MID-STATES CORRIDOR

APPENDIX QQ – BIOLOGICAL OPINION

Mid-States Corridor
Tier 1 Environmental Impact Statement

Prepared for

Indiana Department of Transportation
Mid-States Corridor Regional Development Authority

JUNE 29, 2023

Prepared by

US Fish and Wildlife Service

Framework Programmatic Biological Opinion and Conference Opinion

for the
Tier 1 Effects of Construction, Operation, and Maintenance
of the
Mid-States Corridor Project
Southwest Indiana
(Des. No. 1801941)
on the
Indiana Bat, Northern Long-eared Bat, Fanshell Mussel, Fat Pocketbook Mussel, Tricolored Bat, Little Brown Bat, Salamander Mussel, and Monarch Butterfly.

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USFWS Project Code: 2023-0077369
June 29, 2023

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Introduction

This document transmits the biological opinion and conference opinion (Opinion) of the U.S. Fish and Wildlife Service (Service) prepared under the authority of and in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq. [ESA]). The purpose of formal section 7 consultation is to ensure that any action authorized, funded, or carried out by the Federal government is not likely to jeopardize the continued existence of any listed species action. A formal conference assists agencies in making a preliminary jeopardy determination for proposed species.

We base this Opinion on our review of the Federal Highway Administration (FHWA) and Indiana Department of Transportation's (INDOT) Mid-States Corridor Project and its effects on the federally listed Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septenrionalis*; NLEB), fanshell mussel (*Cyprogenia stegaria*), and fat pocketbook mussel (*Potamilus capax*) per section 7(a)(2) of the ESA. In addition, our Opinion includes a review of the project's effects on the tri-colored bat (*Perimyotis subflavus*), little brown bat (*Myotis lucifugus*), salamander mussel (*Simpsonaias ambigua*), and monarch butterfly (*Danaus plexippus*) per section 7(a)(4). The above species are referred to as the "covered species".

A biological opinion is the document that states the findings of the Service requires under section 7 of the ESA 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.

As defined in the ESA section 7 regulations (50 C.F.R. §402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas."

A conference follows the same procedures as formal consultation and addresses proposed species and proposed critical habitat, resulting in a conference opinion. The conference opinion follows the same format and content of a biological opinion; however, the incidental take statement provided with the conference opinion does not take effect until the Service and action agency adopt the conference opinion as a biological opinion once the species is listed. Since this consultation is following a tiered process, we will not develop an incidental take statement in this Tier 1 Opinion. We will issue subsequent consultations for individual sections of the project as Tier 2 site-specific Opinions that include incidental take statements.

FHWA and INDOT assumed the species listed above are present along the project corridor based on database records and the availability of suitable habitat. They determined the project may affect and is likely to adversely affect Indiana bats, NLEBs, tricolored bats, fanshell mussels, fat pocketbook mussels, salamander mussels, and monarchs; they also determined the project may affect but is **not** likely to adversely affect the gray bat (*Myotis grisescens*), sheepnose mussel (*Plethobasus cyphus*), rough pigtoe mussel (Pleurobema plenum), and lake sturgeon (*Acipenser fulvescens*). Finally, the project will not adversely modify Indiana bat critical habitat.

In their biological assessment, FHWA and INDOT propose to construct, operate, and maintain a new roadway from the I-64/US 231 interchange in Spencer County to I-69 at the existing US 231 interchange in Greene County. We received your request for consultation on January 27, 2023.

Consultation History

A complete administrative record of the consultation is on file in the Indiana Ecological Services Field Office (INFO) in Bloomington, Indiana. The following is the coordination chronology for the Mid-States Corridor Project.

Date	Summary of Activity
July 3, 2019	Service general project introduction meeting • Notification of tiered approach for Environmental Impact Statement and Section 7 consultation • Preliminary discussion of listed species and candidate species • Discussion on approach to tiered Section 7 consultation
August 20, 2019	Mid-States Corridor Agency Scoping Meeting
September 10, 2019	Service response to Early Coordination and Draft Purpose and Need Statement.
December 12, 2019	Service meeting to discuss Tier 1 approach, project species list, and Section 7 consultation expectations.
March 3 and 4, 2020	Mid-States Corridor Agency review meeting and bus tour.
March 23, 2020	Service response to Screening of Alternatives Report.
June 29, 2021	Service provides updated list of endangered, threatened, candidate, and review species for each of the five proposed corridors.
May 5, 2022	Mid-States Corridor Agency Coordination Meeting
June 15, 2022	Service Tier 1 Biological Assessment (BA) Coordination Meeting
January 20, 2023	Pre-Consultation Agreement signed by FHWA and INDOT
January 27,2023	Service receives request for formal consultation and conference
January 31, 2023	Service signs Pre-Consultation Agreement
June 1, 2023	Service receives approval for extension of Opinion delivery

Biological and Conference Opinion

Analytical Framework for Jeopardy Determinations

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components: (1) the Status of the Species, which evaluates the covered species' rangewide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the covered species in the Action Area, the factors responsible for that condition, and the relationship of the Action Area to the survival and recovery of these species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the covered species; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the Action Area on the covered species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the covered species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery in the wild. The jeopardy analysis in this Opinion places an emphasis on consideration of the rangewide survival and recovery needs of the covered species and the role of the Action Area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

1.0 Description of the Proposed Action

The FHWA's Tiered Approach

FHWA is completing the National Environmental Policy Act (NEPA) studies for the proposed Mid-States Corridor in southwest Indiana in two tiers. The Council on Environmental Quality (CEQ) guidelines and FHWA guidelines allow NEPA studies for large, complex projects to be completed in a two-staged or "tiered" process. Tier 1 of the study involves extensive environmental, transportation, and economic studies, and cost analyses. The final Tier 1 NEPA document will be an Environmental Impact Statement (EIS) that provides a basis for the FHWA to grant approval for a specific corridor (presumably Alternative P). In most cases, the proposed corridor is approximately 2,000 feet (ft) wide, but FHWA has proposed to narrow the corridor in some instances to avoid sensitive environmental areas. FHWA developed a working alignment within the corridor, ranging from approximately 180 to 650 ft wide to estimate the potential impacts analyzed in the Tier 1 BA. It is important to note that FHWA will finalize specific alignment decisions within a project section after completing the Tier 2 study processes and consultations for each project section.

FHWA will conduct Tier 2 NEPA studies to determine a specific alignment within the selected corridor. FHWA will divide the corridor it selects in Tier 1 into five segments of independent utility (SIUs; Figure 1), to be addressed in Tier 2. FHWA is not planning any improvements for SIU1 (US 231 from Rockport to I64), and therefore, did not include SIU1 in this consultation. To provide more flexibility, FHWA will conduct detailed Tier 2 NEPA studies on each project section rather than singly on the entire route. Each Tier 2 study will look beyond its project termini to determine if there is anything sensitive just beyond the termini that would affect the location of the adjoining project. This will provide additional assurance that decisions made in one section do not prematurely preclude consideration of alternatives within the preferred corridor for adjoining sections. In general, the range of alternatives in Tier 2 will be confined to the corridor selected in Tier 1. However, flexibility exists to consider alternatives outside the corridor, with consultation, if necessary to avoid unanticipated impacts. While the various potential Local Improvement segments are addressed and incorporated into the proposed action of the Tier 1 BA, these segments along US 231 will not be included in the Tier 2 surveys (i.e., bats and mussels). Each Local Improvement along US 231 is an independent project and will be handled through separate NEPA and ESA evaluation (e.g., Service determination keys).

The Service's Consultation Approach

The Mid-States Corridor Project is a "framework programmatic action" which is defined as a federal action that provides a framework for the development of future action(s) that are authorized, funded, or carried out later, and any take of a listed species would not occur unless and until those future action(s) are implemented. As a result, the Service is taking a programmatic consultation approach and will complete one comprehensive and conservative effects analysis up front in Tier 1 for the entire project rather than repeating the same analyses for each of the four subsequent Tier 2 project sections. One benefit of completing this initial analysis up front in an overall "programmatic" consultation document is we analyze anticipated effects common to each of the Tier 2 project sections and incorporate them into the environmental baseline during the Tier 1 consultation. This provides predictability for FHWA and INDOT as they can be assured that the effects of their future Tier 2 actions have already been broadly accounted for.

Since uncertainty exists in Tier 1 as to the specific impacts that will occur when the entire alignment is eventually finalized, the Service will provide the benefit of the doubt to the species and use "reasonable worst case" assumptions when developing the programmatic-level Opinion. Through early consultation with the Service, FHWA and INDOT agreed to assume presence of the covered species during the Tier 1 consultation, and species-specific field survey studies would not be necessary to evaluate the proposed corridor for the purposes of a "jeopardy" analysis. As such, FHWA based the Tier 1 BA solely on a landscape scale analysis using GIS data, available literature, and personal communication with biologists familiar with and knowledgeable about the species of concern.

FHWA will refine this evaluation during Tier 2 project-level consultations. This approach will ensure that the FHWA can fulfill its responsibilities under section 7(a)(2) of the Act to "insure" that actions implemented under the Mid-States Corridor "framework program" are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat.

Proposed Action

As previously defined, "action" refers to all activities or programs authorized, funded, or carried out by federal agencies in the United States (US). 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."

INDOT, in partnership with FHWA, is developing a federal-aid road project (Des. 1801941) which includes the construction, operation, and maintenance of a new-terrain roadway in southwest Indiana. Alternative P has been identified in the Draft Environmental Impact Statement as the preferred alternative (Figure 1) and is the alternative we analyze in this Tier 1 Opinion. The project will be approximately 55 miles long and begin at the intersection of US 231 and Interstate 64 (I64) in Spencer County. The road will travel east of Huntingburg and Jasper, avoiding developed areas in those cities. It will generally run parallel to and west of US 231 in Martin and Daviess Counties and include a new or modified crossing of the East Fork White River (EFWR) and a bypass of the Town of Loogootee before tying into I69 at US 231. FHWA also proposes a total of nine local improvement projects along existing US 231. We broadly analyze these local projects in this Tier 1 consultation.

FHWA will complete Tier 2 studies to define the facility type (expressway or super 2) and specific right-of-way for the new facility. These studies will provide more detailed planning information and analysis. Consultation needs for local improvements will also be further evaluated during Tier 2. FHWA and INDOT have not developed a construction schedule to date.

The Draft Environmental Impact Statement (DEIS) (Chapter 2 – Alternatives) describes the step-by-step process of alternative development. At each step, some alternatives were eliminated from further consideration, while others were retained and analyzed in further detail. Alternative P has been modified for the FEIS/ROD by incorporating variations at Loogootee. These variations will be carried forward into Tier 2 studies, where a single variation will be chosen.

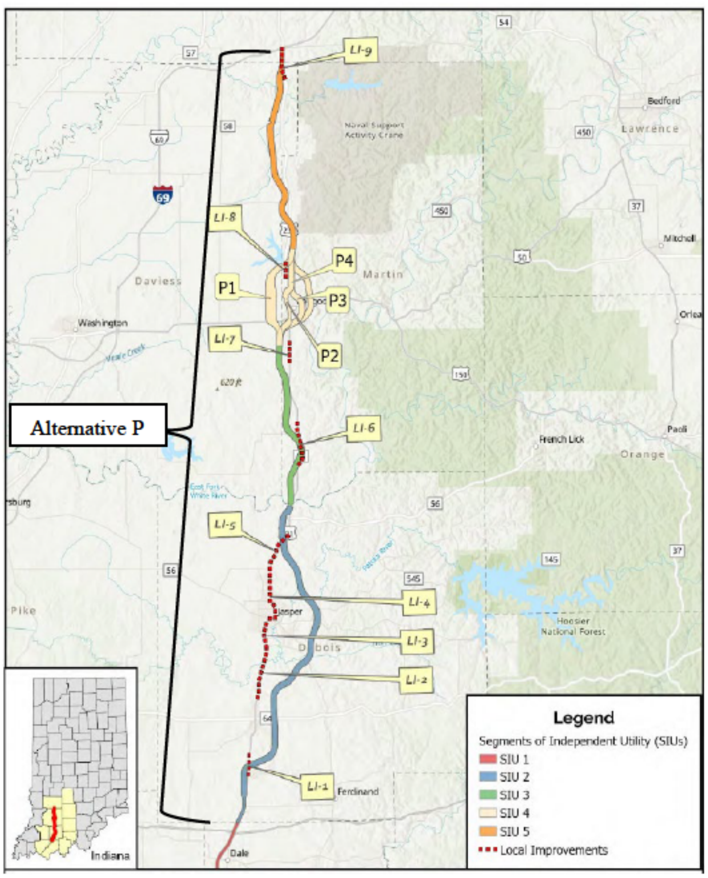

Figure 1. Proposed Mid-States Project Corridor (Alternative P). Different colored line segments indicate SIUs. P1,2,3, and 4 show the proposed variations around the Town of Loogootee. Map taken from BA.

1.1 Avoidance, Minimization, and Conservation Measures

INDOT, in consultation with the Service, incorporated the following unique measures as part of the proposed action to avoid, minimize, and mitigate impacts of the action on the various species included in this consultation. We analyzed the effects of the proposed action based on the assumption that INDOT will implement these measures. A summary of the measures follows.

Proposed Avoidance and Minimization Measures

- Avoid tree-clearing from April 1 through October 1. This will be incorporated into the project construction contract as a special provision to avoid potential impacts to Indiana bats, tri-colored bats, little brown bats, and NLEBs roosting during the summer maternity season. This will include tree-clearing restrictions for utility work and borrow/fill/staging areas as well.

- Incorporate routine inspections of bridges, temporary construction features (e.g., false work, forms, scaffolding, etc.), and other structures (e.g., houses, barns, sheds, etc.) prior to demolition and construction. If bats are found to be using these for roosting an avoidance or minimization measure such as seasonal work restrictions or physical exclusion techniques (Styrofoam sheets, foam backer rolls, expansion foam) to seal off gaps and crevices will be evaluated and implemented if considered appropriate. In addition, form, scaffolding, and other concrete structures will be dismantled in a timely manner to reduce chance of bat use. This will be further evaluated in Tier 2.

- Prohibit or limit nighttime construction and the use of temporary lighting during the active season in areas where such intrusions may unduly affect bats. Lighting will be directed away from suitable habitat. This will be further evaluated in Tier 2.

- Develop an erosion control plan sensitive to the unique challenges of the project area in accordance with INDOT standards and Indiana Department of Environmental Management requirements. This will be further developed in Tier 2.

- Incorporate measures into the design to avoid and intercept contaminants leaving the roadway prior to discharge into sensitive resources such as streams, wetlands, and forests. Where possible, avoid drop drains on bridge decks directly above waterways and use enclosed drainage systems that direct the discharge to where runoff can be filtered via floodplain soils and vegetation. The drainage system for a new US 231 bridge at the EFWR shall be designed to capture all bridge runoff and convey it to the abutments to be discharged on the bridge approach embankments to better reduce road contaminants from being directly discharged into the river. Similarly, the existing bridge shall be retrofitted with an enclosed drainage system to eliminate the existing free fall system that discharges directly into the EFWR.

- US 231 Bridge design will include piers that allow for free passage throughout the channel upon completion. During construction, unique special provisions and project commitments will be developed to ensure that causeways are designed to allow for unencumbered fish passage within the channel throughout construction.

- Permanent lighting, where needed, will use downward facing and full cut-off lenses to meet BUG system thresholds of "0" for uplight and the lowest backlight level practical for the roadway lighting needs.

- Conduct bat mist net surveys prior to the Tier 2 formal consultation on a section by section (SIU) basis. Tier 2 mist netting will follow the most current Service protocol in terms of level of effort (LOE) for the Indiana bat and NLEB and would be seasonally limited to May 15 through August 15. INDOT will consult with the Service prior to conducting surveys.

- Conduct mussel presence/absence survey at the EFWR crossing prior to Tier 2 formal consultation. A study plan detailing the quantitative and qualitative survey methods shall be submitted to the USFWS for approval prior to initiation of the survey. Mussel bed avoidance will be prioritized during Tier 2 development. Any mussel beds that cannot be avoided through Tier 2 development will be relocated if warranted.

- Conduct field studies in Tier 2 to identify suitable monarch butterfly habitat and individuals within and adjacent to the proposed right-of-way. Methods may include procedures such as the Pollinator Scorecard protocol developed by the Rights-of-Way Working Group (ROWHWG 2019) or the Monarch Monitoring Program developed by the Monarch Joint Venture (Monarch Joint Venture 2022). INDOT will consult with the Service to develop field study plans.

- Construction and operation of the Mid-States Corridor will follow avoidance and minimization measures described in the INDOT Candidate Conservation Agreement with Assurances (CCAA) for the monarch butterfly including seeding and planting (enhancement planting, post-construction planting, etc.), brush removal, suitable habitat set-asides, conservation mowing, and targeted herbicide use.

Conservation and Mitigation Measures

- To compensate for the unavoidable and irreversible loss of suitable bat roosting and foraging habitat (i.e., forest loss), INDOT is committed to the development of a compensatory mitigation plan during the Tier 2 phase of the Mid-States Corridor project. In general, impacts to forests within 300 feet of an existing roadway will be mitigated at a 1.5:1 ratio and impacts beyond 300 ft will be mitigated at a 3:1 ratio. The framework of the plan will be structured around one or a combination of the following mitigation approaches:

    - Payment into The Conservations Fund's Indiana bat and NLEB In Lieu Fee Program.
    - Use of an approved habitat mitigation bank

    - Permittee-responsible mitigation project development (land purchase, restoration projects, easement purchases, etc.)

- INDOT will prepare a pollinator habitat development plan which targets specific areas along the new roadway for seeding of native nectar wildflowers, particularly milkweeds, to benefit monarchs. The details of the pollinator habitat development plan will be addressed during Tier 2 of the consultation process.

1.2 Action Areas

The Action Area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The Action Area is not limited to the "footprint" of the action, nor is it limited by the Federal agency's authority. Rather, it is a biological determination of the reach of the proposed action on listed species. Delineating the Action Area is necessary for the Federal action agency to determine what species and critical habitats may occur in that area.

For the purposes of this Opinion, FHWA, INDOT, and the Service developed three Action Areas specific to bats, mussels, and the monarch butterfly. These zones will incorporate all areas directly impacted by the construction, operation, and maintenance of the roadway, including affects related to habitat removal, noise, vibration, lighting, and potential water quality changes, as well as indirect effects related to traffic, maintenance, and induced growth.

1.2.1 Bat Action Area

While the Indiana bat, northern long-eared bat, little brown bat, and tricolored bat vary in their specific summer and winter habitat affinities, their preferred foraging areas, and their foraging ranges, FHWA, INDOT, and the Service collectively developed a single action area for these five species instead of a species-specific action area for each bat (Figure 2). The 2,000-foot corridor, including the optional routes around and through the Town of Loogootee, represents the base from which the bat action area was developed. Construction noise was used to establish the action area boundary beyond the 2,000-foot corridor using a standardized methodology described in detail in Section 11.6.1.5 of the BA. This stressor had the farthest-reaching effects for most of the Action Area.

In addition, the bat Action Area was extended in several locations where induced development-related stressors were predicted to occur. The Transportation Economic Development Impact System (TREDIS) was used to determine areas of induced development in the project corridor. The TREDIS model analyzes economic geographic relationships and economic response factors to forecast potential impacts of new transportation projects. Based on this there are 14 areas (Traffic Analysis Zones; TAZs) that are anticipated to see induced household and job growth due to the building of the Alternative P corridor.

The nine local improvement projects along US 231 were buffered by 575 ft to define an action area based on construction noise specific for these projects. Except for three of the local projects (LI- 2, LI-3, and LI-4), these action area buffers are encompassed within the overall Bat Action

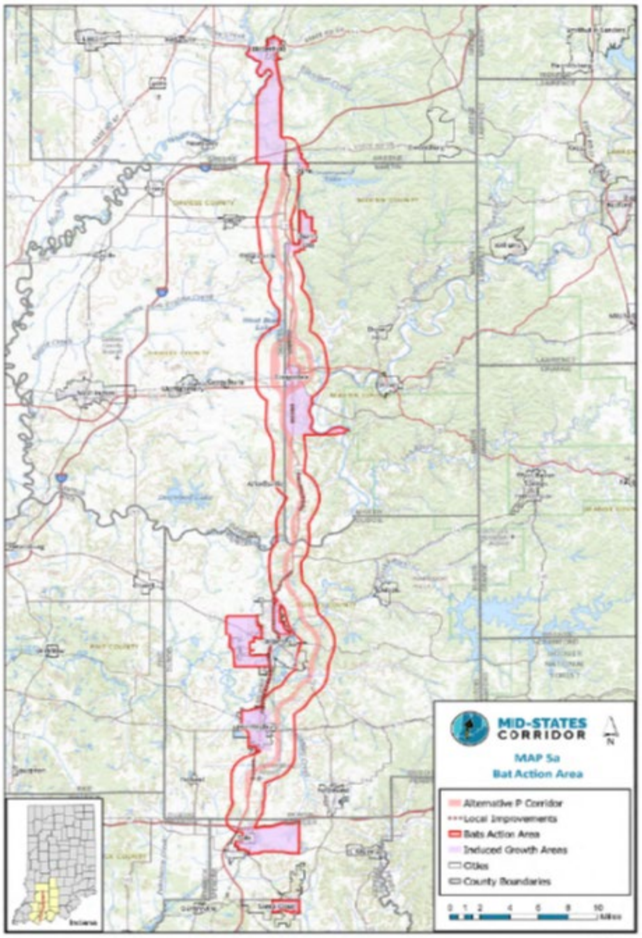

Figure 2. Bat Action Area. Map taken from Biological Assessment.

Area limits for the corridor and induced growth areas. Where the three local improvement projects range beyond the corridor and induced growth areas, the Action Area has been extended.

1.2.2 Mussel Action Area

A collective action area for the three mussel species considered in this Opinion (fanshell, fat pocketbook, and salamander mussel) was developed for the Mid-States Corridor Tier 1 evaluation (Figure 3). Although numerous smaller waterways will be impacted by the proposed project, impacts to federally listed species are limited to the proposed crossing of the EFWR. The mussel action area encompasses a 100-acre area extending approximately 1,800 ft (0.33 mile) downstream of the existing US 231bridge and approximately 1,100 ft (0.20 mile) upstream of the bridge. Perpendicular to the EFWR, the action area extends approximately 700 to 800 ft north and south of the respective banks to include the bridge approach construction zones where equipment staging and land disturbance activities potentially affecting water quality are anticipated.

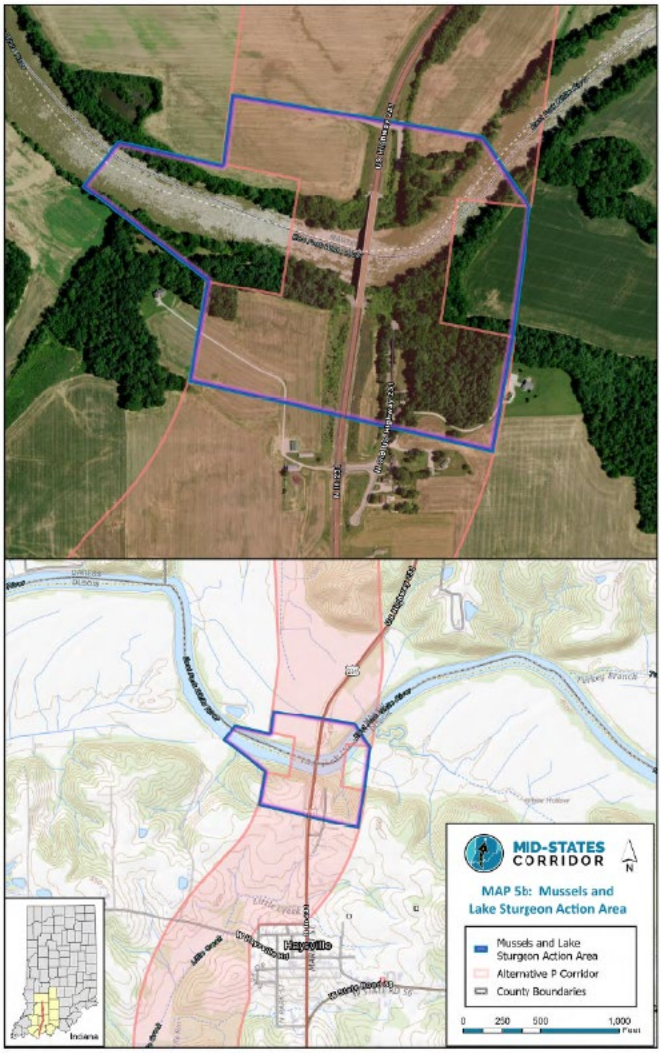

Figure 3. Mussel Action Area. Map taken from Biological Assessment.

1.2.3 Monarch Butterfly Action Area

Direct impacts to the species and suitable habitat will be confined to the right-of-way footprint for the expressway or super-2 facility type, whichever is selected in the Tier 2 phase. Therefore, for the Tier 1 assessment, the spatial extent of the action area is the 2000-foot corridor, including the multiple options around and through Loogootee. There is also the potential for monarch butterfly habitat to occur along the nine proposed US 231 local improvement projects. Accordingly, these locations were incorporated into the Action Area using the same 575-foot centerline buffer as the bats. Lastly, indirect impacts to the monarch butterfly resulting from induced growth have also been incorporated into the monarch butterfly Action Area. While specific locations for such induced growth can’t be determined at this time, monarch habitat impacts in these areas may occur.

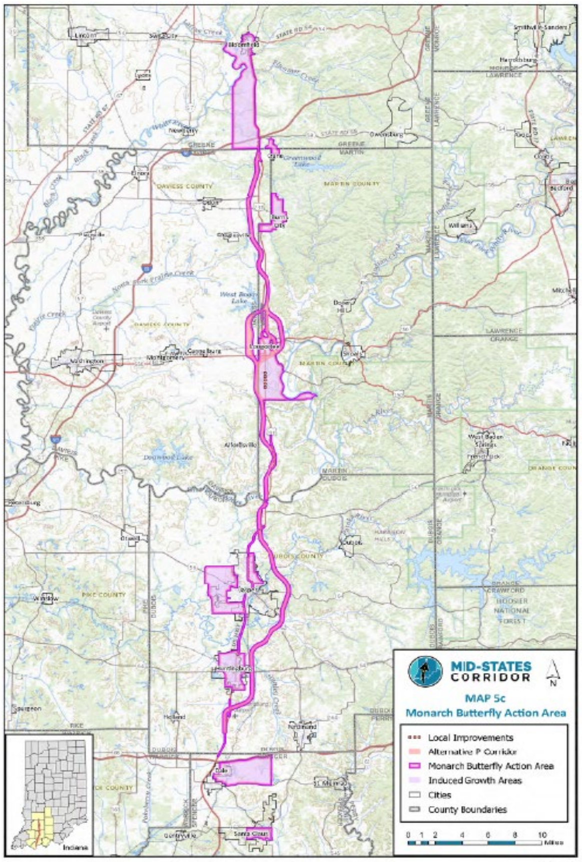

Figure 4. Monarch Butterfly Action Area. Map taken from Biological Assessment.

2.0 Status of the Species

This section presents the biological or ecological information relevant to formulating this Opinion. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. This analysis documents the effects of past human and natural activities or events that have led to the current rangewide status of the species. Portions of this information are also presented in listing documents, recovery plans, status assessments, five-year reviews, among others, and are referenced accordingly.

2.1 Indiana Bat

Species and Critical Habitat Description

The Indiana bat was listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001), under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). In 1973, the Endangered Species Preservation Act was subsumed by the ESA and the Indiana bat was extended full protection under this law. Critical habitat was designated for the species on September 24, 1976 (41 FR 14914). Thirteen hibernacula, including 11 caves and two mines in six states, were listed as critical habitat; however, this action does not affect any of these areas.

The Indiana bat is a medium-sized bat in the genus *Myotis*. It is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter and spends the summer in wooded areas. Thogmortin et al., 2013, found a mean lifespan of 5.7 years and some individuals live more than 20 years, according to LaVal and LaVal (1980). A detailed description of the species physical appearance and a discussion of taxonomy can be found in the *Indiana Bat Draft Recovery Plan: First Revision* (2007 Recovery Plan) (USFWS 2007).

Life History and Biology

The 2007 Plan provides a comprehensive discussion of Indiana bat life history. A summary of the life history follows (citation for information in the summary is USFWS 2007 unless otherwise noted).

Winter Habitat and Spring Migration

In winter Indiana bats hibernate in caves or mines, often with other species. The period of hibernation varies across the range of the species, among years, and among individuals. On a rangewide basis, the months of October through April capture the hibernation period of most individuals. Indiana bats typically return to the same hibernacula each year and often hibernate in dense clusters. They can often be found in the same hibernacula as other species such as gray bats, little brown bats (*Myotis lucifugus*), and NLEBs.

In the spring female Indiana bats emerge from hibernation first. Timing for emergence can vary depending on location and weather. In Indiana, peak emergence for females is in April, while males often lag into May. Female bats are thought to move to summer habitat soon after emergence and arrive at their maternity habitat pregnant. They become pregnant via delayed fertilization from sperm stored in their reproductive tract over winter. Females migrate to their traditional roost sites, where they find other members of their maternity colony. Members of the same maternity colony may come from many different hibernacula. Most documented maternity colonies have 50 to 100 adult female bats; average colony size of 80 adult females was noted in Indiana (Whitaker and Brack 2002) and is a widely used estimate. Less is known about male migration patterns.

Summer Habitat

Female Indiana bats exhibit strong site fidelity to summer roosting and foraging areas and return to the same summer range annually to form colonies and bear their young. Maternity colony habitats include riparian forests, bottomland and floodplain habitats, wooded wetlands, and upland forest communities. Maternity roost sites are most often under the exfoliating bark of dead trees that retain peeling bark. Live trees, especially shagbark hickory, are also used if they have flaking bark under which the bats can roost. Primary roosts, those used frequently by large numbers of female bats and their young, are usually large diameter snags (dead trees). Roost trees are often in mature mostly closed-canopy forests, but in trees with solar exposure (i.e., sunlight on the roost area for at least part of the day) - these may be in canopy gaps in the forest, in a fence-line, or along a wooded edge. Maternity colonies typically use 10 to 20 trees each year, but only one to three of these are primary roosts used by most bats for some or all of the summer (Callahan 1993, Callahan et al. 1997).

Reproduction

Fecundity is low with female Indiana bats producing only one pup per year in late June to early July. Young bats can fly at about four weeks of age. Cohesiveness of maternity colonies begins to decline after young bats become volant and bats tend to roost together in the same roosts less frequently and at lower densities. A few bats from maternity colonies may commence fall migration in August, although at many sites some bats remain in their maternity colony area through September and even into October. Members of a maternity colony do not necessarily hibernate in the same hibernacula and may migrate to hibernacula that are over 300 kilometers (km;190 mi) apart (Kurta and Murray 2002 and Winhold and Kurta 2006).

Fall Swarming

Indiana bats arrive at their hibernacula in preparation for mating and hibernation as early as late July, with adult males or nonreproductive females making up most of the early arrivals (Brack 1983). The number of Indiana bats active at hibernacula increases through August and peaks in September and early October (Cope and Humphrey 1977, Hawkins and Brack 2004, Hawkins et al. 2005). After fall migration, females typically do not remain active outside the hibernaculum as long as males. Males may continue swarming through October in what is believed to be an attempt to breed with late arriving females. Swarming is a critical part of the life cycle when Indiana bats converge at hibernacula, mate, and forage until sufficient fat reserves have been obtained to sustain them through the winter (Hall 1962). Swarming continues for several weeks, and mating may occur on cave ceilings or near the cave entrance during the latter part of the period. Limited mating activity occurs throughout the winter and in spring before the bats leave hibernation (Hall 1962).

Diet and Foraging

The Indiana bat is a nocturnal insectivore. It emerges shortly after sunset and begins feeding on a variety of insects that are captured and consumed while flying. This species feeds almost exclusively on flying insects. Four orders of insects contribute most to the diet: Coleoptera, including beetles; Diptera, including flies; Lepidoptera, including moths; and Trichoptera, including caddisflies. The importance of each order varies across the range. Terrestrial-based prey such as moths and beetles have been reported more commonly in southern studies, whereas aquatic-based insects, including flies and caddisflies, dominated in the north.
Indiana bats forage over a variety of habitat types but prefer to forage in and around the tree canopy of both upland and bottomland forest, along roads, or along the corridors of small streams. Menzel et al. (2005) found that females foraged significantly closer to forests, roads, and riparian habitats than agricultural land and grasslands. Womack et al. (2012) documented selection by reproductive females of forests with higher canopy cover but more open mid-stories caused by management via prescribed fire. Bats forage between dusk and dawn at a height of

approximately 6-90 ft above ground level and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects (Humphrey et al. 1977).

Population Dynamics

The Indiana bat population has decreased significantly from an estimated 808,000 in the 1950s (USFWS 2007). Based on censuses taken at hibernacula in 2022, the current total known Indiana bat population is estimated to number 582,601, which represents an 8% increase since 2019 and a 12.3 % decline since 2007 when White Nose Syndrome (WNS) was first discovered in the U.S. (Figure 2).

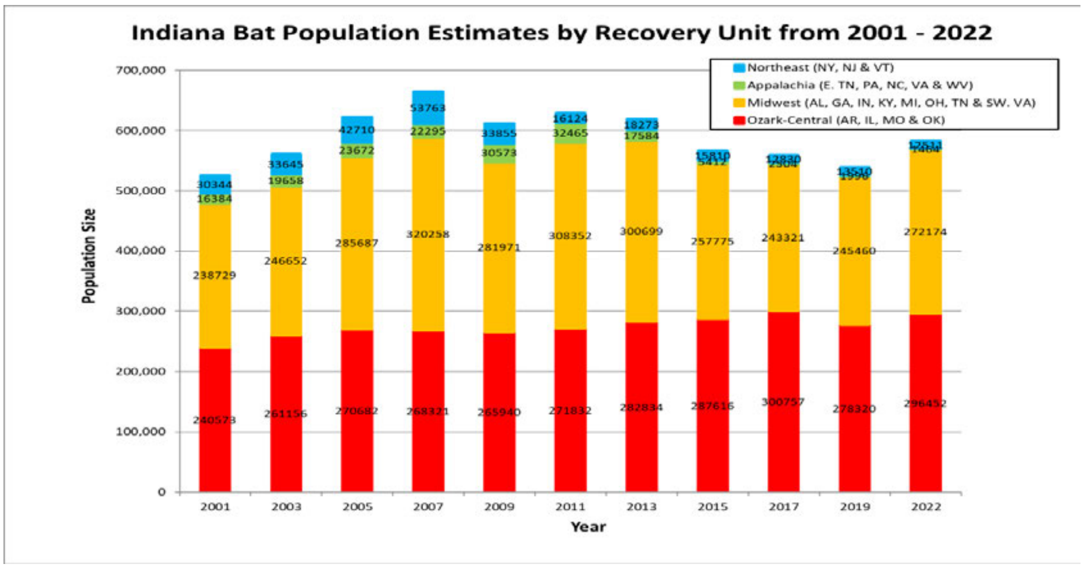

Figure 5. Indiana Bat Population Estimates by Recovery Unit, 2001-2022.

Based on the most recent population data, an estimated 37.6% of the rangewide population of Indiana bats hibernated in caves within the bat's namesake state of Indiana and the Midwest RU contains 47% of the rangewide population. The species' rangewide, regional, state, and hibernacula-specific population trends are being closely monitored by the Service and available at https://www.fws.gov/species/indiana-bat-myotis-sodalis.

Given the 2022 rangewide Indiana bat population estimate of 582,601, we assume that there are approximately 3,641 to 4,855 maternity colonies throughout the species' entire range (assuming a 50:50 sex ratio [Humphrey et al. 1977] with an average maternity colony size of 60 to 80 adult females [Whitaker and Brack 2002]). As of the publication date of 2007 Recovery Plan, we had records of 269 maternity colonies in 16 states that were considered locally extant. Based on the assumptions above, those colonies represent only 5% to 7% of the assumed number of maternity colonies in existence.

Status and Distribution

Indiana bats are found over most of the eastern half of the U.S. In winter, the range of the species is restricted to areas with caves or underground mines, while the summer range is broader. Large wintering populations (more than 45,000 individuals) are found in Indiana, Illinois, Kentucky, and Missouri with smaller hibernacula occurring in 15 additional states. While their overall geographic range has changed relatively little since first listed, with recent declines due to WNS, there has been some shift in spatial distribution and abundance in occupied hibernacula (USFWS 2019c). In some instances, there have been shifts toward manmade hibernacula (mines, tunnels, and a dam), concentration into fewer hibernacula, and noted redistribution from one hibernaculum to another nearby, suggesting immigration (USFWS 2019c).

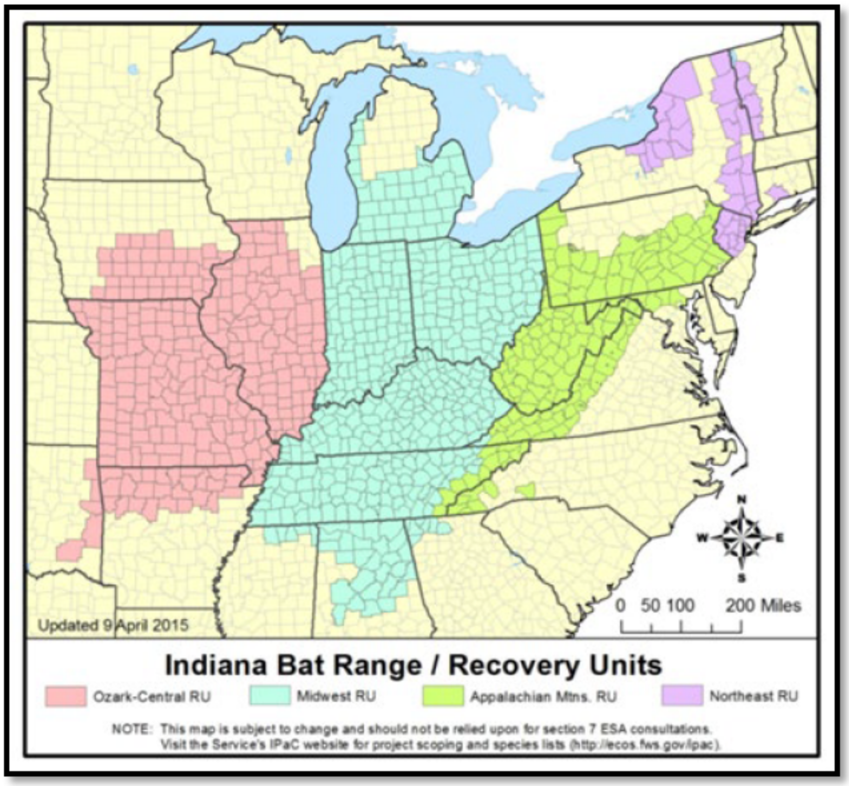

Figure 6. Indiana Bat Range and Recovery Unit map.

The recovery program for the Indiana bat delineates four Recovery Units (RUs): the Ozark-Central, Midwest, Appalachian Mountains, and Northeast RUs (USFWS 2007; Figure 3). The proposed project would be constructed within the Midwest RU, and we assume that bats impacted by the project will be from the Midwest RU.

Currently, the rangewide status of the species has slightly improved from previous few years, but since the onset of WNS, the population is still below the peak in 2007. Declines are associated with the onset of WNS which has spread from New York (NY) south and west across the range. Impacts to Indiana bats to date are most severe in areas with the longest exposure to WNS (e.g., 75-99% declines in NY, WV, and PA) but declines have been observed in all RUs. Hibernacula are divided into groups and defined in the Service's 2007 Plan: Priority 1 hibernacula typically have a current and/or historically observed winter population of greater than or equal to 10,000 Indiana bats; Priority 2 have a current or observed historic population of 1,000 or greater, but fewer than 10,000 bats; Priority 3 have current or observed historic populations of 50 to 1,000 bats; and Priority 4 have current or observed historic populations of fewer than 50 bats. Based on winter surveys, there are a total of 27 Priority 1 hibernacula in seven states: Illinois (one); Indiana (seven); Kentucky (six); Missouri (eight); New York (three); Tennessee (one); and West Virginia (one). There are also 58 Priority 2 hibernacula within the range.

In Indiana, two of the most populous Indiana bat hibernacula are Cave (n=92,951 bats in 2022) and Cave (critical habitat; n=86,991 bats in 2022), which are both located in southern Indiana approximately 7 and 12 miles, respectively, from the project corridor. Cave (P2) and Cave (P2) are also both within 10 miles of the project and housed a combined 5,930 hibernating bats in 2022. These cave populations account for nearly 85% of hibernating bats in the state, 68% in the Midwest RU, and 32% rangewide and thus greatly influence the status of the species within the Midwest RU and rangewide.

In 2019, the Service completed a 5-Year Review of the Indiana bat (USFWS 2019c), which summarized the status of the species, progress towards recovery, and remaining threats to the bat. The review found that the required recovery criteria for the Indiana bat had not been achieved and thus it should remain at its current 'endangered' status. The Recovery Priority Number for the Indiana bat remains at "5", reflecting a species that currently faces a high degree of threat and has a low recovery potential, primarily because of WNS. According to the review, since 2017 all Indiana bat hibernacula are WNS-affected. Although some species, particularly little brown bats and NLEBs, have fared worse, there is still concern regarding the long-term extinction risk for Indiana bats (USFWS 2019c). Both the 2007 Recovery Plan and 5-Year Review are available on the Service's Indiana bat website at https://www.fws.gov/species/indiana-bat-myotis-sodalis.

Threats to the Species

The Service categorizes threats based on the following five factors, consistent with current listing and recovery analyses under the ESA:

- The present or threatened destruction, modification, or curtailment of its habitat or range.
- Overutilization for commercial, recreational, scientific, or educational purposes.
- Disease or predation.
- The inadequacy of existing regulatory mechanisms.
- Other natural or man-made factors affecting its continued existence.

The 2007 Recovery Plan and 2009 and 2019 5-Year Reviews include detailed discussions of threats. The following summary is based primarily on those documents, with emphasis on the Midwest Recovery Unit.

<u>The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range</u>

As discussed in the 2007 Recovery Plan, the Indiana bat requires forested areas for foraging and roosting. Loss of forest cover and degradation of forested habitats have been cited as contributing to the decline of Indiana bats (USFWS 1983, Gardner et al.1990, Garner and Gardner 1992, Drobney and Clawson 1995, and Whitaker and Brack 2002). At a landscape level, Indiana bat maternity colonies occupy habitats ranging from completely forested to areas of highly fragmented forest. Within the core range in the Midwest, forest cover is much more fragmented, at the landscape scale, than at the eastern edge of the range (Brack et al. 2002). According to Humphrey (1978), the conversion of floodplain and bottomland forests, recognized as high quality habitats for Indiana bats, has been a particular cause of concern. Conversion to agriculture has been the largest single cause of forest loss historically (although recent trends show an increase of forest cover in the Midwest RU); however, at present, urbanization and development, which results in more permanent conversion, has become an important factor as Indiana bats appear to avoid foraging in highly developed areas. In addition, one of the greatest emerging causes of conversion of forest and habitat loss within the range of the Indiana bat is energy production and transmission (e.g., oil, gas, coal, wind) (Oswalt et al. 2019, USFWS 2007).

Winter habitat is also at risk. There are well-documented examples of modifications to Indiana bat hibernation caves that affected the thermal regime of the cave, and thus the ability of the cave to support hibernating Indiana bats, as summarized in the 2007 Recovery Plan. Destruction and modifications of hibernacula have been an ongoing concern although many of these caves have been protected in recent times. Of late, several Priority 1 hibernacula have been subject to potentially harmful developments and activities in their vicinity. Habitat threats related to urbanization and development, particularly in the energy sector, are increasing in these wintering areas as well (USFWS 2019c).

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Human disturbance of hibernating bats was originally identified as one of the primary threats to the species and remains a threat at several important hibernacula in the bat's range (USFWS 2007). The primary forms of human disturbance to hibernating bats result from recreational caving, cave commercialization (i.e., cave tours and other commercial uses of caves), vandalism, and research-related activities. Disturbance causes the bats to arouse and use fat reserves essential for successful hibernation. Progress has been made in reducing the number of caves and mines in which disturbance threatens hibernating Indiana bats, but the threat has not been eliminated.

There are far fewer documented examples of disturbance of Indiana bats in summer due to "overutilization for commercial, recreational, scientific, or educational purposes," compared with impacts to hibernating bats. However, research-related disturbance of summering Indiana bats has been observed (USFWS 2007).

As of April 2023, there were approximately 110 active (or in the process of renewal) section 10(a)(1)(A) permits (research permits) for Indiana bats in Region 3 of the Service (which includes most of the Midwest Recovery Unit), and roughly 236 rangewide. Generally, there is more mist netting being conducted for Indiana bat surveys in the Midwest Recovery Unit (as well as other parts of the range) than in the past. Much of this increase is associated with surveys to determine if Indiana bats are present at locations associated with proposed wind energy developments, as well as other development projects. Mortality associated with mist netting and associated handling of bats has been observed. However, insuring that only qualified, permitted researchers conduct this work and follow proper holding and marking techniques minimizes potential for research-related mortality.

Disease or Predation

In the past, disease and predation have generally not been considered major threats to bat populations, or Indiana bats specifically (USFWS 2007). The emergence of WNS has changed that. WNS is considered one of worst wildlife diseases in modern times (WNS 2019c). Prior to the ongoing WNS epizootic, there had been little research into the occurrence and effects of diseases in bats in the U.S., except for rabies (Weller et al. 2009). WNS is now considered to be present within the entire range of the Indiana bat and millions of bats have died from this disease (USFWS 2012 and WNS 2019c).

WNS has been characterized as a condition primarily affecting hibernating bats. Affected bats usually exhibit a white fungus on their muzzles and often on their wings and ears as well (Blehert et al. 2009). Some affected bats may display abnormal behavior including flying during the day and in cold weather (before insects are available for foraging) and roosting towards a cave's entrance where temperatures are much colder and less stable. Many of the affected bats appear to have little-to-no remaining fat reserves which are necessary to survive until spring emergence. The fungus associated with WNS has been identified as *Pseudogymnoascus destructans*, or Pd, (formerly *Geomyces destructans*). The fungus thrives in the cold and humid conditions of bat hibernacula. All the possible modes of transmission are not currently known, although biologists suspect it is primarily spread by bat-to-bat contact. In addition, people may unknowingly contribute to the spread of WNS by visiting affected caves and subsequently transporting fungal spores to unaffected caves via their clothing and gear. Interestingly, Pd has been documented growing on hibernating bats in several European countries, but the fungus does not appear to be causing widespread mortality there (Puechmaille et al. 2010).

Within the U.S., WNS has been confirmed in the Indiana bat, little brown bat, eastern small-footed bat, NLEB, gray bat, tricolored bat, Yuma bat, cave bat, fringed bat, long-legged bat, western long-eared bat, and big brown bat. The Pd fungus has also been detected on six additional bat species: the cave myotis, eastern red bat, silver-haired bat, Rafinesque's big-eared bat, Virginia big-eared bat, and Townsend's big-eared bat. The causative fungus, *Pseudogymnoascus destructans* (Pd), has been found on an additional six species, including two endangered species, without confirmation of the disease.

WNS has been documented in all four RUs and was first detected in Indiana in 2010-2011. As of the winter of 2021-2022, WNS has been documented in bats in 38 states and 8 Canadian provinces, and there is evidence that the fungus that causes white-nose syndrome is present in five additional states and one Canadian province. Since WNS was first noted in 2007, the Northeast Indiana bat RU has declined by 76.7%, the Midwest RU by 15%, the Appalachia RU by 93.4% and the Ozark-Central RU by 15.6%, based on 2022 Indiana bat population data. WNS has caused an overall estimated 90% decline in all hibernating bat populations within the WNS-affected area and threatens regional or rangewide extinction in multiple species including the Indiana bat (Frick et al. 2010b, Thogmartin et al. 2013, Turner et al. 2011). In short, WNS has significantly and rapidly raised the degree of threat against the Indiana bat by causing reductions in its fitness, reproductive success, and survival, which has lowered the species' overall recovery potential. Additional information on WNS can be found at Whitenosesyndrome.org.

The Inadequacy of Existing Regulatory Mechanisms

Ownership of Indiana bat habitat is probably the primary factor that limits effectiveness of existing regulatory mechanisms. Of the 85 Priority 1 and 2 hibernacula, 16 (19%) are federally owned, 22 (26%) are state-owned, 45 (53%) are privately owned, 1 (1%) is city owned and 1 (1%) has an unknown ownership (USFWS 2019c). ESA protection extends to hibernacula that are privately owned, but recovery options are often limited on private lands. However, it should be noted that most private hibernacula owners are cooperative in efforts to protect Indiana bats.

Other Natural or Man-made Factors Affecting its Continued Existence

Several natural factors are a threat to local bat populations, including flooding and freezing events at winter hibernacula (USFWS 2007). These natural events typically are not widespread, but rather associated with specific flood/freeze-prone sites.

Mounting data on the impact of climate change, including extreme events such as drought and flooding, on bats are a cause for concern as recent increases in global temperature represent one fifth, or less, of those expected over the next century (Frick et al. 2019, O'Shea et al. 2016, Rebelo et al. 2010, Sherwin et al. 2013, and USGCRP 2018). In combination with WNS, habitat destruction, and other sources of environmental degradation, climate change poses a serious and increasing threat to Indiana bats.

Climate influences food availability, timing of hibernation, frequency and duration of torpor, rate of energy expenditure, reproduction, and development rates of juveniles (Sherwin et al. 2013). Warmer climates may benefit females by causing earlier parturition and weaning of young, allowing more time to mate and store fat reserves in preparation for hibernation. Similarly, earlier gestation and parturition may benefit juveniles by providing a longer growth period prior to the breeding season (Burles et al. 2009). Frick et al. (2010a) supported this finding by showing that little brown bat pups born early in the summer have higher survival and first-year breeding probabilities than those born later in the summer. In contrast, disruption of hibernation, extreme weather events, reduced water availability in arid environments, and the spread of disease may also cause significant mortalities (Adams and Hayes 2008, Adams 2010, and Hayes and Adams 2017).

With growing concerns about climate change, wind energy has become one of the fastest growing sources of renewable energy in the U.S. (American Wind Energy Association 2019). The current collocation of wind energy facilities within the range of the Indiana bat may lead to a meaningful impact on the population dynamics of the species, depending upon the magnitude of risk from collision faced by migrating and summer resident bats. Large-scale fatalities of bats (mostly other species) have occurred at multiple wind energy facilities across the range of the Indiana bat and recent studies have found that far more bats than birds are typically killed in the Midwest and Eastern U.S. (Arnett and Baerwald 2013, O'Shea et al. 2016). A total of 13 Indiana bat fatalities has been documented at wind energy facilities in six states (Illinois, Indiana, Iowa, Ohio, Pennsylvania, and West Virginia) since 2009 (Pruitt and Reed 2018). While this number may not seem high, monitoring fatalities is expensive and difficult, and many facilities do not participate in such efforts. The only well-documented method to reduce fatalities at wind turbines is limiting operation during high-risk periods, such as nocturnal periods of low wind speeds during fall migration (Arnett et al. 2011 and Baerwald et al. 2009). Such operational curtailment can reduce bat fatalities by 44–93% (Arnett et al. 2011).

Other anthropogenic factors that may affect the continued existence of Indiana bats include numerous environmental contaminants (e.g., organophosphate and carbamate insecticides, oil spills, and PCBs), collisions with poorly constructed cave gates and vehicles, light pollution, and non-native invasive species.

2.2 Northern Long-eared Bat

The Service published its original decision to list the NLEB as a threatened species on April 2, 2015 (80 FR 17974-18033) with an effective date of May 4, 2015. The final rule determined that critical habitat designation for the NLEB was not determinable at the time. Subsequently, in March 2022, the Service proposed to reclassify the NLEB from its current status as federally threatened to federally endangered. The NLEB original listing and current reclassification proposal are due to sharp population declines associated with WNS. On November 30, 2022, the reclassification action was finalized, and the new listing was to go into effect January 20, 2023. That action was delayed, and finally went into effect March 31, 2023.

Species and Critical Habitat Description

The NLEB is a medium-sized bat with an average adult weight of 5 to 8 grams, average body length from 77 to 95 millimeters (mm), and forearm length between 34 and 38 mm (Caceres and Pybus 1997). Its fur ranges from medium to dark brown on the dorsal side, and tawny to pale brown on the ventral side, with dark brown ears and wing membranes. As indicated by its common name, the NLEB is distinguished from other Myotis species by its relatively long ears (average 0.7 inches [17 mm]) (Whitaker and Mumford 2009) that, when laid forward, extend beyond the nose up to 0.2 inches (5 mm) (Caceres and Barclay 2000). Within its range, the NLEB is sometimes confused with the little brown bat or the western long-eared myotis (Myotis myotis). The NLEB is distinguished from the little brown bat by its longer ears, tapered and symmetrical tragus, slightly longer tail, and less glossy pelage (Caceres and Barclay 2000), and from the western long-eared myotis by its darker pelage and paler membranes (Caceres and Barclay 2000).

Life History and Biology

Migration

NLEBs migrate between winter hibernacula and summer roosting habitat. When female NLEBs emerge from hibernation, they migrate to maternity colony areas. The distance and routes traveled from winter hibernacula to summer roosting areas is not definitively known, but the species is considered to migrate shorter distances than the Indiana bat (USFWS 2014). The annual chronology of the NLEB is like the generalized Indiana bat chronology, spring migration from winter hibernacula usually occurs between mid-March and mid-May, whereas most fall migration from summer roosting areas back to winter hibernacula occurs from mid-August through mid-October.

While the NLEB is not considered a long-distance migratory species, short migratory movements (56 km [35 miles] to 89 km [55 miles]) occur between summer roost and winter hibernacula (Nagorsen and Brigham 1993 and Griffin 1945). However, movements from hibernacula to summer colonies may range from 8 to 270 km (5 to 168 miles; Griffin 1945). Several studies show a strong homing ability of NLEB in terms of return rates to a specific hibernaculum, although bats may not return to the same hibernaculum in successive winters (Caceres and Barclay 2000). Banding studies in Ohio, Missouri, and Connecticut show return rates to hibernacula of 5% (Mills 1971), 4.6 % (Caire et al. 1979), and 36(Griffin 1940), respectively.

Summer Habitat

During the summer, NLEBs typically roost singly or in colonies underneath bark or in cavities or crevices of both live trees and snags. Male and non-reproductive female summer roost sites also may include cooler locations (e.g., caves and mines) (Barbour and Davis 1969 and Amelon and Burhans 2006). The NLEB has also been observed roosting in colonies in human-made structures (e.g., buildings, barns, a park pavilion, sheds, cabins, under eaves of buildings, behind window shutters, and bat houses). They are not likely dependent on a certain species of tree for roosts throughout their range; rather, certain tree species will form suitable cavities or retain bark suitable for their use (Foster and Kurta 1999). A significant preference for dead or dying trees was reported for NLEBs in Kentucky (Silvis et al. 2012), Illinois, and Indiana. The use of live trees versus snags may reflect the availability of such structures in study areas (Perry and Thill 2007a) and the flexibility in roost selection when there is a sympatric bat species present (e.g., Indiana bat) (Timpone et al. 2010).

Roosts trees used by NLEBs are often in close proximity to each other within the species' summer home range. For example, in Missouri, Timpone et al. (2010) radio-tracked 13 NLEBs to 39 roosts and found the mean distance between the location where captured and roost tree was 1.7 km (1.1 miles) (range 0.07–4.8 km [0.04–3.0 miles]), and the mean distance traveled between roost trees was 0.67 km (0.42 miles) (range 0.05–3.9 km [0.03–2.4 miles]).

Some studies have found tree roost selection to differ slightly between males and females. NLEB males have been found to use smaller diameter trees more readily for roosting than females, suggesting males are more flexible in roost selection than females (Lacki and Schwierjohann 2001 and Perry and Thill 2007a).

Winter Habitat

The NLEB predominantly overwinters in hibernacula that include caves and abandoned mines. Hibernacula used by NLEB are typically large, with large passages and entrances (Raesly and Gates 1987), relatively constant, cooler temperatures (0 to 9 degrees C [32 to 48 degrees F])

(Raesly and Gates 1987, Caceres and Pybus 1997, and Brack 2007), with high humidity and no air currents (Fitch and Shump 1979, Van Zyll de Jong 1985, Raesly and Gates 1987, and Caceres and Pybus 1997). The NLEB is typically found roosting in small crevices or cracks in cave or mine walls or ceilings, often with only the nose and ears visible.

Swarming and Staging

The swarming season fills the time between the summer and winter seasons (Lowe 2012) and the purpose of swarming behavior may include introduction of juveniles to potential hibernacula, copulation, and stopping-over sites on migratory pathways between summer and winter regions (Kurta et al. 1997, Lowe 2012, Parsons et al. 2003, and Randall and Broders 2014). For the NLEB, the swarming period may occur between July and early October, depending on latitude within the species' range (Caire et al. 1979, Hall and Brenner 1968, Fenton 1969, Kurta et al. 1997, and Lowe 2012).

Spring staging for the NLEB is the period between winter hibernation and spring migration to summer habitat. During this time, bats begin to gradually emerge from hibernation, exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume daily bouts of torpor (state of mental or physical inactivity) (Whitaker and Hamilton 1998). The staging period for the NLEB is likely short in duration (Caire et al. 1979 and Whitaker and Hamilton 1998). Variation in timing (onset and duration) of staging for Indiana bats was based on latitude and weather (USFWS 2007); similarly, timing of staging for NLEBs is likely based on these same factors.

Reproduction

NLEBs typically form their maternity colonies in June and July (Harvey et al. 2011). Maternity colonies, consisting of females and young, are generally small, numbering from fewer than 30 (Whitaker and Mumford 2009) to 60 individuals (Caceres and Barclay 2000); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2009). In West Virginia, maternity colonies in two studies had a range of 7 to 88 individuals (Owen et al. 2002) and 11 to 65 individuals, with a mean size of 31 (Menzel et al. 2002). In Minnesota, the average maternity colony size reported in 2017 was 8.2 females per colony, based on emergence surveys conducted at 39 active maternity colony roosts (Swingen et al. 2017). Lacki and Schwierjohann (2001) found that the number of bats within a given roost declined as the summer progressed. Pregnant females formed the largest aggregations (mean = 26), and post-lactating females formed the smallest aggregation (mean = 4). The largest reported colony size was 65 bats. Other studies have also found that the number of individuals roosting together in each roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, Garroway and Broders 2008, Johnson et al. 2012, Lacki and Schwierjohann 2001, and Perry and Thill 2007a).

Females are pregnant when they arrive at maternity roosts and produce a single young per year, as is typical for the genus Myotis (Asdell 1964, Hayssen et al. 1993, Krochmal and Sparks 2007, and Sparks et al. 1999). Parturition typically occurs between late May and early June (Caire et al. 1979, Krochmal and Sparks 2007, and Whitaker and Mumford 2009). Juveniles become volant between late June and early August (Caire et al. 1979, Sasse and Pekins 1996, and Krochmal and Sparks 2007). As is the case with other species of bats in North America, mortality for NLEB is high during the first year (Caceres and Pybus 1997). NLEBs have been observed roosting in areas of increased solar heating, which increases their developmental rate and reduces the need to lower their body temperature and metabolic rate (i.e., enter a state of torpor) (Lacki and Schwierjohann 2001).

Diet and Foraging

The NLEB has a diverse diet including moths, flies, leafhoppers, caddisflies, beetles (Brack and Whitaker 2001, Griffith and Gates 1985, and Nagorsen and Brigham 1993) and arachnids (spiders) also being a common prey item (Feldhamer et al. 2009); diet composition appears to differ geographically and seasonally (Brack and Whitaker 2001).

Foraging techniques include hawking and gleaning, in conjunction with passive acoustic cues (Nagorsen and Brigham 1993 and Ratcliffe and Dawson 2003). Hawking is aerial foraging, catching insects in flight using echolocation. Observations of NLEB foraging on arachnids (Feldhamer et al. 2009), presence of green plant material in their feces (Griffith and Gates 1985), and non-flying prey in their stomach contents (Brack and Whitaker 2001) suggest considerable gleaning behavior. The NLEB has the highest frequency call of any bat species in the Great Lakes area (Kurta 1995). Gleaning allows this species to gain a foraging advantage for preying upon moths because moths are less able to detect these high frequency echolocation calls (Faure et al. 1993).

Population Dynamics

Prior to the onset of WNS the species was abundant throughout much of the eastern U.S. and thus, was not a focus of detailed demographic studies. Since WNS, populations have been in a period of catastrophic decline across most of the range. Francl et al. (2012) documented a 77% decline in summer capture rates of NLEBs in West Virginia and adjacent areas of Pennsylvania in the two years following the arrival of WNS. Available evidence, including both winter and summer data, indicates NLEB abundance has and will continue to decline substantially over the next 10 years under current demographic conditions (USFWS 2022).

Unfortunately, there are no firm population size estimates for the NLEB rangewide. In 2015, as part of the Midwest Wind Energy Multi-Species Habitat Conservation Plan, an estimate for the six-state area that included the States of Illinois, Indiana, Iowa, Ohio, Michigan, and Missouri, showed there may have been more than four million bats in the area. The estimate was calculated by adjusting the 2013 Indiana bat winter population size in those states based on the ratio of NLEBs compared to Indiana bats in summer mist-net surveys. This information is limited since most of the mist-net data was gathered prior to the onset of WNS in the Midwest. In the 2016 Programmatic Biological Opinion (PBO) on the final 4(d) rule for the NLEB the Service estimated the U.S. population to be 6,500,000 individuals (adults), including 127,842 in Indiana (USFWS 2016). In 2023, using similar methods as the PBO, the Service estimated NLEBs have declined to 201,266 adults rangewide and 2,552 in Indiana (USFWS 2023).

Status and Distribution

NLEB's range includes much of the eastern and north-central U.S., and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Caceres and Pybus 1997, Environment Yukon 2011, and Nagorsen and Brigham 1993) (Figure 4). In the U.S., the species' range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east to South Carolina (Amelon and Burhans 2006, Caceres and Barclay 2000, Simmons 2005, and Whitaker and Hamilton 1998). The species' range includes all or portions of 37 states, the District of Columbia, and seven Canadian provinces, and has been divided into five geographic representation units: Southeast, Eastern Hardwoods, Subarctic, Midwest, and East Coast (Figure 4).

Historically, the species has been most frequently observed in the northeastern U.S. and in Canadian Provinces of Quebec and Ontario, with sightings increasing during swarming and hibernation (Caceres and Barclay 2000). However, throughout most of the species range it is patchily distributed, and historically was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

Although they are typically found in low numbers in inconspicuous roosts, most records of NLEBs are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species range in the U.S., although many hibernacula contain only a few (1 to 3) individuals (Whitaker and Hamilton 1998). NLEBs are documented in hibernacula in 29 of the 37 States in the species' range. Other States within the species' range have no known hibernacula (due to no suitable hibernacula present, lack of survey effort, or existence of unknown retreats).

The current range and distribution of NLEBs must be described and understood within the context of the impacts of WNS. Prior to the onset of WNS, the best available information on NLEB came primarily from summer surveys (primarily focused on Indiana bat or other bat species) and some targeted research projects. In these efforts, was very frequently encountered and was considered the most common Myotid bat in many areas.

Overall, the species was once widespread and abundant throughout its historic range (Caceres and Barclay 2000). WNS has been particularly devastating for NLEBs in the Northeast, where the species was believed to be the most abundant (Herzog and Reynolds 2012, Turner et al. 2011, Langwig et al. 2012). Similarly, there are data supporting substantial declines in NLEB populations in portions of the Midwest due to WNS. In addition, WNS has been documented at more than 100 NLEB hibernacula in the Southeast, with apparent population declines at most sites. We expect further declines as the disease continues to spread across the species' range.

Threats to the Species

As with the Indiana bat, the Service uses the five statutory factors for determining listing decisions, and disease (WNS) is thought to be the dominant factor for the NLEB. The Species Status Assessment (USFWS 2022) describes the primary threats to the NLEB as WNS, wind-

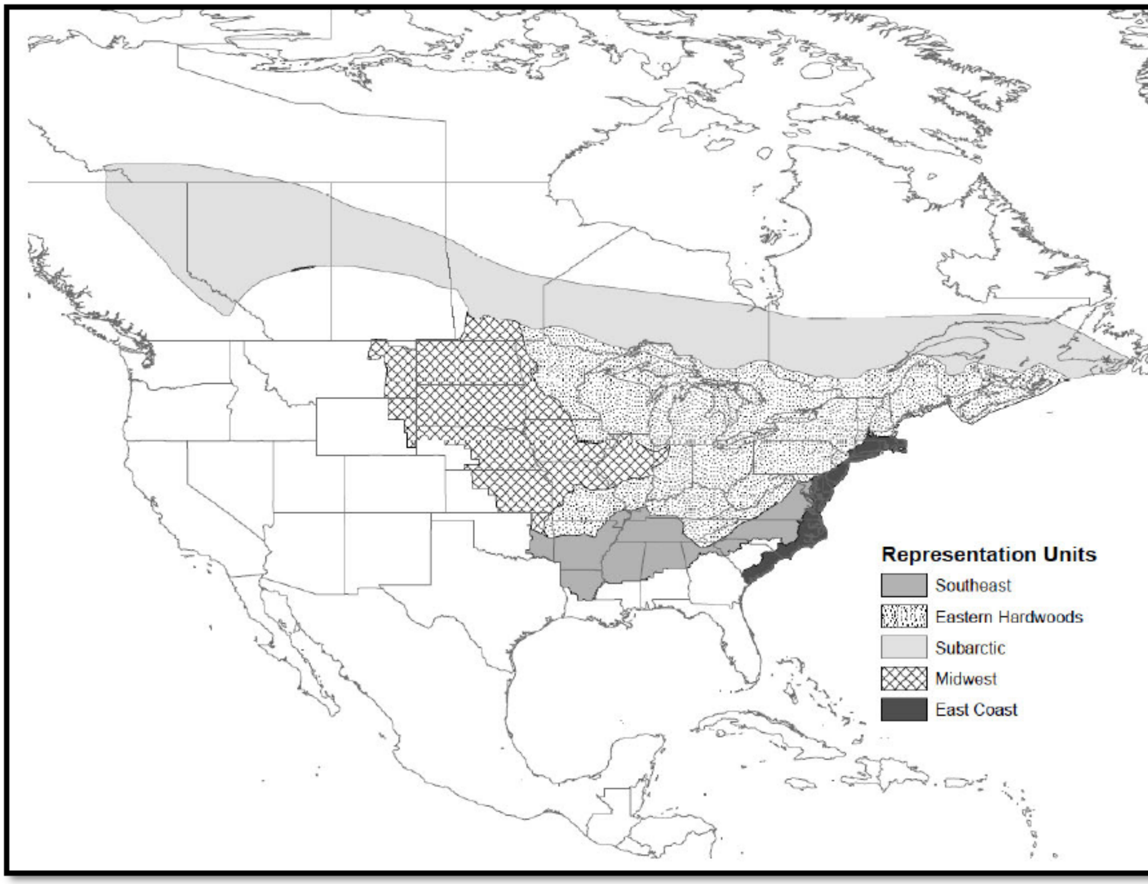

Figure 7. NLEB Range and Representation Units Map.

related mortality, effects from climate change, and habitat loss. The following factors include a discussion of each of these threats.

The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

NLEB require suitable habitat for roosting and foraging, and commuting between those habitats during spring, summer, and fall. Forest is a primary component of roosting, foraging, and commuting habitat. Wetlands and water features are important foraging and drinking water sources. Loss of these habitats influences survival and reproduction of NLEB colonies. Throughout the range of the NLEB, forest conversion is expected to increase due to commercial and urban development, energy production and transmission, and natural changes. Forest conversion causes loss of potential habitat, fragmentation of remaining habitat, and if occupied at the time of the conversion, direct injury, or mortality to individuals. Adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat. As part of the 2022 Species Status Assessment, the Service looked at land cover data over a 10-year period from 2006 to 2016 and found that while overall forest land cover had remained stable (and even increased in some areas), deciduous forest cover had decreased across all RPUs by 1.4 million acres. Emergent wetland habitat decreased by a similar amount as well.

In addition to active season habitat threats, modification of hibernacula, particularly altering or closing hibernacula entrances, is considered a significant threat to the NLEB. Some modifications, for example closure of a cave entrance with structures/materials besides a bat-friendly gate, can cause a partial or complete loss of the utility of a site to serve as hibernaculum. Humans can also disturb hibernating bats, either directly or indirectly, resulting in an increase in energy-consuming arousal bouts during hibernation (Johnson et al. 1998 and Thomas 1995).

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

Various conservation measures such as reducing construction limits, seasonal tree-clearing, developing habitat conservation plans, species-specific programmatic consultations, bat-friendly forest management prescriptions, mitigation, bat-friendly gates at hibernacula, and conservation easements can help protect bats and minimize impacts.

Disease or Predation

The effect of WNS on NLEB has been extreme, such that most summer and winter colonies experienced severe declines following the arrival of WNS. Just four years after the discovery of WNS, for example, Turner et al. (2011) estimated that NLEBs experienced a 98% decline in winter counts across 42 sites in Vermont, New York, and Pennsylvania. Similarly, Frick et al. (2015) estimated the arrival of WNS led to a 10–fold decrease in NLEB colony size. Most recently, Cheng et al. (2021) used data from 27 states and 2 provinces to conclude WNS caused estimated population declines of 97–100% across 79% of NLEB's range.

Long-term summer survey data (including pre- and post-WNS) for the NLEB, where available, corroborate the population decline evident in hibernacula survey data. For example, summer surveys from 2005–2011 near Surry Mountain Lake in New Hampshire showed a 98% decline in capture success of NLEB post-WNS, which is similar to the hibernacula data for the State (95% decline; Moosman et al. 2013). Current hibernacula survey data indicate that populations of NLEBs in the Midwestern states have declined between 50 and 75 % (USFWS unpublished data).

There are multiple national and international efforts underway in attempt to reduce the impacts of WNS. To date, there are no proven measures to reduce the severity of impacts.

Other Natural or Man-made Factors Affecting its Continued Existence

Wind related mortality is proving to be a consequential stressor at local and RPU levels. Wind power is a rapidly growing portion of North America's energy. As of 2019, wind power was the largest source of renewable energy in the country, providing 7.2% of U.S. energy (American

Wind Energy Association 2020). Modern utility-scale wind power installations (wind facilities) often have tens or hundreds of turbines installed in a given area, generating hundreds of megawatts (MW) of energy each year. Installed wind capacity in the U.S. as of October 2020 was 104,628 MW (Hoen et al. 2018 and USFWS unpublished data).

Most bat mortality at wind energy projects is caused by direct collisions with moving turbine blades (USFWS 2022). Bat mortality at wind facilities was identified around 2003, when post-construction studies at the Buffalo Mountain, Tennessee, and Mountaineer, West Virginia, wind projects documented the highest bat mortalities reported at the time (31.4 bats/MW and 31.7 bats/MW, respectively; Kerns and Kerlinger 2004 and Nicholson et al. 2005). Bat mortalities continue to be documented at wind power installations across North America and Europe.

Although bat fatality varies across species, facilities, and season, NLEBs have been documented being killed at wind facilities. Analyses using data from Wiens et al. (2022) and Whitby et al. (2022) suggest that the impact of wind related mortality is discernible in the ongoing decline of NLEB. Based on data from Wiens et al. (2022) comparing a no wind baseline scenario to current and future wind scenarios, the projected NLEB abundance decreases 24–33% by 2030 under the current wind scenario and up to 83% by 2060 under the future high impact wind scenario.

There are many ongoing efforts to improve our understanding of bat interactions with wind turbines and explore additional strategies for reducing bat mortality at wind facilities. To date, operational strategies (e.g., feathering turbine blades when bats are most likely to be active) are the only broadly proven and accepted measures to reduce the severity of impacts.

In addition to wind project concerns, there is growing apprehension about impacts to bat populations in response to climate change (Jones et al. 2009, Jones and Rebelo 2013, and O'Shea et al. 2016). Jones et al. (2009) identified several climate change factors that may impact bats, including changes in hibernation, mortality from extreme drought, cold, or excessive rainfall, cyclones, loss of roosts from sea level rise, and impacts from human responses to climate change (e.g., wind turbines). Sherwin et al. (2013) reviewed and discussed potential impacts of climate change, including effects to bat foraging, roosting, reproduction, and biogeography. Climate change is also likely to influence disease dynamics as temperature, humidity, phenology, and other factors affect the interactions between Pd and hibernating bats (Hayman et al. 2016, McClure et al. 2020, and Hoyt et al. 2021). However, the impact of climate change is unknown for most species (Hammerson et al. 2017).

The NLEB's risk of exposure to climate changes is rangewide, although depending on locations and inherent differences in populations, understanding climate change impacts to a large-ranging species is difficult. While there are several changing climatic variables, the Service's analysis in the status assessment focused solely on changes in temperature and precipitation. These variables influence NLEB resource needs, such as suitable roosting habitat (all seasons), foraging habitat, and prey availability. Overall, average temperature and precipitation has increased since the early 1900's, with some parts of the U.S. experiencing greater changes than others. Although there may be some benefit to NLEB from a changing climate, overall negative impacts are anticipated. While we lack species-specific observations for NLEB, observed impacts to date for other insectivorous bats, such as the little brown bat, include reduced reproduction due to drought conditions leading to decreased availability of drinking water (Adams 2010) and reduced adult survival during dry years (drought) in the Northeast (Frick et al. 2010). Furthermore, too much moisture and precipitation could affect bats' echolocation, foraging, thermal regulation, reproduction, and prey abundance (USFWS 2022). Responses will vary throughout the NLEB range based on the extent of annual temperature rise in the future.

2.3 Little Brown Bat

The little brown bat (*Myotis lucifugus*) is not currently listed under the ESA. The Service has undertaken a discretionary status review of the species and expects to determine if listing of this species is warranted in fiscal year 2024 (National Listing Workplan, https://www.fws.gov/sites/default/files/documents/national-domestic-listing-workplan-fiscal-years-2023-2027.pdf, accessed 8 May, 2023). Currently no federal critical habitat, conservation plans, or recovery plans exist for this species.

Species and Critical Habitat Description

The little brown bat is a medium sized bat, weighing between 5.5 and 14 grams with a wingspan of 22 to 27 centimeters (Harvey et al. 1999 and Whitaker and Mumford 2009), with a body length of 76-95 mm (Laubach et al. 2004) and a forearm measurement of between 33 and 41 mm (Fenton and Barclay 1980). Its fur is glossy and ranges in color from dark brown to a yellowish brown (Fenton and Barclay 1980). The little brown bat is similar to the Indiana bat but can be distinguished by its calcar that is not keeled, and the presence of toe hairs that extend beyond its claws. The little brown bat is also similar to the NLEB, but the NLEB has ears that extend at least 2mm beyond the nose when laid forward and a tragus that is longer and more pointed when compared to the little brown bat (Laubach et al. 2004).

Life History and Biology

Migration, Swarming, and Winter Habitat

Like many bats in the eastern United States, little brown bats migrate between winter hibernacula and summer roosting habitat. The annual chronology of the little brown bat is similar to the generalized Indiana bat chronology, spring migration occurs in parallel with staging with most bats moving from the hibernacula to the summer range in April and May; while fall migration occurs in late July through early August. Multiple banding studies involving little brown bats in the 1960s and 1970s indicate that little brown bats migrate relatively short distances. LaVal and LaVal (1980) banded about 1,600 little brown bats and identified eight at both a hibernacula and summer roosts. Six of these bats travelled fairly short distances (25 miles) between summer roosts and hibernacula while the other two travelled about 150 miles. In another study, Myers (1964) collected data on the movements of 20 little brown bats and found they travelled an average of 94.3 miles between summer and winter habitat, with ranges between 18 and 240 miles. These and other studies (Griffin 1940, Griffin 1945, Davis and Hitchcock 1965, Barbour and Davis 1969, Fenton 1970, and Humphrey and Cope 1976) suggest many little brown bats migrate relatively short distances, but migrations of more than 100 miles are not uncommon.

This movement pattern produces an area of high summer density around important hibernacula, but scattered summer colonies in far-removed areas.

In late summer and fall, little brown bats begin migration back to winter hibernacula. They hibernate in a variety of suitable sites throughout their range, mostly consisting of caves and abandoned mines, with no records of the bats hibernating in buildings (Fenton and Barclay 1980). The hibernation period can vary depending on location and regional temperatures. The areas around the caves and mines serve as swarming habitat where mating and feeding occur prior to entering hibernation. During the swarming period, individual bats may travel significant distances, (Fenton 1970) resulting in mixing of the population of bats from different areas (Fenton and Barclay 1980).

Summer Habitat

After emerging from their hibernacula in the spring, little brown bats roost in a variety of sites, including buildings, under rocks, wood piles, occasionally caves, and hollow trees if temperature conditions are right (Fenton and Barclay 1980). Maternity colonies of little brown bats have been found in a variety of man-made structures including attics, basements, under sheet metal roofs, in barn rafters, and in bat houses (Davis and Hitchcock 1965). A maternity colony of 6,700 little brown bats, discovered in an abandoned barn in Indiana, is the largest maternity colony ever documented (Whitaker and Hamilton 1998).

Less is known about where most male little brown bats spend their summer, but it is thought that they likely spend the summer roosting period scattered in a variety of roost types (Harvey et al. 2011). Studies by Randall et al. (2014) and Broders and Forbes (2004) indicated that female little brown bats captured in forests were found to roost in nearby buildings, whereas the males roosted in nearby trees.

Female little brown bats typically arrive at their maternity roosts pregnant in early to mid-April and give birth to one pup between May, June, and July (Barbour and Davis 1969 and Harvey et al. 2011). In Indiana (Krochmal and Sparks 2007), females in one colony gave birth to a single pup between June 3 and July 15. These pups began fluttering at two days of age, could complete coordinated wing strokes by 15 days and could fly by 21 days. Thus, most pups were flying by mid-July. Maternity colonies begin to break up as soon as the young are weaned in July, and few remain by September (Barbour and Davis 1969).

Reproduction

Like other Myotids, little brown bats engage in reproductive activities when they arrive back at their winter hibernacula. Fall swarming activity peaks from mid to late August through September (Davis and Hitchcock 1965, Fenton 1969, Humphrey and Cope 1976, Thomas et al. 1979, and Whitaker and Mumford 2009). Female little brown bats store sperm in their reproductive tracts until they emerge from hibernation between mid-March and mid-May or early June (likely later at more northerly locations) (Barbour and Davis 1969, Humphrey and Cope 1976, Whitaker and Mumford 2009, Norquay and Willis 2014, and Johnson et al. 2017).

Soon after emergence, ovulation and fertilization occur, and females return to their summer maternity habitat to form their colonies.

Foraging and Diet

The little brown bat prefers to forage over open water but is also known to forage along forest edges or clearings (Harvey et al. 1999). This species is known to use edge habitat, open water, and open agricultural fields for forging more often than the NLEB. In one study, little brown bats were found to forage within 6.9 ft (2.1 m) over the water within 10.5 ft (3.2 m) of the shoreline (Kurta 1982). They emerge from their summer habitats at dusk to feed on moths, leafhoppers, plant-hoppers, beetles, wasps, crane flies, mosquitoes, and midges (Harvey et al. 2011). Little brown bats capture insects using their wingtips, the captured prey is then immediately transferred into a “scoop” formed by the forward curled tail and interfemoral membrane, and then grasped with the teeth (Harvey et al. 2011). Pregnant little brown bats can forage over an area greater than 70 acres, but this area can decrease after young are born (Henry et al. 2002).

Home ranges for actively foraging females vary in size, with home ranges exceeding 30.1 hectares (74.4 acres) for pregnant females and approximating 17.6 hectares (43.5 acres) for lactating females (Henry et al. 2002). Such home ranges are substantially reduced in size to accommodate female nursing responsibilities with morning and evening foraging needs, often occurring within 600 meters (1,968 ft) of the maternity roost. As young become volant (able to fly) and less dependent on natal care in late summer, maternity colonies disband as adult females begin to maximize their use of multiple roosts, commonly referred to as “night roosts”. These "night roosts" allow adult females better opportunities to balance energetic demands associated with foraging and food digestion (Anthony et al. 1981).

Population Dynamics

Little brown bats were once considered one of the more common species in North America (Kunz and Reichard 2010). Rough population estimates of 6.5 million (Frick et al. 2010a) to 8 million individuals (Russell et al. 2014) have been estimated for the population of little brown bats in the eastern United States. Little brown bats are extremely vulnerable to WNS, which has resulted in sharps declines in populations, especially along their eastern range. As the disease spreads geographically and regionally, population collapse has been observed and, in some cases, local species extinction has been predicted, suggesting that even limited take may have the potential for population-level effects (MidAmerican Energy Company [MEC] 2018, Frick et al. 2010, and Ingersoll et al. 2013).

Status and Distribution

The historic and current range of the little brown bat covers large portions of North America from the Alaska-Canada boreal forest south through most of the contiguous US, though the species is generally absent from the southern Great Plains region (Figure 8). Southwestern populations formerly assigned to this species have now been assigned to *M. occultus* (Piaggio et al. 2002 and Wilson and Reeder 2005), so the southwestern boundary of the range includes southern California (except extreme southeast), Nevada, northern Utah, northern Colorado, and perhaps northeastern New Mexico (Piaggio et al. 2002 and NatureServe 2022). The core of the range, based on historical abundance, appears to be the northeastern United States and boreal Canada, with smaller populations in the southern and western United States (Davis et al. 1965).

Prior to arrival of WNS, the largest colonies were found in the northeastern and Midwestern U.S., where some hibernacula contained tens to hundreds of thousands of individuals (Kunz and Reichard 2010). The southern edge of their distribution is limited by the lack of caves, whereas the northern edge of the range is likely defined by a limited number of suitable hibernacula and the longer length of the hibernation season (Humphries et al. 2002 and Humphries et al. 2006). Like the Indiana bat, little brown bats migrate between subterranean habitats in winter to trees and a wide variety of anthropogenic structures during summer (Humphrey and Cope 1976).

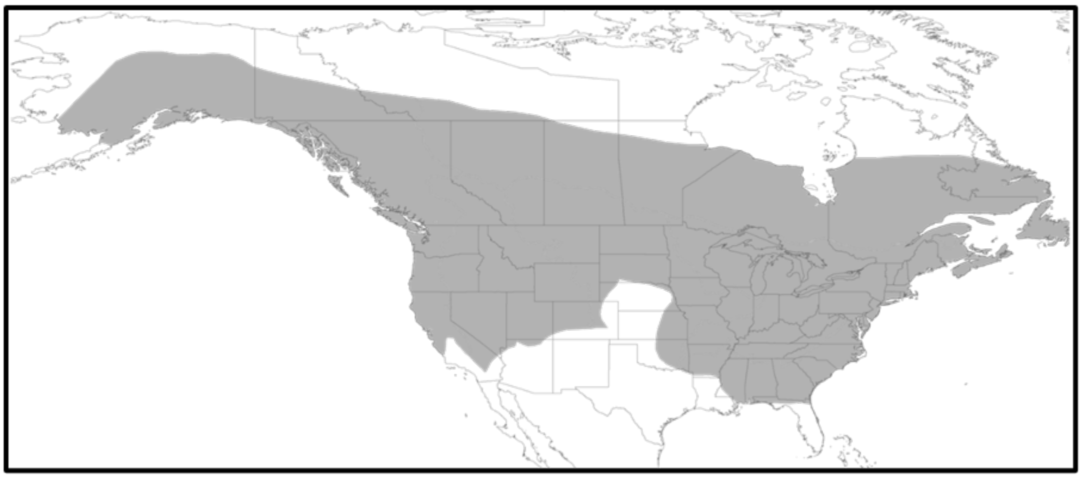

Figure 8. Little Brown Bat Range Map.

Threats to the Species

In 2016, the Service completed a status assessment for the eastern subspecies of the little brown bat. In the assessment, the Service determined that WNS is a significant stressor on this species (USFWS 2016). Other stressors of importance include losses at wind energy sites, environmental contaminants, climate change, human disturbance, and loss and adverse modification of both summer and winter habitat.

<u>The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range</u>

Like the other bat species, little brown bats depend on forests as a primary component of their spring, summer and fall habitat and wetlands and other water resources provide prey and drinking water. In addition, the little brown bat is known for using man-made structures such as attics, barns, and bat houses for summer roosting and caves and mines and other structures during the winter. Changes in the availability of these resources can result in increased energy expenditures, decreased prey availability, and loss of roosting sites, as well as direct mortality if changes occur when bats are present.

Disease

WNS has been devasting to the little brown bat population. In the 2016 status assessment, the Service evaluated 165 little brown bat winter hibernacula where WNS had been confirmed or suspected for 2 or more years. At all but two sites, post-WNS populations had declined, and the median change in population was -95% (range +84% to -100%). In the Midwest specifically, 32 hibernacula in Illinois, Indiana, Missouri, and Ohio were examined and the median change in hibernating population was estimated to be -88% within four years of the confirmation of WNS (USFWS 2016). Also, of these 32 hibernacula, approximately half declined between 80% and 100% within those four years. The Status Assessment notes that WNS has been present longer in the northeast than in other regions and that more severe declines have been observed in this region than others (median change of -93% and 89% of 95 studied hibernacula declined between 80% and 100%).

Just four years after the discovery of WNS Turner et al. (2011) estimated that little brown bats experienced a 91% decline in winter counts across 42 sites in Vermont, New York, and Pennsylvania. Kurta and Smith (2020) estimated an 89.9% decline in hibernating little brown bats due to WNS in the Upper Peninsula of Michigan. Most recently, Cheng et al. (2021) used data from 27 states and 2 provinces to conclude WNS caused estimated declines of 96% –100% at winter colonies across 36% of the little brown bat range. Although variation in these observed declines existed among sites, the arrival of Pd caused marked decrease in population abundances during invasion, epidemic, and established stages of the disease, with few exceptions.

Other Natural or Man-made Factors Affecting its Continued Existence

Climate change is also an emerging threat to the little brown bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm. 2006 in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm. 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change, and such changes may have negative or positive effects on development of bats, depending on the location of the maternity colony. Climate change may influence shifts in forest communities, invasive plants and pests, pathogens, and insect prey. The effect of climate change on little brown bat populations is a topic deserving additional consideration.

There is growing concern that bats, including the little brown bat, may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of little brown bats has been documented at multiple operating wind turbines/farms. A technical report by the American Wind and Wildlife Institute (AWWI 2020) indicated that 4.2% of bat fatality incidents resulting from scheduled searches were little brown bats. The impact of wind related mortality is discernible in the ongoing decline of little brown bats and Whitby et al. (2022) found a decline in the predicted relative abundance of little brown bats with an increasing wind energy risk index.

Additionally, chemical contamination may kill bats directly or lead to sublethal effects that eventually lead to death or reduced reproduction (Clark et al. 1978, Clark et al. 1980, Clark et al. 1982, and Eidels et al. 2016).

Lastly, like other bats, the little brown bat is frequently the subject of persecution by people. Because little brown bats can form large maternity colonies, and tend to use human structures, they are often the target of exclusion efforts (Cope et al. 1991).

2.4 Tricolored Bat

Species and Critical Habitat Description

On September 14, 2022, the Service published a proposal in the Federal Register to list the tricolored bat as endangered under the ESA. The Service has up to 12 months from the date the proposal was published to make a final determination, either to list the tricolored bat under the ESA or to withdraw the proposal. The Service determined the bat faces extinction primarily due to the rangewide impacts of WNS. Species proposed for listing are not afforded protection under the ESA; however, as soon as a listing becomes effective (typically 30 days after publication of the final rule in the Federal Register), the prohibitions against jeopardizing its continued existence and "take" will apply. A species status assessment (SSA) was completed in December 2021 and is the source of most of the information below.

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

Life History and Biology

Migration, Swarming, and Winter Habitat

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

During hibernation, males and females are not segregated (Griffin 1940) and are noted to roost singly, as opposed to in clusters (Hitchcock 1949; Fujita and Kunz 1984). Although tricolored bats primarily hibernate singly, clusters of bats comprising of 2–3 individuals have been documented on numerous occasions (Sandel et al. 2001). Because of the small size and tendency to hibernate singly, McNab (1974) noted that tricolored bats had successfully hibernated in a cave in Florida, where the relatively high ambient temperatures excluded other bat species (Fujita and Kunz 1984). Briggler and Prather (2003) found that cave temperature had a strong influence of site selection by tricolored bats.

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

There is little information about tricolored bat movements, including swarming sites and hibernacula, but the species is currently believed to be mostly a regional migrant (Fraser et al. 2012 and Fujita and Kunz 1984). Species engaging in regional migration travel annually from hibernaculum to summer roosting sites, and then move among swarming locations in the autumn (Fenton 1969; Fraser et al. 2012; Davis and Hitchcock 1965). Recent research has led to some speculations that some individuals migrate farther distances than previously suspected, and that migratory behavior may differ between males and females (Davis 1959; Fraser et al. 2012). The maximum migration distance on record is a female tricolored bat who migrated a straight-line distance of 243 km (151 miles) from her winter hibernaculum in southern Tennessee to a summer roost in Georgia (Samoray et al. 2019). Other migration records between winter hibernacula and summer habitat include distances of 80 km (50 miles) (Barbour and Davis 1969), 44 km (27 miles) (Samoray et al. 2019), and 137 km (85 miles) (Griffin 1940). Hibernaculum to hibernaculum movement up to 209 km (130 miles) has also been documented between two consecutive winters (Lutsch 2019).

Summer Habitat

Tricolored bats are known to roost mostly in foliage, clusters of dead leaves (65%), live foliage (30%), and squirrel nests (5%; Veilleux et al. 2003). The species can occasionally be found in man-made structures (Whitaker 1998), but Veilleux et al. (2003) found that tricolored bats seem to use man-made structures less often than Myotis species. Tricolored bats accounted for only 12 (2.9%) of 401 bat colonies in buildings in Indiana (Cope et al. 1991), suggesting that most colonies are roosting in forests (Veilleux 2003). In Indiana, female tricolored bat maternity roosts occurred mostly in upland habitats (9.4%) as opposed to riparian (0.8%) and bottomland (0.2%) habitats (Veilleux et al. 2003). Preferred upland habitat by this species could be related to the greater availability of preferred roost tree species: white oak (Quercus alba), bur oak (Quercus macrocarpa), and red oak (Quercus rubra) (Veilleux et al. 2003).

Tricolored bats appear to exhibit site fidelity for summer roosting habitat. Veilleux (2003) found site fidelity for 18 tricolored bats in Indiana. The bats were monitored for nine days and found that bats used one to three roost trees and changed roost trees one to two times, on average. Tricolored bats remained at single roost trees for two and a half to six consecutive days on average. However, four individuals late in pregnancy or lactating remained at a roost for two and a half to four days. Eight of eighteen individuals (~44%) returned to previously used roosts trees after initially changing to a new roost (Veilleux 2003).

Roost areas for individuals and maternity colonies are relatively small. In Indiana, Veilleux and Veilleux (2004) radio-tracked four tricolored bats to their respective roosts trees and found that minimum and maximum distances from roosts trees were between 69 and 3,038 ft (21 and 926 m). Minimum roost area for all 4 individuals containing all roosts used during both years (1999-2000) ranged from 0.25 acres to 5.68 acres (0.1 to 2.3 hectares). A comparable study in Nova Scotia found that the average roosting area of maternity colonies varied between 3.9 and 191.3 acres (1.6 and 77.4 hectares), with a mean of 56.3 acres (22.8 hectares).

A study conducted in Ouachita Mountains of central Arkansas radio-tagged 28 male and nine female tricolored bats and found that roosts trees varied from one to three roost trees for males and one to five roost trees for females (Perry and Thill 2007b). Seven of 14 female roosts were maternity colonies based on exit counts and visible pups (Perry and Thill 2007b). Perry and Thill (2007b) also found males roosting in forested habitats also occupied by females, but primarily in solitary roosts.

Reproduction

Adult females store sperm in their uterus during the winter and fertilization occurs soon after spring emergence from hibernation (Guthrie 1933). Females typically give birth to two young, rarely one or three between May and July (Allen 1921, Barbour and Davis 1969, and Cope and Humphrey 1972). Young grow rapidly and begin to fly at 3 weeks of age and achieve adult-like flight and foraging ability at 4 weeks (Lane 1946 and Whitaker 1998). Adults often abandon maternity roosts soon after weaning, but young remain longer (Whitaker 1998). Tricolored bats are considered juveniles (i.e., subadults) when entering their first hibernation and most probably do not mate their first fall (Fujita and Kunz 1984).

Maternity colonies consist of 1 to 8 (mean = 4.4) females and pups at tree roosts in Indiana (Veilleux and Veilleux 2004b). Perry and Thill (2007b) observed an average of 6.9 adult females and pups per colony in Arkansas (range 3 to 13). Maternity colonies include up to 18 females in trees in Nova Scotia (Poissant et al. 2010). Whitaker (1998) found colonies in buildings averaged 15 adult females (range 7 to 29 adult females). Hoying and Kunz (1998) reported the largest colony on record in a Massachusetts barn (19 adult females and 37 young).

Feeding

Tricolored bats are opportunistic feeders and consume small insects including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera) (Whitaker 1972, LaVal and

LaVal 1980, Griffith and Gates 1985, and Hanttula and Valdez 2021). Tricolored bats emerge early in the evening and forage at treetop level or above (Davis and Mumford 1962 and Barbour and Davis 1969) but may forage closer to ground later in the evening (Mumford and Whitaker 1982). Tricolored bats exhibit slow, erratic, fluttery flight while foraging (Fujita and Kunz 1984) and commonly forage with eastern red bats (*Lasiurus borealis*) and silver-haired bats (*Lasionycteris noctivagans*) (Davis and Mumford 1962 and Mumford and Whitaker 1982). Tricolored bats forage most commonly over waterways and forest edges (Barbour and Davis 1969, Mumford and Whitaker 1982, and Hein et al. 2009). Maximal distance traveled from roost areas to foraging grounds was 4.3 km (2.7 miles) for reproductive (pregnant or lactating) adult females in Indiana (Veilleux et al. 2003) and 24.4 km (15.2 miles) (mean=11.4 km; 7.1 miles) for male tricolored bats in Tennessee (Thames 2020).

Population Dynamics

According to the SSA, prior to 2006 the tricolored bat was highly abundant and widespread, with over 140,000 bats observed hibernating in 1,951 known hibernacula (most of the population uses a small subset of all known hibernacula). More recently, evidence indicates a decline in species abundance. For example, since 2000, a 52% decline has been estimated in the rangewide winter abundance and a 29% decrease in the number of extant winter colonies. Similar downward trends have been described in summer data. According to studies by Stratton and Irvine (2022), rangewide occupancy of tricolored bats declined by 28% between 2010-2019. Analyzing acoustic detection data from mobile routes, Whitby et al. (2022) calculated a 53% decline in the rangewide relative abundance. Finally, Deeley and Ford (2022) observed a significant decline in mean capture rates from 1999 to 2019 across the range. Estimates derived from their results correspond to a 12% decline in rangewide mist-net capture rates compared to pre-WNS capture rates. The SSA further suggests that the potential for population growth is 0%.

For additional analysis, the SSA delineates three geographical representation units (RPU) for the tricolored bat (Figure 9): Northern, Southern, and Eastern. Data described by RPU indicates that winter abundance and number of colonies has declined the most in the Eastern RPU (89% and 46%, respectively). Winter abundance has declined the least in the Southern RPU (24%) and number of winter colonies has declined the least in the Northern RPU (24%). Whitby et al. (2022) found measurable summer declines in abundance in the Northern RPU (86%), Southern RPU (65%), and Eastern RPU (38%). Deeley and Ford (2022) found capture rates decreased 19%, 16%, and 12%, in the Eastern RPU, Northern RPU, and Southern RPU, respectively.

Status and Distribution

Based on the 2021 SSA, tricolored bats are known from 39 States (Alabama, Arkansas, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, Wisconsin, West Virginia, Wyoming), Washington D.C., 4 Canadian

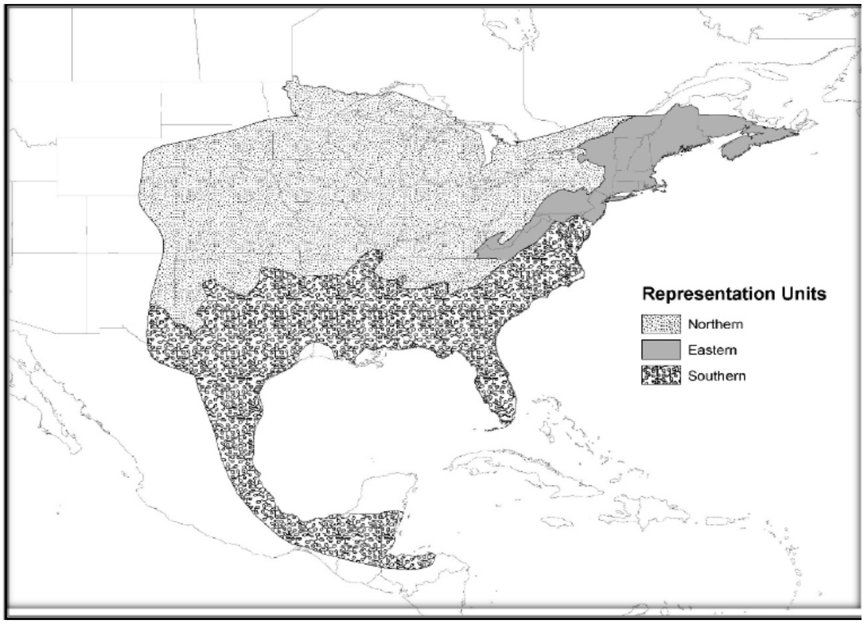

Figure 9. Tricolored Bat Range Map and Representation Units (from Species Status Assessment).

Provinces (Ontario, Quebec, New Brunswick, Nova Scotia), and Guatemala, Honduras, Belize, Nicaragua, and Mexico (Figure 9). The species' current distribution in New Mexico, Colorado, Wyoming, South Dakota, and Texas is the result of westward range expansion in recent decades (Geluso et al. 2005, Adams et al. 2018, and Hanttula and Valdez 2021) as well as into the Great Lakes basin (Kurta et al. 2007 and Slider and Kurta 2011). This expansion is largely attributed to increases in trees along rivers and increases in suitable winter roosting sites, such as abandoned mines and other human-made structures (Benedict et al. 2000, Geluso et al. 2005, and Slider and Kurta 2011). According to the SSA, "Based on current conditions, future projections of tricolored bat abundance, number of hibernacula, and spatial extent will continue to decline. By 2030, rangewide abundance declines by 89%, the number of winter colonies declines by 91%, and tricolored bat's spatial extent declines by 65%. Projected declines in tricolored bat's abundance, number of winter colonies, and spatial extent are widespread across all RPUs under current conditions."

Threats to the Species

As with other bats covered in this Opinion, the primary factors influencing the tricolored bat's viability include WNS, wind related mortality, effects from climate change, and habitat loss.
<u>The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range</u>

Loss of roosting, foraging, and commuting habitat may lead to minor or significant impacts to tricolored bat depending on the timing, location, and extent of the removal. Loss or modification of winter habitats may also result in negative impacts to tricolored bats, especially given the species' high site fidelity and narrow microclimate requirements for hibernation. Additionally, disturbance (e.g., human entry) during hibernation results in increased arousals in tricolored bats, which leads to increased energy expenditure at a time when food and water resources are scarce or unavailable. The Service reviewed changes in various National Land Cover Database (NLCD) landcover classes within each RPU from 2006–2016 in the continental U.S. and found that deciduous forest landcover decreased across all RPUs by 768,903 ha (1,900,000 ac) for an average loss of 76,890 ha (190,000 ac) per year. Other cover types that provide foraging opportunities such as emergent wetland cover types decreased across all RPUs by 687,966 ha (1,700,000 ac). These land cover changes may be associated with decreased habitat and reduced habitat suitability.

Disease or Predation

WNS is the primary driver (or influence) that has led to the species' current condition and is predicted to continue to be the primary influence into the future. According to the SSA, the effect of WNS on tricolored bats has been extreme, such that most summer and winter colonies have had severe declines after the arrival of WNS. Turner et al. (2011) estimated that tricolored bats experienced a 75% decline in winter counts across 42 sites in Vermont, New York, and Pennsylvania just 4 years after the discovery of WNS. Likewise, Frick et al. (2015) estimated a 10–fold decrease in tricolored bat colony size after the arrival of WNS. Most recently, Cheng et al. (2021) estimated population declines of 90–100% across 59% of tricolored bat range based on data from 27 states and 2 provinces.

Other Natural or Man-made Factors Affecting its Continued Existence

Wind related mortality of tricolored bats is also proving to be a consequential stressor at local and regional levels. Tricolored bats are killed at wind energy projects primarily through collisions with moving turbine blades. The Service has estimated 3,227 tricolored bats are killed annually at wind facilities, with a mean of 936 bats in the Service's Midwest Region (USFWS 2021). Data from Wiens et al. (2022) also suggests that wind mortality is apparent in the continuing decline of tricolored bats.

Changing climatic variables including changes in temperature and precipitation influence tricolored bat's resource needs, such as suitable summer and winter roosting habitat, foraging habitat, and prey availability. Although pervasive across tricolored bat's range, the magnitude, direction, and seasonality of climate change will vary geographically (e.g., some regions will experience more frequent droughts which may lead to reduced tricolored bat survival or reproductive success; alternatively, some regions will experience heavier and more frequent precipitation events that may lead to decreased foraging bouts and insect availability).

2.5 Fanshell Mussel

Species and Critical Habitat Description

The fanshell mussel (*Cyprogenia stegaria*) was listed as an endangered species on June 21, 1990 (55 FR 25591-25595). A recovery plan addressing the fanshell was approved on July 9, 1991

(USFWS 1991). Critical habitat has not been designated for this species. A 5-Year Review was completed in 2019 (USFWS 2019a).

The fanshell is a medium-sized mussel, seldom exceeding 3.2 in maximum length. It is subcircular in outline. The ventral margin of the shell is broadly rounded, and the posterior margin is slightly truncated. The posterior ridge is well developed, with a sharp posterior slope. The periostracum is light green or yellowish in color, with green rays and mottling. The posterior two-thirds of the shell are covered with numerous rounded pustules (small, raised spots) and irregular knobs. The nacre is silvery white (USFWS 1991 and Parmalee and Bogan 1998).

Life History and Biology

Like most mussels, fanshell males release sperm into the water column and females take it up with incoming water. Eggs are fertilized and then moved to the marsupia at the gills. The resulting embryos develop into glochidia over time and are released from the marsupia to infect specific host species. The fanshell is a long-term brooder, gravid from September or October to late May (Surber 1912 and Ortmann 1919). It produces conglutinates that resemble oligochaetes that are 0.8 - 3.2 in long and brick-red when containing eggs but fade as glochidia develop (Sterki 1898 and Jones and Neves 2002). The fanshell and western fanshell (*Cyprogenia aberti*) are the only North American unionids that brood most of their larvae in an external marsupium attached to the outer gill. Fanshell conglutinates protrude from the centers of outer gill demibranches. Each mature female produces 6 to 14 conglutinates per reproductive season and discharges them from March until May. Conglutinates are released through the excurrent aperture via the suprabranchial chamber. According to the Service's 5-Year Review (2019a), nine fish species have been identified as hosts for glochidia transformation: mottled sculpin (*ottus bairdi*), banded sculpin (*Cottus carolinae*), greenside darter (*Etheostoma blennioides*), snubnose darter (*Etheostoma simoterum*), banded darter (*Etheostoma zonale*), tangerine darter (*Percina aurantiaca*), blotchside logperch (*Percina burtoni*), logperch (*Percina caprodes*), and Roanoke darter (*Percina roanoka*).

The fanshell is found in medium to large rivers. It buries itself in sand or gravel in deep water of moderate current, with only the edge of its shell and its feeding siphons exposed.

Population Dynamics/ Status and Distribution

The fanshell historically occurred throughout much of the Ohio, Cumberland, and Tennessee River drainages (Simpson 1914 and Burch 1975). In the Ohio River drainage, it was known from the headwaters in Pennsylvania (Ortmann 1909) downstream to the mouth of the Ohio River, including Killbuck Creek (a tributary to the Walhonding River); the Tuscarawas River; the Ohio River at Portland, Marietta, Clarington, Portsmouth and Cincinnati, the Scioto River as far upstream as Columbus, the Little Miami River as far upstream as Xenia, and a single record from the Great Miami River in Ohio (Watters et al. 2009); the Wabash River in Indiana and Illinois; and the Green and Licking rivers in Kentucky (Cicerello et al. 1991 and Cummings and Mayer 1992). In the Cumberland River drainage, it was widespread downstream of Cumberland Falls in Kentucky and Tennessee (Cicerello et al. 1991 and Parmalee and Bogan 1998). In the Tennessee River drainage, records exist of the fanshell occurring historically in the Holston, Powell, Little

Tennessee, Elk and Duck rivers (Starnes and Bogan 1988 and Williams et al. 2008). Shells of the species have been recovered from aboriginal middens along the French Broad and Little Pigeon rivers in Sevier County, Tennessee (Parmalee 1988).

The fanshell mussel is now sparsely distributed within most of its highly restricted range (Figure 10). Most fanshell populations are small, and all are geographically isolated from each other (USFWS 1991 and USFWS 2019a). The best remaining extant populations of the fanshell occur in the Licking, Green and Rolling Fork rivers in Kentucky, and in the Clinch River in Tennessee and Virginia. These populations are considered healthy with evidence of recruitment and multiple year classes present over several years or even decades (USFWS 2019a). Since the species recovery plan was written (USFWS 1991), the Rolling Fork River population, an additional reproducing population, has been identified, but it is a relatively small population compared to the Licking, Green and Clinch River populations (USFWS 2009). The fanshell may also be reproducing in the Muskingum River, the largest Ohio River tributary in the state of Ohio (USFWS 2019a). Other locations (e.g., EFWR, Tippecanoe River, Kanawha River, Ohio River, etc.) appear to have small and restricted extant populations with limited evidence of recruitment. Additional survey efforts need to be conducted in portions of its historic range to better assess its current status.

Small, potentially non-reproducing populations of the fanshell persist in the Ohio River drainage. There are recent records of live fanshell mussels from mainstem Ohio River reaches bordering West Virginia and Ohio in the Belleville and Racine pools (USFWS 2011). Restoration efforts have been ongoing within the Belleville pool since 2007. In 2010, 200 fanshells from the Licking River in Kentucky were used to augment the population at Muskingum Island. These fanshells have shown good survival and more recently naturally recruited fanshells have been collected in the area (USFWS 2019a).

Tributaries in the Ohio River system where small populations are known or believed to still occur include the Kanawha River (West Virginia), the Wabash River system (Illinois and Indiana), the EFWR (within the Wabash River drainage in Indiana), the Tippecanoe River (a Wabash River tributary in Indiana) and the Barren River (a Green River tributary in Kentucky) (USFWS 2009, 2011b). In Indiana, Brant Fisher (Indiana Department of Natural Resources) indicated the fanshell was still extant in the EFWR but that the species was not abundant, and most individuals encountered were older specimens. He indicated there may be some recruitment occurring in the Tippecanoe River but that the Wabash River population was likely not reproducing (USFWS 2019a).

In the mainstem Tennessee River, the fanshell may be extant in the Wilson Dam tailwaters, based on a single, live individual collected adjacent to Seven-mile Island in the Wilson Dam tailwaters, Alabama, in 2001, but the population may not be viable (Williams et al. 2008). In 2012, Dr. Monte McGregor (Kentucky Division of Fish and Wildlife Resources) stocked 100 adult fanshells into the lower Tennessee River downstream of Kentucky Lock and Dam. Monitoring of this stocking has indicated high survival and gravid females; however, no evidence of juveniles has been observed (McGregor 2017).

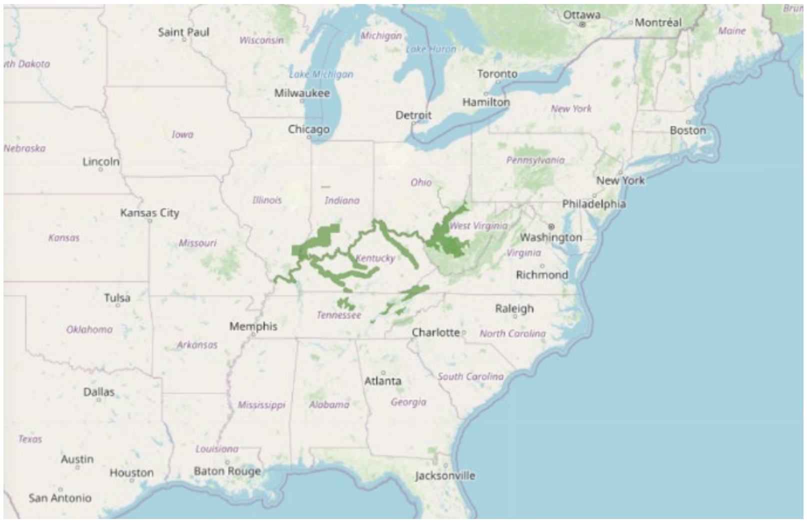

Figure 10. Fanshell Mussel Range Map. Dark green areas represent the current range (https://www.fws.gov/species/fanshell-cyprogenia-stegaria/map accessed May 16, 2023).

Surveys done in the mainstem Cumberland River by the Tennessee Wildlife Resources Agency from June 2011 to August 2012 looked at 34 sites in areas that historically supported diverse mussel fauna however no fanshell mussels were encountered (USFWS 2019a).

Threats to the Species

Present or Threatened Destruction, Modification or Curtailment of Its Habitat or Range

Ongoing threats to fanshell habitat include water quality degradation from point and non-point sources, hydrologic and water quality alterations from impoundments, instream activities and disturbances such as gravel and sand mining, road and bridge construction, etc. Also land development near or adjacent to streams can increase sedimentation and stormwater run-off.

Overutilization for Commercial, Recreational, Scientific, or Education Purposes

The fanshell is not a commercially viable species although it may be inadvertently included in commercial harvests. Overutilization for recreational, scientific, or educational purposes was not considered to be a limiting factor in the recovery plan (USFWS 2019a).

Disease or Predation

The fanshell has numerous natural predators such as muskrats, raccoons, and fish, but it is unknown what overall impacts this threat may have. Recently, invasive black carp *(Mylopharyngodon piceus)*, have been found in parts of the fanshell's range. The black carp is known to prey on snails and mussels, but it is unclear at this time if it will be a significant threat to the fanshell (USFWS 2019a).

Inadequacy of Existing Regulatory Mechanisms

Numerous industries, point source discharges, and land use options (coal, oil, sewer, road and bridge construction, agriculture, development, etc.) have the potential to impact water quality and flow directly and indirectly. Regulations and water quality criteria can vary by industry and location, and many potential pollutants are not adequately tested for impacts to mussels. In addition, few regulatory mechanisms exist to address land use changes and development.

Other Natural or Manmade Factors Affecting Its Continued Existence

Zebra mussels have continued to spread in North American waterways since their accidental introduction in the 1980s. Large zebra mussel populations in Lake St. Clair, the Detroit River, and Lake Erie appear to have eliminated most native mussels from the colonized areas, although the species may persist in refugia where habitat is less suitable for zebra mussels. Zebra mussel populations in the Ohio River could possibly be negatively impacting fanshell mussel populations. Zebra mussels could also influence recovery actions to benefit this species by limiting locations in which to establish new populations and/or impacting newly established populations.

2.6 Fat Pocketbook Mussel

The following information is primarily from the 2019 5-Year Review for the fat pocketbook mussel.

Species and Critical Habitat Description

The fat pocketbook was listed as endangered on June 14, 1976 (41 FR 24062-24067). A recovery plan was written in 1985, revised in 1989, and amended in 2019 (USFWS 2019b). The fat pocketbook has a round to oblong shell that is greatly inflated and has a strong s-shaped hinge line. The beak cavity is very deep (Cummings and Mayer 1992). The shell is thin to moderately thick and the periostracum varies in color from light brown, yellow, or olive, and becoming dark brown in older individuals. The shell is typically rayless, smooth, and very shiny. Both anterior and posterior ends of the shell are rounded. The fat pocketbook is known to grow to a length of 5 inches. The nacre is bluish white and often iridescent; however, it may include some pink or salmon color in some specimens (Cummings and Mayer 1992).

Life History and Biology

The fat pocketbook is a large-river species that is typically found in slow-flowing water with a mud (silt/clay), sand, or gravel substrate, at depths of a few inches to eight or more. It is a long-term brooder, with females becoming gravid in the fall, retaining glochidia over winter, and releasing the progeny during spring and summer. The freshwater drum (*Aplodinotus grunniens*) is the primary host fish for the species (Barnhart 1997 and Watters 2007).

Population Dynamics/Status and Distribution

Historically, the fat pocketbook mussel was widely distributed in the Mississippi River drainage from the confluence of the Minnesota and St. Croix rivers, downstream to the White River system, with documented occurrences in Minnesota, Wisconsin, Iowa, Illinois, Indiana, Missouri, Kentucky, and Arkansas (USFWS 2019b). The range of the fat pocketbook has increased in recent years, over the historically documented extent (Figure 11). While it remains extirpated in the upper Mississippi River, it has expanded its range into the Lower Mississippi River and is known to occupy approximately 1,000 channel miles in three distinct drainages. Over the last thirty years or so, the known range in the St. Francis River has expanded from a 15-mile reach (and a few tributary sites) to around 200 channel miles of river and 18 tributaries. The population in the Ohio River and Wabash River have increased from locally rare in 1998 to locally common, with records from a 160-mile reach of the Ohio River and 150-mile reach of the Wabash River. Recruitment has been documented in multiple areas including the St. Francis, Ohio, and Lower Mississippi Rivers. In the most recent Five-Year Review for this species, the Service recommended delisting due to recovery (2019b).

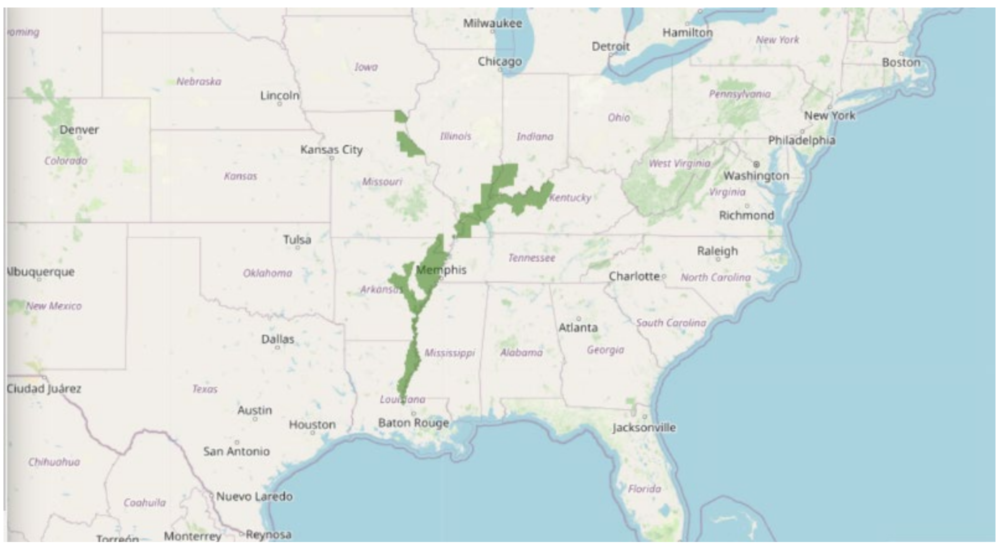

Figure 11. Fat pocketbook mussel current range. Dark green areas indicate current range (https://www.fws.gov/species/fat-pocketbook-potamilus-capax/map accessed May 16, 2023).

Threats to the Species

Present or Threatened Destruction, Modification or Curtailment of Its Habitat or Range

Primary threats to fat pocketbook habitat include navigation and flood control activities (i.e., impoundments, channelization, dredging, etc.), hydropower, water quality degradation from point and non-point sources, increased sedimentation, spills, and stormwater run-off. However, impoundment and hydropower projects have been completed within the past 10 years with minimal impacts and the U.S. Army Corp of Engineers (USACE) has developed best management practices to help minimize adverse effects to fat pocketbook mussels during dredging, channel cleanout, and sand and gravel mining operations (USFWS 2019b). Although there are still concerns with spills and non-point source pollution, the species appears to be expanding and adapting to many local conditions.

Inadequacy of Existing Regulatory Mechanisms

The U.S. Environmental Protection Agency has regulated industrial discharges by implementing a permitting process. Some studies suggest that the pollutant standards or criteria may not be protective for all species and life stages; however, the fat pocketbooks status suggests they may be generally protective of this species.

Other Natural or Manmade Factors Affecting Its Continued Existence

Zebra mussels have continued to spread in North American waterways since their accidental introduction. Despite this, there does not appear to be any evidence of impacts of zebra mussel competition to the fat pocketbook. Climate change may have adverse effects for many aquatic species by affecting weather, temperature, and water levels. The fat pocketbook's current status and expanded distribution should reduce their vulnerability to severe weather and drought conditions caused by climate change.

2.7 Salamander Mussel

Species and Critical Habitat Description

On April 20, 2010, the Service received a petition to list 404 aquatic, riparian, and wetland species from the southeastern United States as endangered or threatened species and to designate critical habitat concurrent with listing under the ESA. The Service responded with a 90-day finding indicating most of the species may warrant listing, including the salamander mussel. The Service is currently completing a 12-month review and will complete an SSA and make a listing decision later this year.

The salamander mussel is a small mussel that grows to about 2 inches in length. They have an elongated, oval-shaped shell that is smooth and thin. They are typically a yellowish tan to dark brown in color and do not have any shell markings or rays. Salamander mussels inhabit medium to large rivers with calm to swift currents. The species lives in areas where it's host, the mudpuppy, is found. This includes streams with sand, silt, mud and/or gravel substrates. They can often be found under large, flat rocks (Cummings and Mayer 1992). Due to their small size and habitat, they may often be overlooked in surveys.

Life History and Biology

The reproduction cycle for the salamander mussel is like most species except the salamander mussel is the only North American mussel that uses a non-fish species, the mudpuppy salamander (*Necturus maculosus*) as host for reproduction. They are thought to be long-term brooders, spawning in the summer, and retaining glochidia until the following spring. (Lefevre and Curtis 1912; Oesch 1984; Watters 1995).

The salamander mussel is a filter feeder, obtaining nutrition from material suspended in the water column. The species is thought to grow quickly for the first couple of years and then slow down significantly. They can live for 10 years, but most appear to reach 4-5 years (Watters 2009).

Population Dynamics/Status and Distribution

The Salamander Mussel is found in North American streams and rivers in the Great Lakes and the Mississippi River and Ohio River basins of the following states: Arkansas, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Tennessee, West Virginia, Wisconsin and Ontario, Canada (NatureServe accessed May 2023). Data from the Indiana Department of Natural Resources indicates that the salamander mussel likely occurs in tributaries of the Wabash River, Maumee River, Tippecanoe River, and White River, including Sugar Creek and Graham Creek (B. Fisher, pers.comm.).

NatureServe (2023) estimates that this mussel has declined by up to 50% in the long-term and has continued to decline in the short-term by up to 30%, stating, "While this species is easily overlooked, intense searches in areas where the species has previously been indicate decline (Stansbery, 1970 and Clarke, 1985). Sietman (2003) reports it extirpated from the Mississippi River below St. Anthony Falls and portions of the Minnesota River drainage in Minnesota. Cummings and Mayer (1997) report it may be extirpated in Illinois. In Canada, it has been extirpated from the Cedar and Detroit Rivers by the zebra mussel and only a single population remains in the Sydenham River in Ontario (Metcalfe-Smith and Cudmore-Vokey, 2004) and possibly Lower Thames (Watson et al. 2000 and Cudmore et al. 2004). In the 19th Century, it was collected from several sites near Buffalo including Lake Erie, Buffalo Creek [River], and Cayuga Creek at Lancaster in New York (Strayer and Jirka, 1997)."

Threats to the Species

Threats to the salamander mussel are similar to threats previously discussed for the fanshell: water quality degradation from point and non-point sources, hydrologic and water quality alterations from impoundments, instream activities and disturbances such as gravel and sand mining, road construction, etc. In addition, based on the sole reliance on the mudpuppy for reproduction, threats to the mudpuppy could be significant to salamander mussels. According to a paper by Hoffman et al. (2014), mudpuppy populations in Indiana, Illinois, and Ohio are declining.

2.8 Monarch Butterfly

The following information is from the monarch SSA (USFWS 2020) unless otherwise noted.

Species and Critical Habitat Description

In 2014, the Service received a petition to list the monarch as threatened and published a 90-day finding that December indicating that listing may be warranted. In 2016, the Service began an in-depth status assessment, looking at the global population as well as focusing on monarchs in

North America, where most of the world's population occurs. In December 2020, the Service determined that listing the monarch butterfly as an endangered or threatened species is warranted but precluded by higher priority actions. As a result, the species is considered a candidate species. As a candidate species, neither section 7 of the ESA, nor the implementing regulations for section 7, contain requirements for federal agencies. The Service will continue to seek new information and evaluate this species as new data become available. The monarch's status will be reviewed each year as part of our annual Candidate Notice of Review, and if a change in status is warranted, we will act at that time. As of now, the Service intends to propose listing the monarch in 2024, if listing is still warranted at that time.

The monarch is a species of butterfly in the order Lepidoptera (family Nymphalidae) that occurs in North, Central, and South America; Australia; New Zealand; islands of the Pacific and Caribbean; and elsewhere (Malcolm and Zalucki 1993). Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic.

Life History and Biology

Monarchs begin their lifecycle as eggs, which are laid on milkweed plants and hatch after two to five days. The eggs hatch into larvae, or caterpillars, and progress through five instars over the next two weeks before pupating into a green chrysalis. An adult monarch will emerge one to two weeks later. In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites. This migration can take monarchs distances of over 3,000 km (Urquhart and Urquhart 1978) and last for over two months (Brower 1996). Migratory individuals in eastern North America predominantly fly south or southwest to mountainous overwintering grounds in central Mexico, and migratory individuals in western North America generally fly shorter distances south and west to overwintering groves along the California coast into northern Baja California (Solensky 2004). As temperatures warm at the overwintering sites in the spring, monarchs begin to breed and lay eggs on milkweed throughout their migration back to their summer habitat. The following generations breed and lay eggs throughout the summer.

Monarchs can be found in a variety of habitats including fields, roadside areas, open areas, wetlands, or urban gardens. They require healthy and abundant milkweed plants for laying eggs on and as a food source for larvae or caterpillars. By consuming milkweed plants, monarchs obtain toxins, called cardenolides, that provide a defense against predators. Additionally, nectar from other flowers is needed for adult monarchs throughout the breeding season, migration, and overwintering.

Population Dynamics

The eastern North American monarch population has been systematically censused annually since 1994 (Vidal and Rendón-Salinas 2014). Although varying year-to-year, monarchs consistently numbered in the hundreds of millions throughout the 1990s and early 2000s (assuming a 21.1 million monarch/hectare density; Thogmartin et al. 2017a). There are additional survey data suggesting that monarch populations were as high or higher in the two decades prior to standardized monarch monitoring at the Mexican overwintering sites (Vidal and Rendón-Salinas 2014 and Calvert and Brower 1986). Based on the past annual censuses, the eastern North American population has been generally declining over the last 26 years (Figure 12). Although the numbers at the overwintering sites have declined there was not a corresponding change in the spatial extent of the population during the breeding season.

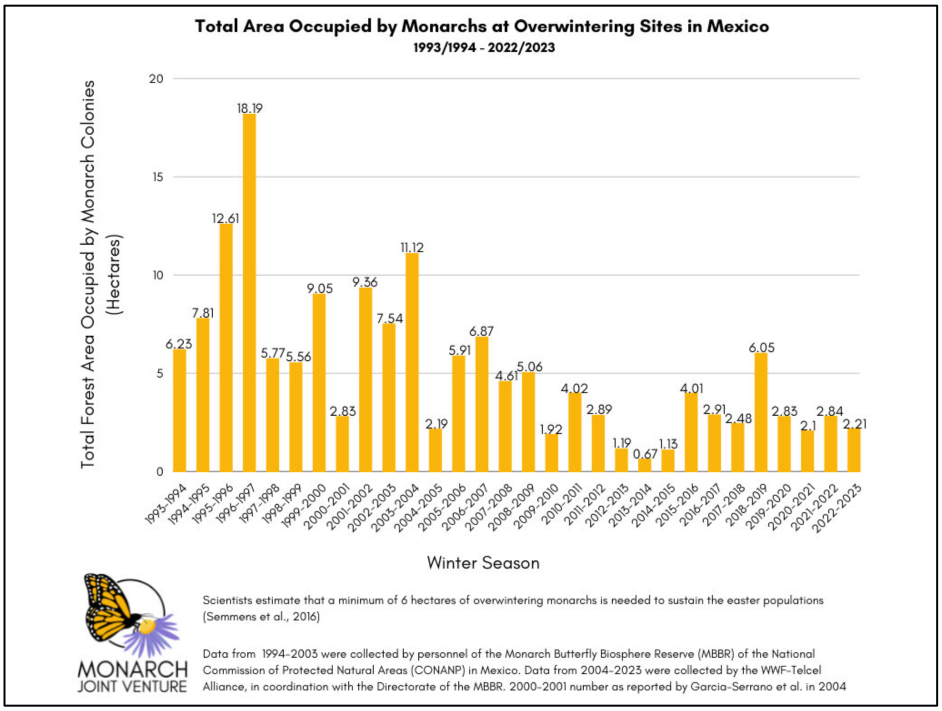

Figure 12. Eastern Monarch Population Estimates (Monarch Joint Venture 2023).

Status and Distribution

North America contains two migratory populations of the monarch and a year-round population in South Florida. The monarch also occurs in parts of South America; Aruba and nearby islands; Central America and the Caribbean; Australia, New Zealand, and other Pacific Islands; Hawaii; and the Iberian Peninsula (including Spain, Portugal, Morocco, and nearby Atlantic islands). The Service found monarch occurrence records in 90 countries, islands, or island groups and delineated these occurrences into 31 different populations.

Threats to the Species

According to the SSA, the primary drivers affecting the health of the two North American migratory populations are changes in breeding, migratory, and overwintering habitat (due to conversion of grasslands to agriculture, urban development, widespread use of herbicides, logging/thinning at overwintering sites, unsuitable management of overwintering groves, and drought), continued exposure to insecticides, and effects of climate change.

Present or Threatened Destruction, Modification or Curtailment of Its Habitat or Range

The availability of milkweed is essential to monarch reproduction and survival. Reductions in milkweed is cited as a key driver in monarch declines (Brower et al. 2012, Pleasants and Oberhauser 2013, Inamine et al. 2016, Thogmartin et al. 2017b, Waterbury and Potter 2018, and Saunders et al. 2019). Most of the milkweed loss has occurred in agricultural lands, where intensive herbicide usage for weed control has resulted in widespread milkweed eradication. Pleasants (2017), for example, estimated that over 860 million milkweed stems were lost in the Midwest between 1999 and 2014, a decline of almost 40%.

Milkweed is also lost on the landscape through development and conversion of grasslands (Lark et al. 2015). Between 2008 and 2012, a total of 5.7 million acres of grassland were converted to new cropland, including up to 3 million acres of Conservation Reserve Program (CRP) land (Lark et al. 2015). Pleasants and Oberhauser (2013) estimate that the loss of agricultural milkweeds in the Midwest has resulted in an 81% decline in monarch production, in part because monarch egg densities were higher on milkweed in agricultural fields (3.89 times more eggs than on non-agricultural milkweed). This particularly impacts the eastern monarch population because more Mexico overwintering monarchs originate from the Midwest crop belt region than any other region (estimates range from 38% to over 85% of all overwintering monarchs originating from the Midwest; Wassenaar and Hobson 1998 and Flockhart et al. 2017).

Loss of other nectar sources during breeding and migration is also a potential driver in monarch declines. These losses are due to the same stressors as milkweed reduction.

Both western and eastern monarchs rely on the microclimate provided by the trees at their overwintering sites (Leong et al. 2004 and Williams and Brower 2015). Loss of trees occurs at overwintering sites in Mexico primarily through small- and large-scale logging, storms, and an increasingly unsuitable climate (see *Climate Change* section below for more details). Most overwintering sites used by eastern monarchs occur within the Monarch Butterfly Biosphere Reserve, a 56,259-ha protected area. Within this area, there is a logging ban within the 13,551-ha core zone (Ramírez et al. 2015). However, recent logging has occurred both legally (including salvage logging allowed after storms) and illegally at multiple colonies (Vidal et al. 2014 and Brower et al. 2016).

Disease and Predation

Monarchs are impacted by several diseases and natural enemies. One of the most well-known and well-studied natural enemies of monarchs, *Ophryocystis elektroscirrha* (a monarch parasite), can cause reduced longevity, smaller body size, wing deformities, reduced mating success, and lower flight performance, leading to decreased survival and fitness (USFWS 2020). While infection rates can be high, a large and continuous increase in proportion of monarchs that are heavily infected over time in eastern North America has not been noted (Project Monarch Health 2016).

In addition to disease and parasites, immature monarchs are heavily preyed upon by natural enemies (upwards of 90% of monarchs are killed in immature stages; Nail et al. 2015a), but there is not any conclusive evidence available that suggests predation rates are currently increasing. These immature monarch predators range from ants (e.g., red imported fire ant), tachinid fly parasitoids, various other insects for eggs and larvae, and wasps (*Pteromalus cassotis* and *Polites dominulus*) for pupae (Oberhauser et al. 2015).

<u>Other Natural or Manmade Factors Affecting Its Continued Existence</u>

Insecticide exposure via agricultural application, as well as use in home gardens, nurseries, parks, etc. is a potential threat to monarch survival. Pesticide use in the US is pervasive, with expenditures topping $5 billion in 2012 (USEPA 2017). Studies looking specifically at dose-response of monarchs to neonicotinoids, organophosphates and pyrethroids have demonstrated monarch toxicity (e.g., Krischik et al. 2015, James 2019, Krishnan et al. 2020, and Bargar et al. 2020).

Climate change can affect monarchs both directly and indirectly (Nail and Oberhauser 2015) on both the overwintering and breeding grounds. Increasing storm frequency and severity in the Mexican overwintering colonies can lead to catastrophic situations (Anderson and Brower 1996 and Brower et al. 2004). A warming climate may influence breeding habitat by altering suitable locations for both monarchs (Batalden et al. 2007) and their milkweed host plant (Lemoine 2015). Climate change impacts, particularly increasing temperatures, may also impact monarch fecundity (Oberhauser 1997), mating success (Solensky and Oberhauser 2009), and survival during migration and while overwintering (Masters et al. 1988 and Alonso-Mejía et al. 1997). Laboratory studies indicate optimal temperatures for monarch range from 27–29°C with sublethal effects beginning around the 30–36°C range and an upper lethal thermal limit of 42°C (Zalucki 1982, York and Oberhauser 2002, Zalucki and Rochester 2004, and Nail et al. 2015b). Changes in climate may also result in mismatch of food resources and migration and breeding or range mismatch with associated species, such as changing encounters with natural enemies (Thogmartin et al. 2017b and McCoshum et al. 2016).

Impacts of highways on monarch butterfly (and, more generally, pollinators) mortality is only now emerging as an area of conservation concern. What few studies that are available demonstrate that mortality from vehicle strikes is a potentially important conservation challenge (NRCS 2016).

3.0 Environmental Baseline

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

The purpose of the environmental baseline is to describe past and ongoing human and natural factors that have contributed to the current status of the species and their habitat in the project Action Areas. Rangewide factors affecting the species include those listed previously in the *Threats to the Species* subsection. Additional landscape information is available in Section 3.25 and Appendix HH of the Tier 1 Draft Environmental Impact Statement.

General Habitat Conditions in the Action Areas

Because no field studies were conducted during the Tier 1 phase of this project, there is no information regarding the quality or general condition of the forest or wetlands that will be impacted. Nevertheless, the following generic description of the existing habitat is believed to be representative of much of the project area.

The native forest communities that once dominated southwestern Indiana are now largely confined to scattered woodlots; much of the area has been converted to agricultural land uses. Within the species' Action Areas, agriculture, residential and commercial development, and transportation infrastructure have resulted in extensive clearing and construction. Agriculture and forest land uses dominate much of the landscape. Vegetation adjacent to most streams and tributaries that will be crossed by the Mid-States Corridor includes row crops, pasture, old fields, and riparian forest. In addition to riparian forest vegetation, woodland habitat within the Action Areas varies from clusters of scattered individual trees associated with residential sites to large expansive woodland tracts, including a few larger areas of managed forest habitat (e.g., Gantz Woods Nature Preserve, Glendale Fish and Wildlife Area, NSA Crane). Some grassy and brushy areas with widely scattered mature trees and tree-lined fencerows also provide limited wildlife habitat.

Two major rivers are crossed by the Alternative P corridor: the EFWR and Patoka River. The EFWR is the largest river crossed by the preferred alignment. It is a slow stream that drains approximately 5,700 square miles. The Indiana Department of Environmental Management (IDEM) has listed the EFWR on the 2022, 303 (d) List of Impaired Waterbodies. Parameters of concern for the EFWR are impaired biotic communities and PCBs. Pastureland and cultivated cropland comprise approximately 62% of the landscape with forest being the other predominant land use at about 29% cover.

The Patoka River is approximately 100 miles long with an 860 square mile drainage basin. Much of this river has been dredged and straightened. The IDEM has listed the Patoka River on the 2022, 303 (d) List of Impaired Waterbodies. Parameters of concern for the Patoka River include impaired biotic communities, low dissolved oxygen, pathogens, and PCBs. Within the smaller Altar Creek-Patoka River watershed that the project traverses, forest cover and agriculture are the predominant land uses (45% and 44%, respectively).

Both rivers are listed on Indiana's Natural Resources Commission's *Outstanding Rivers List*. The Patoka River is identified as having outstanding ecological, recreational, and scenic importance. The EFWR is identified as being a State Heritage Site, a state-designated canoe/boating route, and has also been included on the National Park Service's Nationwide Rivers Inventory.

Karst features (e.g., caves, sinkholes, underground streams) are especially common in the eastern portion of Martin County; however, the Alternative P corridor crosses only the very western edge of the county, and no karst features are known to occur along the proposed corridor. According to the BA, bedrock geology in the area consists primarily of the Pennsylvanian age Raccoon Creek Group (Seelyville, Buffaloville, and Lower Block coals). The Raccoon Creek Group is mostly shale and sandstone and includes thin beds of limestone, clay, and coal. Elevations in the proposed corridor range from approximately 420 ft above mean sea level at the EFWR to roughly 710 ft south of I-69 near the northern end of the corridor.

3.1 Status of Species within Action Areas

The following information is primarily from the BA. Maps with generalized species locations can be found in Appendix A of the BA and are incorporated by reference.

3.1.1 Bat Status in the Action Area

Bat Habitat Assessment

As previously discussed, the bat Action Area was developed using the estimated distance of the stressor with the farthest ranging impact (construction noise) and adding that distance to the 2,000-foot project corridor (see Section 11.6.1.5 of the BA for methodology). This resulted in an Action Area of approximately 186.5 square miles. According to the Tier 1 BA, FHWA and INDOT estimate that Alternative P will directly impact between 547 and 815 acres of forest, with local improvement projects adding another 59 acres of impact. The high end of the impact range is a worst-case scenario. The precise amount of forest impacts will be determined during Tier 2 when facility types for each SIU are decided and the route around Loogootee is determined. Although no field surveys or qualitative habitat assessments were completed in Tier 1 to determine whether bats or suitable bat habitat are present, the Service will use the forest data information summarized in the BA as an approximate baseline of currently existing habitat available within the bat Action Area. The benefit of the doubt will be given to the bats covered in this Opinion and assume that a number of maternity colonies are present and that all of the forestland within the Action Area, approximately 38,800 acres, is high quality bat roosting and foraging habitat. We believe this is a reasonable assumption given that the project is within the core maternity range of several of the species and that we know from personal observations that many patches of high-quality habitat are scattered along the proposed corridor.

The assessment of potential bat habitat and impacts was performed by Lochmueller Group, Inc., project consultant, using available GIS data, National Wetland Inventory (NWI) data, and aerial photograph interpretation. Forestland is an essential landscape component for bat habitat; therefore, forest cover was used as the principal assessment metric in the analysis. For the general corridor forestland assessment, maternity colony assessments, and forest fragmentation assessments, the 2016 NLCD GIS information was used as the base source.

To evaluate the amount forestland estimated for clearing, refined preliminary right-of-way limits for a "working alignment" based on the centerline of the Alternative P corridors were developed during the NEPA process for both the expressway and super 2 facility types and used for this consultation. The working alignments were created within the Alternative P 2,000-foot corridor based on terrain, land use, and facility type and range from 180 to 650 ft wide.

Other parameters that may affect the quality of the summer habitat within the action area is the size of existing forest tracts and the degree of forest fragmentation. Based on a thorough review of literature on Indiana bat summer habitat, Rommé et al. (1995) concluded that areas with less than 5% cover by deciduous forest will not support summering Indiana bats. Areas considered optimal are generally at least 30% forested. Forest cover within some portions of the Alternative P corridor may already be too low or too fragmented for the covered bat species.

Many of the larger expansive forest tracts within the project area are to the east of the Alternative P corridor in Martin and eastern Daviess Counties and have been avoided through corridor selection. However, there are still scattered medium to large forest tracts in the Alternative P corridor. To provide a general sense of the forest fragmentation potential for the Alternative P corridor, NLCD forest cover data and the Alternative P "working alignment" were used to detect forest parcels that would be potentially fragmented into two or more smaller tracts. This exercise identified between 20 and 23 forest tracts, ranging from 39 to 1175 acres, as possibly being fragmented by the project in the working alignment.

Finally, core forests were also evaluated for project related impacts. Core forest was defined as interior woodland habitat that is 328 ft (100 meters) from a forest edge. The forest edge is defined by any adjacent cleared polygon (fields, residential parcels) or linear features (roadways, large streams, cleared utility easements). Narrow ATV trails, old logging roads with canopy cover, or other minor clearings in an otherwise intact forest tract are not generally considered forest edge delineators. NLCD data was used to estimate forest tracts within the Alternative P corridor where core forest habitat could be potentially impacted either through bifurcation or removal of existing forest edge habitat. Because the NLCD data lacks the spatial resolution required to conduct an accurate evaluation of core forest loss using the Alternative P "working alignment", the Tier 1 assessment was limited to identifying locations where core forest intersects the corridor. As a result, between 35 and 41 core forest tracts were shown to intersect with the Alternative P corridor, depending on the alignment around Loogootee. Core forest acreage within the Alternative P corridors ranges from 471 acres for Alternative P1 (west of Loogootee) to 539 acres for Alternative P4 (to the far east of Loogootee).

Bat Maternity Colony Assessment

The Indiana bat, NLEB, little brown bat, and tricolored bat are dependent upon forests with suitable trees for roosting and foraging for maternity colony establishment. Bat maternity colony habitat for these species is commonly associated with bottomland/wetland floodplain forest habitats but can also include more mesic and upland habitats (e.g., tricolored bats) with easy access to adjacent rivers and streams.

Because the scope of work for the Tier 1 BA analysis does not include and field studies to identify maternity colony areas and existing survey information in the area is limited, the maternity colony impact analysis used available GIS data, aerial photography, and familiarity with the project area landscape resources to identify hypothetical maternity colony areas. The following factors were considered for placement of maternity colony locations:

- Relatively large forest cover within the nursery colony boundary.
- Skewed toward bottomland/wetland floodplain habitats associated with perennial rivers/streams and forested oxbow habitats.
- Locations where large numbers of dead snag trees are known to occur.
- Landscape within the colony boundary includes multiple interconnecting flyway and foraging corridor opportunities in the form of second and third order perennial streams.
- Colonies were centered as close to the Alternative P corridor as deemed reasonable considering distribution of suitable landscape features proximal to the corridor.
- Colony boundaries were not precluded from overlapping, but overlap was limited to no more than 20%.
- Colonies were not necessarily oriented immediately adjacent to each other in a contiguous fashion, thus allowing for some gaps along the Alternative P corridor where no potential colony was designated.

The Service typically uses a 2.5-mile buffer around a primary roost tree or the centroid of multiple primary/secondary roost trees to establish the epicenter of a specific Indiana bat maternity colony. Since the little brown bat and the tricolored bat are not listed species at this time, and have no standard default colony area, the INFO, in coordination with other regional bat biologists, has determined a 2.5-mile radius buffer would be suitable for Tier 1 analyses for these species. As a result, the BA developed 10 hypothetical maternity colony areas for the Indiana bat, little brown bat, and the tricolored bat. While maternity colonies for each of these species would not likely share the same epicenter, for the purposes of the Mid-States Corridor maternity colony assessment the same maternity colony locations were used.

For each colony, the BA provided a generalized habitat description, including an analysis of forest and wetland composition within the colony and the number of miles of proposed roadway that falls within the colony (see *Bat Maternity Colony Assessment,* pg. 52 of the BA). Appendix A of the BA, Maps 14a and 14b, shows the general location of the ten potential colonies for the Indiana bat, little brown bat, and tricolored bat. Appendix A Maps 15a through 15e shows the individual potential colonies relative to the action area, Alternative P corridor, and Local Improvements. These maps are incorporated by reference.

NLEB maternity colonies were developed using 1.5-mile buffers and similar criteria. Because the colony size is smaller, 14 potential maternity colony areas were developed. Appendix A of the BA, Maps 16a and 16b, shows the general location of the 14 potential colonies for the northern long-eared bat. Appendix A Maps 17a through 17e shows the individual potential colonies relative to the action area, Alternative P corridor, and Local Improvements. These maps are incorporated by reference.

The following are the presumed maternity colonies for the Indiana, little brown, and tricolored bat (listed south to north): Hunley Creek, Patoka River, Buffalo Pond Nature Preserve, Wenig-Sherritt Seep Springs, EFWR South, Haw Creek, EFWR North, West Boggs Creek, North Fork Prairie Creek, and First Creek. Collectively, the ten 2.5-mile radius potential maternity colonies cover 183.8 square miles of the Mid-States Corridor project area landscape. Approximately 65% of the forest within the Action Area is within the combined colonies' boundaries. Similarly, approximately 82% (Alternatives P1 and P2) to 84% (Alternative P4) of the forest cover within the corridors is within the combined colonies' boundaries.

The presumed NLEB maternity colonies are as follows: Hunley Creek, Patoka River, Buechlein, Buffalo Pond Nature Preserve, Wenig-Sherritt Seep Springs, EFWR, Slate Creek, Haw Creek, Friends Creek, Boggs Creek, West Boggs Creek, Seed Tick Creek, North Fork Prairie Creek, and First Creek.

Collectively, the fourteen maternity colonies for the northern long-eared bat cover 98.6 square miles of the Mid-States Corridor project area landscape. Approximately 50% of the forest within the action area is within the combined colonies' boundaries. Similarly, approximately 72% (Alternative P1) to 76% (Alternative P4) of the forest cover within the corridors is within the combined colonies' boundaries.

Bat Swarming Habitat Assessment

Each of the included bat species partake in fall swarming prior to entering hibernation. During this period bats are active within suitable habitat foraging and mating in the vicinity of their hibernaculum. The Service considers suitable habitat within 10 miles of Priority 1 and 2 hibernacula and 5 miles of Priority 3 and 4 hibernacula to be of value and concern for fall swarming activities. Similarly, a 5-mile buffer is used for NLEB. Since the little brown bat and tricolored bat have not yet been listed, the Service has not prioritized hibernacula or designated a fall swarming buffer zone for these species; therefore, a 5-mile radius was adopted to describe the landscape surrounding known hibernacula where fall swarming impacts may potentially be a concern.

The Alternative P corridor does not directly intersect any known hibernacula buffer area for any of the bat species; however, a 10-mile buffer for an Indiana bat Priority 1 cave (also critical habitat) is slightly intersected by a predicted indirect growth area although this area does not intersect any other bat hibernacula buffers. Approximately 4.6% of the Action Area (the induced growth area) falls within the southwestern edge of the Indiana bat P1/critical habitat 10-mile buffer.

Bridge Habitat Assessment

The EFWR and Patoka River are the two largest streams crossed by the Alternative P corridor. The exiting US 231 bridge across the Patoka River south of Jasper was built in 1964 and reconstructed in 2017. Under normal water conditions the central span crosses the channel, while the two northern and two southern spans bridge the floodway. There are no vertical abutment gaps or expansion seams beneath the bridge for bat roosting. Roosting features are limited to the vertical concrete faces of the beams and end bents, concrete diaphragms, and defects in the concrete ceiling. A bridge inspection conducted on December 6, 2022, showed no signs of consistent roosting (i.e., staining or large guano deposits) and no likelihood of maternity use, although a few trace guano pellets were observed on the sides of concrete beams on the south side of the Patoka River.

The existing US 231 bridge across the EFWR was built in 2007 to replace the old steel truss structure that was located approximately 150 ft upstream of the current structure. Under normal water conditions the four southern spans convey water under US 231, while the northern span bridges the floodway. There are no vertical abutment gaps or expansion seams beneath the bridge for bat roosting. Roosting features are limited to the vertical concrete faces of the beams and abutments and the metal edges/seams of the stay-in-place form. A bridge inspection conducted on September 18, 2022, revealed several locations where guano was present. These locations did not exhibit staining or significant accumulations of guano on the riprap beneath the bridge, suggesting a lack of large group and repeated summer roosting. Guano analysis indicated that both the big brown bat and the Indiana bat were present.

There are numerous other bridges and culverts that will be crossed by the proposed alternative. Additional bridge surveys will be conducted during Tier 2 studies.

3.1.1.1 Indiana Bats in the Action Area

The Indiana bat is known to occur state-wide in Indiana and is dependent on forested habitat, particularly during summer, fall, and spring (see Life History section). There is suitable habitat for this species throughout the project corridor landscape. Despite a lack of survey data within the bat Action Area, there are numerous capture, roost, acoustic, and hibernacula records in the southern part of the state, primarily associated with the nearby I-69 Interstate project as well as the Naval Support Activity (NSA) Crane facility. Based on the captures of reproductively active female Indiana bats near the Alternative P corridor and other recent evidence of male and female Indiana bat presence in southern Indiana, the Service concurs with the Tier 1 BA's conclusion that Indiana bats may be present in all forest habitat along the entire Alternative P corridor.

The lack of Indiana bat records in the project Action Area is most certainly attributed to the lack of studies conducted in the vicinity. The nearest capture and roost tree data to Alternative P is east of US 231 at the NSA Crane in northern Martin County. This includes captures from the 1980s, 1990s, to as recent as 2015. Documented roost trees from NSA Crane (1998), along I- 69 in Daviess County (2013), and south of SR 45 in Greene County (2004) are as close as 2.9 miles from the Alternative P corridor. However, given the abundance of forested habitat in northwestern Martin and northeastern Daviess County, it is expected that additional Indiana bat roosts closer to the corridor exist. Evidence was recently found of Indiana bats roosting on the bridge over the EFWR.

There are also three Priority 3 and 4 hibernacula caves documented in eastern Martin County (Hoosier National Forest, the closest of which is approximately 10.0 miles from the Alternative P corridor. Additionally, there are five documented hibernacula caves in eastern Greene County, the nearest of which is a Priority 4 cave 7.0 miles to the northeast of the Alternative P corridor termini at I-69. The Alternative P corridor junction with I-69 is over 11 miles from Cave (Priority 1 and Indiana bat Critical Habitat) and more than 15 miles from Cave (Priority 2). Map 6 in Appendix A of the BA illustrates the 10-mile Priority 1 and 2 hibernacula fall swarming ranges and the 5-mile Priority 3 and 4 hibernacula ranges. The proposed action would not directly encroach upon fall swarming woodland habitat associated with any of these hibernacula, although a small amount of predicted indirect growth may occur within the southwestern edge of Indiana bat Critical Habitat.

3.1.1.2 Northern long-eared bats in the Action Area

As with the Indiana bat, there is suitable habitat for the NLEB in the Action Area and surrounding landscape. Most of the NLEB data is attributed to I-69 project surveys and studies at the NSA Crane facility in Martin County. The lack of records within the Action Area is a result of lack of survey effort in the area. There are more than 175 northern long-eared capture records from NSA Crane between 1998 and 2015. However, the nearest capture record was from the 2004 I-69 survey on Rocky Branch within the Alternative P corridor. NLEB roost tree data is scarce within the Mid-States Corridor project area (and statewide due to the lack of telemetry studies); nonetheless, there are multiple records within NSA Crane, the closest of which is from 2015 just over 2 miles from the Alternative P corridor.

Known NLEB hibernacula within the project area include multiple locations in Greene County and a single 2001 record from extreme eastern Martin County more than 12 miles from the Alternative P corridor. The nearest documented Greene County NLEB hibernacula is Cave more than 7.5 miles from the Alternative P corridor. BA Appendix A Map 7 of the BA illustrates the 5-mile hibernacula fall swarming range for the NLEB caves in Greene County. The proposed action would not encroach upon fall swarming habitat associated with any of these hibernacula.

3.1.1.3 Tricolored bats in the Action Area

Many of the tricolored bat capture records are associated with the I-69 corridor in western Daviess County and southern Greene County. Included among these are capture records from 2004 at Rocky Branch and Doans Creek, within and adjacent to the northern termini for the Alternative P corridor. There are also multiple accounts of tricolored bat (including capture and acoustic data) from NSA Crane (Martin County) between 1998 and 2018. There are a few records of the tricolored bat on the Hoosier National Forest in Lawrence County, east of the project area. Since the tricolored has not yet been listed by USFWS as endangered, telemetry studies and roost tree data are lacking.

Tricolored bat hibernacula near the project corridor are found in southeast Greene County, northwestern and southwestern Lawrence County, scattered through Orange County, and two locations in extreme eastern Martin County. The closest documented tricolored bat hibernacula is approximately 7 miles to the northeast of the Alternative P corridor termini at I-69 (same cave as the little brown bat). The two Martin County tricolored bat caves (2001 and 2016, same caves as the little brown bat) are more than 12 miles to the east of the Alternative P corridor. BA Appendix A, Map 10 illustrates the 5-mile hibernacula fall swarming ranges for documented tricolored bat caves. The proposed action would not encroach upon fall swarming habitat associated with these hibernacula.

3.1.1.4 Little brown bats in the Action Area

Many of the capture records for little brown bats are associated with the I-69 corridor in western Daviess County and southern Greene County, and the NSA Crane facility in Martin County. This includes capture records from Doans Creek and First Creek (Greene County) in the general vicinity of the northern termini for the Alternative P corridor.

Documented little brown bat hibernacula near the project area are in southeast Greene County and northwestern Lawrence County, with additional scattered locations in Lawrence County and extreme eastern Martin County. The closest documented little brown bat hibernacula is approximately 7 miles to the northeast of the Alternative P corridor termini at I-69 (same cave as the tricolored bat). The two Martin County little brown bat caves (2001 and 2016, same caves as for the tricolored bat) are more than 12 miles to the east of the corridor. BA Appendix A Map 9 illustrates the 5-mile hibernacula fall swarming ranges for documented little brown bat caves. The proposed action would not encroach upon fall swarming woodland habitat associated with any of these hibernacula.

3.1.2 Mussel Status in the Action Area

Mussel Habitat Assessment

As discussed previously, the mussel Action Area is limited to an area upstream and downstream of the proposed Alternative P crossing over the EFWR. The EFWR is formed by the joining of the Driftwood and Flatrock Rivers near Columbus, IN. The EFWR flows a total of 192 miles (309 km) southwest before reaching the West Fork where the two rivers merge and form the White River. The White River eventually empties into the Wabash River. Most of the mussel records within the EFWR occur near Williams Dam in the Lower EFWR watershed, upstream of the mussel Action Area, although there are a few scattered records downstream.

There are several types of nonpoint sources located in the Lower EFWR watershed such as unregulated livestock operations, agricultural row crops, straight piped, leaking, or failing septic systems, wildlife, and erosion. Agricultural row crop land use, livestock operations, and erosion often coincide with elevated levels of *E. coli*, TSS, and total phosphorus. Approximately 48% of the land use in the Lower EFWR is agricultural. Portions of the Lower EFWR watershed possess elevated levels of *E. coli*, total suspended solids, and total phosphorus. These elevated parameters can impact availability of food sources, light penetration, temperature and dissolved oxygen levels which can in turn affect many aquatic organisms and their ability to forage, grow, and reproduce.

Biological analysis of the EFWR was conducted in 2018 at three locations; two sites were downstream of the US 231 bridge and one site was upstream. The three locations scored between 26 and 32 on the benthic aquatic macroinvertebrate community Index of Biotic Integrity, corresponding to poor and very poor ratings. These low ratings are typically associated with the dominance of tolerant aquatic macroinvertebrate species and the rarity or absence of many expected species. The upstream site and the further downstream site also scored a very poor rating on the fish community Index of Biotic Integrity (16) indicating the sites were dominated by tolerant fish species and few species and individuals overall. The other downstream site scored higher (38), with a "fair" rating. Freshwater drum (fat pocketbook host), spotfin shiner, and sauger were observed (IDEM 2019).

The existing US 231 bridge over the EFWR is a 700-foot-long prestressed concrete continuous tee beam with a concrete cast-in-place deck. According to the National Bridge Inventory, the most recent bridge inspection rates the bridge's quality as good. The inspection notes that the banks and channel show minor amounts of drift and the river's embankment protection is slightly damaged. The existing bridge was constructed in 2007 approximately 200 ft downstream of a metal truss bridge built in 1934. The older truss bridge was subsequently removed.

In 2001, prior to the replacement of the older US 231 bridge, a substrate and mussel investigation were conducted by McClane Environmental Service downstream of the older bridge. The study area overlaps the existing US 231 bridge. The study noted that substrates in the vicinity of the current bridge consisted of unconsolidated sand with smaller amounts of cobble and slab concrete boulders. The water depth observed during the 2001 mussel and substrate survey averaged six feet, with a maximum depth of approximately 12 ft. Other substrate types noted included silt and gravel.

The mussel survey at the bridge location did not find any significant population of mussels but did document live fragile papershell (*Potamilus fragilis*) and pink heelsplitter (*Potamilus alatus*). Based on the time of year the survey was completed (November), some mussels may have been buried and therefore not discovered.

3.1.2.1 Fanshell mussels in the Action Area

The Service and the Indiana Natural Heritage Data Center have multiple records for the fanshell on the EFWR in the Mid-States Corridor study area. Most of these records include fresh dead and a few live mussel collections from the early 1990s through 2014 between US 231 and the Williams Dam. Based on this data, the Service identified a 129-mile reach of the White River and EFWR from the Wabash River confluence to Williams Dam (Lawrence County) as likely habitat for the fanshell (see BA Appendix A Map 18). The nearest record to the Alternative P corridor is of a weathered dead mussel documented in 1990 approximately 2 miles upstream of the existing US 231 bridge. A fresh dead specimen from 2007 is documented approximately 6 miles upstream.

3.1.2.2 Fat pocketbook mussels in the Action Area

The Service and the Indiana Natural Heritage Data Center have scattered historic, subfossil, fresh dead, and live mussel records (1995 through 2010) for the fat pocketbook on the White River and EFWR from the confluence with the Wabash River to the Martin/Dubois County line. The Service considers an 83-mile reach from the White River confluence to near the Lost River confluence as suitable habitat for the mussel (see BA Appendix A Map 18). Based on the presence of relatively recent fresh dead and live captures throughout this reach, the fat pocketbook is considered extant within the White River and EFWR. The nearest fresh dead record of the fat pocketbook on the EFWR is over 10 miles downstream of the US 231 Bridge.

3.1.2.3 Salamander mussels in the Action Area

The IDNR has records for multiple salamander mussels in the EFWR, all but one upstream of the Alternative P crossing. Although the species is not federally listed, based on known records the Service considers a 78-mile reach from the White River confluence to the Williams Dam as potential suitable habitat for the mussel (see BA Appendix A Map 18). The nearest live record for the salamander mussel is approximately 10 miles upstream of the US 231 bridge in Martin County. A single 1999 weathered dead mussel documented in Daviess County is the only record downstream of the US 231 bridge, approximately 15 miles.

3.1.3 Monarch Status in the Action Area

The Service is not aware of any formal surveys or studies of monarchs in the Action Area. Because its distribution is generally synonymous with the range of the common milkweed, habitat is expected to occur throughout the project area where milkweeds and other flowering species occur along rights-of-way, as well as other natural and disturbed habitats. According to the BA, there are several citizen science datasets that include records (e.g., iNaturalist, [https://www.inaturalist.org], Monarch Larvae Monitoring Program [https://www.monarchjointventure.org/mlmp], Journey North [https://www.journeynorth.org], etc.) that indicate both monarchs and milkweeds are present throughout Action Area.

3.2 Factors Affecting Species' Environments within the Action Areas

3.2.1 Bat Factors in the Action Area

Factors affecting the included bat species in the Action Area are generally a subset of the threats previously discussed that affect the species rangewide, particularly WNS and habitat conversion. Activities such as year-round timber harvesting, land development, cutting of snags, agriculture, degradation of water quality, and roadkill along existing roadways likely affect all the included bats to varying degrees within the bat Action Area, and may continue into the reasonably foreseeable future.

3.2.2 Mussel Factors in the Action Area

Threats affecting mussels in the action area are also typically a subset of the concerns rangewide. In the Action Area, degradation from point and non-point sources (e.g., spills, illegal discharges, agricultural runoff) and instream habitat alterations (e.g., dams, dredging, bridge projects) likely contribute to the decline of freshwater mussels. In 2018, a diesel spill in southwestern Indiana affected fat pocketbook mussels in a small tributary to the Wabash River (USFWS pers. comm.). In addition, the EFWR is listed on the Indiana Department of Environmental Management's 2022 303(d) List of Impaired waterbodies for impaired biotic communities and polychlorinated biphenyls (PCBs). Additional threats include natural resource exploration and extraction (e.g., gravel or sand mining), land development, predation, and competition from invasive species such as zebra mussels.

In addition to anthropogenic concerns, isolation of populations from one another can restrict the natural interchange of genetic material between populations and exacerbate threats to the species (USFWS 2019a). Species such as the salamander mussel with very specific host requirements are also threatened by impacts to their host species.

3.2.3 Monarch Factors in the Action Area

Factors affecting the monarch butterfly in the Action Area are likely related to habitat quantity, quality, and conversion. Monarchs are completely dependent upon milkweed and other nectar resources for the completion of their lifecycle. As a result, impacts to these resources via pesticide use and conversion of cropland and other suitable habitat areas, are a primary threat and are expected to be ongoing in the project area.

Other threats found in the Action Area may include highway/road mortality and insecticide use. One study on road mortality on pollinating insects in Canada (Baxter-Gilbert 2015) suggested that hundreds of billions of these species across North America could be lost because of vehicle collision. Another study by McKenna et al. (2001) on monarch mortality due to highway collisions estimated over 500,000 monarchs may have been killed along interstate highways in Illinois.

Neonicotinoid insecticides are used to control insect pests on crops and may impact non-target species such as monarchs. Plants grown from seeds treated with neonicotinoids maintain the toxin systemically throughout their lifespan and can poison insects feeding on plants, including monarchs (Simon-Delso et al. 2015).

For a detailed description of threats affecting the each of the covered species rangewide, please refer to the *Threats to the Species* subsections for each species.

4.0 Effects of the Action

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

Effects of proposed mitigation, which has been incorporated into the project, will also be assessed. Our analysis considers the following factors:

Proximity of the action: The proposed action will affect presumed occupied maternity and foraging habitat, and to a much lesser extent, fall swarming and spring staging habitat of the covered bat species. The proposed action will also affect mussels present in the EFWR at the new or modified US 231 crossing. Finally, the project will traverse a variety of floral resources used by monarchs during breeding and migration.

Distribution: The Action Areas are spread along a long linear project corridor crossing summer maternity and foraging bat habitat, a potential mussel bed in the EFWR, and a variety of floral resources used by monarchs.

Nature of Effects: See Sections 4.1, 4.2, and 4.3.

Timing: Project activities will affect the covered bats primarily in the summer maternity stage of their life cycle. During the inactive, winter season, all covered species hibernate in caves and mines underground. Only a limited number of indirect activities are anticipated to fall within fall swarming and spring staging areas. Depending on construction activities, mussels could be affected at any point in their life cycle, and monarchs are expected to be affected during their breeding and migration periods (spring through fall). Monarchs in the Eastern U.S. population overwinter in Mexico and therefore would not be subject to direct impacts in the winter.

Duration: Construction effects, such as noise, lighting, and water quality concerns, will be relatively short-term. In addition, the project will be constructed in phases so that impacts will be spatially and temporally spread out and not occur simultaneously along the entire Alternative P corridor. Habitat removal will be permanent as will impacts from roadway maintenance and operation such as road run-off, traffic, and bat vehicular collisions (although collision impacts may be offset by a shift of vehicles from use of local roads to the new roadway section).

Disturbance frequency: Habitat removal and construction impacts will result in a one-time disturbance to habitat and impacts to individuals within the Action Area. As mentioned above, construction will be completed in phases over several years. Roadway operation will result in ongoing potential for vehicular collision, traffic noise/lights, spills, and road run-off.

Disturbance intensity and severity: In general, intensity increases as projects impact more acres of suitable habitat or greater number of individuals. Severity is a function of the effect of a disturbance related to the recovery rate of the species; for example, severity is highest for impacts to bat maternity colonies and less severe for migratory individuals. Monarch impacts will be less intense and severe based on the availability of nearby suitable habitat and conservation measures to reduce impacts and replant habitat. Severity and intensity for mussels is expected to be low based on the small area of impacts, conservation measures, and limited construction period.

Below, we deconstructed the project into its various components and outlined the anticipated direct and indirect impacts and their effects on the covered species. The outline is organized by species groups, direct vs. indirect impact/effect, and phase of the project: construction, operation, or maintenance. The applicable time of year impacts are realized is also indicated. After each adverse effect is a brief description of specific avoidance, minimization, and mitigation efforts that FHWA and INDOT have already taken or agreed to implement (or attempt to implement) to further reduce adverse effects and incidental take to covered species within the Action Areas (these are shown in italics). Descriptions of proposed avoidance and minimization measures is included in Section 1.1, *Avoidance, Minimization, and Conservation Measures*.

4.1 Effects Analysis for Bats

4.1.1 Direct Effects

Construction

- Tree/Forest Clearing (Spring, Summer, Fall)
    - <u>Mortality/Injury/Harm of roosting bats</u> – Removal of an occupied roost tree would likely result in death, injury, or harm of individuals or a colony. Construction and tree removal activities near occupied roost trees could result in bats fleeing trees during the day and increase risk of predation and stress.

      FHWA and INDOT have agreed to abide by seasonal tree-cutting restrictions by not clearing any trees greater than 3 inches in diameter when bats are likely to be present, between April 1 and October 1. This includes tree-removal associated with utility relocations and borrow/fill and staging areas. Therefore, <u>direct</u> take of bats is not anticipated from tree clearing during construction.

    - <u>Permanent Loss of Roosting and Foraging Habitat</u> – Rough estimates of direct loss of forest habitat are indicated in Figure 8 in the Tier 1 BA. These impacts range from 547 to 815 acres depending on the final alignment near Loogootee and facility type (super 2 or expressway). Another 59 acres of forest loss is anticipated to occur because of local projects associated with the Mid-States Corridor Project. This combined amount represents a range of loss of approximately 1.6% to 2.3% of forest within the bat Action Area. In addition, impacts to individual presumed maternity colonies were calculated by estimating the amount of forest within each of the 10 Indiana, little brown, and tricolored bat hypothetical maternity colony areas and the 14 NLEB colony areas. Colony information for each bat species is found in the Tier 1 BA, starting at page 52. A summary of estimated forest impacts within each presumed colony is shown below in Table 1. The range of forest impacts within the Indiana bat, little brown bat, and tricolored bat maternity colony areas is 0-145 acres. This could result in a 0-3.2% reduction of existing colony forest cover. The EFWR South colonies are estimated to lose up to 145 acres, which is 3.2% of the colonies' forest cover. For NLEB colonies, impacts range from 0-111 acres or 0-6.3% forest cover loss. The Buechlein colony has the potential for the highest loss of forest (111 acres), while the EFWR colony may lose up to 6.3% of its forest cover.

While the Alternative P corridor does not directly encroach upon any of the 10-mile (Indiana bat) or 5-mile (NLEB, tricolored, and little brown bat) bat hibernacula/fall swarming zones, the bat Action Area, which includes an anticipated induced growth area north of I-69, includes a small part located approximately 7 miles and 8.5 miles from an Indiana bat P1 and P2 cave, respectively. According to Lochmueller Group (project consultants), induced growth in this area is projected to be very minimal.

FHWA and INDOT minimized impacts to forest and wetland areas when developing the preferred corridor. They also propose to provide compensatory mitigation for unavoidable loss of forest using either an in-lieu fee program, approved habitat bank, or permittee-responsible mitigation projects. Mitigation for suitable forest habitat will be completed at a 3:1 ratio for areas beyond 300 of existing roads and 1.5:1 for impacts to forests within 300 ft of an existing roadway. Mitigation will include impacts due to utility relocations as well as impacts from borrow, fill, and staging areas. Presence/absence surveys will be conducted during Tier 2 to determine specific species locations and colony areas.

- <u>Fragmentation of foraging habitat</u> – Fragmentation of roosting and foraging habitat from tree clearing within the construction limits may degrade the remaining habitat's quality by reducing the size of and distance between remaining forest tracts and thereby lowering the overall amount of roosting and foraging habitat available to a maternity colony. In some areas where forest cover is already sparse, the percentage of remaining forest may fall below the minimum amount needed to sustain a colony. It may also create a barrier to bat movement along commuting and foraging corridors. Between 20 and 23 forest tracts associated with the Alternative P corridors could be fragmented into two or more 10-acre or greater tracts. Table 3 of the BA summarizes the results of the fragmentation analysis. Alternatives P3 and P4(along the eastern side of the Town of Loogootee) have the potential for the highest fragmentation.

Table 1. Bat Colony Estimated Forest Impacts Based on Working Alignment. Some of these impacts are double counted where colonies overlap. Amounts do not include acreage from local projects which consists of 59 additional acres of tree removal scattered along the alignment.

Indiana, Little Brown, and Tricolored Bat Colonies	Total Colony Forest Amount (acres)	Estimated Colony Forest Impacts within the Working Alignment (acres) *	Estimated Colony Forest Impacts within the Working Alignment (%) *
Hunley	3317	49-68	1.5-2.1
Patoka River	4281	82-103	1.9-2.4
Buffalo Pond Nature Preserve	4413	57-72	1.3-1.6
Wening-Sherritt Seep Springs	2745	44-71	1.6-2.6
EFWR South	4481	110-145	2.5-3.2
Haw Creek	4395	30-41	0.7-0.9
EFWR North	5695	0-107	0.0-1.9
West Boggs Creek	4906	29-73	0.6-1.5
North Prairie Creek	3739	32-41	0.9-1.1
First Creek	6761	99-108	1.5-1.6
NLEB Colonies			
Hunley	1273	33-48	2.6-3.8
Patoka River	1820	14	0.8
Buechlein	2522	85-111	3.4-4.4
Buffalo Pond Nature Preserve	1826	32-41	1.8-2.2
Wening-Sherritt Seep Springs	1525	26-39	1.7-2.6
EFWR	1587	80-100	5.0-6.3
Slate Creek	1592	52-70	3.3-4.4
Haw Creek	1902	20-26	1.1-1.4
Friends Creek	613	8-11	1.3-1.8
Boggs Creek	2235	0-96	0.0-4.3
West Boggs Creek	2042	12-34	0.6-1.7
Seed Tick Creek	3386	0	0
North Prairie Creek	1311	13-16	1.0-1.2
First Creek	2708	89-94	3.3-3.5
*Range includes the various alignment options and super 2 and expressway facility types.			

- Core forest impacts - Although not a determining habitat requirement for the covered bat species, core forest habitat can be a valuable resource for wildlife since it is often less likely to be disturbed by invasive species and neighboring land uses (i.e., row crops, pasture, residential, industrial, etc.). Table 4 and Figure 10 of the BA summarize core forest information and effects within the corridor (the working alignment was not used for this analysis due lack of spatial resolution with the data). Like fragmentation, core forest impacts are potentially higher for the Alternative P3 and P4 corridors.

  When selecting potential corridors, FHWA and INDOT attempted to avoid and minimize impacts to forested areas.

- Stream Modifications (Spring, Summer, Fall)

  - Water Quality and Aquatic Impacts - Stream and water quality impacts can affect bats in terms of aquatic insect prey and drinking water quantity and quality. According to the BA, the Alternative P corridor crosses over 200 stream segments including ephemeral, intermittent, and perennial streams. Spills of hazardous materials, soil erosion, and stream alterations could occur during construction and degrade the quality of surface and ground water, as well as physical stream properties. Several larger streams crossed in the corridor are noted as having high quality bat habitat including Hunley Creek, Patoka River, Cooper Run, Hayesville Run, EFWR, Haw Creek, First Creek, Rocky Creek, and Stone Branch.

    FHWA and INDOT will follow best management practices and will mitigate for stream impacts as appropriate. Where possible, road run-off from bridges, will be directed to the floodplain and not discharged directly to the stream. This will be a priority for the EFWR bridge. Erosion plans will include, but not necessarily be limited to, silt fences, and temporary seed mixtures to control migration of sediment to streams during and post-construction. Fueling and other hazardous material activities will be confined to locations where accidental spills can be best managed.

- Bridge Construction and Bridge/Structure Demolition (Spring, Summer, Fall)

  - Stream and Riparian Impacts - Construction activities at or near streams could impact water quality, stream flow, and bank vegetation. This could lead to reduced aquatic insect production and degrade the quality of riparian foraging areas. Furthermore, new structures may create barriers to or disrupt existing foraging areas and flyways.

    Impacts will be minimized by spanning as much of the floodplain as possible to preserve wildlife corridors and to minimize fill. Nighttime work on bridge construction will be limited or avoided to reduce deterrents to nighttime bat movement/foraging along the corridor.

- Roosting Impacts - Demolition and modification of an unknown number of existing structures or bridges within the proposed project area could cause a loss of night or day bat roosts and result in direct death or injury if occupied at the time of construction. Bats forced to relocate from occupied areas would expend energy to seek out other roosts that may be less suitable or otherwise limited in a bat's range. Bats may also attempt to roost in construction materials or equipment such as scaffolding and falsework (concrete forms) and be affected by ongoing construction activities, such as concrete pouring. Preliminary inspection of the EFWR bridge indicated Indiana bats have used the structure for roosting.

  FHWA and INDOT will conduct visual inspections of all potential roost areas on bridges and structures designated for removal based on Tier 2 design prior to construction or demolition. They will conduct routine inspections of crevices and cracks on concrete forms and scaffolding for the presence of bats, especially prior to concrete pouring. All concrete forms, scaffolding, and supporting structures will be dismantled at the earliest possible opportunity to reduce the period that such structures might be exploited by roosting bats. If pre-construction inspections reveal bat presence at a building structure or bridge, measures to resolve this situation will be developed during Tier 2.

- Construction Noise and Lighting (Spring, Summer, Fall)

  - Foraging and Roosting Disruption – Many bats are known to be light averse, especially where artificial white and green light is present. Much of the current project area is rural with few streetlights or other light sources to deter bat use. Nighttime work typically involves high powered lighting and is often accompanied by construction noise related to equipment and machinery which could cause bats to avoid foraging areas or be more susceptible to predation. The BA analysis on noise impacts during construction estimated that noise from construction equipment would attenuate to background levels, similar to noise in rural areas, at a distance of approximately 1 mile. This reflects a maximum distance of noise effects on bats since terrain and other factors were not factored into this analysis. Section 11.6.1.5 of the BA provides additional details.

    FHWA and INDOT plan to conduct most construction during daylight hours. However, for some phases of the construction process (e.g., summertime concrete pours), INDOT and/or the contractor may elect to conduct all or part of a particular construction element at night when temperatures are cooler, thus requiring the use of portable temporary lighting. The Tier 2 BA will explore the need to include measures that prohibit or restrict night construction and the use of temporary lighting for roadway and bridge construction within portions of the project area where such intrusions may unduly affect and disturb night foraging.

Project operation

- Increased Traffic and Traffic Speed (Spring, Summer, Fall)

  - Death or Injury Due to Collision - Individuals may be directly killed by vehicles traveling on the new roadway once it is operational. There have been various studies that have shown bats are killed by vehicular traffic (Russell et al. 2009; Gaisler, 2009; Lesinski 2007, 2008; Berthinussen and Altringham 2012).

    The Service anticipates that all bats that are struck by vehicles will be killed. However, based on the best available scientific data, the actual number of bats that may be struck and killed from vehicles cannot be precisely quantified. There will likely be some offset from reduced use of other local roads and some bridge heights should allow for foraging bats to pass under the roadway.

- Increased Light / Noise / Vibration (Spring, Summer, Fall)

  - Foraging Disturbance - Increased light, traffic noise, and vibrations could cause disturbance to bats while commuting, roosting, and foraging, and thereby lower the suitability of adjacent habitats or create a barrier effect to bat movement. Several studies have indicated that noise and light impacts may result in decreased use of areas near roads (Bennett and Zurcher 2013; Kitzes and Merlender 2014; Stone et al, 2015; Siemers and Schaub 2011).

    FHWA and INDOT did not propose specific measures to avoid, minimize, or mitigate novel traffic noise and vibration, although most work will be done in the day which may reduce noise impacts to foraging bats. Permanent lighting will be addressed in Tier 2.

Project Maintenance

- Bridge Repair / Replacement (Spring, Summer, Fall)

  - Roosting Disturbance - Bridges may be used as day or night roosts (and rarely as maternity roosts), and repairs or future replacement could affect bats using the structures. Some habitat destruction could occur because of access needs during maintenance or other bridge work.

    INDOT routinely assesses bridges for bat use and will coordinate with the Service if needed to reduce unnecessary disturbances.

  - Aquatic Habitat Impacts - Highway project maintenance could result in spills of hazardous materials into streams and wetland areas. Spills could degrade the quality of both surface and ground waters. Construction debris could fall into or be left in waterways. Water quality impacts could affect availability of suitable prey and drinking water.

Impacts will be reduced or avoided via standard best management practices (BMPs). Bridge drainage systems, such as over EFWR, will be designed so that run-off will be directed to the banks and side slopes and not deposited directly into the stream.

4.1.2 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Many of the indirect effects are beyond the authority of the FHWA or INDOT to control. Anticipated indirect effects include the following.

<u>Construction, Operation, and Maintenance</u>

- Habitat Loss and Degradation from Relocated and Induced Commercial and Residential Development
    - The Mid-States Corridor project is expected to increase accessibility to major business markets, provide more efficient freight transportation, and improve intermodal access. While economic development is not a primary goal of the project, Alternative P from I-64 to I-69 is anticipated to directly result in an influx of new job opportunities and housing developments. Modeling identified fourteen areas (see Section 10 of the BA for model discussion), known as TAZs from south of I-64 to north of I-69 where inducted growth was anticipated as an indirect result of a new roadway along the Alternative P corridor. For each of these TAZ areas, the model estimates 10 or more new households and/or 10 to 30 new job opportunities in the future. The locations of these new households and employers are beyond the scope of the Tier 1 analysis.
    - Other associated infrastructure (e.g., new roads, fire houses, schools, etc.) are certain to occur along the new project corridor, especially near proposed interchanges or access points.
    - Some number of homes and business will be relocated which may result in the removal, degradation, and fragmentation of additional forest and wetlands.
- Water Quality Degradation
    - Road salt and herbicides used to maintain the roadway may degrade surface and ground water through runoff. Some herbicides can affect bats by accumulating in their tissues as they consume contaminated insects or drink contaminated water.

- Erosion and sedimentation from disturbed soil areas where induced development is occurring can degrade water quality.

- Long-term roadway runoff from vehicular travel can affect water quality by introducing pollutants such as oil, grease, metals, sand, rubber, salts, etc.

  Where possible, bridge drainage systems will be designed to capture and discharge runoff to the floodplain and prevent runoff from being deposited directly into the streams.

- Utility Right-of-Way (ROW) Impacts

  - Utility relocation is likely to result in permanent removal of some amount of foraging and commuting habitat. Utility ROWs may also be maintained with herbicides.

    The scope of potential utility work has not yet been determined. Seasonal tree clearing will be implemented along with standard BMPs for sediment/erosion control and construction within sensitive areas. Utility tree impacts will be assessed during Tier 2 and included in final tree-clearing acreages and project mitigation.

- Impacts to Soil and Water from Vehicle Accidents

  - Spills could degrade quality of both surface and ground waters. Water quality affects bats in terms of their aquatic insect prey and drinking water.
    Where possible, bridge drainage systems will be designed to capture and discharge runoff to the floodplain and prevent runoff from being deposited directly into the streams.

4.1.3 Effects Discussion

As a result of project activities, maternity roosting and foraging habitat will be modified during biologically significant times of year. These activities include the permanent removal of an estimated 547 to 815 acres of suitable bat habitat for the construction of Alternative P and an additional 59 acres of local project impacts. Degradation of remaining habitat is also likely to occur because of increased fragmentation and disturbances such as the introduction of novel noise, light, and traffic. To a minor extent, some fall swarming and spring staging habitat may be indirectly affected by induced growth. Because the footprint of this transportation project is primarily linear in shape, losses to any one patch or area of important habitat (e.g., maternity colony area) are minimized. Due to the similar life history and habitat use, the following discussion pertains to all covered bat species.

Existing occurrence data in the project area is lacking, except for records associated with NSA Crane and portions of Daviess and Greene counties at the north end of the Alternative P corridor where I-69 surveys were conducted. Despite the absence of data, the Tier 1 forest analysis indicates 27% to 31% of the project corridor is forested and likely contains suitable bat habitat. As a result, we have estimated that as many as 10 Indiana, little brown, and tricolored bat colonies and 14 NLEB colonies may be present. We anticipate being able to conduct more precise effects analyses after Tier 2 field studies are completed and when more site-specific information regarding the presence of bat maternity colonies and the proximity of their roost trees to proposed impact areas is known.

Effects of Loss of Roosting, Swarming, and Staging Habitat,

A primary effect on bats will be the loss of traditional roosting habitat as a result of the proposed project. While no maternity roost trees are currently known to be located within the proposed corridor, some may be present and would be lost during construction or as induced development occurs. Cutting a roost tree when bats are present (typically April 1 – September 30) is likely to result in bats being injured or killed. Therefore, FHWA and INDOT will restrict the removal of trees in the project area to the period between October 1 and March 31 when bats are absent.

Some adverse effects could still stress bats to the point where take is reasonably certain to occur. One important feature of the biology of the covered species is the fact that they exhibit strong site fidelity to summer roosting and foraging areas. The effect of cutting (or having a potential roost tree fall naturally) an unoccupied roost ranges from "irrelevant (in the case of a rarely used alternative roost) to dramatic (when a roost is actively used by a colony)" (Kurta 2004). For example, the loss of a primary roost tree or multiple alternate roost trees during the non-occupancy season would cause displaced individuals to expend increased levels of energy while seeking out replacement roost trees when they return the following spring. If increased energy expenditure occurs during a sensitive period of a bat's reproductive cycle (e.g., pregnancy) it is assumed that spontaneous abortion or other stress-related reproductive delays or losses would be a likely response in some individuals, particularly those that may have already been under other environmental stresses (e.g., WNS). It has been hypothesized that these stresses and delays in reproduction could also result in lower fat reserves being deposited prior to hibernation and ultimately lead to lower winter survival rates (USFWS 2002). For example, females that do give live birth may have pups with lower birth weights or their pups may have delayed development (i.e., late into the summer). This could in turn affect the overwinter survival of the young-of-the-year bats if their delayed development caused them to enter fall migration and winter hibernation periods with inadequate fat reserves.

Removal of a bat primary roost tree (that is still suitable for roosting) in the winter is also expected to result in temporary or permanent colony fragmentation and smaller colonies may provide less thermoregulatory benefits for adults and for nonvolant pups in cool spring temperatures. Removal of multiple alternate roost trees in the winter is also expected to result in similar adverse effects. Kurta (2005) suggested that loss of a single alternate roost at any time of year probably has little impact on Indiana bats because the colony has a minimum of 8–25 other trees from which to select, but loss of a primary roost could be detrimental. Similarly, in a long-term study of an Indiana bat maternity colony in Indiana, 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) the year following the roost loss.

Several hibernacula are within 15 miles of the northern end of the project corridor (and a small portion of the indirect growth area falls within swarming habitat for a couple hibernacula). This northern area may be utilized to some degree by bats migrating to and from hibernacula. According to the 2007 Indiana Bat Recovery Plan, habitat surrounding hibernacula may be one of the most important habitats in the annual cycle of the Indiana bat [and other species]. Migratory bats may pass through areas surrounding hibernacula to facilitate breeding and other social functions (i.e., bats that utilize the area for swarming may not hibernate at the site) (Barbour and Davis 1969 and Cope and Humphrey 1977). Although no direct impacts are expected within fall swarming areas, some projected induced growth may occur and result in habitat removal.

The loss of bat habitat (and future bat habitat) associated with construction of the roadway project will be permanent. Some bats displaced by clearing for the project may perish, but many displaced bats will likely establish a new summer home range in nearby habitat. The relative abundance and availability of suitable habitat in areas surrounding the project site should enhance the potential for displaced bats to successfully relocate to a new area. Compensatory mitigation may help offset some impacts.

Effects of Lost Commuting and Foraging Habitat

Tree-clearing may alter foraging habitat and travel corridors, forcing bats to fly farther while foraging at night or avoid former foraging areas. The quality of foraging habitat may also be temporarily degraded due to erosion, and subsequent sedimentation of stream corridors, associated with construction of the project.

Forest removal and roadway construction will not only reduce available habitat but will fragment the commuting and foraging habitat and likely create some barrier to bat movement. As previously mentioned, multiple new stream crossings will occur in areas with high quality bat habitat. The new crossings will bifurcate the riparian forest habitat and create gaps that bats may avoid or risk increased predation. With the new roadway, we also expect increases in traffic volume (and accompanying noise and light), roadway width, and traffic speed. Numerous studies have concluded that roadways can impact the movement of bats between areas separated by roads. Kerth and Merber (2009) discovered bats making significant detours to avoid roads and find more suitable crossing points. Other studies have found that fewer bats crossed roads as the gap created between habitat on each side increased (Abbott et al. 2012, Bennett and Zurcher 2013, and Russell et al. 2009). Two different studies found that bats were significantly more likely to reverse course as they approached roadways with vehicles present (Zurcher et al. 2010), and that this turning frequency was further increased as the vehicular noise level increased (Bennett and Zurcher 2013). This barrier to movement can reduce the available foraging habitat and alter commuting routes, which in turn can increase energy expenditure and mortality. In addition, since the covered bats are known to return to their same foraging areas year after year, those bats displaced by the project may alter their foraging areas and create increased competition in other nearby territories.

Some bats have been known to cross roadways and use underpasses (D. Sparks, Environmental Services Inc., personal communication, Kerth and Merber 2009, and Bach et al. 2004). Increased height of bridge structures can help to facilitate some movement under the roadway in those locations; however, design details will not be made available until the Tier 2 phase. We anticipate some bats will be deterred from various drainages and seek alternate foraging areas once clearing, construction, and operation of the new roadway commences.

Overall, the effect of the loss of foraging habitat on individual bats from colonies in the Action Area may range from no effect to death (e.g., as the result of exposure to predation or overwinter mortality of bats that have not stored adequate fat). The effect on a maternity colony may be lost reproductive capacity and death of some proportion of the individuals. These effects are expected to be relatively short-lived; and bats that survive the impacts of habitat loss will have likely found replacement foraging habitat within the second year after the habitat is lost.

Effects from Lighting and Noise

Bat behavior may be affected by lights and noise while foraging and traveling between roosting and foraging habitat. Foraging in lighted areas may increase risk of predation or it may deter bats from using those areas. Woodland species, including many Myotids, have been shown to avoid lighted spaces. Stone et al. (2012) revealed that even at low light levels, Myotis species' [and others] activity was significantly reduced in lit areas verses dark, controlled areas. In other studies, certain species appear to only be found away from lights, despite the lighting being within their home range (Stone et al. 2015). In a 2017 paper by Spoelstra et al., they concluded that the reduction of slow-flying species (such as Myotids) in the study area, in the presence of white and green light, suggests habitat loss for these animals.

Artificial lights may reduce foraging opportunities if bats pass through these areas hurriedly. Polak et al. (2011) showed that *Eptesicus bottae* passed through lit areas more quickly without foraging and only foraged in the dark areas. Furthermore, insects may be drawn out of the darker woodland areas, decreasing prey availability for woodland bats. A recent study suggested that artificial lighting may also negatively affect bat drinking activity (Russo et al. 2017). In this study, most of the 12 recorded species showed reduced drinking activity under illumination and the forest species never drank from the troughs when illuminated.

Lighting impacts are expected to be short-range since light intensity decreases with distance. Currently, plans for night-time construction activities are unknown, but according to the BA, night-time work will be limited as much as possible, particularly at stream crossings and areas with known bat use, and all lighting will be directed away from bat habitat. This will eliminate or limit exposure to lights during the construction phase. Although permanent lighting schemes have not been developed in Tier 1, we anticipate some new lighting will be installed near interchanges and other access points, as well as in newly developed areas. While some measures may reduce the reach of light impacts within the surrounding habitat, we anticipate that new permanent lighting, temporary lighting, and lights from vehicle headlights, will affect some bats as they commute and forage in the area and likely contribute to a barrier effect of the roadway. In addition to light, noise impacts from construction, operation and maintenance of the new roadway may also impact bat activity in the area. Most noise generated from project-related construction activities will likely occur during daylight hours when bats are roosting in trees. Unfamiliar noises from the operation of chainsaws, bulldozers, skidders, trucks, etc. are likely to occur in relative proximity to occupied primary and alternate roost trees during the summer reproductive season. The novelty of these noises and their relative volume levels will likely dictate the range of responses from individuals or colonies of bats. At low noise levels (or farther distances), bats initially may be startled and have increased respiration/heart rates, but they would likely habituate to the low background noise levels. At closer range and louder noise levels (particularly if accompanied by physical vibrations from heavy machinery and the crashing of falling trees) many bats would probably be startled to the point of fleeing from their day-time roosts and in a few cases may experience increased predation risk. Because the noise levels in construction areas will likely continue for more than a single day the bats roosting within or close to these areas are likely to shift their focal roosting areas further away or may temporarily abandon these roosting areas. Bats that flush their roost and/or avoid travel and foraging areas in response to this stressor may be harmed due to an increase in energy expenditure. Increased energy demands could have a significant effect on bats due to their low body mass. Because females require increased energy reserves during lactation (Kurta et al. 1989), an increased demand for energy in response to noise and vibrations could be especially detrimental to lactating females and, subsequently, their pups.

Callahan (1993) noted that the likely cause of bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree. Female bats in Illinois used roosts at least 1640 ft (500 m) from paved roadways (Garner and Gardener 1992). Very low bat usage close to interstates has also been noted by other bat biologists (Whitaker, Jr. per. comm.). Conversely, some bats did use roosts near the Interstate-70/Indianapolis Airport area, including a primary maternity roost 1,970 ft (0.6 km) south of Interstate-70. This primary maternity roost was not abandoned despite constant noise from the interstate and airport runways; however, their proximity to the interstate could also have been due to lack of more suitable habitat nearby.

Finally, many bats rely on hearing their echolocation calls to maneuver, detect prey, and communicate (Altringham and Kerth 2016). Siemers and Schaub (2011) found that noise affected foraging efficiency of *M. myotis* (a gleaning feeder). Schaub et al. (2008) also determined that captive *M. myotis* preferred silent chambers versus chambers with traffic noise being played. Noise from traffic and construction may disrupt bats' communication and passive listening for prey, predators, or other environmental information (West 2016).

Like lighting, noise impacts are anticipated to be limited in their spatial reach because of sound reduction over distance; however, due to the rural nature of the project area, background noise levels are low and new noises in this area may be more significant, at least initially. Minimal construction is planned to occur at nighttime, reducing impacts to foraging bats. There is evidence that bats may acclimate to noises over time, such as the Indiana bat maternity colony at the Indianapolis Airport (USFWS 2002); however, other studies indicate bats are sensitive to these stressors. As a result, we anticipate some small amount of take will occur due to introduced noise and lighting.

Effects of Water Quality Impacts

Impacts to water resources may also adversely affect bats in the Action Area. Potential adverse impacts include contamination of drinking water and reduction or contamination of the aquatic insect forage base. Foraging habitat and aquatic insect production associated with disturbed stream segments will likely be relatively poor until the riparian zone and aquatic community become re-established. Removal of vegetation during or after grading activities could also potentially cause short-term adverse effects on the hydrologic characteristics and water quality in the watershed. A reduction in vegetative cover could potentially increase water yield and stream discharge; changes in vegetation cover could alter normal nutrient cycles in both terrestrial and aquatic systems, and use of temporary access/construction roads and trails during the construction phase could cause soil erosion leading to sedimentation.

Other impacts may result in the short term from construction runoff, and over the long-term from road salts and other pollutants resulting from vehicular traffic and accidental spills. Some small potential exists for accidental fuel/oil spills or spills of other hazardous materials from chainsaws and heavy equipment during the forest-clearing phase and subsequent roadwork, which could degrade the quality of both surface and ground water. Water quality could also be adversely affected during a major spill or accident once the new roadway is operational, although the probability of this is not known. We expect effects from removal of vegetation and soil disturbance to be temporary in nature. Other potential effects will be minimized by the implementation of best management practices during the construction, operation, and maintenance of the project.

Effects of Vehicular Collision

While some bats may avoid roads, for those that do attempt to cross the roadway, death due to collision with a vehicle is a possibility. Use of linear landscape features such as riparian corridors, forest edge, tree lines, etc., make bats susceptible to vehicle collision where these features intersect roadways. Russel et al. (2009) found 27 road-killed *M. lucifugus* and *one M. sodalis* along a stretch of highway in Pennsylvania that separated roosting and foraging areas. Bat mortality has been documented in many other instances where roadways have divided habitat (Gaisler et al. 2009, Medinas et al. 2013, and Russel et al. 2009). Lesinski (2008) found over 50 *Myotis nattereri* dead along a section of highway in Poland where tree lanes ran perpendicular to the roadway. Like many species, tree canopy is especially important to the covered bats in the vicinity of roosts and along flight corridors and foraging areas.

Although bats are very agile, many Myotis species will fly at slower speeds when foraging (Stone et al. 2012) and often lower to the ground (Harvey 1992, LaVal et al. 1977, and Brack 1985 as cited in Mitchell 1998). In the Pennsylvania study, the highway separated a known maternity roost from foraging habitat. The researchers observed that the lower the canopy cover near the road, the lower the bats flew. Bats that were observed flying across an open field during the study did so at heights less than two meters (Russel et al. 2009). Another study also found bats crossing at lower heights where vegetation was limited (Berthinussen and Altringham 2012). These lower flight paths can put bats at higher risk for vehicular collision. According to the BA, on September 12 and 19, 2022, two dead bats (hoary bat and eastern red bat, respectively) were observed on the shoulder of the US 231 bridge over the EFWR. It is presumed that these fatalities were the result of vehicle collisions.

Some direct mortality from vehicular collisions may be compensatory rather than additive as the number of collisions currently occurring on other local roads may decrease as traffic shifts to the new roadway. And, while it has been shown that Indiana bats will cross over busy highways when they separate foraging from roosting areas, it should also be noted that through a radio telemetry study done by Indiana State University, Sparks (pers. comm.) observed that individuals of the Indianapolis Airport Colony avoided flying over Interstate-70 where a bridge provided a 35-ft high corridor beneath the road. The results of this study indicate that bats may avoid flying over highways when an alternative corridor is present. Research published by Zurcher et al. (2010) indicates that bats may avoid traffic. In this study, bats were more than twice as likely to reverse their flight course while crossing a road when vehicles were present.

No detailed analysis of vehicle collision on population-level biology is available at this time but given the long lives and low fecundity of bats it is likely that even occasional road-related fatalities can have population-level impacts (D. Sparks, written communication, February 4, 2010). The new Mid-States Corridor will likely have a design speed between 55-65 mph, which could reduce a bat's chance of avoiding collision. Although some bridges may have adequate room for bats to maneuver underneath, some will cross at a lower height or potentially intersect with the canopy. As a result, we anticipate that some bats may be killed crossing the roadway at these locations during foraging or commuting.

Indirect Effects

Habitat loss and degradation due to home and business relocations and due to predicted induced commercial and residential development may impact bats in the Action Area. Modeling identified fourteen areas from south of I-64 to north of I-69 where induced growth was anticipated as an indirect result of the new roadway. For each of these TAZ areas, the model estimated 10 or more new households and/or 10 to 30 new job opportunities. Each of the TAZs vary in size and land use composition (see Figure 20 of the BA). New building and infrastructure construction due to relocations and new development is not likely to avoid tree-clearing in the maternity season, nor mitigate for forest impacts. However, forest cover is not a large percentage of the landscape in most of the predicted growth areas and we expect most development would occur on already cleared areas (e.g., agricultural areas).

Habitat loss and degradation from utility relocations and maintenance, long-term water quality impacts, or hazardous spills resulting from roadway accidents, could indirectly impact bats. Water quality impacts would be like those described under the "Direct Effects" section and reduced, in part, with appropriate best management practices and bridge drainage systems that avoid direct runoff to the stream. Utility tree-clearing will be estimated and included in the total tree-clearing amount. Tree removal for utilities will occur in the non-active period and be included in compensatory mitigation amounts.

Avoidance and Mitigation Effects

The FHWA and INDOT have incorporated measures into the proposed project design to avoid, minimize and mitigate the impacts of the project to the maximum extent practical (e.g., seasonal tree-clearing). Proposed avoidance, minimization and mitigation procedures are discussed in the BA and included in the beginning of this Opinion as part of the proposed action.

Compensatory mitigation for bats will be provided at a 3:1 mitigation ratio for impacts to all suitable habitat greater than 300 ft from existing paved roads and a 1.5:1 ratio for impacts to habitat less than 300 ft from existing paved roads. Mitigation will be in the form of payment into the Range-Wide Indiana Bat and Northern Long-Eared Bat In-Lieu Fee Program (USFWS 2022), habitat banks, or permittee-responsible mitigation projects. Compensatory mitigation will provide suitable habitat for breeding, foraging, sheltering, or dispersal commensurate with habitat lost because of the project. Implementation of mitigation will be in consultation with the Service's INFO.

Finally, some floodplain impacts are expected to be mitigated according to the Indiana Department of Natural Resource's Construction in a Floodplain permit guidelines. This activity would benefit bats in the project area.

4.1.4 Species Response to the Proposed Action

We estimate that adult female and juvenile bats from up to 10 Indiana, little brown, and tricolored bat maternity colony areas and 14 NLEB maternity colony areas may be directly or indirectly taken by the proposed activity. The estimated minimum forest loss to any one colony area is 0% and the maximum estimated loss of forest cover is 6.3%, with over 65% of the presumed colonies predicted to lose less than 2.5% of their existing forest coverage. Although a somewhat high number of colony areas were presumed to occur along the project corridor for this Tier 1 analysis, it is unlikely that each of these potential locations represents an occupied bat maternity colony. Based on the number of Indiana bat colonies detected along the I69 corridor during extensive mist-net surveys (16 colonies along an approximate 142-mile corridor), the number of colonies along the Mid-States corridor is likely less than presumed. Under no likely scenarios is the estimated amount of take of reproductive individuals likely to cause an appreciable long-term change in viability of an individual maternity colony or to the species' regional or rangewide status. In none of the maternity colony areas is the amount of proposed tree clearing or other effects believed to be extensive enough to cause a maternity colony to be permanently displaced from its traditional summer range; the availability of suitable habitat in the area, along with various avoidance and minimization measures will limit overall effects and these impacts are not likely to alter a colony's long-term reproduction and survival. Thus, all currently extant bat colonies are likely to persist within the Action Area following implementation of the proposed action. Tier 2 surveys will provide more accurate information regarding colony location and numbers.

4.2 Effects Analysis for Mussels

A super-2 facility type and an expressway facility type are currently being considered for the preferred Alternative P corridor. A super-2 facility type would likely use the existing bridge rather than requiring construction of a new bridge. Modifications to the deck may be needed, but in-channel work would probably not be required. An expressway facility would likely use the existing bridge as either the northbound or southbound bridge and a new bridge would be constructed adjacent to the existing bridge. This would require the construction of permanent piers in the river and temporary causeways and caissons to facilitate construction activities. The effects analysis assumes this worst-case scenario, as well as the presence of listed mussels. Project-specific mussel surveys have not been completed but will be conducted during Tier 2 if an additional structure is proposed across the EFWR. If mussels are found, a relocation plan will be developed.

None of the local improvements associated with Alternative P will impact the EFWR or directly affect the quality of habitat within the river. Other than effects related specifically to relocation efforts, most effects discussed below will only impact mussels that are not detected during salvage operations and remain in the Action Area during construction.

4.2.1 Direct Effect

Construction

- Pier Construction and Instream Impacts (Year-round)
    - Mortality/Injury/Harassment – Direct take of individuals may arise due to crushing via equipment use, temporary cofferdam construction, permanent bridge pier placement, and causeway installation and removal. Desiccation could also result from cofferdam construction or other dewatering activities.
    - Sedimentation - Instream activities or activities adjacent to the river can result in injury or mortality due to increased smothering due to sediment deposition instream turbidity. This can interfere with mussel filtration, feeding, respiration, fertilization, and mussel-host interactions.
    - Permanent Loss of Habitat – Some amount of habitat may be lost because of pier installation. Not only would piers reduce habitat areas, new piers and temporary causeways could result in hydrologic changes including scour, altered flow patterns, and shifts in sediment. These effects could displace or bury mussels or render habitat unsuitable in the future.
- Relocation Activities (Dependent on relocation timing)
    - Mortality/Injury/Harassment - Direct take may occur as result of handling and relocation efforts. Furthermore, some mussels may be missed during relocation efforts.

- Equipment Staging, Use, and Site Preparation – (Year-round)

    - Site preparation associated with construction activities would involve removal of vegetation, including riparian habitat, and soil disturbance. These exposed areas, if not properly stabilized, could experience significant erosion during rainfall events, and result in sediment entering the EFWR.

    - Use of heavy equipment along and adjacent to waterways increases the risk for introduction of fuels, lubricants, coolant, and hydraulic fluids into the riparian zone or water where they can injure or kill aquatic organisms. Oils, heavy metals, and other toxic substances could be absorbed by the soil in the construction area during construction activities and carried via runoff into the river. Additionally, noise and vibrations can have deleterious effects on mussels and their host fish.

      If a new bridge is proposed for construction, and mussels are found to be present during Tier 2 studies, FHWA and INDOT will develop a relocation plan to move mussels out of the area of impact. Therefore, direct take of mussels will be significantly reduced during construction. BMPs for sediment and erosion control, such as silt fences, buffer strips, seeding, and erosion control mats will help to further reduce impacts. Also, causeways will be limited in size and duration of use to maintain appropriate river flow.

Operation

- Traffic accidents and spills (Year-round)

    - Accidents or spills at the bridge location could result in physical or chemical impacts (death or injury) to mussels in the vicinity of the bridge or immediately downstream in the case of spills.

      Where possible, bridge drainage systems will be designed to capture and discharge runoff to the floodplain and prevent runoff from being deposited directly into the streams. Relocated mussels would be placed outside of potential impact areas.

Maintenance

- Bridge Repair/Replacement (Year-round)

    - Habitat impacts- Repair or replacement activities may result in instream work including the use of coffer dams and causeways. Staging and access needs could result in vegetation clearing and increased erosion and sedimentation as well as equipment leaks and spills.

Where possible, bridge drainage systems will be designed to capture and discharge runoff to the floodplain and prevent runoff from being deposited directly into the streams. Relocated mussels would be placed outside of potential impact areas. BMPs related to silt fencing, erosion mats, debris collection, placement of staging areas, etc. will be used to reduce maintenance impacts.

4.2.2 Indirect Effects

Construction, Operation, and Maintenance

- Habitat Degradation (Year-round)
    - The construction, maintenance, and operation of the new bridge has the potential to cause degrade mussel habitat over time. The operation and maintenance of the new bridge could result in contaminated runoff entering the river via road run-off, herbicide treatments, salt and deicer application, accidents, and spills. Induced growth and development in the watershed could increase erosion, sedimentation, these impacts could result in lower water quality and mortality events (in the case of accidents or spills).

      Where possible, bridge drainage systems will be designed to capture and discharge runoff to the floodplain and prevent runoff from being deposited directly into the streams. Relocated mussels would be placed upstream of potential impacts.

4.2.3 Effects Discussion

The mussel action area encompasses a 100-acre area extending approximately 1,800 ft (0.33 mile) downstream of the existing US 231bridge and approximately 1,100 ft (0.20 mile) upstream of the bridge. Perpendicular to the EFWR, the action area extends approximately 700 to 800 ft north and south of the respective banks to include the bridge approach construction zones where equipment staging and land disturbance activities potentially affecting water quality are anticipated. Mussels are long-lived, often hard to detect, and have a complex life cycle, making assessment of effects difficult (e.g., effects of water quality changes, long-term relocation effects, impacts to host species, mortality detection, etc.).

Effects of Construction Activities

Construction activities related to a new crossing, as well as future repair and replacement will have impacts to mussels in the project area. Instream construction can lead to crushing or burying of mussels overlooked during relocation efforts. Also, disturbance of the streambed can create sedimentation and increased turbidity causing mussels to limit siphoning activity (affecting feeding, respiration, reproduction, etc.) and cause host fish to disperse. Feeding mollusks respond to heavy siltation by instinctive closure of their valves, since irritation and clogging of the gills and other feeding structures occurs when suspended sediments are siphoned from the water column (Loar et al. 1980). Studies have shown valve closures under these conditions average 50% longer than closures for mussels in silt-free water, resulting in reduced feeding activity (Ellis 1936) and dilution of food sources (Dennis 1984 and Widdows et al. 1979). Suspended sediment can also interfere with fish gills and reduce encystment of glochidia (Beussink 2007).

Other impacts during construction include activities adjacent to the waterway, such as clearing for equipment staging and access. Removal of riparian vegetation results in elevation of stream temperatures, destabilization of streambanks and siltation, and removal of submerged root systems that provide habitat for fish and macroinvertebrates (Johnson and Jones 2000 and Sutherland et al. 2002). Silt settling on the stream bottom, especially in winter, can smother eggs and larval fish, as well as benthic macroinvertebrates upon which adult fish feed (Starnes and Starnes 1981). This could potentially affect mussels and mussel host fish use of the Action Area. Interstitial spaces in mixed substrates may become clogged with sediment (Gordon et al. 1992). When clogged, interstitial flow rates and spaces may become reduced (Brim Box and Mossa 1999), thus reducing habitat for juvenile mussels and some adults as well. A recent study of sediment impacts on mussels indicated a measurable decline in mussel biodiversity from substrate instability associated with scour (Goldsmith et al. 2021).

Finally, the use of heavy equipment near waterways can result in various pollutants entering the riparian area or water. Oils, heavy metals, and other toxic substances could be released directly into the river or be absorbed by the soil in the construction area during construction activities and carried to the river via runoff. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons, which can cause lethal or acute and chronic sublethal effects on aquatic organisms (Neff 1985 and Eisler 1987).

Water Quality Degradation

Water quality impacts are likely to occur because of pollutants associated with road runoff as well as bridge maintenance. Exposure to these chemicals can have detrimental effects to aquatic organisms and their environments. Maintenance activities are required on bridges to ensure safety, preserve the integrity of structural components, and extend their useful life. Routine maintenance often requires application of chemical products such as paint, sealants, lubricants, epoxy, or concrete. Seasonal maintenance includes use of roadway salts and other chemicals to improve safety for the motoring public.

In a laboratory study on the toxicity of roadway salts at two bridges, it was determined that a large portion of the samples had levels of chloride acutely toxic to mussels in early life stages (Gillis et al. 2021). Although salt appeared to be the toxicity driver in the study, other contaminants in the roadway runoff such as ammonia, zinc, and potassium were theorized to contribute to some degree in the detected toxicity to glochidia. Gillis et al. (2021) noted that mussels at distances over 100 meters from one bridge were observed to be more diverse, abundant, and contain a broader distribution of age classes than those in close vicinity to the bridge.

Common contaminants in roadway runoff include heavy metals, inorganic salts, and aromatic hydrocarbons (Jongedyk and Bank 2016). Due to the ephemeral nature of runoff, it is often difficult to fully comprehend its toxic effects. According to Levine et al. (2005), polycyclic aromatic hydrocarbons and several metals (copper, lead, platinum, and palladium) have been observed in higher concentrations in mussels downstream from road crossings. Chronic exposure may affect organisms that can ordinarily handle higher levels of toxins for short periods of time (e.g., mussels using valve closure). More acute exposure, such as accidents and spills, could result in immediate impacts. In 1998, a tanker truck overturned on U.S. Route 460 near the town of Cedar Bluff, Virginia. The spill release approximately 1,400 gallons of a rubber accelerant into a small tributary about 500 ft from its confluence with the Clinch River. The spill killed more than 7,000 mussels, including federally listed species, over a seven-mile stretch downstream of the spill (Jones et al. 2001).

Effects of Mussel Relocation and other Avoidance and Minimization Measures

Relocating mussels has long been considered a viable option to protect individuals occurring within the footprint of a project. However, some mussels could be overlooked during relocation efforts (Strayer and Smith 2003). In a mark/recapture study for a bridge replacement in Alabama, Service biologists tagged approximately 900 mussels over a period of 24 months and estimated that only about 10% of mussels present at the site were recovered in the initial three-pass sweep of the area. Furthermore, untagged individuals comprised nearly 35% of the mussels recovered in the final monthly sweep, suggesting that mussel relocations should be viewed only as a minimization measure (Ford and Grunewald 2015). Survival after relocation hinges on selecting a proper recipient site that contains suitable habitat in areas where substrates are stable and mussel species with similar habitat preferences are present (Mittiga and Aubin 2013).

Other avoidance and minimization measures include erosion and sedimentation control BMPs, a bridge drainage system that directs road runoff away from the water, towards the embankment, to reduce contaminants entering the stream, strategic pier placement, limited causeway lengths, and reducing the length of time the causeway is in the river. These measures will reduce construction, as well as long term effects of a new river crossing.

4.2.4 Species Response to the Proposed Action

The construction of the project may result in direct and indirect effects to fanshell, fat pocketbook, and salamander mussels within the Action Area. Based on the limited data available, we expect mussel density in the project area to be low. Effects are anticipated to include harm in the form of mortality or injury via crushing, smothering due to fill or sedimentation, chemical exposure, or desiccation from exposure in dewatered areas. Additionally, individuals may be harmed by indirect impacts from construction, maintenance, and operational activities leading to water quality and habitat degradation, which can disrupt normal respiration, feeding, growth, and reproduction.

Avoidance and minimization measures will reduce erosion and sedimentation and directing bridge runoff to the floodplain instead of directly to the stream will reduce the introduction of pollutants to the stream. Relocation of individuals is anticipated to also reduce mussel impacts.

However, capture, handling, temporary holding, and transport during relocation have the potential to cause harm by creating physiological stress (and potential mortality) due to disruption of normal behavioral patterns (e.g., spawning, fertilization, growth, feeding). Furthermore, it is likely not all mussels will be detected and moved out of the impact area, exposing them to the various stressors. A mussel survey and mussel relocation plan will be developed during Tier 2 (if necessary) to refine and further develop appropriate avoidance and minimization measures.

4.3 Effects Analysis for Monarchs

4.3.1 Direct Effect

Construction

- Vegetation Clearing (Spring, Summer, Fall)

    - Mortality/Injury - Vegetation clearing during the breeding and migratory season can lead to direct death of individual butterflies, eggs or larvae present on those floral resources.

    - Permanent loss of breeding and foraging habitat – Vegetation removal can lead to destruction of milkweed essential for egg-laying adults and dependent larvae, and of suitable foraging habitat where nectar-producing floral species are removed/destroyed. This impact would be temporary and likely affect a few generations between the time vegetation is removed/destroyed and the right-of-way is revegetated.

      Construction and operation of the Mid-States Corridor will follow avoidance and minimization measures described in the INDOT CCAA for the monarch butterfly. Additionally, FHWA and INDOT will prepare a pollinator habitat development plan which targets specific areas along the new roadway for seeding of native nectar wildflowers, particularly milkweeds. The details of the pollinator habitat development plan will be address during Tier 2 of the consultation process.

Operation

- Increased Traffic and Traffic Speed

    - Death or Injury Due to Collision - Individuals may be directly killed by vehicles traveling on the new roadway once it is operational. Traffic speed will likely increase making it more difficult to avoid vehicles. Some impacts may be offset by less travel on other roadways.

Maintenance

- Mowing, herbicide application, and road salting
  - <u>Death or Injury</u> - Individuals may be directly killed by mowing or chemical application.
  - <u>Loss of habitat</u> – Mowing and herbicide application will reduce available habitat and quality of habitat.

    Construction and operation of the Mid-States Corridor will follow avoidance and minimization measures described in the INDOT CCAA for the monarch butterfly such as selective herbicide use, seasonal mowing schedules, maintain buffer areas, etc. Additionally, FHWA and INDOT will prepare a pollinator habitat development plan which targets specific areas along the new roadway for seeding of native nectar wildflowers, particularly milkweeds. The details of the pollinator habitat development plan will be address during Tier 2 of the consultation process.

4.3.2 Indirect Effects

Indirect impacts to the monarch butterfly are largely unclear based on Tier 1 designs; however, in areas where the Mid-States Corridor increases traffic efficiency, potential for economic growth can lead to further decreases in potential foraging and breeding habitat as natural areas near the highway are lost to development.

4.3.3 Effects Discussion

Effects of Construction, Operation, and Maintenance Activities

Construction of the Mid-States Corridor will likely lead to destruction of milkweed essential for egg-laying adults and dependent larvae, and of suitable foraging habitat where nectar-producing floral species are removed/destroyed. The impact would be temporary and likely affect a few generations between the time vegetation is removed/destroyed and the right-of-way is revegetated. Furthermore, operation of the new roadway may adversely impact individuals foraging or moving proximate to the right-of-way through direct collision or turbulence from passing traffic.

Maintenance activities could result in death to individuals from mowing/removal of occupied floral resources and herbicide applications, as well as result in a loss of habitat. Specific literature is limited with respect to the effects of mowing on monarchs. Mowing can be an effective management tool to control woody and weedy species if timed appropriately. However, mowing too often and during certain times of the year may result in high mortality to monarchs and other wildlife, including pollinators (Monarch Joint Venture 2015).

In a study of the effects on common milkweed of various mowing strategies in upstate New York, Fischer et al (2015) found that mowing encouraged the regrowth of milkweed and provided a more continuous, stable habitat for monarch oviposition and larval development than the control (un-mowed) sites. Further, they found that re-sprouted milkweeds harbored significantly more eggs than the older and taller control plants (Fischer et al 2015). The authors cautioned that timing of mowing is critical and must be determined specifically for different milkweed species and different locations.

Effects of Avoidance and Minimization Efforts

Restoration and revegetation of the Mid-States Corridor right-of-way can increase available foraging and host plant habitat for adults and larvae across the entire length of the corridor. Earlier work has demonstrated the value of roadsides as breeding habitat for monarch butterflies (Kasten et al. 2016), and while per-plant use is generally lower compared to other habitats, in the absence of suitable host plant habitat (e.g., proximate forests or agriculture), roadsides may provide the only host plant habitat for monarchs in some areas on the landscape. Roadsides can also serve as corridors that provide monarchs with a way to access other habitat patches. Phillips et al. (2020) reviewed 140 studies associated with pollinators and roadways and found benefits of vegetation proximate to roadways for pollinators far outweighs their costs. Depending on the extent of right-of-way restoration development for the Mid-States Corridor, restoration focusing on milkweed establishment may more than offset the loss of existing suitable habitat along the corridor and benefit future generations from increased recruitment.

As mentioned above, FHWA and INDOT will implement avoidance and minimization measures where appropriate as described in the INDOT CCAA for the monarch butterfly. Additionally, they will prepare a pollinator habitat development plan which targets specific areas along the new roadway for seeding of native nectar wildflowers, particularly milkweeds. The details of the pollinator habitat development plan will be address during Tier 2 of the consultation process.

4.3.4 Species Response to the Proposed Action

Construction of the Mid-States Corridor (expressway or super-2 facility type) will result in wide-spread loss of habitat and has the potential for direct and indirect impacts to monarch butterflies via both vehicle collisions and individuals lost during construction and maintenance activities. Such negative impacts are likely associated with roadways throughout Indiana. While INDOT is a participant in the CCAA for the monarch butterfly and will continue to manage its rights-of-way for pollinator habitat conservation, unavoidable impacts (loss) of pollinator habitat through the Mid-States Corrido project implementation are expected. Loss from initial construction activities will be short term, and restoration efforts are expected to replace lost habitat within a year or two. In addition, construction impacts will occur in phases and revegetation efforts in one section will likely be complete prior to loss in another section. Some marginal habitat may be replaced by higher quality areas.

5.0 Cumulative Effects

In the context of the ESA, cumulative effects are defined as the effects of future State, tribal, local, or private actions that are "reasonably certain" to occur in the Action Area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the ESA.

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

6.0 Conclusion

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

After reviewing the current status and environmental baseline of each of the covered species in the project Action Areas, the effects of the proposed action, and the cumulative effects, it is the Service's biological and conference opinion that the Mid-States Corridor Project, as proposed, is not likely to jeopardize the continued existence of the Indiana bat, NLEB, little brown bat, tricolored bat, fanshell mussel, fat pocketbook mussel, salamander mussel, or monarch butterfly because the proposed action is not expected to significantly reduce the reproduction, numbers, or distribution of any of the species within their range. Therefore, we do not anticipate a reduction in the likelihood of survival or recovery of any of the covered species.

Incidental Take Statement

This Opinion analyzes FHWA and INDOT's proposed program to build the Mid-States Corridor highway project. This "programmatic action" provides a framework for the future development of the Alternative P corridor which will be authorized, funded, or carried out later and take of any listed species would not occur unless and until the future actions are implemented. The mere potential for future take from these actions is not a legitimate basis for providing an exemption for take. Therefore, the Service is not issuing an ITS for this Opinion or identifying associated Reasonable and Prudent Measures (RPMs) and Terms and Conditions (TCs). This is in accordance with the 2015 guidelines outlined in the "Interagency Cooperation—Endangered

Species Act of 1973, as Amended; Incidental Take Statements" which amends regulations associated with ITSs for programmatic actions (50 CFR 402.14(i)). The amendment states, "for a framework programmatic action, an incidental take statement is not required at the programmatic level; any incidental take resulting from any action subsequently authorized, funded, or carried out under the program will be addressed in subsequent section 7 consultation, as appropriate." Subsequent consultations for each specific corridor section will serve as the basis for determining if an exemption from section 9 take prohibitions is warranted. If so, the Service will provide RPMs and TCs, as appropriate, to minimize the impacts of the take on listed species in accordance with 50 CFR 402.14(i).

Conservation Recommendations

Sections 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a Proposed Action on listed species or critical habitat, to help implement recovery plans or to develop information that is useful for the conservation of listed species. The Service will provide conservation recommendations for the FHWA's consideration during the Tier 2 phase of this consultation. These activities may be conducted at the discretion of the FHWA as time and funding allow.

Reinitiation Notice

This concludes formal consultation and conference for the covered species and the effects of the construction, operation, and maintenance of the Mid-States Corridor Project in Southwest Indiana. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (3) a new species is listed or critical habitat designated that may be affected by the action. The Service retains the discretion to determine whether the conditions listed in (1) through (3) have been met and reinitiation of formal consultation in required.

You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if the monarch butterfly, tricolored bat, little brown bat, or salamander mussel is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

Literature Cited

Citations available upon request from the Indiana Ecological Services Field Office.