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IN REPLY REFER TO

Final Biological Opinion

for

Ultrasonic Bat Deterrent Technology Effectiveness Research Funded by the Department of Energy and Conducted by the General Electric Company and Partners

July, 2015

Prepared by:
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Summary

This document transmits the biological 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 (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This opinion is based on our review of documentation submitted by the U.S. Department of Energy (DOE) pertaining to research being funded by the DOE in partnership with the General Electric Company (GE) and partners. The DOE has requested formal consultation from the U.S. Fish and Wildlife Service (Service) on the effects of the proposed project on listed species.

The federal action requiring formal consultation and this biological opinion is the expenditure of federal funds to conduct studies to determine the effectiveness of bat deterrent devices at wind farms. This action may involve take of the federally endangered Indiana bat and threatened northern long-eared bat in conjunction with wind energy-bat interaction research in Champaign and Vermillion Counties, Illinois. In this opinion, the Service has determined that authorizing take of the activities described in the Statement of Project Objectives (SOPO) and associated documents will not jeopardize the continued existence of the Indiana bat or northern long-eared bat, but may result in incidental take of these species. The DOE funded research will also involve field testing of the deterrent device in forested areas in southern Illinois, but this portion of the project is not expected to cause take. Other species listed for Champaign and Vermillion Counties include the eastern prairie fringed orchid (*Platanthera leucophaea*), prairie bush clover (*Lespedeza leptostachya*), clubshell mussel (*Pleurobema clava*), and rabbitsfoot mussel (*Quadrula cylindrica*). However, this action will have no effect on these species. Therefore, they are not addressed in this biological opinion.

Consultation History

Section 7 consultation was initiated after a June 17, 2015, phone conference between the DOE and the Service where DOE requested initiation of formal consultation under the ESA for the implementation of acoustic deterrent research at the California Ridge Wind Energy Project (CRWE) and Shawnee National Forest (Shawnee). After the June 17, 2015, phone conference, the DOE and the Service corresponded through a series of emails in which the DOE and partners provided the Service with additional information and other important documents pertaining to the proposed research.

1. Description of the Proposed Action

The DOE proposes to fund research associated with the development and use of acoustic deterrent devices to be used to deter bats from wind turbines, thereby reducing mortality of all bat species, including listed *Myotis* bats. The research project will take place at Texas Christian University (TCU), the Shawnee, Wolf Ridge, and the CRWE located within Champaign and Vermillion Counties, Illinois. This work will build on work initiated by Bat Conservation

International in 2010 (Arnett et al. 2011) and will complement numerous existing and ongoing research efforts related to the effects of wind turbine operation on bat species, including the Indiana bat and northern long-eared bat.

The first phase of the project will be conducted in controlled conditions (a bat flight room) at TCU. This phase will involve the testing of acoustic deterrent device configurations and signals on live bats to better understand their response to deterrence. This phase will not involve listed species.

The second phase of the project will be conducted from mid-July through September 30, 2015, at the Shawnee. This phase will involve the operation of the acoustic deterrent in habitat known to be occupied by *Myotis* bats and the recording of their behavioral responses using night vision recording technology. Acoustic deterrent devices will be tested periodically throughout the study period on no more than five consecutive nights at a time. Testing will involve deterrent pulses combined with periods of no deterrent as a control.

The second phase of the project at the Shawnee may temporarily displace foraging activity of Indiana bats and northern long-eared bats. However, displacement is not expected to significantly disrupt normal behavior of the local population of bats and, as such, not create the likelihood of injury to any individual. Therefore, this part of the action is not expected to rise to the level of take. Similarly, the operation of the deterrent at the CRWE during the 2016 (and possibly 2017) trials will also displace bats but is also not expected to rise to the level of take.

The third and final phase of the project will be the deployment and operation of acoustic deterrent devices at the CRWE in Champaign and Vermilion Counties, Illinois, during the fall of 2016 and/or fall of 2017 (project schedules will evolve with the preliminary research described in phase 1 and 2). This research will involve the operation of study turbines at the manufacturer's cut in speed of 3.0 m/s. Actively deterred turbines will be operated simultaneously with control (undeterred turbines) to test the effectiveness of the optimal deterrent operation regime explored in phases one and two. Approximately 30 turbines are expected to be a part of the study, number of turbines may be adjusted slightly to optimize the study design based on the results of phases one and two. Two randomly selected turbines will be equipped with thermal-sensitive cameras. These cameras will be used to record bat activity around the turbines during the study period. At any given time, during each evening, one of the turbines will be the control (deterrent system off) and one turbine will be the treatment (deterrent system on). These turbines will likely operate under these conditions for 3 nights, after which the assignment would switch. The assignment is randomly selected for each 6-day period. Video from a randomly selected pair of nights within each 6-day period will be processed to determine bat activity using video analysis software and manual review.

To determine the effectiveness of the research, mortality monitoring will be conducted. The primary objectives of the mortality monitoring are to; (1) estimate bat mortality rates associated with deterred and non-deterred turbine operation; (2) determine species-specific fatality rates for bats to the extent possible; (3) provide a general understanding of the factors associated with the

timing, extent, distribution, and location of fatalities; and (4) determine if the deterrent operation reduces all bat fatality rates and minimizes the risk of take of listed species. All study turbines will be monitored daily and monitoring methods may include canine search teams to optimize searcher efficiency.

1.1 Conservation Measures

Test turbines at the CRWE facility will be feathered below cut-in speeds to reduce all bat mortality. It is expected that operation of the acoustic deterrent will serve as a conservation measure to minimize bat mortality at the site. Furthermore, this research is intended to explore the viability of acoustic deterrent devices as a conservation measure for all bat species in the region.

The U.S. Forest Service (Forest Service) requests that caution be exercised when conducting work on their lands. Researchers should refrain from driving on earthen levees which may damage and comprise their structural integrity. The Forest Service has also issued stipulations and requirements pertaining to the acoustic deterrent research. First, there will be no acoustic bat deterrent research activities within 500 feet of any known Indiana bat or northern long-eared bat roost trees or hibernacula. The effective distance of the acoustic deterrent is expected to be 65 to 131 feet. Placement of the device 500 feet from any known Indiana bat or northern long-eared bat roost is nearly four times farther than the expected effective distance of the deterrent and is expected to be protective. Written concurrence from the Forest Service will be received by DOE and partners to confirm that placement of deterrent devices meet this requirement. This written concurrence should be transmitted to the Service. Second, any equipment, flagging tape, buoys, or other items placed on national forest lands must be removed within 72 hours from completion of testing activities. Third, no all-terrain vehicles (ATV's) may be used to access sites on national forest lands. Fourth, no permanent structures may be placed on national forest lands.

2. Status of the Species

This section presents the biological or ecological information relevant to formulating this Biological 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 range-wide status of the species. Portions of this information are also presented in listing documents, the recovery plan (USFWS 1983), and the draft revised recovery plan (USFWS 1999), and are referenced accordingly.

2.1 Species Description and Life History

The Indiana bat is an insectivorous, temperate, medium-sized bat that migrates annually from winter hibernacula to summer habitat in forested areas. The bat has a head and body length that ranges from 41 to 49 mm, with a forearm length of 35 to 41 mm. The fur is described as dull pinkish-brown on the back but somewhat lighter on the chest and belly, and the ears and wing

membranes do not contrast with the fur (Barbour and Davis 1969). Although the bat resembles the little brown bat and the northern long-eared bat, it is distinguished by its distinctly keeled calcar and a long, pointed, symmetrical tragus.

The key stages in the annual cycle of Indiana bats are: hibernation, spring staging, pregnancy, lactation, volancy/weaning, migration and swarming. Figure 1 provides a depiction of the annual cycle. While there is variation based on weather and latitude, generally bats begin winter torpor in mid-September through late-October and begin emerging in April. Females depart shortly after emerging and are pregnant when they reach their summer area. Birth of young occurs between mid-June and early July and then nursing continues until weaning, which is shortly after young become volant (able to fly) in mid- to late-July. Migration back to the hibernaculum may begin in August and continue through September.

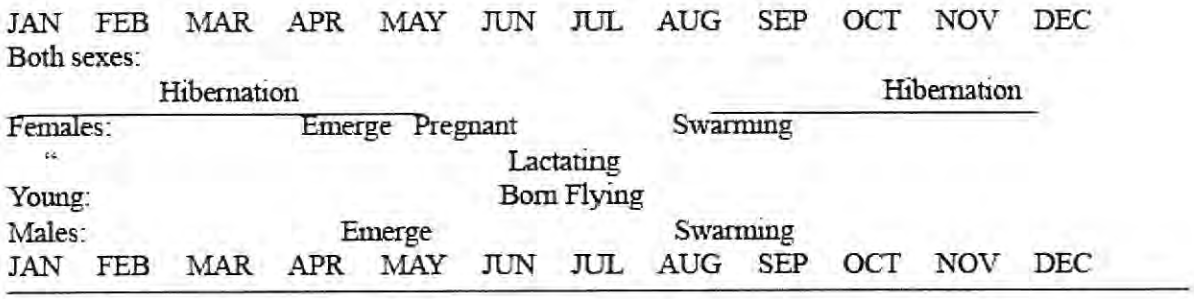

Figure 1. Indiana Bat Annual Chronology

Winter Hibernation

Generally, Indiana bats hibernate from October through April (Hall 1962, LaVal and LaVal 1980), depending upon local weather conditions. They hibernate in large, dense clusters, ranging from 300 bats per square foot to 484 bats per square foot (Clawson et al. 1980, Clawson, pers. observ. October 1996 in USFWS 2000). Upon arrival at hibernating caves in August-September, Indiana bats "swarm," a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, with relatively few roosting in the caves during the day (Cope and Humphrey 1977). Swarming continues for several weeks and mating occurs during the latter part of the period. Fat supplies are replenished as the bats forage prior to hibernation.

Females emerge from hibernation ahead of males; most winter populations leave by early May. Some males spend the summer near hibernacula in Missouri (LaVal and LaVal 1980) and West Virginia (Stihler, pers. observ. October 1996, in USFWS 2000). In spring when fat reserves and food supplies are low, migration is probably hazardous (Tuttle and Stevenson 1977). Consequently, mortality may be higher in early spring, immediately following emergence.

Summer Roosting

After hibernation ends in late March or early April, most Indiana bats migrate to summer roosts. Females emerge from hibernation ahead of males. Reproductively active females store sperm from autumn copulations through winter, and ovulation takes place after bats emerge from hibernation. The period after hibernation and just before spring migration is typically referred to as "staging," a time when bats forage and a limited amount of mating occurs (Service 2007).

Most winter populations leave hibernacula by late April or early May. In spring when fat reserves and food supplies are low and females are pregnant, migration is probably hazardous (Tuttle and Stevenson 1977). Consequently, mortality may be higher in early spring, immediately following emergence. Once en route to their summer destination, females move quickly across the landscape. Radio-telemetry studies in New York documented females flying between 10 and 30 miles (mi) in one night after release from their hibernaculum, arriving at their maternity sites within one night. Indiana bats can migrate hundreds of miles from their hibernacula. Observed migration distances range from just 34.1 mi to 356.5 mi (Service 2007).

Females seek suitable habitat for maternity colonies, which is a requisite behavior for reproductive success. They exhibit strong site fidelity to summer roosting and foraging areas, generally returning to the same summer range annually to bear their young (Garner and Gardner 1992). Females arrive in their summer habitats as early as April 15 in Illinois (Gardner et al. 1991, Brack 1979), and usually start grouping into larger maternity colonies by mid-May. Humphrey et al. (1977) reported that Indiana bats first arrived at their maternity roost in early May in Indiana, with substantial numbers arriving in mid-May. During this early spring period, a number of roosts may be used temporarily, until a roost with larger numbers of bats is established.

After the summer maternity period, Indiana bats migrate back to traditional winter hibernacula. Some male bats may begin to arrive at hibernacula as early as July. Females typically arrive later and by September the number of males and females is almost equal. Autumn "swarming" occurs prior to hibernation. During swarming, bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day. By late September many females have entered hibernation, but males may continue swarming well into October in what is believed to be an attempt to breed with late arriving females.

Male Indiana bats may be found throughout the entire range of the species. Some males spend the summer near hibernacula, as has been observed in Missouri (LaVal and LaVal 1980) and West Virginia (Stihler, pers. observ. October 1996, in USFWS 2000). Males appear to roost singly or in small groups, except during brief summer visits to hibernacula. Males have been observed roosting in trees as small as 3 inches dbh, but the average roost diameter for male Indiana bats is 13 inches (USFWS 2007).

Northern Long-Eared Bat

The northern long-eared bat is a medium-sized bat with an average adult weight of 5 to 8 grams, average body length from 77 to 95 millimeters, and forearm length between 34 and 38 millimeters (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. Its ears and wing membranes are dark brown, and the northern long-eared bat is most readily distinguished from other species of *Myotis* by its longer tragus and ears, ears which average 17 millimeters in length and extend beyond the nose when laid forward. (Whitaker and Mumford 2009).

During the summer, the northern long-eared bat occupies forested habitat and roosts (singly or in colonies) in the cracks, crevices, and bark of both live and dead trees (Lacki and Schwierjohann 2001), but they also have been found to roost in human made structures, such as buildings, barns, sheds, cabins, etc. Also, it appears that the northern long-eared bat does not depend on any specific species of tree, but rather the tree characteristics and/or tree decay structure are the most important factors in roost selection (Foster and Kurta 1999). The northern long-eared bat has been found to roost below the canopy in forests with a variety of canopy cover percentages, but research has indicated that females do tend to roost in more open areas than males (Perry and Thill 2007). Open areas receive greater solar insolation, which increases roost temperature and therefore pup development.

The northern long-eared bats occupy their summer habitat from approximately March through August and then begin to swarm near their hibernacula in August or September (Caire et al. 1979), depending on the geographical region. In Indiana, the majority of northern long-eared bats in Copperhead Cave have been observed to enter hibernation during October, and emerge from about the second week of March to mid-April (Whitaker and Mumford 2009). Hibernation periods farther north may begin earlier and last longer (Stones and Fritz 1969; Fitch and Shump 1979). The northern long-eared bat has been observed to share hibernacula with other bat species (Whitaker and Mumford 2009), but is rarely observed in concentrations over 100 in one hibernaculum (Barbour and Davis 1969). Individuals also rouse and may switch hibernacula throughout the winter, which makes it difficult to accurately estimate winter population numbers (Griffin 1940; Whitaker and Rissler 1992b; Caceres and Barclay 2000).

2.2 Diet and Foraging

Indiana Bat

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 or along the corridors of small streams. Bats forage at a height of approximately 2-30 meters under riparian and floodplain trees (Humphrey et al. 1977). They forage between dusk and dawn and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects. Females in Illinois were found to forage most frequently in areas with canopy cover of greater than 80%, and typically utilize larger foraging ranges than males (Garner and Gardner 1992).

Northern Long-eared Bat

The northern long-eared bat forages on a variety of insect types and does so primarily above the understory, but under the canopy in forested habitats (Nagorsen and Brigham 1993). It is capable of both capturing prey in midair and gleaning perched insects from surfaces. This gleaning ability, combined with agile flight capabilities, enables the northern long-eared bat to forage in dense forests with heavy understory (Foster and Kurta 1999). The northern long-eared bat has shown a preference for forested hillsides and ridges, as opposed to riparian areas (Brack and Whitaker 2001; LaVal et al. 1977) and other data indicates that mature forests are important foraging habitat for the northern long-eared bat (Caceres and Pybus 1998). It is estimated that the northern long-eared bat has a home range of 47 to 425 acres (Lacki et al 2009, with an average maternal home range of approximately 160 acres (Owen et al. 2003).

In general, the northern long-eared bat consumes moths, flies, leafhoppers, caddisflies, and beetles. However, the most common insects found in the diet of the northern long-eared bat are moths and beetles (Feldhammer et al. 2009; Brack and Whitaker 2001). The northern long-eared bat's foraging patterns include a peak activity period within five hours of sunset, and a second peak within 8 hours of sunset (Kunz 1973). Insects consumed during these periods do not seem to be significantly different (Brack and Whitaker 2001).

2.3 Range, Population Dynamics, and Migration

Indiana Bat

The historical summer range of the Indiana bat is thought to be similar to its modern range. However, the bat has been locally extirpated due to fragmentation and loss of summer habitat. The current species range includes much of the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida.

Based on censuses taken at all hibernacula, the total known Indiana bat population is estimated to number about 534,239 bats (Figure 4). Population trend data have shown a relatively stable population from 2005 to present. However, with the advent of White-nose syndrome, future population trends are uncertain.

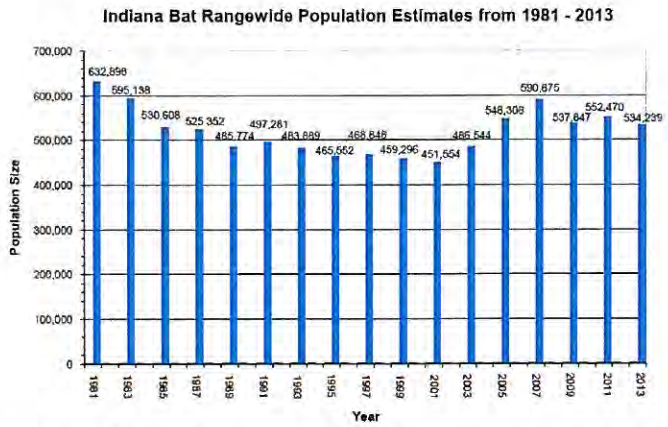

Figure 4. Indiana bat rangewide population estimates from (http://www.fws.gov/midwest/Endangered/mammals/inba/index.html).

Northern Long-Eared Bat

The northern long-eared bat is a wide-ranging North American species that is considered to be present in all Canadian provinces across to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993, and Caceres and Pybus 1997). In the United States, the bat can be found in 39 states (including the District of Columbia) from Maine to Montana, south to Kansas and eastern Oklahoma, and southeast to the Florida Panhandle (Whitaker and Hamilton 1998; Caceres and Barclay 2000; Amelon and Burhans 2006).

While the species is wide ranging, it appears to be unevenly distributed, and found in low numbers in both roosts and hibernacula (Amelon and Burhans 2006; Whitaker and Hamilton, 1998). However, populations are generally categorized into the Eastern Population, the Midwest Population, the Southern Population, the Western Population, and the Canada Population, although these will not be considered to be Distinct Population Segments under Endangered Species Act (ESA) (USFWS 2013b). The northern long-eared bat has been noted in typically small numbers in numerous hibernacula across its range, but insufficient data is available at this time to estimate a range-wide population. Population estimates are also unavailable for the Midwest Population, although mist net survey data indicate that the species is commonly captured in this region during mist-netting efforts.

Migration of Indiana Bats and Northern Long-Eared Bats

A 2011 spring migration study at the Blackball Mine hibernacula documented that the majority of tracked Indiana bats emerging from Blackball travelled south and west down the forested Illinois River corridor (Hicks et al. 2011). This suggests that during spring migration, Indiana bats may follow watershed drainage corridors while migrating to their summer habitats in Illinois. Because Indiana bats and northern long-eared bats share hibernacula and have many

overlapping summer habitats in Illinois, it is logical to infer that northern long-eared bats may have similar spring migration patterns. However, no direct spring migration data from Illinois exists for the northern long-eared bat, at present. Also, at present, no *Myotis* fatalities have been reported to the Service from spring wind power mortality monitoring efforts in Illinois. An Indiana bat mortality was noted at a facility in western Ohio, but this is the only spring mortality known to-date. This information implies that spring fatality risk of these two species in Illinois may currently be low, and therefore represent a less significant effect on their baseline population dynamics than habitat and white nose syndrome concerns.

Fall migration routes or patterns for both species are currently unknown. The recent discovery of four Indiana bat and five northern long-eared bat carcasses at various wind facilities in Illinois, Indiana, Iowa, Missouri, and Ohio in the fall, demonstrates that some individuals cross open, treeless landscapes during their fall migration. Additionally, a 2014 fall migration telemetry study conducted on a population of Indiana bats and northern long-eared bats living in the Middle Fork of the Vermillion River riparian corridor showed that most tagged individuals did not appear to follow the river corridor when the maternity colonies broke up, but rather headed northeast across the open landscape (Boyles and McGuire, unpublished report). If other bats from other maternity colonies have the same tendency to cross open landscapes during fall migration, some level of mortality risk during fall migration is likely associated with wind turbines in the region. This risk is difficult to quantify with currently available data. The Service continues to engage with our partners to gather information to inform this risk.

2.4 Status

Indiana Bat

The Indiana bat (*Myotis sodalis*) was listed as an endangered species via notice in the Federal Register on March 11, 1967 (32 Fed. Reg. 48) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U. S. C. 668aa(c)). The reasons for listing the species are summarized in the 2007 Draft Recovery Plan and include destruction/degradation of hibernation habitat, loss/degradation of summer habitat, migration habitat, and swarming habitat, disturbance of hibernating bats, disturbance of summering bats, disease and parasites, predation, and various anthropogenic factors (USFWS 2007). Relevant to the project area, the closest known Indiana bat occurrences are from the upper portion of the Middle Fork of the Vermilion River. Currently, the Service has knowledge of approximately 485 Indiana bat captures (males and females inclusive) statewide (Illinois).

Northern long-eared bat

The northern long-eared bat was proposed for listing as endangered on October 2, 2013, via a notice in the Federal Register (78 Fed. Reg. 191) and was formally listed as threatened on April 2, 2015. The primary reason for listing is the recent severe and ongoing decline of the species due to white-nose syndrome. Relevant to the project area, the closest known northern long-eared bat occurrences are from the upper portion of the Middle Fork of the Vermilion River.

Currently, the Service has knowledge of approximately 222 northern long-eared bat captures (males and females inclusive) statewide.

2.5 Reasons for Decline

Indiana bat

Not all of the causes of Indiana bat population declines have been determined. Although several known human-related factors have caused declines in the past, they may not solely be responsible for recent declines.

Documented causes of Indiana bat population decline include:

Disturbance and vandalism. A serious cause of Indiana bat decline has been human disturbance of hibernating bats during the decades of the 1960s through the 1980s. Bats enter hibernation with only enough fat reserves to last until spring. When a bat is aroused, as much as 68 days of fat supply is used in a single disturbance (Thomas et al. 1990). Human use (e.g., including recreational cavers and researchers) near hibernating Indiana bats can cause arousal (Humphrey 1978, Thomas 1995, Johnson et al. 1998). If this happens too often, a bat's fat reserves may be exhausted before it is able to forage in the spring.

Active programs by State and Federal agencies have led to the acquisition and protection of a number of Indiana bat hibernacula. Of 127 caves/mines with populations >100 bats, 54 (43%) are in public ownership or control, and most of the 46 (36%) that are gated or fenced are on public land. Although such conservation efforts have been successful in protecting Indiana bats from human disturbance, they have not been sufficient to reverse the downward trend in many populations.

Improper cave gates and structures. Some hibernacula have been rendered unavailable to Indiana bats by the erection of solid gates in the entrances (Humphrey 1978). Since the 1950's, the exclusion of Indiana bats from caves and changes in air flow are the major cause of loss in Kentucky (an estimated 200,000 bats at three caves) (USFWS 1999). Other cave gates have so modified the climate of hibernacula that Indiana bats were unable to survive the winter because changes in air flow elevated temperatures which caused an increase in metabolic rate and a premature exhaustion of fat reserves (Richter et al. 1993).

Natural hazards. Indiana bats are subject to a number of natural hazards. River flooding in Bat Cave, Mammoth Cave National Park, drowned large numbers of Indiana bats (Hall 1962). Other cases of hibernacula being flooded have been recorded by Hall (1962), DeBlase et al. (1965), and USFWS (1999). A case of internal cave flooding occurred when tree slash and debris (produced by forest clearing to convert the land to pasture) were bulldozed into a sinkhole, blocking the cave's rain water outlet and drowning an estimated 150 Indiana bats (USFWS 1999).

Another hazard exists because Indiana bats hibernate in cool portions of caves that tend to be

near entrances, or where cold air is trapped. Some bats may freeze to death during severe winters (Humphrey 1978, Richter et al. 1993). Indiana bats are vulnerable to the effects of severe weather when roosting under exfoliating bark during summer. For example, a maternity colony was displaced when strong winds and hail produced by a thunderstorm stripped the bark from their cottonwood roost and the bats were forced to move to another roost (USFWS 1999).

Suspected causes of Indiana bat decline include:

Microclimate effects. Changes in the microclimates of caves and mines may have contributed more to the decline in population levels of the Indiana bat than previously estimated (Tuttle, in lit. August 4, 1998). Entrances and internal passages essential to air flow may become larger, smaller, or close altogether, with concomitant increases or decreases in air flow. Blockage of entry points, even those too small to be recognized can be extremely important in hibernacula that require chimney-effect air flow to function. As suggested by Richter et al. (1993) and Tuttle (in lit. August 4, 1998), changes in air flow can elevate temperatures which can cause an increase in metabolic rate and a premature exhaustion of fat reserves.

Land use practices. The Indiana bats' maternity range has changed dramatically since pre-settlement times (Schroeder 1991; Giessman et al. 1986; MacCleery 1992; Nigh et al. 1992). Most of the forest in the upper Midwest has been fragmented, fire has been suppressed, and native prairies have been converted to agricultural crops or to pasture and hay meadows for livestock. Native plant species have been replaced with exotics in large portions of the maternity range, and plant communities have become less diverse than occurred prior to settlement. Additionally, numerous chemicals are applied to these intensely cropped areas. The changes in the landscape and the use of chemicals (McFarland 1998) may have reduced the availability and abundance of the bats' insect forage base.

In the eastern U.S., the area of land covered by forest has been increasing in recent years (MacCleery 1992; Iverson 1994; Crocker et al. 2006). Whether or not this is beneficial to the Indiana bat is unknown. The age, composition, and size class distribution of the woodlands will have a bearing on their suitability as roosting and foraging habitat for the species outside the winter hibernation season.

Chemical contamination. Pesticides have been implicated in the decline of a number of insectivorous bats in North America (Mohr 1972, Reidinger 1972, Reidinger 1976, Clark and Prouty 1976, Clark et al. 1978, Geluso et al. 1976, Clark 1981). The effects of pesticides on Indiana bats have yet to be studied. McFarland (1998) studied two sympatric species; the little brown bat (*Myotis lucifugus*) and the northern long-eared bat (*M. septentrionalis keenii*) as surrogates in northern Missouri and documented depressed levels of acetylcholinesterase, suggesting that bats there may be exposed to sublethal levels of organophosphate and/or carbamate insecticides applied to agricultural crops. McFarland (1998) also demonstrated that bats in northern Missouri are exposed to significant amounts of agricultural chemicals, especially those applied to corn. BHE Environmental, Inc. (1999) collected tissue and guano samples from five species of bats at Fort Leonard Wood, Missouri, and documented the exposure of bats to

p,p'-DDE, heptachlor epoxide, and dieldrin.

New Threats/Disease epidemics: White-nose syndrome (WNS): WNS was first documented in New York in February of 2006 and has since been observed to have spread to western Virginia and Pennsylvania (www.nwhc.usgs.gov). It is currently unknown if WNS is the primary cause or a secondary indicator of another pathogen, but it has been correlated with erratic behavior such as early or mid-hibernation arousal that leads to emaciation and mortality in several species of bats, including the Indiana bat (www.fws.gov).

Overall mortality rates, primarily of little brown bats, for 2007 and 2008 ranged from 81% to 97% among four study sites. It is currently estimated that 1 million bats have died from WNS in infected regions (www.dnrec.delaware.gov). Apparent losses of 685 Indiana bats in Hailes Cave and all but 124 of 13,014 Indiana bats in the Williams Preserve Mine in New York were documented during the first winter WNS was observed at each site. Additionally, Indiana bat surveys conducted at hibernacula in New York during early 2008 estimated the population to be down by 15,662 bats, which represents 3.3% of the 2007 revised rangewide population estimate.

WNS is thought to be transmitted by direct bat contact with an infected bat and by transmission of the causative agent from cave to cave. The distribution of WNS appears to be expanding in all directions from its epicenter in Albany and Scoharie Counties, New York. Between 2007 and 2008, it was documented to have spread from a 9 km radius to a 200 km radius, and at the end of the 2008-2009 winter, it was documented in all major hibernacula in New York. Most recently it has been found as far west as Illinois, Missouri, Iowa, and it's expected to spread further west The Service and partners are conducting research to develop management strategies to reduce the spread and impacts of WNS. However, it remains a significant and immediate threat to the Indiana bat.

In response to many of these threats and in accordance with Federal law, a Recovery Plan has been drafted for the species that outlines strategies and actions believed to be necessary for the recovery of a species. In summary, the objectives of the Recovery Plan are to: (1) protect hibernacula; (2) maintain, protect, and restore summer maternity habitat; and (3) monitor population trends through winter censuses.

Northern Long-Eared Bat

The northern long-eared bat has been listed as threatened based on the severity of population impacts that have been realized in areas with WNS, and the expected population impacts that will likely occur with the spread of the disease in the future. There are other reasons for decline that are discussed in the listing package, but none as serious as WNS (USFWS 2015).

2.6 Collisions with Wind Turbines

To date, seven Indiana bat fatalities have been documented at wind facilities throughout the range of the species. Five of these fatality events occurred in the fall, one occurred in the spring, and the other occurred in July. Several northern long-eared bat fatalities have been reported in publically-available literature from several eastern and Midwestern states, as well as Canada. (The Environmental Assessment for the Pioneer Trail Wind Farm (PTWF) project identifies 24 specific fatalities). This information, combined with the fact that bat fatalities of several other species are ubiquitous at wind facilities, suggests that operating wind turbines pose some lethal risk to both species across their ranges. It should be noted that two take permits have already been issued to operational wind facilities in Region 3. The Fowler Ridge Wind Farm in northwestern Indiana is currently authorized to take 184 Indiana bats over the project's permitted life (2014-2035), which is approximately nine bats per year. PTWF has been authorized to take 129 Indiana bats and 86 northern long-eared bats over a 43-year permit term. A second take permit has been issued to the Buckeye Wind Project for the taking of up to 130 Indiana bats over a 25-year permit term, but this facility has not yet been constructed.

According to the American Wind Energy Association (www.awea.org), 11,384 MW of wind power capacity are currently installed in the Midwest and Ozark Central Recovery Units (IA, IL, IN, OH, MO). It is important to note, however, that the majority of installed wind power capacity in Iowa is outside of the Indiana bat range, but within the northern long-eared bat range. Because of the fatalities mentioned above, it is reasonable to assume that some of these facilities pose some level of risk, and may be taking some Indiana bats and northern long-eared bats annually. Given the difficulty of detecting rare events during ground searches at wind facilities, the uncertainty surrounding migration paths of bats from summer to winter habitat, and the variation in topography, habitat configuration, and wind resources at each wind facility, the baseline mortality from wind turbine operation is unknown and very difficult to estimate. Consequently, the effect of wind energy alone, on local, regional, or range wide populations is also exceedingly difficult to quantify.

3. 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 its habitat in the project vicinity. Range-wide factors affecting the species include those listed previously under Section 2.4. Other factors with the potential to adversely affect the species in the area include forest clearing by private industry within the summer range in Illinois, woodlot management and wetland drainage by landowners, and other private and municipal land management activities that affect the structure and abundance of forest resources in the area.

3.1 Status of the Indiana Bat and Northern Long-Eared Bat within the Action Area

The action area includes the CRWE, small sections of the Shawnee, TCU, and Wolf Ridge Energy Center. The latter two are outside of the range of the Indiana bat and northern long-eared bat, and no other listed bat species are expected to be affected by the research at these two facilities. Therefore, our analyses focus on the CRWE and the Shawnee.

The CRWE and surrounding landscape consist almost entirely of row-crop agricultural fields, with the occasional farmstead on field edges. A few grass waterways with sparse trees do extend into the project area, but all turbines are located at least 1000 feet from those waterways that may function as bat foraging corridors. The turbine nearest to the Middle Fork of the Vermillion River is approximately one and one half miles away.

Indiana bats have been known to occupy the stretch of the Middle Fork between the Middle Fork Forest Preserve and I-57 since 1988 (Copperhead 2010). Mist-net surveys conducted in 2010 (Copperhead 2010) and 2014 (Boyles et al, unpublished data) indicate that Indiana bats continue to occupy the area. In addition reproductively active northern long-eared bats were also caught during the 2010 survey, but not radio-tracked. Exit counts of located roost trees show that at least 45 Indiana bats occupy the 2010 mist-netted area. However, it is plausible that the population in the area is larger and may harbor more maternity colonies. Of the eight Indiana bats captured, only two Indiana bats were transmitted and tracked to their respective roost trees, which were found near their capture site. In addition, juvenile and adult Indiana bats were caught approximately two miles to the south of these roost trees, and still other Indiana bats were captured two miles to the north of the roost trees. Given the three mile approximate foraging radius (USFWS 2007), it is quite plausible that this long distance between captures indicates the presence of at least two maternity colonies. Furthermore, it is plausible that these bats may venture and forage up into the small wooded drainages that are present in the southern half of the project action area.

Additional Indiana bat and northern long-eared bat occurrences are known to the Service from approximately 20 miles south and 30 miles west of the CRWE, respectively. Population sizes in these two areas were unknown, but reproductively active individuals were caught, suggesting the presence of maternity colonies.

The nearest winter hibernacula for both species is near LaSalle, Illinois (Blackball Mine), but several other Priority 1 and 2 hibernacula are within a 200 mile radius of the project site and could serve as hibernacula for the regional bat populations that may migrate through the project area. These hibernacula are either affected, or expected to be affected by white nose syndrome in the near future.

Shawnee contains 286,400 acres (88% forest cover constituting 83% uplands, 5% bottomlands and the balance in non-forested cover) and is located in the southern tip of Illinois between the Mississippi River and the Ohio River. The Shawnee has a variety of habitat types, including

rolling hills, deciduous forests, open lands, lakes creeks, and rugged bluffs. It contains some of the largest and most diverse blocks of mature hardwood forest, forest-interior habitat, and bottomland forest habitats in Illinois. Due to its habitat variability, there is a high amount of plant and animal diversity.

The Shawnee is also home to multiple colonies of Indiana bats. However, it is unknown how many Indiana bats occupy the forest habitat within the Shawnee boundaries during the summer maternity season. Past sampling and survey efforts have documented roosting and foraging habitats and use across the Shawnee. This information has informed the habitat use and distribution across the wide variety of forest habitats within the Shawnee (USFWS 2006). It appears from these studies that summer maternity roosting and foraging habitat is found primarily on bottomland hardwood areas. These areas tend to have significant mature hardwood tree mortality that is the indirect result of being heavily affected by past and present prolonged flooding (USFWS 2006). This tree mortality results in numerous snags (dead or dying trees) that serve as maternity roosts. The past surveys have also documented male Indiana bats in upland hardwood forests in the vicinity of abandoned mines which are known hibernacula.

Indiana bats also occupy subterranean habitats (mines and caves) within the Shawnee boundaries during the winter. These populations are distributed among one Priority 1 hibernacula, four Priority 2 and several smaller Priority 3 hibernacula. Overall, due to the amount and availability of wintering habitat, the Shawnee is estimated to have at least 45,000 Indiana bats currently hibernating on or near the Shawnee (USFWS, 2011 unpublished data).

The wide variety of forested/wooded habitat at the Shawnee also provides suitable summer and fall swarming habitat for northern long-eared bats. Northern long-eared bats are also known to hibernate in the underground caves and cave-like structures within the Shawnee. As of 2011, the estimated population of hibernating northern long-eared bats on the Shawnee was 433 (USFWS, 2011 unpublished data). However, this population estimate is likely low due to the hibernating characteristics (i.e. singularly in cracks or crevices) of northern long-eared bats make it difficult to locate and count hibernating individuals.

During ongoing surveys by the Forest Service, northern long-eared bats are routinely encountered. Given the abundance of northern long-eared bats and the amount of suitable habitat distributed across the Shawnee, it is expected that northern long-eared bats are widely distributed across the available forest habitats on the Shawnee.

3.2 Factors Affecting the Indiana Bat or Northern Long-Eared Bat Environment within and adjacent to the Action Area

The CRWE portion of the action area is expected to produce agricultural crops as normal, and no land use changes are expected during the term of the action. The Middle Fork of the Vermillion River, adjacent to the project area, contains potential roosting and foraging habitat for the Indiana bat or northern long-eared bat. Ongoing or future expected effects to the river corridor are uncertain, but could include timber harvests or other tree removal, storm damage, and/or

regeneration of forested areas through natural regeneration or conservation practices. No Federal actions that would affect the Indiana bat or northern long-eared bat in the immediate vicinity of the CRWE are known to be proposed at the time of this Biological Opinion, with the exception of the PTWF, which currently has a take permit issued under Section 10 of the Endangered Species Act.

Forest management activities at the Shawnee portion of the action area are expected to continue as usual. The Forest Service currently has take authorization for ongoing forest management and research activities that may affect Indiana and northern long-eared bats. However, no work or research involving bat take is expected to occur in/near Big Prairie Creek and Oakwood Bottoms during the time of deterrent deployment.

4. Effects of the Action

This section includes an analysis of the direct and indirect effects of the proposed action and associated interrelated and interdependent activities on the Indiana bat and its potential and critical habitat.

4.1 Federal Actions

The federal action is the funding of the proposed deterrent research, which consists of the following actions:

Research conducted at TCU and Wolf Ridge are preliminary studies that will evaluate the effects acoustic deterrent research has on all bats. No listed species will be affected by this action because no listed species are expected to be present at Wolf Ridge and no listed bats will be used in the flight room trials.

Researchers will also measure bat activity (with and without acoustic deterrent operation) for 3-5 nights per week at the Shawnee near Big Grand Prairie Creek and Oakwood Bottoms for a total of 30 nights. This action may temporally displace foraging activity of Indiana bats and/or northern long-eared bats. The deterrent will be positioned in habitat occupied by a *Myotis* bat colony. The Forest Service requests that the deterrent be situated in foraging habitat greater than 500 feet from any known roost tree or hibernacula. The deterrent will then emit a pulse every 1-3 seconds. Foraging behavior may temporarily be altered within the proximity of the deterrent. However, due to the substantial amount of contiguous suitable habitat available at the Shawnee, bats temporarily displaced from the deterred area are expected to simply shift to a non-deterred zone and continue normal foraging behavior. This temporary displacement is not expected to create the likelihood of injury and, as such, not significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering. Therefore, this portion of the action is not expected to rise to the level of take. At the conclusion of the research at Shawnee in 2015, bat forging behavior at the deterred site is expected to return to its original state.

In the fall of 2016 and/or fall of 2017, researchers will deploy acoustic deterrent devices at the CRWE Facility in Champaign and Vermilion Counties, Illinois (where researchers are planning to utilize approximately 30 turbines). This research will involve the operation of study turbines at the manufacturer's cut-in speed of 3.0 m/s with actively-deterred turbines operating simultaneously with undeterred turbines that will serve as the control. In order to effectively analyze bat activity around the actively deterred turbines and undeterred turbines, researchers will also deploy 2 thermal-sensitive cameras, which will be used to record bat activity around the turbines during the study period.

Although research conducted at the CWRE facility is actively trying to deter bats from colliding with turbines, take still may occur because deterred and control turbines will be operating at manufacturer's cut in speeds (3.0 m/s). Based on previous deterrent and cut-in speed research at this facility, it is expected that this portion of the research may result in the take of up to four Indiana bats and six northern long-eared bats over the two year period. Because, the CRWE turbines are sited at least 1000 feet from any potential habitat for Indiana bats and northern long-eared bats, no take is expected during the summer. Rather, it is expected that any Indiana bats and/or northern long-eared bats taken would be migrating bats. These bats could be either male, or female, and adult, or juvenile bats passing through the project area from summer to winter habitat.

4.2 Interrelated Activities, Interdependent Activities, and Indirect Effects

Indirect effects could be a minor shift in the route of migrating Indiana bats or northern long-eared bats in order to avoid the areas with operating acoustic deterrents. This effect is not expected to constitute harassment and rise to the level of take. No other indirect effects to the species are expected as a result of the project.

5. Cumulative Effects

Cumulative effects include the effects of State, local or private actions that may occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. The Service is unaware of any other Federal or non-Federal actions that are reasonably certain to occur which may adversely affect the Indiana bat or northern long-eared bat in the CRWE project action area. The Forest Service currently operates under a programmatic biological opinion for listed species, including the Indiana bat, that addresses ongoing forest management activities. Given that the acoustic deterrent research at Shawnee is not expected to rise to the level of take, this part of the action is not expected to increase or decrease the effects to the species analyzed under this programmatic consultation.

6. Conclusion

After reviewing the current status of the Indiana bat and northern long-eared bat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed project, interdependent, and interrelated actions are not likely to jeopardize the continued existence of the Indiana bat or northern long-eared bat. There is no critical habitat for the Indiana bat in the project area, and therefore, destruction or adverse modification of critical habitat as a result of the expected project is not foreseen.

7. Incidental Take Statement

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

7.1 Extent of Take Anticipated

Take authorization is being granted for the taking of four Indiana bats and six northern long-eared bats over a two year period (approximately two Indiana bats and three northern long-eared bats per year).

7.2 Effect of the Take

Effect of the Take on Indiana bats

The take of four Indiana bats should it occur, would happen at random during the fall migration season. Therefore, it is not possible to predict if these bats would be male, female, adult, or juvenile. Because take is expected to occur during the fall migration season, if females are taken, the take should not result in the loss of offspring for that year, but only the removal of the individual(s) from the population, and the loss of their remaining reproductive potential. Given the project location, it is difficult to predict if the taken bats would come from a single or multiple maternity colonies. However, the greater population from which the bats would be

removed is expected to be the Ozark-Central Recovery Unit, containing 197,707 bats (2013 estimate). The four individuals proposed to be taken constitutes 0.000002% of the population. It is our opinion that this minor level of expected take by the project is not likely to affect the survival or recovery of the species, nor is it expected to result in jeopardy to the species, destruction, or adverse modification of critical habitat.

Effect of the Take of Northern Long-Eared Bats

The project proponent has estimated that take of northern long-eared bats will be approximately three per year, taken in the fall migration season. Very little data exists on summer or winter colony dynamics, migration pathways, and hibernacula locations. Therefore, it was not possible to model the effects of the project to this species to the extent available for Indiana bats. However, given that the reproductive rates of northern long-eared bats are likely to be comparable to Indiana bats (USFWS 2014), and regional populations of northern long-eared bats are expected to be larger than regional Indiana bat populations, it is logical to infer that effects on this species would be extremely low.

7.3 Reasonable and Prudent Measures

The Service has identified the following reasonable and prudent measures to minimize impacts of incidental take of Indiana bats or northern long-eared bats.

- After the first year of the study, the DOE and partners should discuss the results with the Service and the observed effectiveness of the acoustic deterrent devices.
- If fatality monitoring during 2016 at CRWE indicates that take of either species may exceed authorized levels, the DOE and partners should meet and confer with the Service to discuss measures to reduce take rates. These measures could include, but are not limited to; increasing the cut-in speeds at the acoustic deterred and/or control turbines.
- The DOE and partners must feather turbine blades below cut-in speeds to reduce bat mortality at the site. This measure is also a conservation measure mentioned above.
- Upon completion of ultrasonic bat deterrent research at the Shawnee, researchers will notify the Forest Service of their results

8. Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the lead agency for an action must comply with the following terms and conditions. These terms and conditions are non-discretionary.

- In order to ensure that the authorized take is not exceeded, the DOE and partners should estimate bat fatality rates, by species, using currently accepted statistical methods.
- Results of the research, including statistical analyses, calculated mortality estimates, summaries of monitoring efforts, searcher efficiency calculations, and carcass removal times should be provided to the Service within a reasonable time period after the 2016 and/or 2017 monitoring seasons (not to exceed one year). In addition, we request that the

DOE and partners work with the Service to facilitate the dissemination of research results/conclusions among Service personnel to facilitate the recommendation of acoustic deterrent devices installation in conjunction with other research or projects, should they prove to have conservation value to the Indiana bat, northern long-eared bat, or other wildlife.

Closing

The reasonable and prudent measures and terms and conditions are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the monitoring period, the level of incidental take described above is exceeded, reinitiation of consultation and review of the reasonable and prudent measures is required. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Reinitiation Notice

This concludes formal consultation on the federal action, which is the funding of acoustic deterrent research. 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) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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