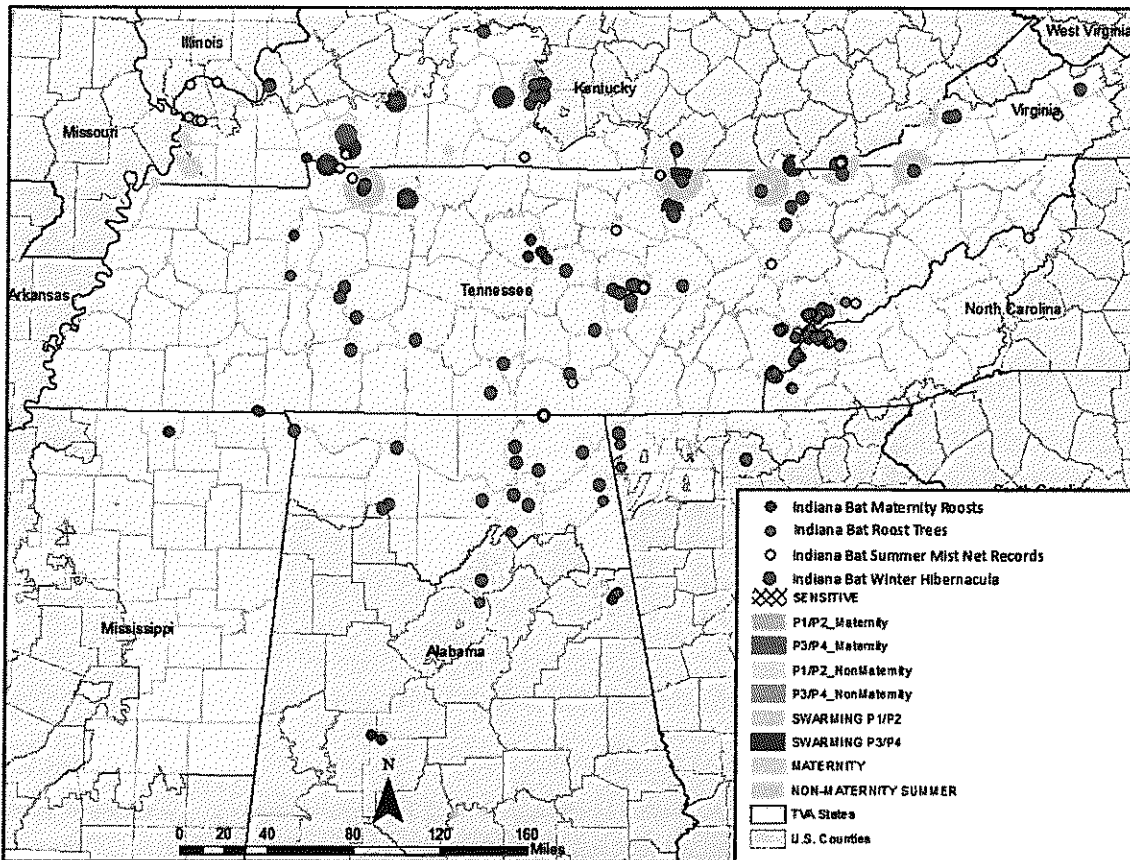


Figure 4-2. Documented occurrences of Indiana Bat in the TVA Region (source: BA Figure 4-2).

hibernacula counts are likely a reasonable approximation of Ibat numbers within the TVA Region. Ibat hibernacula are widely distributed in the portion of the Ibat range that is within the TVA Region and occur in every TVA state except Mississippi.

Hibernacula-specific counts from the 2015 or 2017 winter surveys, which each reflected a decline in range-wide total numbers relative to the previous biennial survey, are not yet compiled in a report that is available for use in this consultation. Therefore, for purposes of this consultation, we consider that the TVA region supports the same percentage observed for the 2013 range-wide census (4.4 percent) relative to the 2017 census total (530,705), or 23,244 adult I bats. Assuming a 1:1 sex ratio, and 60 adult females per maternity colony (see section 3.2.1), the I bats hibernating within the TVA Region would form about 194 maternity colonies ($23,244 \div (2 \times 60) = 194$).

As discussed in the first paragraph of this section, we assume that the Action Area and its forested acreage are uniformly distributed in the TVA Region. This means that the fraction of the Action Area that is within the range of the Ibat is same as the fraction of the Action Area in the TVA Region as a whole: 1.015 million acres in 82 million acres, or 1.226 percent. We do not

assume that the Action Area supports a disproportional share (more or less) of the TVA Region's Ibat population. Therefore, the Action Area supports 1.226 percent of TVA Region's Ibat population, or $0.01226 \times 23,244 = 285$ adult Ibats. Assuming a 1:1 sex ratio, and 60 adult females per maternity colony, these bats would constitute about 2–3 colonies ($285 \div (2 \times 60) = 2.375$), which we round up to 3 colonies.

The size of the area that all individuals belonging to an Ibat colony use for roosting and foraging is not reported in the literature. As we discussed in section 3.2.4, studies using radio telemetry tagging have estimated average *individual* Ibat summer home range sizes of 205–917 acres. Callahan (1993) reported a range of 0.81–1.48 km (0.5–0.9 mile) for minimum-radius circles that encompassed all roost trees of four Ibat colonies in MO, which corresponds to areas of 509–1,700 acres. The Service uses a radius of 2.5 miles around an Ibat summer survey detection to delineate the area in which the foraging and roosting activity of a maternity colony may occur. This corresponds to an area of 12,566 acres, which is several orders of magnitude greater than individual home range or the area encompassing documented roost trees reported in the literature. For purposes of this BO, we use 1,700 acres (the largest roost-tree area reported by Callahan 1993) as the area in which a single Ibat colony roosts and forages. Three non-sympatric Ibat colonies residing fully within the Action Area would occupy $3 \times 1,700 = 5,100$ acres. Forested habitat of the Action Area within the range the Ibat is about 153,498 acres (see second paragraph of this section). We expect that three Ibat colonies would occupy $5,100 \div 153,498 = 3.3$ percent of the Action Area's forested habitat within the Ibat range.

Relatively narrow (75–200 feet) transmission line ROWs represent about 80 percent of the Action Area (see section 2.1), and the remainder is patchy and widely dispersed throughout the TVA Region (e.g., power plants, TVA reservoir lands). Therefore, it is unlikely that the home range of an Ibat maternity colony lies fully within the Action Area, except perhaps on TVA Reservoir lands. It is more likely that the Action Area overlaps a portion of the home range of several of the 194 Ibat colonies that we estimate may occur in the TVA Region based on hibernacula counts. However, it is still useful to treat the programmatic Action Area as a unit that we expect to support the equivalent of 3 whole Ibat maternity colonies.

4.1.2. Northern Long-Eared Bat

The TVA region lies at southern limits of, but entirely within, the broad range of the NLEB. Figure 4-3 (taken from the BA) shows documented NLEB hibernacula and summer detection records that are within and near the TVA Region. The BA states (pg. 104) that “occurrence data for maternity roost trees [are] not available for anywhere in the TVA Region.” However, the Service reported a total of 387 known maternity roost trees for the six States that are partially within the TVA Region, and 50 for the State of Tennessee, which is wholly within the TVA Region (USFWS 2016, BO for the 4(d) rule; Table 2.1).

Hibernacula counts, such as those described previously for the Ibat, are not a reliable means of estimating NLEB population size, either range-wide or in the Action Area (see section 3.3.2). To estimate NLEB numbers, we must instead make inferences based on the extent of forested habitats, observed detection (occupancy) rates from summer surveys, and the characteristics of NLEB summer colonies. TVA reports that the 1.015-million acre Action Area contains 240,103

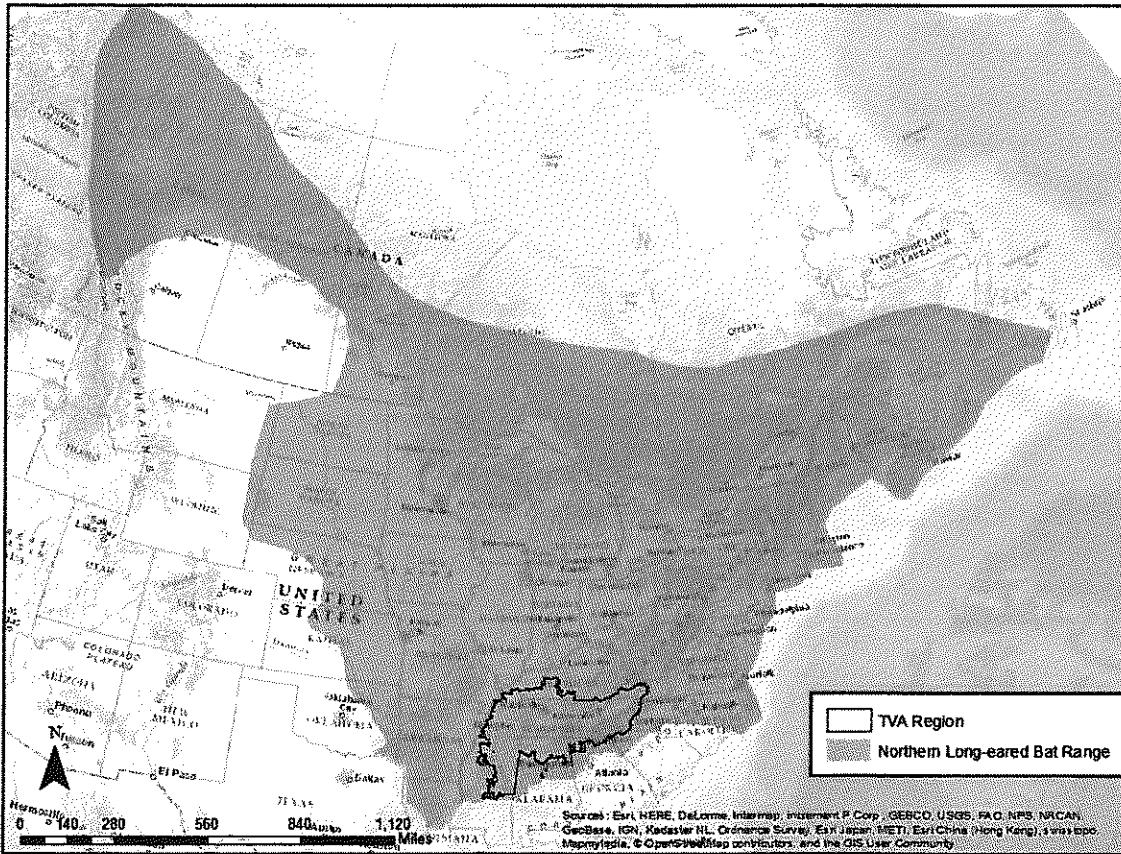


Figure 4-3. Range of the northern long-eared bat showing the TVA Region (source: BA Figure 4-3)

acres of forest cover (see section 2.1). The following paragraphs describe the occupancy rates and colony characteristics that we apply to this forest acreage to estimate NLEB numbers in the Action Area.

Occupancy Rates

The Service compiled data for post-WNS NLEB occupancy rates (percentage of survey sites in forested habitats that detected NLEB) in its 2016 BO for the 4(d) rule. Data for six of the seven TVA region states were either not available or available only from surveys on National Forests. Conditions on National Forests are not representative of the Action Area for this consultation, which is only 24 percent forested, and several of the Forests that provided data for the 2016 BO lie outside the TVA Region. Only Kentucky had occupancy data compiled from surveys conducted statewide, including the portion of the state within the TVA Region. The Service estimated the post-WNS NLEB occupancy rate from all 2013–2014 surveys in Kentucky as 14 percent (USFWS 2015a). The Service relied on this Kentucky occupancy estimate as best available data in evaluating the Tennessee Field Office’s statewide bat conservation strategy (USFWS 2015b). Tennessee constitutes about half of the area of the TVA Region. Therefore, for

purposes of this consultation, we also rely on the Kentucky-based estimate of 14 percent as the occupancy rate in the Action Area. We expect that the NLEB occupies 14 percent of the 240,103 forested acres of the Action Area, or 33,614 acres.

Estimated Number of NLEB Colonies

Summer home range includes both roosting and foraging areas, and range size may vary by sex. Studies of maternity roosting areas have reported sizes that vary from a mean of 21–179 acres (Owen *et al.* 2003; Broders *et al.* 2006; Lacki *et al.* 2009) to a maximum of 425 acres (Lacki *et al.* 2009). Foraging areas are six or more times larger (Broders *et al.* 2006; Henderson and Broders 2008). The distance traveled between consecutive roosts varies widely from 20 ft (Foster and Kurta 1999) to 2.4 miles (Timpone *et al.* 2010). Likewise, the distance traveled between roost trees and foraging areas in telemetry studies varies widely, e.g., a mean of 1,975 ft (Sasse and Perkins 1996) and a mean of 3,609 ft (Henderson and Broders 2008). Circles with a radius of these distances have an area of 281 and 939 acres.

Based on reported maximum individual home range (425 acres) and travel distances between roosts and foraging areas described above (corresponding to circular areas up to 939 acres), we use 1,000 acres for purposes of this BO as the area a NLEB colony uses. Within this 1,000-acre area, one or more members of a maternity colony and sympatric adult males/non-reproductive females would likely appear in mist net or acoustic surveys. Such appearance is the basis for the 14 percent occupancy rate we use to estimate the acreage of available forested habitat that we expect NLEB to use during the active season in the Action Area (33,614 acres).

The literature we have reviewed reports no information about the degree of spatial overlap between NLEB maternity colonies. We believe a 14 percent occupancy rate for the Action Area is appropriate; therefore, it is unlikely that limited habitat availability would contribute to substantial colony-range overlap in the Action Area. However, mist net survey data in Kentucky indicate that there is substantial overlap in the summer home range of reproductive females and that of males and non-reproductive females (J. Garland, pers. comm., 2015). Of 909 capture locations for males and non-reproductive females, only 87 (9.57 percent) did not have reproductively active females and were more than 3 miles away from captures of reproductive females. These data suggest a $100 - 9.57 = 90.43$ percent overlap between the home range of individuals belonging to maternity colonies and other individuals, which we adopt for use in this BO. Because the 14 percent occupancy rate includes detections of males and non-reproductive females, we multiply the occupied forest acres of the Action Area by 0.9043, and then divide by 1,000 acres to compute the number of probable maternity colonies in the Action Area:

$33,614 \text{ occupied (both sexes) acres} \times 0.9043 = 30,397 \text{ acres; which supports}$
 $30,397 \div 1000 = 31 \text{ maternity colonies (rounding up the fractional remainder).}$

Estimated Number of Individuals

For each 1,000 occupied acres of the Action Area, we assume the NLEB population associated with the single maternity colony that these acres support is comprised of 45 adult females, 45 adult males, and 45 juveniles following parturition (see section 3.2.1). Therefore, the active-season population associated with 31 colonies within the Action Area include $45 \times 31 = 1,395$

adult females, the same number of adult males, and the same number of juveniles after July 31 each year.

Relatively narrow transmission line ROWs represent about 80 percent of the Action Area (see section 2.1), and the remainder is patchy and widely dispersed throughout the TVA Region (e.g., power plants, TVA reservoir lands). As we discussed in the last paragraph of section 4.1.1 regarding Ibat colonies that we expect to occur in the Action Area, it is unlikely that the home range of 31 or more NLEB maternity colonies lie fully within the Action Area. It is more likely that the Action Area overlaps a portion of the home range of a larger number of colonies that occur in adjacent portions of the TVA Region. However, it is still useful to treat the programmatic Action Area as a unit that we expect to support the equivalent of 31 whole NLEB maternity colonies.

4.2. Action Area Conservation Needs and Threats

The conservation needs of and threats to the Ibat and NLEB in the Action Area are a regional subset of the range-wide needs and threats discussed in section 3.4. WNS is their greatest threat in the Action Area and eliminating this threat is their greatest conservation need. All seven states within the TVA Region have reported detecting the disease and fungus in hibernacula that are within the TVA region (<https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf>). The BA reports that TVA monitors caves on TVA-managed lands and cooperates with other agencies to monitor caves elsewhere in the TVA region. This monitoring tracks bat populations and the spread of WNS.

Sections 4.1.4 and 4.2.4 of the BA describe several ongoing TVA activities that support Ibat and NLEB conservation, including various studies, habitat management, artificial roosting structures, and installing bat-friendly cave gates.

5. EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the Action on the Ibat and NLEB. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2, which lists tree removal (section 2.2) and prescribed burning (section 2.3) as the components of the Action that may affect the Ibat and NLEB that require this BO for ESA compliance purposes. For the reasons we discussed in section 2.4, we are unable to assess meaningfully the beneficial effects to bats resulting from the “additional conservation measures” that TVA describes as part of the programmatic Action. However, we acknowledge that these measures to some degree offset the adverse effects of tree removal and prescribed burning.

5.1. Effects Analysis Methods

In the two following activity-specific sections (5.2 Tree Removal, and 5.3 Prescribed Burning), we identify the stressors (alteration of the environment that is relevant to the two species) that

each activity will cause based on the description of the proposed Action. We then review the best available science and commercial information about how individual Ibat and NLEBs are likely to respond to each stressor. Lastly, we identify the circumstances for an individual bat's exposure to each stressor (overlap in time and space between the stressor and an Ibat or NLEB, considering the proposed conservation measures), and estimate the amount or extent of individual responses at the Action Area scale. This section explains the methods we apply to the last step under each activity-specific analysis.

Estimating the Spatial Extent of Bat Exposure

TVA projects will affect about 100,000 acres annually within a 1.015-million acre Action Area that is not delineated in the BA, and this Action Area is distributed throughout the 82-million acre TVA Region (see section 2.1). The BA provides the maximum annual acreage, and the 20-year cumulative acreage, of various activities that may occur during seasons that are relevant to the bats' life history (see sections 2.2 and 2.3). Ibat and NLEB are not ubiquitous in the Action Area, and we do not assume that all Action activity will occur in occupied habitats. Instead, our effects analyses compute the expected degree of spatial overlap between activities and occupied areas as the product of two independent event probabilities within the same space. We multiply a total area by the percentage of the area that will receive an activity and by the percentage of the area that a species occupies. The resulting acreage is the expected overlap (intersection) between the activity and the species' occupied habitat.

The area for the NLEB analyses is the forested acreage of the entire Action Area, which is 240,103 acres, and the NLEB occupancy rate within this area is 14 percent (see section 4.1.2). The area for the Ibat analyses is the forested acreage of the Action Area within the Ibat range, which is 153,498 acres (63.93 percent of the full Action Area), and the Ibat occupancy rate within this area is 3.3 percent (see section 4.1.1). For the Ibat analyses, we prorate the acreage of activities according to the percentage of the Action Area that is within the Ibat range (63.93 percent). Table 5-1 shows these calculations for tree removal activity. Such proration of the acreage of activities is not necessary for the NLEB analyses, because the range of the species encompasses the entire Action Area.

Table 5-1. Estimated acreage of seasonal tree removal activity that is within the range of the Ibat (63.93 percent of the total Action Area acreage from Table 2-1).

Years	Inactive Season^a	Active Season; All Bats Volant^b	Active Season; Pups Non-Volant^c	Total
Annual 2018-2021	1,258	557	589	2,403
Annual 2022-2037	810	277	198	1,285
Cumulative 2018-2037	17,990	6,667	5,516	30,172

^a Mid-November to mid-March

^b Mid-March to April 30, and August 1 to mid-November

^c June and July

Table 5-2 shows the amount of seasonal tree removal activity that will occur in the Action Area expressed as a percentage of the total amount of forested acreage (240,104 acres) in the Action Area. These percentages apply to both the Ibat and NLEB analyses, because we have prorated both the amount of tree removal activity and the amount of forested acreage within the range of the Ibat by the same fraction (63.93 percent).

Table 5-2. Seasonal tree removal activity expressed as a percentage of the total acreage of forest cover within the Action Area (240,103 acres within NLEB range, and 153,498 acres within Ibat range).

Years	Inactive Season^a	Active Season; All Bats Volant^b	Active Season; Pups Non-Volant^c	Total
Annual 2018-2021	0.82%	0.36%	0.38%	1.57%
Annual 2022-2037	0.53%	0.18%	0.13%	0.84%
Cumulative 2018-2037	11.72%	4.34%	3.59%	19.66%

Estimating Numbers of Bats Exposed

Our analyses examine effects to Ibats and NLEBs while they are in their day-time roost trees, which constitute a tiny fraction of the total number of trees in the forested habitats they use for foraging and travel during the spring, summer, and fall. The broadly defined Action Area and programmatic nature of this consultation precludes any attempt to estimate effects at the scale of roost trees, or to partition the effects of Action activities between areas that contain roosts for pregnant females, solitary males, fall swarming, spring staging, etc. A substantial majority of the available data on Ibat and NLEB home range describes summer habitat and roost characteristics; therefore, we use summer home range and roost characteristics to represent the possible intersection between Action activities and the bats' active-season occupied habitats.

Although male Ibats generally remain closer to hibernacula during the active season than females (see section 3.2.1), we cannot attempt separate effects analyses for males and females without a partitioning of the Action Area relative to known Ibat hibernacula. NLEB migrate shorter distances from hibernacula than Ibats, and both sexes are frequently observed in the same summer habitats (see section 3.2.4). Therefore, we include both Ibat and NLEB adult males in an analysis based on maternity colony characteristics, recognizing that maternity colonies may occur in areas that are both close to and far from known hibernacula. Projects located closer to Ibat hibernacula would likely affect a higher percentage of Ibat males and cause fewer effects to pups, and vice versa for projects located farther from hibernacula.

We estimate numbers of bats affected in the expected area of overlap between Action activities and occupied habitats as the product of:

- (a) the overlap area;
- (b) the density of bats in a maternity colony home range, including sympatric males and non-reproductive females; and
- (c) an expected response rate.

For adult I bats, the density under (b) above is 60 females and 60 males in 1,700 acres, or $120 \div 1,700 = 0.0706$ bats per acre (see section 4.1.1). Following the birth of up to 1 pup per adult female during the active season, this density increases to a maximum of $180 \div 1,700 = 0.1056$ bats per acre. The density we use for NLEBs is 45 females and 45 males in 1,000 acres, or $90 \div 1,000 = 0.090$ bats per acre (see section 4.1.2). Following the birth of up to 1 pup per adult female during the active season, this density increases to a maximum of $135 \div 1,000 = 0.135$ bats per acre. The response rates we use under (c) above are stressor and life-stage specific. We explain the basis for the response rates we use in the discussion for each stressor caused by tree removal and by prescribed burning.

5.2. Tree Removal

In section 5.2 we examine the direct and indirect effects on Ibat and NLEB of the proposed tree removal associated with various routine activities over the next 20 years. Section 5.2.1 reviews best available data about stressors associated with tree removal and the responses of bats to these stressors. Section 5.2.2 provides our estimation of the amount or extent of bat exposure to these stressors caused by the Action. In this introduction to section 5.2, we first dismiss from further analysis potential stressors that are not likely to have measurable or detectable effect on bat numbers, reproduction, or distribution.

TVA determined that its BMPs and other conservation measures for protecting water quality during tree removal operations would reduce the introduction of sediments and contaminants to drinking water sources to levels that are not likely to adversely affect listed bats. The Service previously concurred with this determination relative to the gray bat, Virginia big-eared bat, and Ibat critical habitat (see section 1). We also concur with this determination relative to the Ibat and NLEB (see section 2.2.2; discussion under “Sedimentation, Spills, Pollutants, and Contaminants”). Therefore, we do not further address changes in water quality resulting from tree removal as a stressor to bats.

The removal of substantial amounts of forest cover may reduce the local availability and quality of foraging habitat for the Ibat and NLEB. However, analyzing such effects that projects implemented under this programmatic Action may cause is not feasible, because we have no data on the availability or quality of forest cover at the project scale. Further, we estimate that the Ibat and NLEB occupy only 3.3 and 14 percent, respectively, of all forest cover at both the Action Area and TVA Region scales; therefore, it is unlikely that foraging habitat is limiting for these species at these scales. In this BO, we assume that the individuals associated with Ibat and NLEB summer colonies forage and roost in an area of about 1,700 and 1,000 acres, respectively (see sections 4.1.1 and 4.1.2). Maximum annual tree removal under the Action is 3,759 acres (section 2.2.1). This tree removal will occur on multiple projects distributed throughout the 1.015-million acre Action Area. We consider the potential for a project under this Action to cause a measurable or detectable response by Ibat or NLEB individuals through reducing the availability or quality of foraging habitat as negligible. Therefore, we do not further address the effects of tree removal on bats via exposure to changes in foraging habitat availability or quality.

The conservation measures that TVA proposes to implement for tree removal activity (see section 2.2.2) include a general prohibition for tree removal near known Ibat and NLEB hibernacula. Specially, measure TR2 states:

“Removal of suitable summer roosting habitat within 0.5 mile of Priority 1/Priority 2 Indiana bat hibernacula, or 0.25 mile of Priority 3/Priority 4 Indiana bat hibernacula or any northern long-eared bat hibernacula will be prohibited, regardless of season, with very few exceptions (*e.g.*, vegetation maintenance of TL ROW immediately adjacent to Norris Dam Cave, Campbell County, TN).”

We believe this measure limits the severity of any effects of tree removal on the microclimate of hibernacula, and on any bat individuals hibernating within, to insignificant levels. Therefore, we do not further address the direct or indirect effects of tree removal under this Action on bats in hibernacula.

Two of TVA’s proposed conservation measures address the removal of trees that are documented as Ibat or NLEB roost trees (TR6) or are within 150 feet of documented roost trees (TR5) (see section 2.2.2). If documented roosts are present or within 150 feet of a tree-removal project area, these measures commit TVA to a site-specific review and assessment. If pups are present in trees planned for removal, these measures also commit TVA to coordination with the Service in determining how to “minimize impacts to pups to the extent possible” (BA pg. 117).

Although the Service supports these measures, we have no ability to assess their effectiveness at reducing impacts at the scale of this programmatic Action. The BA does not identify or tally the number of documented roost trees that are within the Action Area. Because the Action Area is not specifically delineated, we are unable to determine whether the Action may affect any particular documented roosts. Therefore, we acknowledge the potential benefits of these measures in project-level implementation of the Action, but do not attempt to estimate the extent to which they may avoid or minimize adverse effects of tree removal in the following analyses.

Six other proposed conservation measures for tree removal (TR1, 3–4, and 7–9) either relate to tracking and reporting tree removal activity or prescribe general conditions that may or may not reduce potential adverse effects (*e.g.*, TR7, which limits tree removal within 100 feet of existing transmission ROWs to hazard trees). The tracking and reporting measures are appropriate components of this programmatic Action, but do not change the effects of the Action. For the remaining measures, we are unable to estimate the degree to which they may change the effects of the Action, and do not further consider them in the following analyses.

5.2.1. Stressors and Responses

The BA describes three primary stressors associated with the proposed tree removal activity: (1) noise and disturbance during removal operations; (2) loss of shelter (roost trees); and (3) introduction of sediments and contaminants to drinking water sources. We have dismissed #3 from further analysis (see section 5.2), but we agree that (1) and (2) are environmental changes caused by tree removal that are relevant to the Ibat and NLEB.

Noise/Disturbance

The people, chainsaws, and heavy equipment involved in tree removal generate noise and disturbance. During the active season for bats, this disturbance could cause volant bats to temporarily flee or permanently abandon roosts during the day, which is a disruption of normal behavior. Gardner *et al.* (1991b) reported that Ibats continued to roost and forage in an area with an active timber harvest. Callahan (1993) monitored the location of a primary roost by evening exit counts, which Ibats abandoned at some point during an 18-day gap between successive counts. Also at some point during that 18-day gap, a bulldozer started clearing brush adjacent to the tree, which Callahan noted as the likely, but not confirmed, cause of the roost abandonment.

Adult females that permanently abandon a roost with non-volant nursing pups would cause the death or injury of these pups. Although Ibats are known to carry pups between roosts, such movement increases the likelihood of injury. Regardless whether pups are present, the additional energy expenditure that flight away from disturbance causes is an adverse effect, and day-time flight is an alteration of normal nocturnal behavior.

Mikula *et al.* (2016) reviewed about 1,500 reports from 109 countries of attacks by 143 species of diurnal birds on 124 species of bats. The review compiled cases involving species from several bat taxonomic families. The family Vespertilionidae, to which the genus *Myotis* belongs, represented 22.8 and 58.8 percent of the cases of bats taken by raptors of the hawk and falcon families, respectively, and 77 percent of the bats taken by non-raptors (e.g., gulls, crows). Citing data from other studies, the authors surmised that the diurnal predation rate on bats is likely 100–1,000 times higher than the nocturnal predation rate when standardized relative to the duration of day versus night bat activity. The authors concluded that the reports and studies they reviewed strongly suggest that predation by birds restricts daytime activity in bats and is likely a major factor that contributed to the evolution of their generally nocturnal behavioral patterns.

About half of the forecast 20-year cumulative tree removal activity under this Action will occur within the narrow ROWs of power lines (see Table 2-1). Noise and disturbance will move with these operations along the length of the ROW, such that the duration of high sound and activity levels at any one location is brief. We believe it is unlikely that brief periods of noise and disturbance during daylight hours would cause females to permanently abandon roosts containing their non-volant pups, but noise, vibration, and machinery exhaust sufficiently close to roosts it may temporarily flush a percentage of volant bats. Despite the evidence of no such response in Gardner *et al.* (1991b) cited above, we conservatively estimate in this BO that 10 percent of volant bats exposed to daytime tree removal disturbance will fly to an alternate roost located away from the disturbance. The results of Mikula *et al.* (2016) summarized above support a finding that such disruption of diurnal sheltering behavior increases the likelihood of injury through predation by diurnal predators, which is consistent with the definition of incidental take in the form of harassment.

Roost Tree Loss – Direct Effects

Ibats and NLEBs use a network of multiple roost trees within their home range, and show fidelity to roosts used in previous years (see section 3.2.1). However, trees are an ephemeral

resource, especially the trees preferred for roosting, which are typically dead or dying, with cavities, crevices, exfoliating bark, and other characteristics of senescence or poor health. Despite the observed use of the same roosts between years, both species must seek new roosts as necessary when traditional roost trees inevitably fall. Potential bat responses to roost loss, caused by natural factors or felling by humans, depends on when the loss occurs during the annual life cycle: (a) when non-volant pups (or adults in torpor) are present in the tree; (b) other times during the active season; or (c) during the inactive (hibernation) season. Removal of an occupied roost tree during the spring, summer, or fall has direct and immediate effects. Removal of an unoccupied roost tree has indirect (later in time) effects, which we discuss in the following subsection.

Due to their small size, it is extremely unlikely to detect an Ibat or NLEB killed or injured by tree felling in a forested setting. The literature we have reviewed contains no reports of NLEB mortality resulting from roost tree removal. In the biological opinion for the NLEB 4(d) rule (USFWS 2016: pg. 38), the Service summarized three accounts of Ibat injury and mortality resulting from tree removal, which we quote here.

“Cope *et al.* (1974) reported the first felling of an occupied Indiana bat maternity roost tree in Wayne County, Indiana. The landowner observed bats exiting the tree when it was bulldozed down. The original account stated that eight bats (2 adult females and 6 juveniles) were “captured and identified as Indiana bats,” and that about 50 bats flew from the tree. Although the original account did not specify how the eight bats were captured, J. Whitaker (Indiana State University, pers. comm., 2005) recounted that those bats were killed or disabled, retrieved by the landowner, and subsequently identified by a biologist. In another case, Belwood (2002) reported on the felling of a dead maple in a residential lawn in Ohio. One dead adult female and 33 non-volant young were retrieved by the researcher. Three of the young bats were already dead when they were picked up, and two more died subsequently. The rest were apparently retrieved by adult bats that had survived. In a third case, 11 dead adult female Indiana bats were retrieved (by people) when their roost was felled in Knox County, Indiana (J. Whitaker, pers. comm., 2005).”

All three of these accounts document adult bat mortality. Two document juvenile mortality, two document adult survival, and one documents juvenile survival. Of the two documenting adult survival, apparently far more adults survived than were killed, and more juveniles survived than were killed in the Belwood case. The juvenile survival rate in the Belwood case was apparently high (5 died out of 33 retrieved, and the rest were apparently carried away by adults). This case from a residential lawn is the only available data on juvenile bat survival/mortality rates following roost tree removal. However, we believe it is not representative of tree felling in forested settings, where the ability to detect, retrieve, and place pups where adult bats may find them and carry them away is likely negligible.

For purposes of this consultation, we conservatively assume that removal of an occupied roost will harm (kill or injure) all non-volant pups present. We also assume that roost removal will either harm or harass all volant bats present. Cutting an occupied roost tree may cause some to fly away before the tree falls and crush some when the tree falls, but will cause all volant survivors to seek an alternate roost after the tree falls. Expelled from their roost, survivors are exposed to diurnal predators and other hazards until finding alternate shelter. For simplicity, and

to avoid underestimating lethal effects, we treat these two responses to tree removal (immediate death/injury vs. displacement that creates the likelihood of injury) as a single effects pathway, to which we attribute a 100 percent harm response.

Roost Tree Loss – Indirect Effects

The effects of removing a roost tree while it is unoccupied depend on how individual Ibats and NLEBs use that tree at other times, whether as a maternity roost, an alternate summer roost, or a roost during spring staging or fall swarming. Removal of a primary maternity roost likely has the greatest impact, but the loss of any previously established roost causes bats to spend time and energy seeking a new roost that meets their requirements in that area.

Ibats and NLEBs form summer maternity colonies that exhibit “fission-fusion” behavior (Barclay and Kurta 2007; Garroway and Broders 2007). Members coalesce to form a group (fusion), but the composition of the main unit is dynamic. Individuals exit the main unit for solitary roosting or to form smaller roosting groups (fission), and later return to the main unit, which may sometimes move to another roost. Ibats and NLEBs switch roosts often, typically every 2–3 days (Kurta *et al.* 2002; Kurta 2005; Foster and Kurta 1999; Owen *et al.* 2002; Carter and Feldhamer 2005; Timpone *et al.* 2010). Several researchers interpret these behaviors as an adaptation to the ephemeral nature of tree roosts, whereby bats proactively seek and test the suitability of new roost trees in preparation for the eventual loss of the primary and secondary roosts they previously and currently use (Kurta *et al.* 2002, Carter and Feldhamer 2005, Timpone *et al.* 2010).

Because Ibats and NLEBs rely on previously established roosts, roost tree loss, regardless whether it occurs during the active or inactive (winter) seasons, may affect the fission-fusion dynamics of their maternity colonies. Kurta (2005) suggested that loss of a single alternate roost at any time of year probably has little impact on Ibats, because Ibat colonies use at least 8–25 alternate summer roosts, but that loss of a primary roost could disrupt colony social structure. Sparks *et al.* (2003) found that the natural loss of a single primary maternity roost led to the fragmentation of the colony (bats used more roosts and congregated less) following the roost loss. Because colonial behavior contributes to reproductive success (see section 3.2.1), colony fragmentation could reduce the colony recruitment rate (survival of offspring to sexual maturity).

Silvis *et al.* (2014a) studied the social dynamics of an Ibat colony located in central Ohio for two years using telemetry methods. These investigators represented the observed roosting networks in a mathematical model and then simulated the effects of roost removal. Results varied between the models of each year’s networks. The probability of colony fragmentation exceeded 50 percent with the simulated removal of only 5 percent of the roosts using the 2009 network data, but with the simulated removal of 30 percent of the roosts using the 2010 network data. In both years, simulated removal of the primary roost resulted in fragmentation. The advantages of colonial behavior are reduced or lost when a colony fragments. However, colony fragmentation is probably also a necessary dispersal adaptation to the inevitable loss of ephemeral roosts. The authors of this study concluded: “As the ephemerality of roost trees likely cause Indiana bat maternity colonies to experience frequent roost loss, including that of primary roosts, fission-

fusion dynamics may provide a mechanism for the formation of new maternity colonies by presenting opportunities for the colony to split.”

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

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

The studies summarized above suggest that colony fragmentation is a likely later-in-time Ibat response to the loss of a primary roost tree and to the loss of a sufficient percentage of alternate roost trees. Colony fragmentation, or delayed colony formation upon returning from hibernation to an altered colony home range, could reduce recruitment rates. Such reduction is consistent with the definition of incidental take in the form of harm, but no studies have yet investigated this indirect effect on either Ibats or NLEBs. Experimental results of roost tree removal during winter from two NLEB colonies did not document fragmentation, but loss of secondary roosts doubled the distances individuals travelled between roosts, and effects on reproductive success were not investigated. Therefore, available evidence indicates that, at minimum, the later-in-time Ibat and NELB response to roost tree loss is an increased energy expenditure to establish a new roost network, and that this increase is likely proportional to the fraction of home range roost trees removed. Although studies have focused on summer maternity habitats, it is reasonable to assume that loss of roosts in spring staging and fall swarming habitats also causes an increased energy expenditure. Whether this response to habitat modification actually reduces survival or reproductive success is uncertain.

Service policy regarding significant gaps in the best available data is to either:

- “extend the due date of the biological opinion until sufficient information is developed for a more complete analysis” (if the action agency agrees); or
- “develop the biological opinion with the available information giving the benefit of the doubt to the species” (USFWS and NMFS 1998: pg 1-6).

The need to determine whether, and to what degree, roost tree removal reduces survival or reproductive success is not unique to this consultation. Further, studies that could address this

data gap are not feasible within a time frame that would serve TVA's ESA compliance obligations for the activities included under this programmatic Action. Therefore, in this BO we give the "benefit of the doubt" to the listed species by treating the removal of unoccupied roost trees as a habitat modification that may injure Ibat and NLEBs by significantly impairing their essential breeding or sheltering behaviors, *i.e.*, incidental take in the form of harm.

The increased energy expenditure caused by the removal of unoccupied roosts is likely proportional to the number of roosts an individual bat lost, the type of roost (a primary maternity roost, an alternate social roost, or a solitary roost), and other factors. Whether the time and energy spent seeking replacement roosts actually injures a bat (e.g., causes reproductive failure) likely depends on the availability of suitable roosts, the individual's condition (e.g., fat reserves depleted by hibernation and migration, suffering from WNS, etc.), and other factors. These factors are variable and will not always combine in a manner that causes injury. For this BO, we limit the injury caused by unoccupied roost removal, regardless of season, to adult females, and we use an injury rate of 10 percent to estimate numbers of bats responding to this stressor in this manner.

5.2.2. Estimation of Exposure and Numbers of Bats Affected

Section 5.2.1 identified noise/disturbance, direct physical trauma, and the loss/reduction of shelter (roost trees) as stressors caused by tree removal that are relevant to Ibat and NLEB individuals. We identified the bat responses to these stressors as: (1) fleeing noise/disturbance; (2) death or injury (removing occupied roost trees); and (3) reduced survival or reproductive success (removing unoccupied roost trees). We identified the response to disturbance as a disruption of diurnal roosting behavior that creates the likelihood of injury thorough predation (harassment), with an expected 10 percent response rate upon exposure (*i.e.*, 10 percent will flee; 90 percent will not). We identified the response to unoccupied roost tree removal as a reduction in reproductive success (harm), with expected 10 percent response rate upon exposure (*i.e.*, 10 percent will fail to raise a pup to volancy). Although some bat pups and volant bats may survive the felling of an occupied roost tree, we assume a 100 percent lethal/injurious (harm) response rate to such exposure. Ibat and NLEB exposure to the three stressors depends on the timing and location of tree removal relative to their home ranges within the Action Area.

TVA does not specify the locations for tree removal activity under this programmatic Action. Instead, the BA provides annual and 20-year cumulative acreages for tree removal that will occur in the 1.015-million acre Action Area, and specifies the seasonal timing for these acreages (see Table 2-2). Conducting 60 percent of the 20-year cumulative tree removal during the inactive season limits the direct impacts of noise and physical trauma to 40 percent of the acreage affected by this activity. Proposed conservation measures that may further limit the extent of exposure to the stressors caused by tree removal include (paraphrased):

- TR2 – With few exceptions, prohibiting the removal of suitable summer roosting habitat within 0.5 mile of P1/P2 Ibat hibernacula, and within 0.25 mile of P3/P4 Ibat hibernacula or any NLEB hibernacula.
- TR5 and TR6 – Requiring a site-specific review and assessment before removing a known Ibat or NLEB maternity roost tree, or any trees within 150 feet of a known Ibat or NLEB maternity roost tree, during the active season. If pups are present in trees planned

for removal, TVA will coordinate with the USFWS to determine how to minimize impacts to pups.

Table 5.3 provides our estimates of the numbers of Ibat and NLEBs that we expect tree removal activity to affect. For each stressor and corresponding life-stage-specific response, the table provides data for the expected spatial overlap between seasonal tree removal activity and occupied areas, bat densities in occupied areas, and the expected bat response rate, to calculate bat numbers affected, and the corresponding percentage of the Action Area total population affected. Three sets of seasonal tree removal activity are used in these calculations: (1) Annual 2018–2021; (2) Annual 2022–2037; and (3) Cumulative 2018–2037. These sets correspond to the description of the Action, which estimates a higher acreage of tree removal during the first 3 years than in the remaining 17 years, and the 20-year total acreage.

5.3. Prescribed Burning

In section 5.3, we examine the direct and indirect effects on Ibat and NLEB of the proposed prescribed burning on TVA lands over the next 20 years. Section 5.3.1 reviews best available data about stressors associated with prescribed burning and the responses of bats to these stressors. Section 5.3.2 provides our estimation of the amount or extent of bat exposure to these stressors caused by the Action. In this introduction to section 5.3, we first dismiss from further analysis potential stressors that are not likely to have measurable or detectable effect on bat numbers, reproduction, or distribution.

TVA determined that prescribed fire under this Action is not likely to adversely affect listed bats when they are within caves and mines documented as hibernacula or as active-season roosts. The TVA burning program prohibits prescribed fire within 0.25 mile of the entrances to such sites and other measures that limit the potential for smoke entering caves and mines that bats occupy (see section 2.3.2). The Service previously concurred with this determination relative to the gray bat, Virginia big-eared bat, and Ibat critical habitat (see section 1). We also concur with this determination relative to the Ibat and NLEB. Therefore, we do not further address in this BO the effects of prescribed burning on bats via exposure to smoke in hibernacula.

Prescribed fire may have both beneficial and adverse effects on the availability of suitable tree roosts and prey resources, which some of the literature we reviewed for the following section describes. However, we believe the scale of the TVA prescribed burning program, which will rarely exceed 1,500 acres annually (see section 2.3) on 26,247 acres of TVA Reservoir Lands (5.7 percent), is unlikely to have a measurable or detectable effect on the availability of roost tree or prey resources for the Ibat or NLEB colonies that may occupy these lands. Further, several of the TVA burning objectives listed in Table 2-3 are to maintain an early-successional seral stage, which is not Ibat and NLEB habitat.

Table 5-3. Estimated numbers of bats affected by tree removal.

Stressors -->	Noise/ disturbance	Physical trauma		Reduction of shelter resource
		Direct	Direct	
Stressor type	Direct	Direct	Direct	Indirect
Exposure period	Entire active season	Pup season	Entire active season	Year round
Life stage affected	Volant bats	Pups	Volant bats	Adult females
Individual Response	Flight to alternate roost (harassment)	Death or injury (harm)	Death or injury (harm)	Reduced reproduction (harm)
A. Response rate (section 5.2.2)	10%	100%	100%	10%
B. Percent of forest cover affected (from Table 5-2)				
Annual 2018-2021	0.75%	0.38%	0.75%	1.57%
Annual 2022-2037	0.31%	0.13%	0.31%	0.84%
Cumulative 2018-2037	7.94%	3.59%	7.94%	19.66%
C. Percent of forest cover occupied (sections 4.1.1 and 4.2.2)				
Ibat		3.30%		
NLEB		14.00%		
D. Total Action Area Forested Acres (section 2.1)				
Ibat		153,498		
NLEB		240,103		
E. Expected overlap (acres) (B*C*D)				
Ibat				
Annual 2018-2021	38	19	38	79
Annual 2022-2037	16	7	16	42
Cumulative 2018-2037	402	182	402	996
NLEB				
Annual 2018-2021	251	129	251	526
Annual 2022-2037	104	43	104	281
Cumulative 2018-2037	2,668	1,208	2,668	6,607
F. Bat density in occupied areas (section 5.1)				
# Ibat/acre	0.0706	0.0353	0.0706	0.0353
# NLEB/acre	0.0900	0.0450	0.0900	0.0450
G. Number of bats affected (A*E*F) (rounded up to nearest whole integer)				
Ibat				
Annual 2018-2021	1	1	3	1
Annual 2022-2037	1	1	2	1
Cumulative 2018-2037	3	7	29	4
NLEB				
Annual 2018-2021	3	6	23	3
Annual 2022-2037	1	2	10	2
Cumulative 2018-2037	25	55	241	30
H. Percentage of Action Area bats affected (G/H)				
Ibat (H=360 adults, or 180 pups, as applicable)				
Annual 2018-2021	0.28%	0.56%	0.83%	0.28%
Annual 2022-2037	0.28%	0.56%	0.56%	0.28%
Cumulative 2018-2037	0.83%	3.89%	8.06%	1.11%
NLEB (H=2,790 adults, or 1,395 pups, as applicable)				
Annual 2018-2021	0.11%	0.43%	0.82%	0.11%
Annual 2022-2037	0.04%	0.14%	0.36%	0.07%
Cumulative 2018-2037	0.90%	3.94%	8.64%	1.08%

In this BO, we use occupancy rates in the Action Area of 3.3 and 14 percent for Ibat and NLEB, respectively. Assuming that all 26,247 acres of Reservoir Lands that could use prescribed fire are forested, burning 5.7 percent of these lands annually yields an expected overlap between burning and bats of 49 and 210 acres for Ibat and NLEB, respectively. While we do not discount this overlap, assessing the indirect effects (later in time changes in roost and prey availability) of burning at this small scale in a programmatic context without site-specific data is not feasible. Therefore, we limit our analysis of prescribed burning to its direct effects on bats in forested habitats.

5.3.1. Stressors and Responses

Smoke and heat are stressors that are relevant to all species within or near the path of a fire, including the Ibat and NLEB, whether it is a wildfire or a prescribed burn. Three of the proposed avoidance and minimization measures listed in section 2.3.2 should limit the severity of smoke and heat as stressors in forested settings that bats occupy. TVA will use fire breaks to burn larger areas in smaller units (SHF1 and SHF3). Burns in April and May will occur when temperatures exceed 55°F to avoid affecting adult bats in torpor, who are unable to rouse quickly and fly to a roost beyond the smoke (SHF4).

Perry (2012) provided a review of fire effects on bats in the eastern oak region of the U.S., and Carter *et al.* (2002) provided a similar review for bats in the southeastern and mid-Atlantic states. Forest-dwelling bats, including the Ibat and NLEB, were presumably adapted to the fire regime that preceded European settlement and subsequent fire suppression in many parts of the eastern U.S. These reviews summarized how fire may affect individual bats directly (negatively) through exposure to heat, smoke, and carbon monoxide, and indirectly (both positively and negatively) through habitat modifications and resulting changes in their food base and tree roosts (Dickinson *et al.* 2009).

Direct Effects in Tree Roosts

Few studies have examined bat escape behaviors, direct mortality, or potential reductions in survival associated with fire. Dickinson *et al.* (2009) monitored two NLEB (one male and one female) in roosts during a controlled summer burn. Within 10 minutes of ignition near their roosts, both bats flew to areas that were not burning. All four bats they tracked before and after burning switched roosts during the fire, with no observed mortality. Rodrigue *et al.* (2001) reported flushing a *Myotis* bat from an ignited snag during an April controlled burn in West Virginia. Although these studies did not document injury or mortality resulting from daytime flights away from prescribed fire, this disruption of normal sheltering behavior creates the likelihood of injury by exposure to diurnal avian predators (see discussion in section 5.2.1 under “Noise/Disturbance”).

Carter *et al.* (2002) suggested that the risk of direct injury and mortality to southeastern forest-dwelling bats resulting from summer prescribed fire is generally low. During warm temperatures, bats are able to arouse from short-term torpor quickly. Most adult bats are quick, flying at speeds > 30 km/hour (> 18 miles/hour) (Patterson and Hardin 1969), enabling escape to unburned areas. Ibats and NLEBs use multiple roosts, switching roost trees often (see section 3.2.1), and could

likely use alternative roosts in unburned areas, should smoke make the current roost uninhabitable or fire destroy it. Non-volant pups are likely the most vulnerable to death and injury from fire. Although most eastern bat species are able to carry their young for some time after they are born (Davis 1970), the degree to which this behavior would allow females to relocate their young if fire threatens the nursery roost is unknown.

Dickinson *et al.* (2010) used a fire plume model, field measurements, and models of carbon monoxide and heat effects on mammals to explore the risk to the Ibat and other tree-roosting bats during prescribed fires in mixed-oak forests of southeastern Ohio and eastern Kentucky. Carbon monoxide levels did not reach critical thresholds that could harm bats in low-intensity burns at typical roosting heights for the Ibat (8.6 m) (28.2 ft). NLEB roost height selection is more variable, but on average lower (6.9 m) (22.8 ft) than the Ibat (Lacki *et al.* 2009). In this range of heights, direct heat could cause injury to the thin tissue of bat ears. Such injury would occur at roughly the same height as tree foliage necrosis (death), or where temperatures reach 60 °C (140 °F). Generally, forest managers plan prescribed fires to avoid significant tree scorch.

5.3.2. Estimation of Exposure and Numbers of Bats Affected

Prescribed burning is proposed for a well-defined portion of the larger Action Area for this consultation. This portion is comprised of 26,247 acres of TVA Reservoir lands on which TVA believes fire is an appropriate habitat management tool during the next 20 years (see section 2.3.1). These lands are entirely within the range of both the Ibat and NLEB; therefore, no partitioning of the proposed prescribed burning activity by species is necessary for this analysis.

Due to funding and staff limitations, TVA indicates that its burn activity is unlikely to exceed 1,500 acres annually, and that burn frequency on parcels presently treated with fire ranges from 1–5 years. Burning 1,500 different acres only once every year for the next 20 years would cover 30,000 acres, slightly more than the 26,247 acres that could benefit from prescribed fire. Maintaining a fire frequency of 1–5 years on some parcels and burning less than 1,500 acres annually will necessarily fall short of covering all the lands TVA would like to burn.

TVA proposes to conduct 10 percent of its prescribed burning during the active season outside of the pup season, none during the pup season (June and July), and the remainder (90 percent) during the inactive (winter) season (see section 2.3.1). Burning under the proposed Action will have no direct effects on non-volant pups. As we discussed in the introduction to section 5.3, we have dismissed from further analysis the direct effects of smoke on bats in hibernacula, due to the proposed conservation measures that limit such effects to insignificant levels. We have also dismissed from further analysis the indirect effects of burning on bats through changes in their forested habitat resources, such as roost tree availability and prey abundance. Winter burning has no direct effects on bats in forested habitats (bats are not present); therefore, our analysis in this section is limited to the direct effects of active season burning, which is limited to the months in which all bats are volant.

The 20-year cumulative acreage proposed for burning during the bat active season outside the pup season is 10 percent of 26,247 acres, or 2,624 acres. Lacking more specific data, we assume that the seasonal breakdown for the 20-year cumulative acreage applies to annual burning

activity, which TVA indicates will rarely exceed 1,500 acres. Therefore, 150 acres is the expected annual amount of burning that may directly affect Ibats and NLEBs in their forested habitats, which is 0.571 percent of the TVA Reservoir Lands that may receive prescribed fire.

In this BO, we use occupancy rates in forested portions of the Action Area of 3.3 and 14 percent for Ibat and NLEB, respectively (see sections 4.1.1 and 4.1.2). Assuming that all 26,247 acres of Reservoir Lands that could use prescribed fire are forested, burning 0.571 percent of these lands annually yields an expected overlap between burning and occupied areas of 4.9 and 21.0 acres for Ibat and NLEB, respectively ($0.00571 \times 0.033 \times 26,247 = 4.9$, and $0.00571 \times 0.14 \times 26,247 = 21.0$).

In this BO, we use a density of 120 adult bats per 1,700 acres for Ibat (0.0706 bats/acre), and 90 adults per 1,000 acres for NLEB (0.09 bats/acre). On 4.9 and 21.0 occupied acres burned annually, the expected number of Ibats and NLEBs affected is 0.35 and 1.89, respectively, which we round up to 1 and 2. Without rounding up, burning 0.571 percent of the eligible Reservoir Lands annually for 20 years with constant bat occupancy rates and densities, we would expect fire to affect about 7 Ibats and 38 NLEBs over the full duration of the Action (20×0.35 and 20×1.89).

Based on our literature review of the effects of fire on bats in section 5.3.1, we expect that all adult Ibats and NLEBs exposed to smoke or heat from prescribed fire would fly to alternate roosts, and that most would do so without injury. However, daytime flight away from such annoyance exposes bats to diurnal avian predators (see discussion in section 5.2.1 under “Noise/Disturbance”), which is consistent with the definition of incidental take in the form of harassment.

5.4. Summary of Effects

In section 5.2, we identified four unique pathways by which we expect stressors caused by tree removal under this Action to affect bats: noise and disturbance, physical trauma to non-volant pups, physical trauma to volant bats, and loss of shelter indirectly causing reduced reproduction. Bat responses upon exposure to the latter three pathways are consistent with the definition of incidental take in the form of harm, and responses to disturbance are consistent with the definition of take in the form of harassment.

However, the scale of this harm and harassment is small relative to the size of the Action Area and the numbers of bats we estimate it supports. We expect that noise from tree removal will each year cause a few individuals (1 Ibat and 3 NLEB) to flee their roosts, exposing them to diurnal predators. These numbers are low because we believe that Ibats and NLEBs are more likely (90 percent) to remain in a roost during tree removal operations that do not actually remove the roost tree.

For the Ibat, we expect the three pathways leading to harm to affect up to 5 individuals annually (1 pup, 3 volant bats, and 1 adult female). The 20-year cumulative estimates of harm are 7 pups and 29 volant bats killed or injured by felling an occupied tree, and 4 adult females injured (reproductive failure that year) by removal of unoccupied roost trees from the individual’s roost

network. Harming up to 4 volant bats annually represents 1.11 percent of the Ibat adult population that we believe the Action Area is likely to support (3 maternity colonies; 360 adults).

For the NLEB, the scale of harm caused by tree removal is greater than for the Ibat, but also small relative to the Action Area population. Two factors explain the different results for NLEB and Ibat: (a) the range of the NLEB encompasses the entire Action Area, whereas the range of the Ibat covers only 64 percent; and (b) we use an occupancy rate of 14 percent for the NLEB, and only 3.3 percent for the Ibat. The same three pathways leading to Ibat harm lead to NLEB harm. We expect tree removal to annually harm up to 6 NLEB pups, 23 volant bats, and 3 adult females. The 20-year cumulative estimates of harm are 55 pups, 241 volant bats, and 30 adult females. Harming up to 26 volant bats annually represents 0.93 percent of the NLEB adult population that we believe the Action Area is likely to support (31 maternity colonies; 2,790 adults).

In section 5.3, we determined that only the direct effects of prescribed burning during the bat-volant season (portion of the active season outside the pup season) are relevant to our analysis. Only 10 percent of the proposed burning will occur in this seasonal period. We expect that up to one (1) Ibat and two (2) NLEB annually will experience heat and smoke in their roosts and fly to an alternate roost, which will expose them to diurnal avian predators. This disruption of normal sheltering behavior, which creates the likelihood of injury, is consistent with the definition of incidental take in the form of harassment.

6. CUMULATIVE EFFECTS

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA.

The BA suggests that many types of non-federal actions may occur within the 1.015-million-acre Action Area during the next 20 years that may affect environmental resources. As examples, TVA lists state highway maintenance and improvement projects, airport operations and expansions, rail development projects, and others. However, the BA does not provide an assessment of how these actions may affect the Ibat or NLEB.

Most of the lands (about 89 percent) included in the Action Area are under a large or substantial degree of TVA control:

- 331,000 acres of TVA-retained lands (33 percent); and
- 569,001 acres of transmission line easements (56 percent) (source: BA Table 2-1).

Although non-federal actions may occur within transmission line easements, we believe it reasonable to assume that all actions on TVA-retained lands and many on TVA easements will involve managing and maintaining conditions for TVA purposes. Such actions are federal actions that we do not consider under cumulative effects in a consultation. The BA does not assess the effects of other non-federal actions that are reasonably certain to occur on these lands.

The remaining 11 percent of the Action Area lands are other non-TVA public lands associated with an anticipated level of TVA economic development support (7 percent), and an anticipated acreage of private lands identified for distributed solar energy generation (4 percent). These areas not under TVA ownership or easement, but are not specifically identified in the BA, because many of the sites that may support such activity in the next 20 years are not yet determined.

TVA expects that activities under the Action will affect only about 462,000 acres (45 percent) of the 1.015-million-acre Action Area. Therefore, it is not necessary to consider cumulative effects on about 55 percent of the Action Area. We lack a spatial delineation of the area that the Action may affect and any data about non-federal actions that are reasonably certain to occur in that area; therefore, the Service is unable to assess meaningfully the cumulative effects that may be relevant to this consultation.

7. CONCLUSION

In this section, we summarize and interpret the findings of the previous sections for the Ibat and NLEB (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

- a) jeopardize the continued existence of species listed as endangered or threatened; or
- b) result in the destruction or adverse modification of designated critical habitat.

“Jeopardize the continued existence” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status – Biennial Ibat population estimates were increasing from 2001 to 2007, suggesting a reversal in a long-term decline. The decline thereafter is largely attributable to WNS, especially in the Northeast Recovery Unit. The NLEB was common in many areas of its broad range until the onset of WNS in 2006, but has declined rapidly since. We expect further declines in both species as WNS continues to spread. The most recent Ibat census (2017) estimated a total of 530,705 Ibats in 229 hibernacula in 17 states. The Service calculated a rough range-wide population estimate of about 6.5 million NLEB in the intra-Service BO for the species’ final 4(d) rule. Although WNS continues to kill and weaken individuals in most of the species’ range, NLEB populations may still number in the millions, but its status is highly uncertain.

Baseline – Based on the Ibat hibernacula census data, we estimate that the 82-million-acre TVA Region supports about 23,000 adult Ibats. Of this regional population, we estimate that the 1.015-million-acre Action Area supports three (3) Ibat maternity colonies, each comprised of 60 adult females and associated with the same number of sympatric adult males. Estimates of NLEB numbers cannot rely on hibernacula census data. Instead, we make inferences based on an observed occupancy rate of 14 percent in the TVA Region and colony characteristics from the literature. We estimate that the Action Area supports about 31 NLEB maternity colonies, each comprised of 45 adult females and associated with the same number of sympatric adult males. Ibat and NLEB conservation needs and threats in the Action Area are largely the same as the range-wide needs and threats. WNS is detected in all 7 states of the TVA Region, and is the primary threat to their survival and recovery.

Effects – We expect that noise and disturbance caused by tree removal activity under the proposed Action will harass small numbers (up to 1 Ibat and 3 NLEB) each year by flushing individuals from tree roosts. We expect tree removal to harm relatively small numbers of Ibats and NLEBs each year.

For the Ibat, our estimates of harm are up to 1 pup and 3 volant bats killed or injured by felling occupied roost trees, and up to one 1 adult female injured (reproductive failure that year) by removing roost trees from the individual's roost network. Harming up to 5 bats in a year represents about 1 percent of the Ibat population that we believe the Action Area is likely to support before pups are born (3 maternity colonies; 360 adults).

For the NLEB, our estimates are higher than for the Ibat, but not large. Our estimates of harm are up to 6 pups and 23 volant bats killed or injured by felling occupied roost trees, and up to 3 adult females injured (reproductive failure that year) by removing roost trees from their roost networks. Harming up to 32 bats in a year represents about 1 percent of the NLEB population that we believe the Action Area is likely to support before pups are born (31 maternity colonies; 2,790 adults).

The extent of prescribed burning on TVA lands that may affect bats is about 150 acres per year. This burning will not affect bat pups. We expect that up to 1 Ibat and 2 NLEB annually will experience heat and smoke in their roosts and fly to an alternate roost, which will expose them to diurnal predators.

Harming up to 5 Ibats per year of the current range-wide population of about 530,000 Ibats will not appreciably reduce the likelihood of the species' survival and recovery in the wild. Ibat numbers have declined due to WNS by about 10,000–60,000 adults between successive biennial winter census counts in recent years. The effects of this Action will not alter that trend by an amount that is biologically meaningful at either the recovery unit or range-wide scales.

Harming up to 32 NLEBs per year from a wide-wide population that may still number in the millions will not appreciably reduce the likelihood of the species' survival and recovery in the wild. The Service determined previously that an average annual timber harvest rate of about 3.7 million acres per year throughout the range of the NLEB was not likely to appreciably reduce the likelihood of the species' survival and recovery in the wild (USFWF 2016). Tree removal under this Action, up to 3,759 acres per year, is a tiny subset of this range-wide average annual activity. Although NLEB numbers continue to decline due to WNS, the effects of this Action will not alter this trend by an amount that is biologically meaningful at the scale of either regional populations overlapping the Action Area or the species' range.

Cumulative Effects – TVA expects that various activities under the Action will affect about 462,000 acres (45 percent) of the 1.015-million-acre Action Area. Therefore, it is not necessary to consider cumulative effects on about 55 percent of the Action Area. We lack a spatial delineation of the 462,000 acres that the Action may affect and any data about non-federal actions that are reasonably certain to occur in that area; therefore, the Service is unable to assess meaningfully the cumulative effects that may be relevant to this consultation.

Conclusion – After reviewing the species’ current status, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the Service’s biological opinion that the Action is not likely to jeopardize the continued existence of the Ibat or the NLEB.

8. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term “take” in the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (ESA §3). In regulations at 50 CFR §17.3, the Service further defines:

- “harass” as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;”
- “harm” as “an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;” and
- “incidental take” as “any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.”

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

Regulations issued under ESA §4(d) prohibit the taking of the northern long-eared bat (NLEB) under specific conditions and circumstances, which are more limited than under the definitions quoted above. These prohibitions include incidental take resulting from tree-removal activity that “cuts or destroys known occupied maternity roost trees, or any other trees within a 150-foot (45-meter) radius from the maternity roost tree, during the pup season (June 1 through July 31)” (50 CFR §17.40). In this BO, we anticipate that projects under the programmatic Action will cause the taking of NLEB incidental to the removal of undocumented roost trees. Such taking is not prohibited under the NLEB 4(d) rule, and, therefore, does not require special exemption through compliance with the terms and conditions of an ITS. None are included for the NLEB in this ITS.

The programmatic Action evaluated in this BO does not authorize, fund, or carry out any of the future project-level activities that it describes, and these future Federal activities are subject to the requirements in ESA §7(a)(2). The TVA must determine on a project-level basis whether a proposed activity is consistent with the description of activities included in the programmatic Action and addressed in this BO, and if so, may rely upon the findings of this BO to document its compliance with §7(a)(2) with respect to the Indiana bat (Ibat) and NLEB. Such compliance does not relieve TVA of the requirements in §7(a)(2) for activities that may affect designated critical habitat or endangered and threatened species other than the Ibat and NLEB.

For the exemption in ESA §7(o)(2) to apply to the incidental taking of Ibats caused by project-level activities that are consistent with the programmatic Action addressed in this BO, TVA must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. TVA has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the TVA fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of prohibited incidental take, TVA must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

8.1. Amount or Extent of Take

This section specifies the amount or extent of take of Ibats that the Action is reasonably certain to cause, which we estimated in the “Effects of the Action” section of this BO. We reference, but do not repeat, these analyses here. We do not specify the anticipated amount or extent of take of NLEBs, because we do not expect the proposed Action to cause take of NLEB that is prohibited under the applicable regulations at 50 CFR §17.40.

The Service anticipates that the Action is reasonably certain to cause incidental take of individual Ibats consistent with the definition of harm resulting from tree removal activities (see section 5.2). We expect that the amount of take will not exceed five (5) individuals per calendar year and will not exceed 40 individuals over the 20-year duration (2018–2037) of the programmatic Action (see Table 5-3).

The Service anticipates that the Action is reasonably certain to cause incidental take of individual Ibats consistent with the definition of harass resulting from tree removal activities (see section 5.2) and from prescribed burning (see section 5.3). We expect that the amount of harassment caused by tree removal will not exceed one (1) individual per calendar year and will not exceed three (3) individuals over the 20-year duration (2018–2037) of the programmatic Action (see Table 5-3). We expect that the amount of harassment caused by prescribed burning will not exceed one (1) individual per calendar year and will not exceed seven (7) individuals over the 20-year duration (2018–2037) of the programmatic Action (see section 5.3.2).

The Service expects that incidental take of Ibats caused by the Action will be difficult to detect for the following reasons:

- individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to observe;
- the species forms maternity colonies of about 60 adult females under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- finding dead or injured individuals during or following tree removal in forested habitats is unlikely;
- observing individuals flying away from trees that are not known to contain a bat roost during tree removal operations or prescribed burning is unlikely; and

- some of the anticipated incidental take is in the form of reproductive failure that is not directly observable.

Due to the difficulty of detecting take of Ibats, TVA will monitor the extent of taking using the annual and 20-year cumulative acreages of tree removal and prescribed burning under the programmatic Action as a surrogate measure, because these activities will cause the taking. The amount of anticipated taking depends upon the seasonal timing of these activities. Therefore, TVA will monitor the annual and cumulative acreages according to the three seasonal periods defined for these activities in the description of the proposed Action. Taking of Ibats is expected in the Counties of the Action Area that are within the range of the Ibat (as shown in Figure 4-1), which represent about 64 percent of the total Action Area. Taking of Ibats will not exceed the levels we estimate in this BO resulting from tree removal and prescribed burning on an acreage within the range of the Ibat that is less than or equal to the following amounts:

Years	Tree Removal Acreage			Total
	Inactive Season: Bats Hibernating: November 15 – March 15	Active Season: All Bats Volant: March 16 – April 30, and August 1 – November 14	Active Season: Pups Non- Volant: June 1 – July 30	
Annual 2018-2021	1,258	557	589	2,403
Annual 2022-2037	810	277	198	1,285
Cumulative 2018-2037	17,990	6,667	5,516	30,172
	Prescribed Burning Acreage			
Annual	1,350	150	0	1,500
Cumulative 2018-2037	23,622	2,625	0	26,247

8.2. Reasonable and Prudent Measures

The proposed programmatic Action includes conservation measures to avoid and minimize impacts to the Ibat (see sections 2.2.2, 2.3.2) and to promote its recovery (see section 2.4). The analysis of effects of the Action in this BO considers that TVA will authorize, fund, or carry out all activities under the Action in a manner that is consistent with the description of activities in the BA, including all applicable conservation measures.

TVA also proposes procedures to document and report the alignment of TVA activities with the proposed programmatic Action (see section 2.5). These procedures include advance notification of the appropriate Service Field Office regarding project-specific effects determinations, alignment with the programmatic Action, bat survey results (if conducted), and coordination with Service Field Offices in the event that tree removal activity may directly affect Ibat or NLEB non-volant pups.

Based on our review of the proposed Action, its conservation measures, and its project-level review and notification procedures, the Service believes that no reasonable and prudent measures are necessary or appropriate to minimize the impacts of incidental take on the Ibat caused by the Action. Minor changes that do not alter the basic design, location, scope, duration, or timing of

the Action will not reduce incidental take below the amount or extent anticipated for the Action as proposed. Therefore, this ITS does not provide reasonable and prudent measures.

8.3. Terms and Conditions

No reasonable and prudent measures to minimize the impacts of incidental take caused by the Action are provided in this ITS; therefore, no terms and conditions for carrying out such measures are necessary.

8.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the TVA “must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement” (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R). As necessary and appropriate to fulfill this responsibility, the TVA must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the TVA and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

M&R1. Annual Reporting. Each year from 2019–2037, TVA will file a report not later than March 31 covering the preceding calendar year ending December 31. The report will:

- (a) identify all tree-removal and prescribed burning projects, and report the seasonal timing and total acreage for each project;
- (b) provide the results of any bat surveys associated with such projects;
- (c) provide the effects determination for each project according to the procedures specified under Chapter 6 of the BA;
- (d) summarize the outcome of any coordination with Service Field Offices as specified under tree removal conservation measures TR5 and TR6 in Chapter 5.2.4 of the BA.
- (e) provide the results of any TVA-sponsored bat monitoring and research in the TVA Region.

TVA will provide these annual reports to the U.S. Fish and Wildlife Service, Tennessee Field Office, at 446 Neal Street, Cookeville, Tennessee 38501.

M&R2. Annual Coordination. TVA will convene a meeting with the Tennessee Field Office at least once each calendar year on a mutually agreeable date between May 1 and December 31 to:

- (a) discuss the annual report under M&R1;
- (b) review the progress of the Action; and
- (c) review any new information relevant to the Action and its effects on the bat species considered in this consultation.

M&R3. Handling and Reporting Dead or Injured Listed Species. All personnel involved in activities under this TVA programmatic Action must take care when handling dead or injured Ibats, NLEBs, and any other endangered or threatened species that are found in a project area to preserve biological material in the best possible state, and to protect the handler from

exposure to diseases, such as rabies. Project personnel are responsible for ensuring that evidence for determining the cause of death or injury is not disturbed unnecessarily. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this ITS is exceeded. Personnel finding a dead, injured, or sick specimen of any endangered or threatened species, must promptly notify the Service's Division of Law Enforcement at 1875 Century Blvd., Suite 380, Atlanta, Georgia 30345 (Telephone: 404/679-7057), and then the Service's Ecological Services Field Office of applicable jurisdiction.

9. CONSERVATION RECOMMENDATIONS

§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 activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or 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 TVA. In general, our recommendations are to continue and expand the various programs that TVA already undertakes to contribute to bat conservation.

1. Continue the TVA collaboration with partners to survey bridges that may support maternity colonies.
2. Continue the TVA collaboration with partners to learn more about how bats are using habitats within the TVA region (*e.g.*, spring migration radio tagging and tracking, location and assessment of roost trees).
3. Conduct bat monitoring following bat habitat enhancement and artificial roost projects on TVA-managed lands to assess project benefits.
4. Monitor and maintain gates and signage at caves that listed bats use, and determine the need for new gates, fences, or signage at other caves on TVA lands that listed bats use.
5. Continue to serve as a member of state WNS planning committees.
6. Continue to update and maintain a database of listed bat occurrence records (*i.e.*, mist net captures, cave, bridge, and tree roosts, *etc.*), and use this database to inform project-specific environmental reviews and BAs.
7. Continue to offer workshops to TVA staff interested in assisting with conducting bat habitat assessments.

10. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

- a. the amount or extent of incidental take is exceeded;
- b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
- c. the Action is modified in a manner that causes effects to listed species or designated

- critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the TVA is required to immediately request a reinitiation of formal consultation.

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