Cave Hill, Dennison Hollow, Stoneface, and Simpson Prescribed Burn Project Wildlife Working Paper

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INTRODUCTION/PROPOSED ACTION

The Hidden Springs Ranger District, Shawnee National Forest, is proposing to conduct prescribed burning on about 3108 acres on three (3) Research Natural Areas (Cave Hill, Dennison Hollow, and Stoneface) and adjacent land; and about 494 acres on one (1) Ecological Area (Simpson Township Barrens) and adjacent land. Burning may be conducted at about five times in the first ten year period. Burning is proposed to take place each year for the first two years. Additionally, up to two (2) acres per year may be treated using gas-powered or mechanical equipment to girdle or cut-n-remove shrubs/saplings-trees (slashing and removal of slash debris from site) to release Mead's Milkweed. The resulting openings in the canopy should be small (less than 2 acres in size). Only one Action Alternative (Alternative Two) is being considered.

No standing dead trees (snags) greater than 6 inches dbh will be cut/removed during the summer maternity period (April 1-September 30). Any suitable Indiana bat live summer roost trees greater than 9 inches dbh that need to be removed will be done only for the purpose of restoring Mead's Milkweed (federally endangered) plants. In the event any suitable live Indiana bat summer roost trees need to be removed, removal will only occur with the following stipulations: 1) between April 1 and September 30: trees will only be girdled and left standing; or, 2) between October 1 and March 31: trees may be girdled or cut and removed from site. No suitable live summer Indiana bat roost trees will be cut/removed from April 1-September 30. The proposed planned benefits of dormant season burning and removing/girdling trees/shrubs will be to: 1) correct the existing unnatural tree density in historical barren and glade areas to restore them to their natural condition; 2) to understory vegetative diversity through reducing canopy allowing a greater amount of solar radiation to reach the forest floor; 3) to improve habitat conditions for rare plant and animal species; and 4) to control non-native invasive plants.

Where feasible, prescribed burning will make use of existing natural and man-made fire control breaks (creeks, streams, roads, trails, etc.). Any new fire control line that must be constructed will be done using minimal disturbance (i.e gas-powered leaf blowers, hand tools, and/or gas-powered chainsaws). No new dozer-constructed fire control line will be created.

No burning will be conducted from May 1 through September 1. Any burning conducted within .25 miles of Equality Cave shall be conducted under conditions that will reduce or eliminate smoke dispersing into this cave, which is a hibernacula for southeastern myotis (*Myotis austroriparius*).

Ignition techniques will be used near rock outcrops/cliff faces so as to minimize the degree of direct contact of fire flames with cliff face surfaces, openings in rock, or other cliff-like habitat. Restrictions on the use of prescribe fire adjacent to the opening of Equality Cave will be implemented to preclude the risk of smoke or other emissions from prescribed burning entering Equality Cave. Specific monitoring requirements will be fully adhered to in order to avoid adversely impacting roosting bats in Equality Cave.

LOCATION

The location of the proposed activities is as follows:

Table 1. Location of Proposed Project.

Area	Approximate Size	County	Location	USGS Quad
Cave Hill, Stoneface, and Dennison Hollow Research Natural Areas	3108 acres	Saline	Section 34 and 35, T9S R7E Section 2,3,9,10,15, 16, 21, and 22, T10S R7E	Rudement, IL
Simpson Township Ecological Area	494 acres	Johnson	Section 10, 11, 14, and 15, T12S, R4E	Bloomfield and Glendale, IL

Restoration activities are to take place on Forest Service lands designated to be managed under three Management Prescriptions: Natural Area, Even-Aged Hardwood, and Mature Hardwood Forest in the 2005 Revised Shawnee National Forest Land and Resource Management Plan (Forest Plan). All Management Prescription standards and guidelines will be fully adhered to, all Forest standards and guidelines, and all "*Terms and Conditions*" as listed in the December 3, 2005 US Fish and Wildlife Service Biological Opinion (BO) on the Revised Shawnee National Forest Land and Resource Management Plan (Forest Plan).

As required by applicable Forest Service regulations and laws, this working paper will discuss potential effects from the implementation of the proposed project on:

- *Federally listed animal species known or likely to occur within the potentially affected proposed project area;*
- *Forest Service Regional Forester's Sensitive animal species known, or likely to occur, within the potentially affected proposed project area;*
- *Illinois State-listed animal species known or likely to occur within the potentially affected proposed project area; and*
- *Animal Management Indicator Species (MIS) known, or likely to occu, within the potentially affected proposed project area.*
- *Wildlife species with population viability concerns, as listed in the Forest Plan.*
- *Neotropical migratory birds known or likely to occur within the potentially affected proposed project area.*
- *U.S. Fish and Wildlife Service Birds of Conservation Concern*
- *Other components of wildlife diversity.*

EXISTING CONDITION

Past and Present Actions That Have Affected the Existing Situation

The exclusion of fire from these four areas over the past 50 years has permitted the areas to become "unnaturally" overstocked with hardwood trees, saplings, brush and red cedar,

creating a more dense canopy condition and densely stocked trees than what is believed to have historically prevailed. The absence of fire has encouraged the establishment of non-native invasive plants, such as Japanese honeysuckle, autumn-olive, Japanese stilt-grass, and multi-flora rose in disturbed areas and along public access ways (i.e. along roadsides, trails, abandoned wildlife openings, and abandoned farmsteads). The resulting action is perceived to have resulted in a reduction in native plant and animal diversity, and the establishment of non-native invasive plants within/adjacent to portions of the four areas. Much of the cliff-line habitat, boulder fields, and rock outcrop areas are un-naturally shaded, thus retarding the development of a diverse forest floor flora and fauna. The unnaturally dense canopy conditions have reduced the quality of summer foraging and roosting habitat for most tree-roosting bats, including the federally endangered Indiana bat (*Myotis sodalis*), state endangered southeastern myotis , as well as other more common bat species, by increasing the amount of vegetative clutter in the mid-story and overstory.

All four areas have received some degree of dormant season prescribed burning and tree/shrub removal conducted over the past five to ten years, which was conducted for the purpose of enhancing habitat conditions for Mead's milkweed (*Asclepias meadii*), which is a listed by the U.S. Fish and Wildlife Service (USFWS)as "*threatened*".

All four areas are dominated by a mix of upland hardwood forest types. Several small stands of mature yellow pine are also located within portions of the four areas. These areas once were agricultural fields but were planted by the Forest Service in yellow pine for the purpose of stabilizing the soil and to return these once open areas to forested habitat conditions. Scattered small areas, once managed as agricultural fields, were designated to be managed as wildlife openings. However, active management of these scattered wildlife openings was suspended five to ten years ago, allowing them to become invaded by colonizing trees, shrubs, and other herbaceous and woody plant species. Evidence of many of these old wildlife openings can still be seen throughout portions of the project area. Stoneface and Dennison Hollow have well traveled open roads that lie adjacent to the areas, serving as a continual potential source of non-native invasive plants and animals. All four areas lie in close proximity to well traveled open roads.

Unique wildlife habitat features (i.e. caves, karst, wetlands, spring seeps, bogs, rock outcrops, boulder fields, clifflines, etc.) are known to exist throughout portions of all four areas. Rocky cliff-line (sandstone and limestone) habitat is well distributed throughout portions of all four areas. Rock outcrops and boulder fields are also prevalent throughout many portions of the areas. One limestone cave is present (Cave Hill Cave or Equality Cave) within the Cave Hill Area. This cave supports a known population of a Regional Forester's Sensitive bat species (southeastern myotis, *Myotis austroriparius*), as well as several more common species of bats, such as little brown bats (*Myotis lucifugus)*, northern long-eared bat (*Myotis septentrionalis*), big brown bat (*Eptesicus fuscus*), and tri-colored bats (*Perimyotis subflavus*). The federally-endangered Indiana bat (*Myotis sodalis*) has also been documented using the cave during fall swarming (late September and early October).

Equality Cave is known to serve as both a summer and winter roost site for southeastern myotis. Southeastern myotis were first found using Equality Cave during the summer/fall of 2006. Forest Service wildlife biologists conduct fall swarming surveys of Equality Cave each October, and have subsequently documented a growing population of southeastern myotis at Equality Cave.

Fall swarming surveys (harp trapping) conducted by Forest Service wildlife biologists in October of 2008 captured one male Indiana bat (*Myotis sodalis*). A winter survey conducted of the cave in February 2009 failed to find any Indiana bats using Equality Cave as a winter roost site. Forest Service wildlife biologists captured three adult male Indiana bats while harp trapping Equality Cave in early October 2009, providing increasing evidence of the potential use of Equality Cave by Indiana bats.

The increased use of Equality Cave by rare, as well as common bat species is most likely the result from the placement of a cave gate across the entrance to Equality Cave in 2007 to prevent unauthorized entry. A decision was made by the District Ranger to place a protective gate across the entrance to Equality Cave due to: 1) heavy vandalism of the cave by unauthorized public users, 2) the documentation of the cave being used by southeastern myotis, and, 3) to reduce the potential risk of physical harm/injury/disturbance occurring to rare bats by unauthorized public users.

The predominant overstory forest type of the four areas is upland mixed hardwood. Several relatively small stands of yellow pine are present in some of the areas. Habitat needs for wildlife species dependent upon larger hardwood snag and cavity tree habitat is abundantly available. Large hardwood cavity trees are very abundant throughout the four areas. A variety of hardwood snags are distributed throughout all for areas, with some areas having higher densities of larger diameter snags. The amount of down woody debris varies throughout the four areas, with some areas having very good amounts of larger diameter down woody debris.

The availability of early seral habitat is very limited in the project area. Numerous abandoned wildlife openings are scattered throughout portions of the project area, and represent the only early successional habitat within these four areas. No timber harvesting has taken place within the past 10 years within any of the four areas. There is no other early seral habitat (less then 10 years of age) that exists in the four project activity areas.

Numerous permanent to semi-permanent watered ponds are scattered throughout the four areas, some of which may have fish in them. All of the ponds serve as permanent to semi-permanent aquatic habitat for amphibian species, especially those ponds that have no fish in them. They also serve as an important source for drinking water by bats, as well as use by popular game species such as white-tailed deer and wild turkey.

All four areas are believed to support healthy and abundant populations of traditional game wildlife species, such as white-tailed deer, eastern wild turkey, and gray squirrel. The deer population in all four areas is believed to be moderate to moderately-high, based on the amount of deer sign (trails, droppings, buck rubs), deer browsing, and harvest data

provided by the Illinois Department of Natural Resources. All four areas receive moderate to heavy public deer hunting pressure during the Illinois deer seasons. The turkey population is also believed to be moderate. Turkey sign is commonly visible throughout the four areas (turkey tracks, turkey feathers, scratching in hardwood leaves, etc.). All four areas are heavily used for public hunting, including deer hunting, turkey hunting, and squirrel hunting.

The following "*Design Criteria*" have been built into the action alternatives as part of the "proposed actions" so as to meet Forest Plan standards and guidelines, compliance with USFWS "*reasonable and prudent measures*" to reduce the likelihood of incidental take to federally-listed species, to reduce adverse impacts to neotropical migratory birds, and to reduce potential adverse impacts to biological diversity.

Table 2. Summarization of "Design Criteria" to be used for the Burn Project.

Resource Area	Design Criteria	Rationale / Effectiveness
Wildlife Resource	#1-Avoid removal of live suitable Indiana bat roost trees from 4/1 through 9/30 unless necessary for human safety or resource objectives. Removal can only proceed after exits counts have determined non-use by roosting bats. -Where live suitable Indiana bat summer roost trees must be removed between April 1 and September 30 to enhance Mead's Milkweed, suitable roost trees will be "girdled" and left standing to serve as future bat roost trees and cavity trees for cavity nesting birds.	-Required "*reasonable and prudent measures*" in Dec. 2005 USFWS Biological Opinion to minimize the impacts of incidental take of Indiana bats. -To maintain availability of suitable summer Indiana bat roost trees. -To avoid potential for direct impacts to nesting neotropical migratory birds.
Wildlife Resources	#2-Retain all standing dead trees unless necessary to cut for human safety or to accomplish resource objectives. Standing dead trees greater than 6"dbh that represent suitable Indiana bat summer roost trees cannot be removed from 4/1 through 9/30 unless they are evaluated to document non-use by roosting bats. Snags must be removed within 72 hours after completion of exit surveys.	-Required "*reasonable and prudent measures*" in Dec. 2005 USFWS Biological Opinion to minimize the impacts of incidental take of Indiana bats.
Wildlife Resources	#3-No prescribed burns shall be done from 5/1 through 9/1 in upland forest types.	-Required "*reasonable and prudent measures*" in Dec. 2005 USFWS Biological Opinion to minimize the impacts of incidental take of Indiana bats. -To avoid potential for direct impacts to nesting neotropical migratory birds.
Wildlife Resources	#4-Burning within the vicinity of Equality Cave will be conducted in such a manner (wind direction, fuel moisture, buffer zones, i.e.) so as to prevent smoke from entering the cave and impacting roosting bats. From 9/1-4/30, no burning may take place within 500 feet of the entrance to Equality Cave. Burning must be conducted so as to prevent the settling of smoke into the cave after sunset.	-Forest Plan standards and guidelines to provide for the conservation of biological diversity. -To minimize the potential for smoke entering winter hibernacula.
Wildlife Resource	#5- Within 50 feet of pond perimeters or dams, any trees to be removed will be directionally felled away from ponds or dams.	-To maintain amphibian habitat in old wildlife ponds.
Wildlife Resources	#7-No trees containing hawk or owl nests will be felled, girdle, removed from April 1 through August 31.	-To reduce the likelihood of direct mortality to nesting hawks and owls.
Wildlife Resources	#8-No trees or shrubs containing known bird nests will be felled from April 1 through August 31.	-To reduce the likelihood of direct mortality to nesting neotropical migratory birds.

DESIRED FUTURE CONDITION

The 2006 Shawnee National Forest Land and Resource Management Plan was prepared to meet the requirements of the National Forest Management Act (NFMA) of 1976. All four areas planned for management actions are in the Natural Areas (NA) management prescription of the 2006 Forest Plan. This management prescription provides for preservation, protection, and/or enhancement of the unique scientific, educational, or natural values found in these four areas. Management activities that may be part of landscape management in these areas include prescribed burning, tree and shrub removal, trail construction and maintenance, and non-active invasive species control (Shawnee National Forest LRMP 2006, p. V-76-78).

CUMULATIVE EFFECTS

The *spatial boundary* utilized for conducting the cumulative effects analysis for terrestrial animal species is as follows:

Small Mammals	Johnson, Pope, and Saline Counties
Bats	A five mile radius extending out from the perimeter of the project area boundary for each of the areas.
Timber Rattlesnake	A five mile radius extending out from the perimeter of project area boundary for each of the areas.
Birds	Johnson, Pope, and Saline Counties

TES Bats: Several Indiana bat research studies have suggested that Indiana bats will travel as far as 2.5 miles from individual primary summer roost trees. A 3 mile radius extending from the project activity area boundary would seem appropriate to cover any potential project-level effects to Indiana bats. A 5 mile radius extending from the project activity area boundary would seem appropriate for analyzing potential cumulative effects to Indiana bats. The Forest Plan also conducted a comprehensive cumulative effects analysis to the Indiana bat at the Forest-wide scale. This cumulative effects analysis tiers to this analysis in the Forest Plan EIS and the Biological Assessment.

MIS Birds: Since many neotropical migratory birds are long-distance migrants, the appropriate cumulative effects analysis area should be the entire Shawnee National Forest. The 2006 Forest Plan conducted a comprehensive landscape-level cumulative effects analysis of potential effects to neotropical migratory birds and MIS birds from the implementation of land management activities. This document incorporates by reference the Forest-wide cumulative effects analysis conducted in the Forest Plan EIS. This wildlife working paper has evaluated the potential cumulative effects to neotropical migratory birds from the proposed action using a 5 mile radius extending out beyond the affected project area boundaries. This distance was selected because it takes into account actions that could occur within the surrounding landscape area that could realistically result in a cumulative effect to neotropical migratory birds that could be present within the project area boudaries.

Timber Rattlesnake: Timber rattlesnake activity ranges can be as large as 500 acres and males have been found as much as 4.5 miles from their den (Brown 1993). Therefore, we

used a five mile distance extending out from the project area boundaries to analyze potential cumulative effects. This distance should provide a biologically defensible area that takes into account actions, in conjunction with the proposed action, that may result in a cumulative effect to the species.

The *temporal boundary* utilized for conducting the cumulative effects analysis for terrestrial animal species is five years in the past, and extending out to 50 years into the future. The date chosen for past activities was selected because: 1) little to no activity has taken place within the past five years. The date chosen out into the future was chosen because around 50 years is when a forested habitat begins to take on conditions of a mature forest.

Cumulative effects analysis takes in to account all known past actions, the proposed action, present actions, and reasonably foreseeable actions, that could or will impact the analysis area.

Past actions in the project area vicinities (both non-Forest Service and Forest Service lands) include: farming (private land); livestock grazing (private lands); land clearing for forestry (private land), timber harvesting; agricultural crop production and livestock grazing (private land), residential and commercial development (private land); pine and hardwood establishment; road construction and road maintenance; use of agricultural pesticides (private land), recreational facility construction and maintenance; abandoned well and cistern filling; Natural Area designation; power line construction and maintenance; user-created equestrian and hiker trails; unauthorized user-created all terrain vehicle (ATV) trails; mining (private land); tree planting; wildlife opening creation and maintenance; timber stand improvement; slashing/felling of shrubs/trees to release Mead's milkweed plants; authorized and unauthorized off-highway recreational vehicle use; hunting; scenic viewing; hiking; wildfire suppression; prescribed burning; unauthorized artifact hunting and collection; pond and wildlife waterhole construction and maintenance; firewood collection; various special uses authorized by the Forest Service; various fisheries, wildlife, and plant monitoring and surveys; hiking; camping equestrian activities; and railroad construction and maintenance.

In 2007, the Hidden Springs Ranger District constructed a cave gate across the opening to Equality Cave to protect rare cave resources. The gate was vandalized in the fall of 2007, but was immediately repaired and has been effective in curtailing unauthorized entry into the cave.

The closest prescribe burn that has been carried out on Forest Service lands is the 542 acre Eagle Mountain Burn, which was burned in 2006. No timber harvesting has taken place on Forest Service lands within the past 5 years within a five mile radius of the project activity areas.

Present action in the project area vicinities (both non-Forest Service and Forest Service lands) include: trail construction and maintenance; trail use-hiking and equestrian; power line maintenance; unauthorized ATV use; timber harvesting (private lands); land clearing

for municipal, residential, and commercial development (private lands); wildlife habitat management; agricultural management; livestock grazing; wildfires; prescribed burning; fire suppression; user-created equestrian trails; road construction and maintenance; tree planting; railroad maintenance and use; trail rehabilitation; scenic viewing; hunting; fishing; various fisheries, wildlife, and plant monitoring and surveys; firewood collection; bat surveys of Equality Cave; and, various special uses authorized by the Forest Service.

Reasonably Foreseeable future actions in the project area vicinities (both non-Forest Service and Forest Service lands): include all of the above listed activities and some repeat of the past actions, including land clearing for residential, municipal, and commercial development. The only prescribe burn that is planned for burning in the reasonably foreseeable future, within a five mile radius of the project activity areas, is the Eagle Mountain Burn (542 acres) which is proposed to be burned for the second time in 2009. No timber harvesting is planned to occur on National Forest lands within a five mile radius of the project activity area for the reasonably foreseeable future.

The Forest is currently in the process of preparing a draft Environmental Assessment (EA) to apply herbicides to treat a selective list of non-native invasive (NNIS) plants in selected natural areas across the Forest. None of this activity would take place within close proximity to any of the four natural areas/ecological areas being evaluated in this proposal.

PAST SURVEYS

Portions of the four areas proposed for burning have been surveyed over the years by researchers and biologists from Southern Illinois University (SIU), the Illinois Department of Natural Resources (IDNR), the US Forest Service (USFS), volunteers, and private contractors. Private contractors and USFS biologists conducted small mammal and bird surveys of Cave Hill and Dennison Hollow areas in 1994. Private contractors conducted small mammal, reptile, and amphibian surveys of Cave Hill and Dennison Hollow areas in 1995.

Forest service wildlife biologists have conducted fall bat swarming surveys (harp trapping) at Equality Cave (Cave Hill Cave) since 2006. A winter bat survey was conducted by USFS biologists of Equality Cave in February of 2009. Under a cooperative agreement between the Shawnee National Forest and Southern Illinois University, volunteers and researchers at SIU each year run a bird point transect in the Cave Hill NA

In January 2008, Forest Service wildlife biologist Rod McClanahan conducted a field evaluation of the Cave Hill, Dennison Hollow, and Simpson areas to look for animal sign, and the presence of suitable habitat to be used in making a determination of likelihood of occurrence for federally-listed, regional forester's sensitive, Illinois state-listed, and MIS animal species. On January 14-15, 2008, meandering transects were ran throughout a representative sample area on three of the areas.

Federally-Listed, Regional Forester's Sensitive, Illinois-State Listed Animal Species, and Species of Migratory Birds of Conservation Concern Reviewed

Appendix A of this document lists all 14 federally listed and regional forester's sensitive (TES) animal species currently known or expected to occur on or near the Hidden Springs Ranger District, Shawnee National Forest. Appendix B of this document lists all 29 Illinois State-listed (ISL) animal species currently known or expected to occur on or near the Hidden Springs Ranger District, Shawnee National Forest. Appendix C lists all of the 20 US Fish and Wildlife Service "Species of Migratory Birds of Conservation Concern of the Central Hardwoods Bird Conservation Region (SMBCC)". All animal species on these three lists were considered in the preparation of the wildlife effects analysis for this project.

TES and ISL animal species, and SMBCC that may potentially be affected by this project were examined using the following existing available information:

1. Reviewing the list of TES animal species, ISS animal species, and SMBCC known or likely to occur on the Shawnee National Forest, and their habitat preferences. This review included the U.S. Fish and Wildlife Service current list of endangered, threatened, and proposed species for the Forest, and the current Region Nine Sensitive Species list for the Forest.

2. Consulting element of occurrence records (EOR's) for TES animal species as maintained by the Illinois Department of Natural Resources-Natural Heritage Program, and supplied to the Forest.

3. Reviewing sources listed in the references portion of this report.

4. Reviewing the results of any past field surveys that may have been conducted in the project area.

Most TES and ISS animal species known to occur on the Forest have unique habitat requirements, such as rock outcrops, boulder fields, caves, springs or seeps, cypress-tupelo gum swamps, bogs or wetlands, old fields, and riparian or aquatic habitats. SMBCC likewise are associated with special habitats, such as old fields, grasslands, prairies, brushy early successional habitats, large tracts of mature hardwood forest with open understories, riparian forests, or giant river cane.

A "step down" process was followed to eliminate species from further analysis and focus on those species that may be potentially affected by proposed project activities. Species not eliminated are then analyzed in greater detail. Results of this "step down" process are displayed in the Occurrence Analysis Results (OAR) column of the tables in Appendices A and B. First, the range of a species was considered. Species' ranges and potential occurrences on the Forest are based on county records contained in such documents as "Endangered and Threatened Species of Illinois: Status and Distribution, Volume II – Animals, 1992"; "Additions, Deletions and Changes to the Illinois List of Threatened and

Endangered Species-2004"; "October 2003 USDA Forest Service Eastern Region Regional Forester's Sensitive Species List"; "2009 Illinois Threatened and Endangered Species by County-Illinois Natural Heritage Database"; Checklist of Endangered and Threatened Animals and Plants of Illinois", Illinois Department of Natural Resources "Biological Conservation Database (February 17, 2005)", "US Fish and Wildlife Service "Distribution of Federally-Listed Threatened (T), Endangered (E), and Proposed (P) Species in Illinois-March 2003", "1999 Checklist of endangered and threatened animals and plants of Illinois", and various Species Conservation Assessments that have been funded by the Shawnee National Forest. These databases and scientific research publications were reviewed for current listings, habitat associations, historical records, and known location information.

Federally-listed Animal Species

Indiana Bat

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates colonially in caves and mines in the winter. The species was originally listed as in danger of extinction under the Endangered Species Preservation Act of 1966, and is currently listed as endangered under the Endangered Species Act of 1973, as amended. This rare bat species currently has a US Fish and Wildlife Service USFWS Recovery Priority of 8, which means that the species has a moderate degree of threat and high recovery potential. As of October 2006, the USFWS had records of extant winter populations at approximately 281 hibernacula in 19 states and 269 maternity colonies in 16 states. The 2005 winter census estimate of the population was 457,000 (USFWS 2007). The initial 2007 winter census estimate of the population is 501,260 (USFWS 2007). The rangewide population is up approximately 42% since a population low in 1995. On average, the population has increased 3.2% per year since 1995; and increased 5.8% per year over the last five years. The initial 2007 population estimate is the highest since 1980 (Krusac personal communication, 2007).

In 2007, a new threat developed that may have implications in the continued population recovery for this species. In 2006, an outbreak of a new fungal agent referred to as "white-nosed syndrome (WNS)" was documented in caves and mines in New York, Vermont, and Massachusetts. Since 2006, this fungal agent has been documented as being present, and causing substantial bat mortality in additional mines and caves in New Jersey, Connecticut, Pennsylvania, West Virginia and Virginia. WNS has now been confirmed in caves and mines as far south as southwest Virginia. WNS has been documented as causing substantial mortality to little brown bats, northern long-eared bats, tri-colored bats, Indiana bats, big brown bats, and eastern small-footed bats. Total mortality at closely monitored sites with multiple years of infection in New York, Massachusetts, and Vermont has averaged 95 percent (Turner and Reeder 2009). It is suspected that this fungal agent is being spread both from bat-to-bat transmission, as well as by humans on clothing, boots, caving gear, etc. Researchers have named this new fungal agent as *Geomyces destructans*, which is a new species of fungus in the U.S.

Scientific studiews supporting the fungus as the sole causative agent of mortality in bats are on-going but not conclusive at this time (Turner and Reeder 2009). Bat researchers are predicting that the range of spread of this fungal agent, and an expansion in bat mortality, will take place in the winter of 2009.

While the overwhelming majority of the bat mortality has taken place in little brown bats, Indiana bats are susceptible to WNS and mortality of Indiana bats has been documented. The continued spread of WNS throughout the range of the Indiana bat could have rangewide population recovery implications.

Wildlife biologists with the US Forest Service and Illinois Department of Natural Resources have been actively monitoring caves and bat populations across southern Illinois to look for the early-warning signs of the presence of WNS. Biologists conducting surveys of wintering Indiana bat populations in February 2009 in known hibernacula in southern Illinois searched for indications of the presence of WNS (unusual number of dead bats, dead bats with characteristic white fungus around nose/mouth/muzzle, bats more active than normal, a shift in traditional roosting location in caves/mines, and/or live bats showing signs of white fungus around nose/mouth, muzzle) in mines and caves in southern Illinois. These surveys failed to detect any sign that WNS was present in Indiana bat hibernacula in southern Illinois.

Forest Service wildlife biologists and biologists from the Illinois Department of Natural Resources harp trapped Rich's Cave, Dutchman Cave, Griffith Cave, Ellis Cave, Brasher Cave, and Equality Cave during the last week of September through the first week in October 2009 to look for any gross physical indications of exposure of bats to WNS. Over 200 bats were captured. Each captured bat was evaluated to determine the presence of tissue scarring on the wings and uropatagium (tail membrane), which serves as an indicator of past exposure to WNS. No strong evidence was found suggesting the presence of WNS to wintering bat populations in southern Illinois. For the time being, WNS has not been documented in southern Illinois bat populations, nor has it been documented in adjoining states (i.e. Missouri, Indiana, Kentucky).

Illinois Natural Heritage Survey shows Element of Occurrence Records for Indiana bat in Johnson County and Saline County. Forest Service wildlife biologists documented male Indiana bats at Equality Cave both in the fall of October 2008 and 2009 while conducting fall swarming surveys. The entire Shawnee National Forest is considered to represent potential summer range for this species.

In addition to live roost trees and snags, male Indiana bats will also use caves and cliffs for summer roosting sites. In Illinois, bachelor Indiana bat colonies of 1,000-1,500 have been documented using abandoned mines on the west side of the Shawnee National Forest (Widowski, personnel communication, 2007). Other roosts of males have been found in exfoliating bark (Menzel et al. 2001). Caves, cliff lines, boulder fields, and rock shelters are known to be present within portions of the proposed burn areas.

Early researchers considered flood plain and riparian forest to be the primary roosting and foraging habitats used in the summer by the Indiana bat (Humphrey et al. 1977), and these forest types unquestionably are important, especially in the Midwest. The Saline River floodplain habitat is located in close proximity to the Cave Hill NA. Carter (2006) stated that "*In the Midwest, such as southern and central Illinois, USA, maternity colonies are more commonly associated with bottomland, riparian, wetland, or other hydric forest types. Because many large maternity colonies have been observed in hydric habitats of the Midwest, I hypothesize that these are preferred maternity habitats. Moreover, very few large maternity colonies have been located using upland forest habitats within the region. Future conservation efforts for the Indiana bat should focus on protecting and regenerating bottomland habitats along the major river systems of the Midwestern United States. It is within these bottomlands and riparian habitats that future large and long-term maternity colonies will be established"*.

Feldhamer and Carter (2005) studied a known summer maternity colony on the Shawnee National Forest in southwestern Illinois in riparian habitat along the Mississippi River bottoms. These researchers concluded that bottomland forest is selected the most by Indiana bats at Oakwood Bottoms, Bluff Lake, and within Southern Illinois. This study also found that the majority of the Indiana bats tracked at Oakwood Bottoms roosted within the closed canopy bottomland forest but moved to open canopy forest of the floodplain to forage, traveling 3-4 km to their preferred foraging areas.

However, other recent studies conducted in more upland forested habitats throughout the U.S. have also shown that a variety of more upland habitat types are also used by Indiana bats for roosting (Clark et al. 1987; Callahan et al. 1997); and upland forest, old fields, and pastures with scattered trees having been shown to provide foraging habitat. Carter (2006) stated "*In the central and southern Appalachians, maternity colonies have been located in upland areas where bottomland habitats are less extensive. However, these colonies are usually characterized by small numbers of bats and ephemeral persistence*".

According to recent telemetry studies, Indiana bats appear to be very adaptable, living in somewhat altered landscapes and are somewhat dependent upon ephemeral resources (dead or dying trees). Recent research indicates that the Indiana bat may, in fact, respond positively to periodic habitat disturbance. In fact, research suggests that the Indiana bat may be a more adaptable species than previously thought. Within the range of the species, the presence/absence of Indiana bats may be governed by the availability of natural roost structures, primarily standing dead trees with loose bark. Some evidence has been documented, however, of Indiana bats readily using artificial roost structures. Indiana bats have been found using wooden "rocket box bat houses" at Oakwood Bottoms.

The suitability of any tree to serve as a roost site is determined primarily by *(1) its condition-dead or alive, (2) the quantity of loose sloughing bark, (3) the tree's solar exposure and location in relation to other trees, and (4) the tree's spatial relationship to water sources and foraging areas*. Research supports the fact that dead trees and live trees with exfoliating bark characteristics play an important role in providing roosting

habitat, with dead trees oftentimes playing a major role as preferred roost trees for summer maternity roosts. Carter (2003) conducted a study of the summer habitat use of roost trees by Indiana bats in the Shawnee National Forest of Southern Illinois. In this study, all documented Indiana bat summer roost trees consisted of snags. All Indiana bats roosted under exfoliating bark, except for two roosts which were in crevices of snags, one of which was partially covered by bark. Indiana bats used roosts with low canopy closure levels.

Garner and Gardner (1992) ranked the suitability of trees as potential roosts based solely on bark exfoliation. Trees (trunks and main limbs) with >25% coverage of exfoliating bark were ranked high, >10% and <25% as moderate, and <10% and >1% as low. Trees devoid of loose or peeling bark were ranked as having no current value as roosts. Romme et al. (1995), after reviewing Indiana bat roosting ecology literature, assigned three roost tree class suitability rankings (Class 1 trees, Class 2 trees, and Class 3 trees) to specific tree species based upon their bark characteristic and tendency upon death to provide suitable Indiana bat roosting habitat. The following tree species were ranked as Class 1 trees: silver maple, shagbark hickory, shellbark hickory, bitternut hickory, green ash, white ash, eastern cottonwood, red oak, post oak, white oak, slippery elm, and American elm. Class 2 trees are: sugar maple, shingle oak, and sassafras. Class 3 trees were any not listed above. Hardwood slopes and hardwood bottoms within the project area contain many Class 1 trees, as well as some Class 2 and 3 trees. Pine areas proposed for hardwood restoration generally are devoid of Class 1 or 2 roost trees.

No formally documented Indiana bat winter roost sites (hibernacula) are known to occur within the project area, nor within a five mile radius of the project area boundary. While several male Indiana bats have been captured during fall swarming surveys over the past couple of years at Equality Cave, the US Fish and Wildlife Service does not, at this time, recognize Equality Cave as an Indiana bat hibernacula, since no Indiana bats have been found roosting within the cave.

The closest known Indiana bat hibernacula to any of the proposed burn areas is Ellis Cave, which is located approximately thirteen miles to the south of Dennison Hollow NA. Ellis Cave is located on private land. Even though Indiana bats are not known to use Equality Cave (Cave Hill Cave), winter temperatures in many portions of the cave are suitable for use by winter roosting Indiana bats. No Indiana bat summer maternity roosts are known to occur within or near the proposed project area. A considerable amount of summer bat mist netting has taken place over the past 10 years on the Shawnee National Forest by Forest Service biologists and university researchers. In spite of an extensive amount of netting effort conducted in the most potentially suitable summer habitat types by highly respected and reputably bat biologists, the only known summer maternity roosts thus far documented on the Shawnee National Forest are restricted to the far west side of the Forest.

The Marion Illinois Sub-Office of the U.S. Fish and Wildlife Service Office has provided summer maternity records for both Johnson and Saline Counties on non-Forest Service lands.

Saline County: One summer maternity roost has been documented on private land west of Harrisburg, Illinois along Bankston Creek. Dr. Tim Carter subsequently captured two pregnant females in June of 2004. This site is located approximately 11 miles to the northwest of the Dennison Hollow Natural Area

Johnson County: Summer maternity activity has been documented at two sites in Johnson County along the Cache River in southern Johnson County. A juvenile male Indiana bat was captured in July 1986, and in 2004 Dr. Tim Carter captured an adult lactating female Indiana bat along the Lower Cache River near Karnak, Illinois along the Johnson/Pulaski County line. A female juvenile Indiana bat was captured along the Cache River in July 1985. In August of 2004, Dr. Tim Carter captured three adult non-reproductive females.

All three of these summer maternity sites are associated with wetland bottomland hardwood forest.

It is not known how many Indiana bats stay within the Forest boundaries during the non-hibernating season. However, some information about their habitat use and distribution across the Forest has been obtained. Carroll (2001) and Carter (2003) have recently (1999-2001 and 2002) sampled all likely roosting and foraging habitats across the Forest utilizing mist netting as part of a study with the SNF. Their studies have documented a few male Indiana bats in upland, hardwood forest in Alexander County in the vicinity of abandoned mines used as hibernacula. Their studies have also identified the two, relatively large maternity colonies in Jackson and Union counties on the Forest (USFWS BO, 2005). All of these areas are located a considerable distance to the west/southwest of the project area (over 30 miles).

It appears from the studies and surveys for Indiana bats on the Forest since 1992, including mist net surveys from at least 36 different locations on the Forest, that summer maternity roosting and foraging habitat is confined primarily to hydric, riparian, or bottomland hardwood areas with excessive amounts of mature hardwood tree mortality that are the indirect results of being heavily affected by past and present prolonged flooding. It also appears from these surveys and studies that upland hardwood forests across the Forest at present are not providing high quality or abundant maternity roosting habitat for Indiana bats (USFWS BO, 2005). Mist net locations on the Forest included many of the best riparian and associated uplands. Additionally, no Indiana bats have been captured in mist net surveys in many, non-native pine plantations on the Forest since 1992 (Carrol, 2001, Shawnee National Forest Monitoring Reports, 1992-2002). This appears to indicate that non-native pines on the Shawnee National Forest are not providing high quality habitats; or, are not used extensively by either male or female Indiana bats as roosting or foraging habitats (USFWS BO, 2005).

Potential summer foraging habitat is scattered throughout the Hidden Springs Ranger District on the Shawnee National Forest, as well as on adjacent private lands. Past research has strongly suggested that the amount of vegetative clutter and canopy density have a bearing on the use of forested areas by foraging Indiana bats. Feldhamer and

Carter (2005) documented a major movement of Indiana bats from more closed canopy roosting sites to more open-canopy sites to forage. Brack and Brown (2002) studied the foraging habits of Indiana bats and found that Indiana bats most frequently used agricultural land (44.7%), intermediate deciduous forests (22.6%), and open deciduous forests (19.0%), comprising 86.3% of all habitat types used for foraging during the survey. The bats' activity areas included proportionally more agricultural lands and open forests than were available in the study area. Closed canopy woodlands were not used by foraging bats to the extent they were available in the study area. The study concluded that Indiana bats more frequently used power-line rights-of-way, pasture edges, savannah-like woods, and other openings rather than large, continuous tracts of closed canopy forests.

These findings are consistent with the interpretation of telemetry data in similar studies (Brack 1983, Callahan 1993, Gumbert et al. 2002). All roost trees in these studies were located near forest canopy openings such as open woodlands or pastures, scattered trees of recently logged areas, old logging roads, utility line corridors, and natural drainages. Roost trees were very exposed with little or no canopy. Roosts in closed canopy deciduous forests were often in small openings near open corridor flyways (Brack and Brown 2002). During the summer of 2002, Sparks et al. (2005) radio-tracked 11 Indiana bats near Indianapolis International Airport. While bats preferred woodlands over other available habitats, radio-tracked bats spent nearly 50% of their time foraging over agricultural fields. Bats used riparian corridors to travel throughout a somewhat agricultural landscape.

Menzel et al. (2005) compared bat activity levels in the Coastal Plain of South Carolina among five habitat types: forested riparian areas, clearcuts, young pine plantations, mature pine plantations, and pine savannas. They found relatively low levels of bat activity in upland pine stands, which may be the result of a scarcity of insect prey in these stands. Kalcounis et al. (1999) suggested that bat activity may be lower in coniferous stands because of resins synthesized by conifers as a defense against herbivory may result in lower insect densities.

At the microhabitat scale, vertical structure or "clutter" in forest stands, such as tree boles, branches, and foliage affect bat foraging by impeding detection and pursuit of prey (Owen et al. 2004). The structural complexity of a forest, such as the amount of vegetative clutter (e.g., tree trunks, branches) significantly influences the foraging activity of bats, which in turn influences the presence of bats in that forest. Researchers have found that bat species segregate themselves among forests with high and low densities of vegetative clutter. Closely spaced trees and high densities of certain forests can be a hindrance to flying bats by impeding detection and capture of prey. Too much vegetative clutter may also increase the risk of predation by obstructing a clear path of escape (Avina et al. 2006). Patriquin and Barclay (2003) reported that foraging activity of *Myotis* spp. was influenced by vegetation density. *Myotis* spp. as a group, and *M. lucifugus* on its own, foraged more in deciduous clearcuts, specifically at the edge, and in intact forest patches.

Menzel et al. (2005) tracked and determined the home ranges of seven female and 4 male Indiana bats in 1997 and 1998 in Pike and Adam Counties, Illinois. This study highlighted the importance of forested habitat to Indiana bats in agricultural landscapes. Their study also documented the importance of linear landscape features such as riparian corridors and roads to Indiana bats as travel corridors and foraging habitat.

Within the vicinity of the project activity area, potential foraging habitat is available in the form of road corridors, utility corridors, somewhat open-canopied hardwood slopes and bottoms, natural forest openings, open cliff-lines, and abandoned farmland on adjacent private lands. Summer foraging habitat is not considered to be limiting on the Forest, with the possible exception of the larger and more remote tracts of mature hardwood forest (i.e. wilderness areas, etc.) or dense pine plantations. However, there is a biological benefit in having quality summer foraging habitat located within a several mile radius of summer roost sites so that bats can be most efficient in the conservation of food energy, growth and development of young of the year, and enhanced summer fat build up.

The results of this analysis concluded that the Indiana bat (*Myotis sodalis*) is the only federally-listed animal species that has the potential to occur within or near the potentially affected proposed project area.

Regional Forester's Sensitive Animal Species

Bald Eagle (Haliaeetus leucocephalus)

Suitable bald eagle habitat is absent from the project activity area. However, this species will be briefly addressed. The bald eagle is considered a fairly common migrant and winter resident along major river systems in Southern Illinois. Bald eagles require relatively undisturbed wooded roosting habitat and nesting sites located in close proximity to larger rivers, lakes, or other large water bodies, where food sources are plentiful. Bald eagles normally nest in large trees where there is a relatively unrestricted view of a large water body. None of this type of habitat is present within or adjacent to the project activity area. No bald eagle nests were found while conducting field surveys in December 2005 and January 2006. Eighteen active eagle nests were documented during a 2002 aerial census for the lower eleven Illinois counties (R. Lindsey, personal communication, May 2002). This is consistent with Grier et al. (1983) who predicted that with proper management, available habitat in Illinois could support up to 20 breeding eagle pairs by the year 2000.

Currently, bald eagles winter in and around Crab Orchard National Wildlife Refuge, Union and Horseshoe Lake State Wildlife Management Areas, along the Ohio River, Cache, Big Muddy, and Mississippi Rivers, Lake of Egypt, and a few other lakes in southern Illinois. Bald eagles are known in both summer and winter from both Johnson and Saline Counties. However, no nesting records exist within the project area, nor in close proximity to the project area. Annual surveys conducted by the Illinois Department

of Natural Resources have not identified any nests within or in close proximity to the project area. High quality wintering habitat does not occur in the project area, which consists mostly of pines on gently rolling hills. There is no recent evidence of any bald eagle winter roosting in the four areas. Winter hunting perches typically consist of a variety of larger dead and live trees located in relatively close proximity to either concentrations of wintering waterfowl or fish and larger watered areas, such as rivers, lakes, and reservoirs. This type of habitat does not exist within the project area.

It is unlikely that bald eagles would be present within the project activity areas during prescribe burning activities, or during the creation of small forest openings. Because suitable habitat will not be affected, and bald eagles are unlikely to be present when restoration activities are to be carried out, implementation of Alternative Two should have no adverse impacts on bald eagle.

Eastern Timber Rattlesnake (Crotalus horridus)

The historic range of the timber rattlesnake in Illinois was quite broad and included forests of the Ozark Hills, the Mississippi Border, the Southern Division, the Western Division, and the Jo Daviess Hills. Populations apparently occurred throughout the Shawnee Hills. Illinois Natural Heritage EOR's exist for this species in both Johnson and Saline Counties.

Suitable habitat is typically described as rocky hillside bluffs for den sites and woodland forests for summer habitat (Brandon et al. 1994). Brandon et al. (1994) described three distinct habitats where timber rattlesnakes may be encountered during the year were listed, (rocky den sites, summer ranges, and transient areas) within their activity ranges, and pointed out that habitat may vary with age and sex of the individual. Den sites seem to be of three types: fissures in rocky ledges, talus or rock slides, and fallen rock partly covered by soil. During summer months, timber rattlesnakes are commonly found in or near brush piles, upland forest or even in cultivated fields, and near rocky areas. Gravid females tend to use open rocky sites close to dens where they bask and feed.

Highly suitable denning habitat is present throughout portions of all three natural areas and the ecological area in the form of rock outcrops, cliff-lines, tallus slopes, rock shelters, and boulder fields. Foraging habitat is widely distributed in scattered abandoned wildlife openings. The presence of highly suitable denning habitat, as well as foraging areas, suggests that timber rattlesnakes could be present within the project area, and thus potentially affected by implementation of this project.

Southeastern Myotis (Myotis austroriparius)

This bat species is classified by the Illinois Department of Natural Resources as "state endangered", with records of occurrence in both Johnson and Saline Counties. In 2006, this species was documented as being present in the project area in Equality Cave/Cave Hill Cave. Past surveys have found between 18-25 bats, consisting of both adults and young of the year, as well as females and males. Bat surveys conducted of accessible

portions of Equality Cave in February of 2009 documented between 20 and 25 southeastern myotis hibernating in Equality Cave, documenting the use of the cave as a winter roost site. It is postulated that the cave is used during the summer as a bachelor colony, and in the winter as hibernacula. Fall harp trapping of the cave entrance has documented the sustained use of the cave by southeastern myotis, and increased use of the cave by this rare bat species. Fall harp trapping conducted in October 2009 yielded in excess of 29 southeastern myotis in 1.5 hours of harp trapping, which is an increase from 2007 and 2008 fall swarming surveys.

Forest Service wildlife biologists have also documented the presence of southeastern myotis during the summer of 2006 along Grantsburg Swamp in Johnson County during summer mist net surveys.

The southeastern myotis has a global rank of "Vulnerable" (NatureServe 2008). *M. austroriparius* has a Global Heritage Status of G3, G4, and National Heritage Status of N3, N4, indicating that the species may be rare to common. In Illinois, *M. austroriparius* has a ranking of S1, which is based on the Natural Heritage State Rarity ranks (NatureServe 2008). A state rarity ranking of S1 indicates that the species is "critically imperiled". The species is typically tied to mature bottomland hardwood swamp forest, which is declining in distribution and abundance throughout North America.

The geographic range of *M. austroriparius* extends from eastern Texas and southeastern Oklahoma up the Mississippi Valley to Illinois and Indiana and eastward to southern North Carolina (Trani et al. 2007). Southeastern Myotis is fairly widespread in the southeastern U.S., but the population in the heart of the range is declining (NatureServe 2008). Illinois lies at the extreme northern edge of the species range. Maternity colonies have been documented as using caves, hollow trees, mines, and concrete storm drains. Maternity roosts are thought to be the most important component of summer habitat because young are born and reared in these sites, especially Southern populations (Amelon et al. 2006). The physical characteristics that make a cave suitable as a maternity roost are not well understood. Like many cave-associated bat species, recent studies have suggested that human disturbance rather than cave structure may be the factor determining maternity cave use (Amelon et al. 2006).

Males and females roost together in winter and use a wider variety of non-cave roost sites than in summer, but the bulk of the population remains concentrated in caves. Although the species uses different winter and summer roost sites, and possibly different foraging areas, it tends to stay in the same region (Reynolds and Mitchell 1998).

M. austroriparius is associated with water. It forages low over the water's surface, feeding on a variety of insect taxa. Summer maternity colonies have been found using hollow hardwood trees in standing water in Illinois. The species has been documented foraging over slow-moving streams adjacent to upland areas with pine with mixed hardwoods. Other reported foraging types include mature forested wetlands in Illinois and Texas; forested streams in Tennessee; live oaks and shrubby old-fields in Florida, and bottomland hardwood and in baldcypress-tupelo gum swamp in Arkansas and South

Carolina. *M. austroparius* bats leave their roosts somewhat later than other bats and fly to ponds, swamps, rivers, or lakes. They fly over the water, capturing small moths, beetles, midges, and mosquitoes (Amelon et al. 2006).

Human disturbance during hibernation or maternity periods is a significant factor in the widespread decline of cave- and mine-dependent bat species. Maternity and/or hibernacula abandonment, and possible population extirpation, has been reported in many states throughout the Southeast. Human disturbance also includes indirect habitat disturbance. Noise and lights from cave exploration occurring during hibernation may awaken or disturb roosting bats and cause them to abandon the cave and result in depleting their fat supplies (Amelon et al. 2006). Smoke entering a roost site (i.e. cave) generated from wildfires or prescribed burns could also constitute an adverse disturbance such as to cause roosting bats to awaken and cause depletion of winter fat reserves, leading to winter mortality.

In maternity colonies, disturbance may induce adults to fly, resulting in young being knocked from the roost leading to juvenile mortality. The collapse or destruction of natural or artificial roosting structures such as a hollow trees, caves, mines, buildings, or culverts may trap bats or close a roost to future use (Amelon et al. 2006).

Converting or harvesting mature wetland and seasonally-flooded bottom-land forests may impact *M. austroriparius* in areas where the species roosts in hollow trees or forages in mature wetland and bottom-land forests, such as southern Illinois (Amelon et al. 2006). *M. austroriparius* is documented as using portions of the project area for summer as well as winter roosting. It is unlikely that any seasonally flooded bottomland hardwood areas will be involved in the proposed project. It is likely, however, that bats also utilize portions of the project areas for foraging, especially portions of the Cave Hill area.

Eastern Small-footed Bat (Myotis leibii)

This bat species currently has no official Illinois Natural Heritage ranking since prior to 2006 the species had never been documented as occurring in Illinois. However, with only one Element of Occurrence record in the state, it would be safe to assume that the species will be classified as “state endangered”. In most states in the Eastern U.S. the species is classified as either S1 or S2. The only records of occurrence for this bat species in Illinois are in Johnson County. During the summer of 2006, summer interns with the IDNR documented the occurrence of two individuals (one female and one male) roosting under a sandstone slab at the Fink Sandstone Barrens Ecological Area, which is located less then two miles to the northeast of the Simpson Barrens Ecological area.

M. leibii is the smallest Myotis in the Eastern United States, with summer weight ranges from 3 to 8 g (mean of 3.8 g). Reports suggest that it is one of the rarest bats in North America. Very little is known about the ecology and life history of this species.

M. leibii is reported to be among the hardiest of bats with respect to winter temperatures and hibernation, being one of the last to enter hibernacula, seldom entering before mid-

November and often departing by early March. This species often is found in drafty locations near the openings of hibernacula where the temperature may drop below freezing and humidity is relatively low. *M. leibii* appears to be an obligate hibernator, usually roosting singly or in small clusters. Periods of activity observed during hibernation suggest this species may not spend as much time in deep torpor as do other cave-hibernating species (Amelon and Burhans 2006).

The habitat for the *M. leibii* is mostly in hilly or mountainous terrain where the geology provides fractures and cracks in exposed rock or in karst areas. Summer roost sites include caves, mines, ridges, tallus slopes, rock shelters, glades, cracks in rock faces, rock outcrops, trees, and bridges. Two individuals were found roosting under a rock near a rock quarry in April in Tennessee, while one individual was found roosting under a stone on a hillside in Missouri (Amelon and Burhans 2006). *M. leibii* has been observed resting in limestone caves in spring and summer in Virginia. Several accounts have found this species roosting in human-made structures, including houses, barns, and bridges. Proximity to water may be a factor in maternity roost locations (Amelon and Burhans 2006).

All of the above-listed roosting habitats are present throughout portions of all three natural areas and the one ecological area. While this species has not been documented as occurring in any of the four areas proposed for burning, the species has been documented less then several miles from the Simpson Sandstone Barrens Ecological Area. Additionally, highly suitable habitat is present throughout portions of all four of the areas proposed for burning.

Disturbance during the hibernation or maternity periods is a significant factor in the widespread decline of cave- and mine-dependent bat species. The main factor leading to population declines is destruction of roost sites, particularly hibernacula. One major threat to *M. leibii* is the lack of knowledge about its life history needs and population status. Because of its propensity for mines and loose rock materials, this species may be threatened by activities related to mining and surface rock disturbance. Widespread recreational use of caves, causing indirect and direct disturbances by humans during the hibernation period, poses the greatest known threat to this species (Amelon and Burhans 2006).

Smoke entering a roost site (i.e. cave, rock shelter, tallus/boulder fields, cliff-line habitat, etc.) generated from wildfires or prescribed burns could also constitute an adverse disturbance so as to cause roosting bats to awaken and cause depletion of winter fat reserves, leading to possible winter mortality.

The presence of prime summer and winter roosting habitat, and the relatively close proximity of late summer records to the project area suggest that this species could be present within portions of the project area.

Rafinesque's big-eared bat (*Corynorhinus rafinesquii)*

The range for *C. rafinesquii* extends from southern Virginia, Ohio, Indiana, Illinois, south to Florida and the Gulf of Mexico; west to Louisiana, Arkansas, eastern Oklahoma, and the eastern edge of Texas (NatureServe 2008). The species has a global rank of "Vulnerable", with a Global Status of G3. In Illinois, the species has a state rank of S1 (Imperiled), and is classified by the Illinois Natural Heritage Survey as "state endangered". Element of Occurrence records exist only for Johnson County.

Known roost sites for *C. rafinesquii* are scattered and the species is considered rare throughout its range. Although individuals occasionally roost alone, Rafinesque's big-eared bats normally roost in small clusters that range from 2-100 bats. Clusters in the northern parts of the range tend to be larger than those in the South (Trani et al. 2007).

Rafinesque's big-eared bat occurs in several forest types, and will roost during the summer in hollow trees. When caves are available, they may be used as roost sites. When roosting in caves, the bat selects rooting sites located in cool zones near the cave entrance to offer twilight illumination. Most roost sites, however, are located in partially-illuminated, human-constructed shelters, and buildings. Recorded roost sites for this species include occupied buildings, a turpentine still, well shafts and cisterns, concrete culverts, bridges, an artificial limestone grotto, hollow trees, and crevices behind loose bark (Trani et al. 2007). The species also uses rock shelters and caves during the summer.

Much of the historical occupied habitat for this species was lost with the clearing of swampland and bottomland forests in the past several hundred years. Present threats include: forest destruction, hollow tree removal during certain forest management practices, decreasing availability of abandoned buildings through hazing and vandalism, insecticide applications, vandalism of caves and mines, and closing or blasting of mines shut. There is considerable potential for loss and degradation of roosting and foraging habitats by commercial logging practices in preferred habitat (NatureServe 2008).

There are no known records of occurrence for this bat species within the three natural areas or the one ecological area. However, potentially suitable summer and winter roosting habitat does exist throughout portions of all four areas in the form of rock shelters, cliff-lines, rock crevices, and caves. It is feasible that this rare bat species could be present within the proposed burn areas during winter hibernation.

Illinois State-Listed Animals

Bobcat (Lynx rufus)

All of the proposed project area currently constitutes suitable bobcat habitat, with the highest quality foraging habitat being found in the abandoned agricultural fields. The Illinois Natural Heritage EOR database indicates locality records for bobcats in both Johnson and Saline Counties. It is likely that bobcats could use the project area throughout portions of the year for foraging as well as denning habitat.

Bobcats are generally most abundant in early to mid-successional habitats, and often concentrate their activities on human-modified areas. A very small amount of this type of habitat occurs in the project area in the form of abandoned agricultural areas. However, bobcats can occupy a variety of habitat types, including mature pine, mixed pine/hardwood, upland hardwood, and bottomland hardwood. The primary food items of bobcats are rodents and lagomorphs. Thickets, hollow stumps, and logging debris offer adequate cover for both resting and denning. Bottomland hardwood areas are often selected for loafing and travel, possibly because the closed canopy and dense mid-story of these areas supply shade during periods of high summer temperatures. Any vegetation management that results in the creation of additional dense vegetative thickets, and will result in an increase in the distribution and abundance of small mammal and rodent populations will benefit bobcats (Boyle and Fedley 1987).

Cooper's Hawk (Accipiter cooperii) and Sharp-shinned Hawk (Accipiter striatus)

Because the reported habitat requirements for both of these accipiter species are associated with pine, mixed pine and hardwood, and with woodland openings or fields in close proximity, the effects discussion will be conducted by grouping both species together. Both the sharp-shinned hawk and Cooper's hawk breed in deciduous, coniferous, and mixed deciduous-coniferous forests as well as open woodlands, preferring to nest in forest with some conifers (Kleen et al. 2004). Both species utilize a mixture of deciduous, conifer, and open woodlands for foraging, especially a complex of woodlots and openings (Wiggers and Kritz 1991), and rely feed upon other birds, chasing them on the wing in woodlands. Lizards and amphibians are also taken. Both species are considered "aerial or hawking carnivores" (Hamel 1992).

Portions of the project area represent suitable nesting/foraging habitat for both of these species of hawks. The Illinois Natural Heritage EOR database shows locality records for Cooper's hawk and sharp-shinned hawk in Johnson County; and sharp-shinned hawk in Saline County. It is assumed that both species could be present in the project area, due to the presence of suitable habitat. Neither of these species has been documented as occurring within or near the project area. Neither Cooper's or sharp-shinned hawks are considered to be very abundant in Illinois.

Red-shouldered Hawk (Buteo lineatus)

The Illinois Natural Heritage EOR database show locality records for this species for both Johnson and Saline Counties. Red-shouldered hawks are most commonly found in bottomland forests or wooded swamps, but has been known to use upland mature pine stands for nesting and foraging. The red-shouldered hawk is a species that often hunts from a perch and forages along streams and backwaters for crayfish, amphibians, reptiles, small mammals, and birds (Kleen et al. 2004). Red-shouldered hawks generally do not use upland forested habitat for nesting, but have been documented using upland pine stands for nesting in Illinois.

Foraging typically never takes place far from wetlands; feeding takes place at marshes, wooded lakes or ponds, or in swamps. Nest sites are usually in wet or moist hardwood forests (Hamel 1992). Suitable habitat is present in coves and bottomland areas hardwood bottoms and hardwood slopes located within the project area, as well in mature pine stands. Red-shouldered hawk nesting habitat is present in hardwood bottoms, hardwood slopes, and mature pine stands, with the highest quality habitat occurring within hardwood slopes and bottoms. However, this raptor species will use pine stands for nesting. This species is a common raptor on the Forest during the breeding season.

It is likely that this species is present within the proposed burn areas.

Golden Mouse (Ochrotomys nuttalli)

The Illinois Natural Heritage EOR database show locality records for the golden mouse in Johnson and Saline Counties. Golden mice prefer thick, thorny undergrowth, with species such as honeysuckle, greenbrier, brier, spicebush, and rhododendron. In Illinois, the principal food items of golden mice include seeds from poison ivy, blackberry, bedstraw, acorns, and other mast and seeds. Because this small mammal forages on the ground more than other small mammal species, ground litter and dense understory cover have been reported as being important. Nests are often constructed in greenbrier, honeysuckle, sumac, and wild grape (Morzillo et al. 2003).

The majority of the project area represents unsuitable golden mouse habitat. Suitable habitat is restricted to widely scattered small pockets of habitat represented by abandoned wildlife openings and pine stands. These areas currently provide thickets of Japanese honeysuckle, blackberry, greenbrier, and other grasses, forbs, and legumes.

This analysis concludes that the following Illinois state-listed animal species could be present within the project area: bobcat, red-shouldered hawk, Cooper's hawk, sharp-shinned hawk, and golden mouse.

Management Indicator Species (MIS)-Animals

This project is located in the State of Illinois, thus wildlife and fish species are managed in cooperation with the Illinois Department of Natural Resources (IDNR). The IDNR sets policy for hunting and fishing regulations and associated enforcement of state regulations. The Forest Service manages the habitat conditions. The following discussion focuses on the habitat conditions that support wildlife populations in the project area.

Under the National Forest Management Act (NFMA) the Forest Service is charged with providing for a diversity of plant and animal communities consistent with overall multiple-use objectives. Management Indicator Species (MIS) are a planning tool used to accomplish this requirement (36 CFR 219.19 of 1982 Regulations). They are selected during the forest planning "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.10(a)(1) on important elements of plant

and animal diversity. They and their habitat needs are used to set management objectives and minimum management requirements, to focus effects analysis, and to monitor effects of Forest Plan implementation. The Shawnee National Forest Land and Resource Management Plan is designed to provide habitat conditions needed to maintain viable populations of all MIS, along with other species that use similar habitats.

MIS were identified during the forest-planning process for the 2006 Forest Plan in accordance with planning regulations. As part of the 2006 Forest Plan revision process, and after consultation with, and input provided by the Illinois Department of Conservation, the Forest MIS list was developed, resulting in *five species*. The MIS in the 2006 Forest Plan include: *the northern bobwhite quail, yellow-breasted chat, worm-eating warbler, scarlet tanager, and wood thrush*. These five MIS were selected to: (1) provide greater focus to monitor the effects of Forest Plan implementation on wildlife species associated with openlands and early successional habitats, and mature deciduous woodlands; and, 2) to avoid the use of MIS that are considered to be habitat generalists. The selected bird MIS are species that have been and will continue to be monitored as part of the Forests bird monitoring program using permanent point count methodology. Four of the selected MIS are exhibiting recent population declines both regional as well as more locally in Illinois. Additionally, four of these MIS (yellow-breasted chat, wood thrush, worm eating warbler, and scarlet tanager) have been identified as species having population viability concerns on both the Hoosier National Forest and the Shawnee National Forest.

Appropriate MIS will be used to evaluate the effects of the proposed natural areas burning on wildlife. Some of these five MIS may be combined in this analysis where planned project effects would be similar. Management activity effects are examined in light of the existing habitat conditions, both within and outside of the Forest, and documented population conditions or trends.

Based upon habitat requirements, adjacent habitats to the project area, and known occurrence data, the following MIS species-*northern bobwhite quail* is not believed to occur within the proposed project area, suitable habitat does not exist within the project area that could support any of these species, nor is it expected that suitable habitat will result in the short-term or the long-term for this species from the implementation of the proposed project. Any potentially suitable habitat for this species is located far enough away from the project area, and the presence of unsuitable habitat surrounding the project area, making it highly unlikely that northern bobwhite quail or yellow-breasted chats would move into the project area. While the scattered abandoned wildlife openings represent marginally suitable habitat, it is believed that these patches of habitat are too small in size, and too widely disconnected, to support yellow-breasted chats.

Implementation of either Alternative Two is not expected to change habitat conditions to an extent required to support yellow-breasted chats. Yellow-breasted chats require larger blocks/patches of early successional habitat (Woodward et al. 2001). Because these species are not believed to be present within the affected project area, there is expected to

be no adverse direct, indirect, or cumulative impacts to these species from implementation of the action alternative.

A description of the habitat requirements, potential threats, and a discussion of population trends for all five wildlife MIS is listed in the "Appendices-Final EIS for the Land and Resource Management Plan", Appendix F-pages 109-116, and is incorporated by reference. Population trend information for MIS has been addressed on pages 145-147, in the Final EIS for the Forest Plan, and is incorporated by reference. Population trend information for all five MIS has also been addressed in the following discussion for each MIS.

Three animal MIS (*wood thrush, worm-eating warbler, and scarlet tanager*) are likely to occur within the project area, suitable habitat is present that could support any of these species, or suitable habitat will be created by implementation of the project.

Wood thrush

Wood thrushes inhabit deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially in more mesic sites. Bottomlands and other rich hardwood forests constitute prime habitats. This bird also frequents pine forests with a deciduous understory and well-wooded residential areas. Thickets and early successional woodland generally do not provide suitable habitat. However, wood thrushes have been reported nesting in stands of young white pine with a canopy under 9 meters in height. Nests usually are placed in a crotch or are saddled on a branch of a shrub, sapling, or large tree (The Nature Conservancy 1998). However, studies conducted by Rivera et al. (1998) and Anders et al. (1998) have documented the importance of early successional oak-hickory, pine, and mid-successional habitats as post-fledging dispersal habitat for juvenile wood thrushes.

Wood thrush are found in higher breeding densities in saw timber mixed pine/hardwood, saw timber oak/hickory, and saw timber loblolly pine/shortleaf pine. Key habitat requirements include a woodland understory of deciduous shrubs or saplings (Hamel 1992). Habitat degradation and fragmentation are commonly cited as the biggest threats. With loss of habitat and increased conversion to agriculture and pine plantations, both brood parasitism and nest predation rates increase. Rate and impact of cowbird parasitism is highest in the Midwest and lowest in the Northeast (The Nature Conservancy 1998). Data were collected from fragmented forests in Illinois by Tine (1998) where thrushes suffered extraordinarily high rates of brood parasitism.

Population trend estimates for wood thrush populations are -1.3% per year (non-significant) for Illinois and -0.1% per year for the upper Midwest for 1966-2000 (Kleen et al. 2004). At present, chat populations in Illinois are considered to be greatly diminished (Kleen et al. 2004).

Suitable habitat is abundantly present throughout all three natural areas and the ecological area. It is likely that this species occurs in at least portions of all four areas where suitable habitat exists.

Worm-eating warbler

Breeding habitat consists of well-drained upland deciduous forests with understory patches of mountain laurel or other shrubs, drier portions of stream swamps with an understory of mountain laurel, deciduous woods near streams; and, almost always associated with hillsides. Dense patches of shrubs or saplings may be an important component of territories. The species is most abundant in mature woods but also may be common in young and medium-aged stands (The Nature Conservancy 1998). Because of its habitat requirements, this warbler is somewhat limited to the larger hillside areas of the Shawnee National Forest, and a few of the larger forested sites farther north in Illinois (Kleen et al. 2004).

The worm-eating warbler is found on so few BBS routes in Illinois and the region that the reliability of the trend estimates is low. Given this, the population trend estimates for 1966-2000 for Illinois and the upper Midwest are 4.6% per year (non-significant) and 3.1% per year (non-significant).

Suitable habitat is present throughout portions of all three natural areas and the ecological area, and it is likely that this species may occur in at least portions of all four areas where suitable habitat exists.

Scarlet tanager

Scarlet tanager breeding habitat consists of deciduous forest and mature deciduous woodlands, including bottomland swamps, floodplain forests, and rich moist upland forests. Scarlet tanagers prefer oak trees, and are found less frequently in mixed forest. The species is found most common in areas with a relatively closed canopy, and dense understory with high diversity of shrubs, and scanty ground cover. Scarlet tanagers are apparently able to breed successfully in relatively small patches, sometimes being found in wooded parks. It is able to breed in various forest stages, but is most abundant in mature woods. Scarlet tanagers have been found in good numbers in pine plantations on the Forest (Cottam and Robinson 2005). The greatest threat is the continual loss and fragmentation of breeding and wintering habitat (NatureServe 2008).

The scarlet tanager is known to breed throughout Illinois, and is considered a common summer resident in the Shawnee Hills and slightly less abundant in the Floodplains and Till Plains of southern Illinois (Robinson 1996). The breeding trend estimate for scarlet tanager in Illinois is -2.5% per year (non-significant). In the upper Midwest, the trend estimate indicates an increase in population at a rate of 1.2% per year (significant) (Kleen et al. 2004).

Suitable habitat is present throughout all three natural areas and the ecological area. It is likely that this species occurs in at least portions of all four areas.

Population Viability Concern Species

The 2006 Forest Plan listed animal species that were identified during the viability process to have viability risks in the Hoosier and/or Shawnee National Forests to be indicators of biodiversity. These species are listed on page 162, Chapter 3, in the Final Environmental Impact Statement for the Land and Resource Management Plan. Excluding federal threatened-endangered species, regional forester's sensitive species, and MIS, the list includes the following additional terrestrial animal species: gray treefrog, river otter, redheaded woodpecker, eastern woodrat, and American woodcock. Suitable habitat is not believed to be present for river otter in any of the four areas proposed for restoration. Based on the presence/absence of suitable habitat, and known range/occurrence of the species, the following species could be potentially be present within the four areas proposed for restoration: gray treefrog, redheaded woodpecker, eastern woodrat, and American woodcock.

Gray Treefrog

Gray treefrogs are known to occur in a variety of habitats, usually associated with small ponds, borrow pits, roadside ditches, beaver ponds, or other standing water. Forest type associations include many types of hardwoods, including white oak-red oak-black oak and mixed pine-hardwood. These frogs are often found in recently disturbed areas with an abundance of shrubs, herbaceous growth, and vines (Wilson 1995). The 2006 Forest Plan calls for "maintaining a diversity of fish-less, shallow-water breeding areas across the Forest in both upland and bottomland forests." Gray treefrogs are likely to be present in and adjacent to the widely scattered wildlife ponds found throughout portions of the four areas.

Redheaded woodpecker

The redheaded woodpecker is a cavity-dependent bird species that utilizes open, upland and bottomland, oak woodlands and forests with many dead trees for nesting and foraging (USDA Forest Service 2006). Preferred habitat include open woodland (especially with beech and oak), open situations with scattered trees, parks, cultivated areas, and gardens (NatureServe 2008). The redheaded woodpecker once was a common species in much of the Midwest and eastern North America in oak (Quercus sp.) savanna, farmlands, and other open habitats with trees.

This species has experienced a range-wide population decline over the past century that likely is associated with changes in land management within agro-ecosystems and loss of oak savanna (Rodewald et al. 2005). The redheaded woodpecker has a Global Status of G5, and is classified by the Illinois Department of Natural Resources as S5 (Secure). Reforestation of eastern U.S., loss of small orchards, loss of chestnuts, decline of oak savannah habitat, fire suppression, and the switch to cleaner agricultural practices (e.g.

removal of hedgerows, odd corners on fields, larger monoculture fields) probably have all contributed to the decline (NatureServe 2008).

No records for this species are presently known for the project area. However, suitable habitat does occur throughout portions of all four areas. Prescribed burning has the potential to improve the availability of suitable habitat within the affected project area.

Eastern Woodrat)

Historically, woodrats were widespread in suitable habitats throughout southern Illinois. They are now found naturally (not reintroduced) at only four sites in Illinois, all being on the west side of the Forest. Woodrats may live in forested areas, swamps, grasslands, abandoned buildings, and rocky outcrops. In southern Illinois, rocky outcrops in forested areas are an important element of suitable habitat. Connectivity between suitable habitat is vital for dispersal (Feldhammer et al. 2007). Not only is rocky bluff habitat crucial, but consideration of food availability is needed. Woodrats are generalist feeders and adapt their feeding habits to local conditions, collecting a variety of foods, such as seeds, fruits, nuts, and herbaceous material. Oak mast is an important food component in the diets of woodrats (Feldhammer et al. 2007), so hardmast producting forest types is an important habitat element.

From 2003 through 2007, researchers at Southern Illinois University translocated 341 woodrats to four locations in southeastern Illinois (Garden of the Gods, Pounds Escarpment, High Knob, and Buzzard's Point). Woodrats used for the translocation effort came from stable populations in Missouri and Arkansas. Researchers concluded that the translocation effort was a moderate success (Feldhammer et al. 2007). The Garden of the Gods site is located less then five miles to the southeast of one of the proposed areas to be burned (Dennison Hollow).

Suitable habitat is widely dispersed throughout portions of all four areas proposed for burning. However, woodrats have not been documented as occurring in any of the four areas. SIU researchers reported that woodrats dispersed approximately 1 km from the Garden of the Gods release site (Feldhammer et al. 2007). Field surveys of a sample portion of bluff habitats in Cave Hill, Simpson, and Dennison Hollow failed to find any sign of woodrats being present. For this analysis, it will be assumed that woodrats are not present in any of the four areas proposed for burning. Consequently, implementation of Alternative Two should have no direct, indirect, or cumulative adverse effects on the woodrat population on the Forest. However, prescribed burning should, overtime, improve the suitability of all four areas for future occupancy.

American Woodcock

The American woodcock is a species dependent on wet areas in hardwood forests, oldfields, and grasslands for foraging and early-successional areas in forests and oldfields for nesting on the Forest. The species has always been considered an uncommon nesting species in Illinois and on the Forest (USDA Forest Service 2006). The American woodcock is included on the list of *National Species of Special Emphasis* by the US Fish and Wildlife Service (Cade 1985). *Species of Special Emphasis* are: "those fish, wildlife,

and plant species of special biological, legal, or public interest, upon which the U.S. Fish and Wildlife Service effort and attention if focused."

The species would benefit indirectly through effects on its habitats from timber harvesting and prescribed fire to maintain early-successional, hardwood forests in both upland and bottomlands; and openings and openlands management. Vegetation disturbances that create areas of early successional forests are beneficial (USDA Forest Service 2006).

The only suitable habitat that occurs within the four areas would be the scattered abandoned wildlife openings. Burning these abandoned wildlife openings may be effective in retaining these early successional habitats for woodcock. Woodcock may also use lowland wet riparian areas for feeding.

Species of Migratory Birds of Conservation Concern

In February 2009, the Forest Service and US Fish and Wildlife Service signed a "*Memorandum of Understanding on the Migratory Bird Treaty Act*", which outlines considerations for minimizing the take of migratory birds that is incidental to otherwise lawful activities. In the MOU, the Forest Service committed to, as part of the NEPA process, evaluate the effects of land management activities on migratory birds, focusing first on "*FWS Birds of Conservation Concern*" (updated 2002). This list divides bird species by Bird Conservation Regions. The Shawnee National Forest occurs in the Central Hardwoods Bird Conservation Region. The "Birds of Conservation Concern for the Central Hardwoods Bird Conservation Region" includes 20 species, which are listed in Appendix C. This list includes birds that are migrants, winter residents, spring/summer residents, and species that are not known to occur in southern Illinois. After evaluating the type of bird habitats present within the proposed burn areas, and bird species occurrence records, this analysis has determined that it is feasible that eight (8) bird species of special conservation concern may occur within the four burn areas. These are *whip-poor-will, red-headed woodpecker, Bewick's wren, wood thrush, blue-winged warbler, worm-eating warbler, and Louisiana waterthrush.*

Other Wildlife Issues

Compliance with the Migratory Bird Treaty Act and Executive Order 13186

Executive Order 13186 signed on January 10, 2001, among other things, directed all Federal Agencies to "*take certain actions to further implement the Act" (i.e. Migratory Bird Treaty Act). For purposes of this project, the applicable sections of EO13186 are Sec.3.(e) that each agency shall "to the extent permitted by law… and in harmony with agency missions: (1) …avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions*;" and "(6) *ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern.*"

Migratory bird conservation is a primary emphasis in the Forest Services efforts to advance species conservation. Moreover, Executive Order 13186 (January 2001) outlined responsibilities of federal agencies under the Migratory Bird Treaty Act and requires each federal agency whose actions have, or are likely to have, a measurable negative effect on migratory bird populations to develop a Memorandum of Understanding (MOU) with the US Fish and Wildlife Service to promote the conservation of migratory bird populations.

The Forest has taken, and continues to take, many planning and administrative actions, at both the Forest level and the project-level, to conserve populations of migratory birds across the Forest. The Forest is complying with Executive Order 13186, to the extent practicable to work with the USFWS to conserve populations of migratory birds. The Forest consulted with the US Fish and Wildlife Service on the proposed management of migratory birds (planning record) and received no indication that possible Plan actions do not comply with the Migratory Bird Treaty Act (MBTA) and meet fully the intent of Executive Order 13186. The Forest has historically been a leader in Illinois and the Midwest in management to benefit and conserve many species of migratory birds on the Forest.

The new Forest Plan expands the amount of area on the Forest on which management will be emphasized to reduce forest fragmentation and improve forest diversity for migratory birds, especially those that need un-fragmented forest, which will be emphasized. This expansion represents an 89 percent increase in habitat, or 99,400 acres managed with emphasis for migratory bird species that are primarily forest-interior species. Thirty-two areas in the 2006 Forest Plan have been identified to be managed to provide habitat to support viable populations of wildlife species associated with forest interior habitat conditions. The Cave Hill, Dennison Hollow, and Stoneface NA's fall within two of these areas. The 2006 Forest Plan also emphasizes management for both resident and migratory grassland birds with the inclusion of the Large Openlands management prescription and its direction and guidelines.

Standards and guidelines (both at the Forest level and the management prescription level) have been developed in the 2006 Forest Plan to minimize potential direct and indirect adverse effects; to manage and provide for snag and tree cavity habitat; to retain the integrity of breeding habitats; and, to implement actions to enhance habitat and populations of resident, migratory birds and wintering birds.

The best science available was used to develop the 2006 Forest Plan management strategies and direction for migratory birds, which was developed after consultation with recognized avian scientists. The Forest has been, and is, an active partner in the Central Hardwoods Bird Conservation Region. By participating in Partners in Flight, the Forest is coordinating our efforts with the efforts of many other state, federal, local government, and private conservation agencies to focus bird conservation efforts where they will do the most good. The new Forest Plan employs the latest avian, wildlife, and forestry scientific information and input from these avian scientists. Plan management directions and strategies evolved to serve as countermeasures to identified major threats by insuring

forest interior, early-successional forest, and grasslands in the Hoosier-Shawnee ecological assessment area.

The action alternative (Alternative Two) proposed and evaluated for this proposed project fully incorporates the standards and guidelines outlined in the 2006 Forest Plan to reduce the potential for adverse impacts to migratory birds from implementation of land management actions, and thus comply with the intent of Executive Order 13186 to protect and conserve migratory birds.

The action alternative proposed fully complies with the requirements, and obligations to the Forest Service, as outlined in the U.S. Fish and Wildlife Service and U.S. Forest Service "2009 Memorandum of Understanding on the Migratory Bird Treaty Act". The Forest has: *a) addressed the conservation of migratory bird habitat and populations when developing, amending, or revising management plans for the Forest; b) as part of the NEPA process, evaluated the effect of agency actions on migratory birds, through both the Forest Plan and Forest EIS and effects analysis for this proposed project, focusing first on species of management concern along their priority habitats and key risk factors; initiate and support management studies and research to identify the habitat conditions needed to conserve migratory birds, and to evaluate the effects of management activities on habitats and populations of migratory birds; and, promote and recognize the value of migratory birds to the public.*

Sec. 3.(e)(1) of Executive Order 13186 also directs federal agencies to "*support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities…*" Sec 3.(e)(2) further states that federal agencies shall "*restore and enhance the habitat of migratory birds, as practicable.*"

The Shawnee NF has worked toward these goals for decades. The 1992 Forest Plan contained standards and guidelines designed to provide a wide variety of forested habitat conditions, as well as special standards and guidelines for protection and management of specialized habitats (wetlands, caves, glades, riparian, bottomland hardwoods, ponds, and shortleaf pine forest) to restore and enhance habitats for a diversity of avian species. The 2006 Forest Plan carried forth many of the essential elements of the 1992 Forest Plan, but with expanded effort directed toward the designation of areas within which habitat conditions would be restored/perpetuated to support interior migratory birds, restore historical open grasslands, and in restoring/maintaining high quality bottomland hardwood and riparian forest habitat conditions. The standards and guidelines recognize that all successional stages of forest, open habitats, and unique ecological conditions are important components of a healthy ecosystem that will support viable populations of all native species.

Fragmentation/Nest Parasitism/Nest Predation

In the past five to ten years, an extensive amount of research has documented a problem with habitat fragmentation, and resulting adverse impacts to neotropical migrant

songbirds. Any activity that reduces the quantity, arrangement or connectivity of late-successional mature forested habitat may result in habitat fragmentation impacts for bird species associated with interior forested habitats. Conversely, the loss of, or isolation of, early successional, shrub/scrub, and grassland habitats has also been shown to have adverse habitat fragmentation impacts on Neotropical migrant songbirds associated with early successional habitats and scrub/shrub habitats. Increased nest predation and nest parasitism rates are often associated with fragmentation impacts. Numerous bird studies of forest birds support the widely held notion that fragmentation of breeding habitat significantly decreases annual reproductive success and viability. Mechanisms underlying the reduction of breeding success include changes in the local abundance and assemblage of predators, invasive species, and brood parasites associated with edges and the matrix surrounding the fragments (Cottam et al. 2009).

Dormant season burning should have no effect on the distribution, abundance, or connectivity of late succesional mature forest within the four areas proposed for burning. Consequently, there should be no effects on habitat fragmentation, nest parasitism, or nest predation rates for neotropical migratory birds associated with interior forest habitat.

The amount of early successional or shrub/scrub habitat is currently very limited throughout the project area, existing in isolated and disconnected small patches. This habitat type is already “fragmented”. Additionally, these isolated early successional patches are rapidly succeeding toward pole/sapling forest.

While this project may result in the removal of mature trees on up to two acres each year, and thus create early successional habitat conditions within a predominantly mature forested landscape, the scope and magnitude of this action should have negligible and immeasurable effects in the creation of additional habitat edge since a very small amount of habitat will be affected. The small forest openings that are created should be small enough, and of such a low magnitude, and of short-term persistent, so as to have negligible effects in creating additional nest parasitism or nest predation to nesting neotropical migrant songbirds. The resulting forest openings should also be small enough, and of such a low scope, so as to have negligible effects in habitat connectivity. The small forest openings are also expected to be too small in size and too isolated to support viable populations of neotropical migrant songbirds associated with early successional habitats shrub/scrub habitats. In spite of regular prescribed burning, it is projected that eventually the abandoned wildlife openings will convert to mature forest habitat over time.

Burns proposed for the Cave Hill, Stoneface, and Dennison Hollow NA’s are located within areas that have a high potential for providing habitat for wildlife species associated with forest interior habitat conditions. Conducting cool-season dormant season burns, and the creation of scattered small canopy gaps from tree/shrub removal, are compatible with the objective for managing habitat to feature forest interior conditions. Both actions comply with the standards and guidelines in the 20006 Forest Plan. Neither Alternative Two nor Three will modify forest interior habitat conditions to such a degree so as to diminish the value or intent of these areas to provide forest interior wildlife habitat.

Conducting prescribed burning, and the removal of trees or shrubs, will require no new road construction, so there should be no increased amount of linear edge habitat created. All new fire control line constructed will be accomplished using gas-powered leaf blowers, gas powered chainsaws, and handtools (minimum impact methods), so no additional new linear edge habitat should be created.

ANALYSIS OF POTENTIAL EFFECTS OF THE PROPOSED ACTION

For every decision that results in the implementation of a management activity that affects the type, amount, distribution, and/or arrangement of wildlife habitat within a landscape area, there will be corresponding potential differences in effects to wildlife habitat conditions, wildlife species diversity, and wildlife species abundance. Given the fact that different wildlife species have different habitat requirements, changes in the amount and type of habitat will have differing corresponding plus or minus effects to species abundance and diversity. As habitat conditions become less favorable, some species would be expected to become less abundant or to disappear all together. Conversely, as habitat conditions become more favorable, other species would be expected to become more abundant.

Some species are more sensitive to changes in the quantity and quality of habitat, while other species have a much broader range of tolerance to habitat changes. Inherent in any decision to implement a management action is the fact that each action will have varying potential effects in magnitude and duration (both negative as well as positive) for different species. Generally speaking, changes in habitat tend to have less effect on species that are more mobile and those that have broader habitat requirements ("habitat generalists) then for species having more narrow habitat requirements ("habitat specialists") and less mobility, depending upon the proposed action.

While implementation of a management activity may result in lower population levels pre-implementation for some species, the population of a species can still remain at or above a viable or desirable population level within a given area, as well as across the Forest planning area. The implementation of a management action may result in a reduction in habitat quality in a smaller restricted area (i.e. a project area), but have only minor or undetectable changes in effects to population levels across a larger landscape analysis area (i.e. a national forest area). For some species, a particular habitat type may be considered to be more highly suitable, but the species will utilize other habitat types of lower quality at lower population levels.

While implementation of the "no action alternative" (Alternative One) is not likely to have any direct adverse effects, a decision to implement no restoration activities could have differing positive and negative indirect effects to different wildlife species.

The implementation of Alternative Two may result in both direct and indirect affects to some wildlife species. Some of these effects may be very short-term in nature, while some may have more longer term persistent effects. The overall affects could persist over a longer period of time due to fairly frequent re-burning during the first ten year period.

Implementation of Alternative Two could result in temporary elevated disturbance levels within the immediate activity area (i.e. burn area, are where chainsaw activity is taking place, etc.) to such an extent so as to temporarily force some wildlife species that are sensitive to human-induced disturbances to temporarily vacate activity areas. An example of this action would be the short-term effects to wild turkey. Wild turkeys may vacate the burn area during a burn. However, it is highly likely that these same turkeys will quickly return to the burn area immediately post-burn. The likelihood of some wildlife species being temporarily displaced from the active burn areas is most likely higher for Alternative Two, since gas-powered equipment may be used for girdling-slashing-removal of shrubs, saplings, and trees up to two (2) acres per year and for creating fireline. It is possible that this could take place during the peak of nesting season for Neotropical migratory birds. However, this potential disturbance effect is projected to be restricted to a very small localized area and temporal in nature. Some species would be expected to quickly return to activity areas as soon as a few hours after suspension of activities (i.e. in the evening when workers go home, or on weekends), while for other species, returning to treated stands may take longer.

For some species, elevated human-induced disturbance levels could constitute an adverse impact to the point of disrupting nesting or reproduction for the year. An example may be potential impacts to wood thrush nesting in a mature hardwood stand. Should chainsaw activity take place at the immediate site where a female wood thrush has her nest, it is conceivable that this particular female would abandon her nest and eggs for the year. This effect is most likely to occur for nesting Neotropical migratory birds, as well as some raptors (Niemi and Hanowski 1997). In either case, the duration of this activity, and the scope of this impact is expected to be such that no species would be adversely affected at such a level so as to result in substantially reduce population numbers across the Forest.

Implementation of Alternative Two could result in direct mortality to some wildlife species. If tree felling is conducted during the summer period, individuals of less mobile species (i.e. snails, salamanders, invertebrates, amphibians, reptiles, etc.), incubating female birds, roosting bats, and bird nestlings could be killed by the felling of trees, or crushed by falling logs. Non-volant bats could be affected, due to an inability to vacate an occupied roost tree. Volant bats should be able to vacate the immediate disturbed area, thus avoiding potential direct effects.

Some animals, especially less mobile species, could be killed from the direct effects of burning, such as arthropods and amphibians. Some individuals could be killed from intense heat, direct contact with flames, or smoke inhalation resulting from prescribed fire. The more frequently areas are burned, the greater the possibility of persistent longer-term effects. The potential for this occurring is greatest during the first ten year period, due to the frequent re-burning schedule. However, after the first ten year period, the potential for adverse effects would be less.

Cave-dwelling bat species could be adversely impacted if smoke generated from burning is permitted to enter Equality Cave (Cave Hill Cave), especially during the winter hibernation period.

Any potential adverse direct effects should be restricted to isolated individuals, localized in nature, of relatively short-term duration, and are expected to have no long-term adverse impacts to species viability across the Forest. While individual reptiles, amphibians, snail, or invertebrates may be killed, there are no known occurrence records for any rare species within the proposed project activity areas.

Repeated dormant season burning may have indirect effects to habitat for some wildlife species, rendering areas unsuitable or creating less than ideal habitat conditions, while enhancing habitat conditions for other species. The objective in repeated burning of the four areas over the next five to ten years is to create a more open understory and mid-story forest condition, more closely resembling an “Open Woodland Barrens”. Over time, tree spacing should be wider with lower tree canopy density; small-diameter hardwood saplings and pole timber will less frequent; and, the understory will be comprised of a more diverse and complex herbaceous plant community consisting of annuals, perennial, grasses and forbs. Wildlife species that thrive in a more open oak savannah type habitat would be expected to be more abundant after 10 years of burning. Species that thrive in a more closed canopy shaded habitat type would be expected to be less abundant after 10 years of burning.

The frequent re-burning schedule proposed for the first 10 years is likely to cause substantial mortality to smaller diameter thin-barked hardwoods, which should result in an increase in the number of small to medium diameter hardwood snags. Some larger diameter trees are expected to also die from the effects of repeated burning, increasing the number of larger diameter snags. There should be a greater number and distribution of canopy gaps as individual trees are injured or killed from the effects of fire, resulting in a greater number of snags and tree cavities. The degree of habitat change is expected to be more noticeable in more xeric sites, which are more likely to experience more intense fire behavior. Hardwood snags should be abundant. Tree cavities/dens should be more abundant due to fire scarring to live trees. This is gradual change in habitat conditions is expected to have an effect in animal species abundance and diversity, favoring those animal species that thrive in a more open-canopied forest condition and rely on snags and/or tree cavities.

Using a burn frequency of five burns in the first ten years is likely to result in a more open canopied forest condition, as well as lower leaf litter levels on the forest floor within burned areas, which may result in a much drier forest floor condition. If this occurs, it could affect habitat conditions for salamanders, land snails, beetles, saproxlic beetles, spiders and many other forest-floor associated arthropod species. Saproxilic beetles are highly sensitive to forest management practices that reduce the abundance and variety of dead wood (Ulyshen and Hanula 2009).

Fairly regular application of cool dormant-season prescribed burning on the four areas is likely to have an effect on the distribution and abundance of smaller-diameter coarse woody debris on the forest floor resulting from consumption by fire. Given the typical mosaic type burning pattern that is exhibited by prescribe burns on the Shawnee National Forest, some areas are likely to not be burned, resulting in scattered areas with a greater number of smaller-diameter downed woody debris. It is likely that burning will have no negligible effect on the distribution and availability of larger-diameter woody debris, due to their ability to persist during cool dormant-season burns. It is likely that burning will also result in increased tree mortality, which would provide a sustained supply of dead and downed coarse woody debris on the forest floor.

Potential Effects to Federally-listed Animal Species

Indiana Bat

Effects to Indiana bat (*Myotis sodalis*) were considered in this analysis because : 1) the Indiana bat is listed as federally endangered; 2) Indiana bats are known to occur within both Johnson and Saline counties, 3) Indiana bats have been documented as present at certain times of the year within one of the proposed burn areas (Cave Hill); and, 4) it is assumed the entire Forest represents potential habitat (summer roosting and/or summer foraging) for this species. This analysis of effects is tiered to the December 3, 2005 U.S. Fish and Wildlife Biological Opinion (BO) for the Programmatic Biological Assessment prepared for the 2006 Shawnee National Forest Land and Resource Management Plan; and, the 2006 Final Environmental Impact Statement for the Proposed Shawnee National Forest. This analysis incorporates the "Standards and Guidelines for Federally Listed Threatened and Endangered Species-Gray Bats and Indiana Bats-Appendix A in the Forest Plan; and, the "Terms and Conditions" of the USFWS BO. Recent research papers on Indiana bat habitat and ecology, as well as the "*best available science*", were also reviewed prior to the preparation of the biological evaluation/biological assessment, and were utilized in the preparation of this analysis of effects.

A diversity of different size classes and decay classes of snags, and different size classes of suitable live cavity trees are present throughout the four areas to be treated, providing quality summer roosting habitat for both bachelor male Indiana bats as well as summer maternity colonies. Large hardwood snags and suitable live roost trees are very abundant throughout the four areas to be burned. Smaller diameter hardwood snags are also abundant throughout the project area. Larger diameter snags, such that would be suitable in serving as summer maternity roost trees, are least abundant in yellow pine stands, and most abundant in mature upland hardwood stands.

Quality foraging habitat is present throughout all four areas, varying in quality. The highest quality foraging habitat consists of somewhat open mature hardwoods, abandoned wildlife openings, and unimproved narrow roads. The lowest quality foraging habitat consists of densely-stocked pine stands, and dense canopy hardwoods. Sources for drinking water are widely scattered throughout the areas, consisting of creeks, streams, road ruts, and ponds.

One cave is present in the Cave Hill area that provides conditions that are suitable as a winter roost site for Indiana bats. Winter temperature readings taken by Forest Service wildlife biologist at several locations in Equality Cave (Cave Hill Cave) suggest that Equality Cave provides suitable conditions for winter hibernation. Numerous chambers in the cave provide winter time temperatures between 38 and 46 degrees Farenheit, which falls within the range of suitable winter roosting temperatures for Indiana bats. The capture of a male Indiana bats in October 2008 and 2009, the gating of the cave entrance, and the presence of suitable winter temperatures all strongly suggest that Equality Cave would at some time in the future become occupied by Indiana bats during the winter hibernation period. As such, the Forest is committed to continue to provide conditions within, and surrounding, Equality Cave so as to maintain Equality Cave as a suitable hibernation site for Indiana bats.

Alternative One:

Potential Direct Effects

It is anticipated that implementation of Alternative One will have no adverse direct effects to Indiana bat populations or habitats.

Potential Indirect Effects

This alternative will perpetuate existing roosting and foraging habitat conditions for Indiana bat within the four areas. Over time, it anticipated that as trees become older and die, additional snags will become available, resulting in an increase in large diameter downed logs on the forest floor. Canopy conditions will remain somewhat similar to current conditions into the near future. However, over time, the abundance of small canopy gaps is expected to increase. Within these gaps, shade-tolerant hardwood tree seedlings should become established, gradually transitioning into the future dominant canopy. Over time, and in the absence of fire, there should be a shift in tree species composition in the dominant canopy from shade intolerant, fire adapted, hardmast producing hardwoods to shade tolerant, fire non-adapated , non-hardmast producing hardwoods. Oaks and hickories would be expected to become less prevalent, with an increase in tree species such as red maple, sassafras, sugar maple, blackgum, yellow poplar, sweetgum, and ash. This, in itself, could create forest habitat conditions that are less suitable as Indiana bat summer habitat, due to fewer Class One roost trees present across the landscape. The preponderance of non-native invasive plants would be expected to increase.

In the absence of fire, canopy and mid-story densities should increase over time, providing lower quality summer roosting and foraging habitat. Mid-story and understory shrubs and saplings should increase in abundance, creating lower quality Indiana bat foraging and roosting habitat.

Alternative Two:

Conducting prescribed burning and the felling-removal of trees can have both direct and/or indirect effects upon habitat and individuals.

Potential Direct Effects

Prescribed Burning: Burning in summer Indiana bat habitat from late spring through late summer has the risk of directly affecting Indiana bats by: 1) directly killing roosting bats, either from heat, flames, or smoke, that are present in standing snags or live roost trees during burning operations; 2) disturbance to summer roosting bat, causing roosting bats to vacate occupied summer roost trees; and/or, 3) disturbance to summer male bachelor colonies using caves or mines for summer roosting, causing bats to vacate the summer roost site. Burning conducted during the winter hibernation period has the risk of directly affecting Indiana bats by: 1) disturbing and arousing winter roosting bats from the effects of smoke and other fire emissions into hibernacula, which can result in increased winter mortality.

The timing of annual spring emergence of Indiana bats from their hibernacula may vary across the range, depending on latitude and weather. Based on trapping conducted at the entrances of caves in Indiana and Kentucky, researchers have observed that peak spring emergence of female Indiana bats was in mid-April, while most males were still hibernating (USFWS 2007). Peak emergence of males occurred in early May. In Missouri hibernacula females started emerging in late March to early April, and outnumbered males active at hibernacula entrance during that period (USFWS 2007).

Burning the four areas during the non-summer maternity period (December through late March) would virtually eliminate the potential risk of direct mortality occurring to bats roosting in live or dead roost trees within burned areas. The closer that burning occurs to early April the greater the chance that individual Indiana bats may be disturbed/impacted by burning, since adult females quite often depart winter hibernacula in early to mid April in search of maternity roost sites. However, burning earlier in the winter hibernation period increases the likelihood of smoke emissions disturbing winter roosting bats. The likelihood of smoke emissions adverse affecting any Indiana bats is virtually non-existent since the nearest known Indiana bat hibernacula is well over ten miles away. At this distance, smoke dispersion should be such that in the event any smoke would travel in the direction of the hibernacula, smoke concentrations would be miniscule. Prescribed burning operations should pose virtually no risk to winter roosting bats.

While extending burning into early April slightly increases the risk of female bats being present within summer roost trees, the risk is considered to be minimal since young of the year will not have been born yet and the female would be mobile enough to vacate roost trees. Since the most recent research indicates that the majority of male Indiana bats do not emerge from hibernacula until after May 1, dormant season burning is unlikely to directly affect roosting male Indiana bats. Ceasing burning activities after May 1st should minimize the potential for prescribed burning operations having an adverse direct effect on both male Indiana bats and Indiana bat maternity colonies. The potential for direct

effects to summer roosting Indiana bats could be virtually eliminated by restricting all burning to before April 1st.

Tree/Shrub Felling: The felling of snags, or the felling or girdling of suitable live roost trees greater than 6”dbh, has the potential to cause direct effects to summer roosting bats when conducted between April 1-September 30, since bats may using snags and live roost trees as summer roost sites. Since maternity colonies have only been documented as using trees greater than 9”dbh, the risk only exists for maternity colonies when trees greater than 9”dbh will be cut/girdled. In the event that a snag or suitable live roost tree is to be felled or girdled, it is conceivable that bats would be forced to either vacate roost tree, or remain in the tree and potentially be killed/crushed from falling trees or heavy equipment. It is likely that solitary male bats would be aroused and readily vacate the tree, being forced to select a suitable roost tree outside of the influences of the localized disturbance. For maternity colonies, the potential for directly harming summer roosting bats is greatest when young bats are non-volant (unable to fly). After young of the year are volant, the risk of killing roosting bats drops substantially. However, there is a physiological risk to bats that are aroused from semi-torpor during the summer period. Additionally, forcing roosting bats to vacate preferred summer roost trees exposes them to a greater risk of being killed during daylight hours by aerial predators.

The December 2005 USFWS BO requires that no suitable snags or live roost trees be removed from April 1 through September 30 unless an evaluation and/or surveys be conducted to determine non-use by roosting bats. Design criteria have been built into Alternative Two that stipulate that no suitable snags or live roost trees will be cut/felled from April 1 through September 30. During this time period, and only for the purposes of releasing Mead’s milkweed plants, any trees needing to be “removed” will be girdled and left standing, which should remove the potential for direct mortality occurring to roosting Indiana bats. Girdling, if conducted using gas-powered chainsaws, has the potential to disturbe roosting bats resulting from noise from the operation of gas-powered equipment, and vibration to the roost tree. However, this activity will only take place in the event that any Meades Mlkweed plants need to be released. Consequently, the likelihood of this having to take place is low, and the potential for directly affecting Indiana bats is also low. As a worst case scenario, this type of activity would only take place on a maximum of two acres per year. The small amount of acreage treated annually, and the low likelihood of any trees having to be girdled, suggests a very low likelihood of directing affecting any summer roosting bats.

In the event that any suitable standing live roost trees must be girdled/felled from April 1-September 30 for the purpose of releasing Mead’s Milkweed plants, exit counts will be conducted to determine non-use by bats. In the event that exit counts indicate the presence of roosting bats in any tree needing girdled, girdling will only take place after September 30th.

Prescribed burning has a potential to cause direct effects to Indiana bats during both the summer and winter periods.

Burning conducted during the summer maternity period has a potential of directly harming roosting bats resulting from: smoke and other emissions, burning of the roost tree, and disturbance that causes the roosting bat(s) to vacate the roost tree. The "terms and conditions" spelled out in the USFWS December 2005 BO restricts the use of prescribed fire from May 1 through September 1. Design Criteria #3 prohibits conducting burning between May 1 and September 1, so no direct effects to Indiana bats from summer burning. Since female Indiana bats have been reported exiting winter hibernation sites in early April, the potential still exists that individual adult female Indiana bats could be directly affected by any burning that occurs between April 1 and May 1. However, no burning has taken place on the Forest for at least the past four years after about April 10th, due to spring green up, so the likelihood of burns being carried out after April 10th is extremely low.

Burning conducted between September 1 and May 1 has the potential of directly affecting winter roosting bats resulting from smoke and burning emissions entering winter roost sites. Arousal of bats from exposure to smoke in hibernacula is a concern relative to dormant-season burning. Bats arouse from hibernation periodically as a normal course of affairs, possibly because of the need to rehydrate, but each arousal is energetically equivalent to many days of hibernations, and extra arousals from smoke exposure or other causes area serious concern (Dickinson et al. 2008). At the current time, no known Indiana bat hibernacula exist within or near the four areas proposed for burning, so no winter roosting Indiana bats should be directly affected by dormant season burning.

All of the "Terms and Conditions" specified by the USFWS December 2005 BO have been incorporated as "*Design Criteria*", and will be fully implemented.

Potential Indirect Effects

Prescribed Burning: Indirect effects of fire on bats arise from fire-induced habitat change. Fire use is oftentimes advocated as a way of improving bat habitat, through snag production, creation of more open stands preferred for foraging, and increased insect abundance. Fire, alone or in combination with thinning, may affect bat roost availability. Fires both create and destroy snags (dead trees), with unknown long-term effects in eastern hardwood forests (Dickinson et al. 2008). For tree roosting bats, fire can enhance roosting habitat by creating snags and increasing solar radiation at existing roosts (Johnson et al. 2009). Fires would be expected to reduce insect prey abundances in the short-term, but their long-term effects on prey abundances are unknown (Dickinson et al. 2008).

Johnson et al. (2009) looked at roost tree selection by northern myotis (*Myotis septentrionalis*) maternity colonies following prescribed burning in a Central Appalachian mountains hardwood forest. They determined that within burned areas, northern myotis maternity colonies were more likely to use roost trees that were associated with larger canopy gaps created by the senescence and decay of the surrounding fire-killed overstory trees. Northern myotis readily exploited alterations to

forest structure created by the reintroduction of fire, which accelerated snag creation and enlarged existing or created new canopy gaps.

Prescribed burning may burn up some standing snags, depending upon specific burning conditions. This could be minimized by: raking around suitable roost trees, applying foam around the base of suitable roost trees, or burning under wetter conditions such that snags are unlikely to catch fire. Dormant-season prescribed burning conducted on the Hidden Springs Ranger District over the past several years has typically taken place when fuel moisture conditions are such that few standing snags become consumed by fire. It would be virtually unpractical to rake around, or to apply foam to, every suitable Indiana bat roost tree, since live roost trees are very abundant in all four areas and the total size of the proposed burn area is quite large. Burning under wetter conditions would minimize the likelihood of snags catching fire and being consumed.

Prescribed burning operations will undoubtedly result in additional mortality to some live hardwood and pine trees, which should further increase the availability of summer roost trees within the project area. Boyles and Aubrey (2006) conducted a study in Missouri looking at the impacts to evening bats (*Nycticeius humeralis*) from prescribed burning. They found that there were a significantly higher proportion of dead trees, which evening bats commonly use as roost trees, in burned forests compared to unburned forests. They concluded: "*Prescribed burning appears to initially lead to creation or restoration of favorable cavity-dwelling bat habitat and its continual implementation perpetuates an open sub-canopy. Therefore, we suggest that prescribed burning may be a suitable tool for management of roosting habitat for cavity-roosting bats*".

It is highly likely that any snags consumed by burning conducted in the four areas will be more then offset by the creation of additional snags resulting from burning and/or girdling of trees to release TES plants, ultimately resulting in an improvement in roosting habitat conditions for cavity-roosting bats. The distribution and abundance of hardwood tree cavities should increase as the result of butt scarring from repeated burning.

The likelihood of smoke entering any Indiana bat hibernacula should be virtually non-existent, since the closest hibernacula is well over 10 miles away from any of the areas proposed for burning. Winter cave surveys, plus two years of fall harp trapping, have failed to document any Indiana bats using Equality Cave (Cave Hill Cave). It is assumed that Equality Cave is not currently being used by Indiana bats. Consequently, any smoke inadvertently enter this cave should have no adverse direct effects to winter or summer roosting Indiana bats.

If the repeated burning is successful in reducing the density of dominant canopy trees, as well as understory and mid-story shrubs, saplings, and pole timber, there should be an increase in the amount of solar radiation to snags and live roost trees. Summer maternity colonies require somewhat stable warm summer temperatures during the summer months to facilitate growth and development of young bats. Increased solar radiation to suitable roost trees should improve the suitability of summer roost trees. Implementation of

Alternative Two should have beneficial indirect effects by improving the suitability of summer roost trees within the four areas.

Indiana bats oftentimes avoid areas that are dense with mid-story vegetation ("vegetative clutter" for foraging during the summer months. Reducing tree spacing and vegetative clutter should improve the quality of Indiana bat foraging habitat within the four areas. The creation of small forest openings may also have positive indirect habitat benefits by providing bat foraging areas (Grindal and Brigham 1998). Implementation of Alternatives Two should have positive indirect effects by improving the quality of foraging habitat within the four areas.

The USFWS is concerned about the total amount of forested area surrounding hibernacula that is blackened at any one time during any year due to potential reductions in Indiana bat primary prey species. To avoid this from occurring, the USFWS BO established limits on the maximum percentage of Forest Service land that can be blackened in any one year within 2.5 mile and 5.0 mile radii surrounding known Indiana bat hibernacula. However, no known Indiana bat hibernacula exist within a five mile radius of any of the four areas. Consequently, this standard does not apply to this project. The likelihood of smoke generated by prescribed burning carried away from the four areas is extremely low of every reaching the closest Indiana bat hibernacula over ten miles away.

Potential Effects to Regional Forester's Sensitive Animal Species

Eastern Timber Rattlesnake

Alternative One:

Alternative One is not expected to have any direct or indirect adverse impacts to this species. Maintenance of the existing roads as open to public motorized vehicles maintains the current risk of snakes coming into contact with humans and motorized vehicles. With no direct or indirect adverse impacts, there should be no cumulative adverse impacts. Timber rattlesnake habitat quality should remain somewhat constant over time.

Alternative Two:

Implementation of prescribed burning and tree/shrub felling may have both direct and indirect impacts to timber rattlesnakes in the following way: 1) individual snakes could be killed (while in hibernation as well as after emergence from hibernation) from the direct impacts of flame/smoke/heat; and, 2) rattlesnake foraging habitat could be improved, and subsequent increase in prey species numbers, from the indirect impacts from the opening up of the canopy, creation of small canopy openings, and/or maintenance of existing abandoned wildlife openings as foraging habitat.

Potential Direct Impacts

Prescribed Burning: Prescribed burning has the potential to cause mortality to rattlesnakes, if conducted during late spring, summer, or early fall months, since rattlesnakes would be more likely to be present within proposed burn areas. However, all prescribed burning will be conducted after September 31 and before May 1, which should reduce the likelihood of rattlesnakes being present during burning operations. However, the potential exists that rattlesnakes might be present within burned areas in April and October, especially if late spring/early winter weather conditions are warmer then usual. Consequently, the risk exists that individual snakes could be directly impacted by burning operations that are conducted during between April 1 and May 1. This potential impact could be avoided by burning earlier in the spring (before April 1st) and later in the fall (after October 31st).

Over the last several years, little to no prescribed burning has taken place on the Hidden Springs RD before November 1st, and this is not anticipated to change. Likewise, typically no burning has taken place after around April 10th. Again, this is not expected to change since spring green-up usually commences in early April. Thus, the only time period that poses a risk of individual rattlesnakes being directly affected by burning is a very short time period (one to two weeks) in late winter/early spring. Burning conducted during this time period could have direct adverse impacts to individual rattlesnakes. For the majority of the dormant-season burning period, rattlesnakes should be absent from burn areas (i.e. hibernating in winter den sites) and thus relatively unaffected by prescribed burning activities.

While it is feasible that implementation of Alternatives Two could result in direct mortality to an individual rattlesnake that might be present within the project area incurred from the effects of burning, the likelihood of this action occurring is minimized by the fact that the burning will be conducted when a high percentage of snakes should still be in winter hibernation and absent from the affected area.

Additionally, it is anticipated an abundance of unburned areas will be well distributed throughout the burn areas, since typically dormant season burns result in a mosaic of burned and unburned areas. These islands of unburned fuel should provide adequate areas for snakes to retreat to avoid the oncoming flames, heat, and smoke. In addition, there should be a suitable distribution of other refugia sites (i.e. root holes, downed logs, rock crevices, boulder fields, etc.) where snakes can secure suitable refuge to avoid the direct effects of oncoming flames. While the possibility exists that an individual rattlesnake could be killed from burning, this effect should not be of such a magnitude such as to cause an adverse impacts to population viability across the Forest.

Suitable denning habitat is scattered throughout portions of all four areas in the form of rock outcrops, cliff-lines, rock shelters, and boulder fields. There is a risk of direct mortality occurring to hibernating rattlesnakes resulting from prescribed fire. However, the risk of burning directly affecting hibernating rattlesnakes is considered to be low, since snakes should be far enough removed in rocky areas so as to be insulated from any approaching flame, heat or other adverse effects. Implementation of Alternative Two is

not expected to have any direct or indirect adverse impacts on rattlesnake denning habitat.

Potential Indirect Impacts

Prescribed Burning: Frequent burning may alter the type of arrangement of suitable or unsuitable timber rattlesnake habitat within the affected project areas. While fairly frequent burning may reduce the amount of small downed logs on the forest floor, the frequent burning, over time, should result in tree mortality and subsequent increase in the availability of large downed woody debris. This should improve habitat for rattlesnake prey species, and increase the amount of refugia scattered throughout the four areas.

If burning achieves the intended objectives, over time, there should be a reduction in tree canopy density, a reduction in the number of shrubs/saplings/pole timber in the mid and understory, and an increase in the diversity and abundance of herbaceous vegetation on the forest floor. This should support greater numbers of prey species. The existing abandoned wildlife openings should have fewer shrubs and saplings, with a greater diversity and abundance of herbaceous plants, thus supporting a greater diversity and abundance of rattlesnake prey species. Should these changes occur over the four areas, Implementation of Alternative Two should have a positive indirect impact on timber rattlesnake habitat. The creation of a herbaceous ground cover should improve habitat for prey species, which would improve rattlesnake foraging habitat. Repeated burning may retain for a longer period of time the suitability of the scattered abandoned wildlife openings to serve as prey species habitat, both in the short-term as well as in the long-term. At the present time, early successional habitat is somewhat limited within the four areas. An improvement in foraging habitat should result in increased rattlesnake numbers throughout the four areas. The Action Alternative would be expected to result in improved rattlesnake habitat quality in both the short-term as well as the long-term.

Access Roads: The presence of access roads for motorized vehicles and/or trails within habitat occupied by timber rattlesnakes increases the likelihood of snake and human interactions. As timber rattlesnakes forage throughout their home range, the higher the number of roads open to unrestricted public motorized vehicle access the higher the likelihood that snakes will come in contact with people and motorized vehicles resulting in death to snakes. Concurrently, the greater the number and/or density of recreation trails and higher recreational use, the greater the likelihood of snake/people interactions, and the higher the likelihood of mortality occurring to rattlesnakes. Since no new roads or trails are proposed as part of this project, mortality rates incurred from interactions with humans recreating in the four areas, or across the Forest, should remain at levels comparable to current rates.

Implementation of Alternative Two should have no cumulative adverse impacts to timber rattlesnake populations or habitat due to the low level and type of activity proposed for the project area, as well as past, present, and reasonably foreseeable future activities that modify rattlesnake habitat on non-National Forest and National Forest lands. Timber rattlesnake habitat should be improved in the project area in the

long term, potentially benefiting rattlesnake populations on the Forest.

Southeastern Myotis

Conducting prescribed burning, and the felling of trees and shrubs has the potential to have both direct and indirect impacts on southeastern myotis. Suitable live summer roost trees could be destroyed during fall/winter burning, resulting in fewer roost trees available. Smoke could enter hibernacula, causing disturbance to roosting bats, and potentially increase winter mortality rates. One cave is present in the Cave Hill area that provides conditions suitable for use by *southeastern myotis both during the summer and winter months.* The Forest is committed to continue to provide conditions within, and surrounding, Equality Cave so as to maintain Equality Cave as a suitable hibernation site for southeastern myotis.

Alternative One:

Implementation of Alternative One will maintain existing foraging and roosting habitat conditions throughout the four areas. The risk of smoke generated from prescribed burning entering Equality Cave is non-existent. There will be no improvement in the quantity, quality, or distribution of summer roosting habitat. There will be no improvement in foraging or summer roosting habitat.

This alternative should have no direct or indirect adverse impacts to southeastern myotis populations or habitat. Since there will be no direct or indirect impacts, there should be no cumulative adverse impacts.

Alternative Two:

Equality Cave (Cave Hill Cave) is known to harbor both a summer roosting bachelor colony, as well as winter roosting bats. Since prescribe burning will only take place during the dormant season (October-April), there is no risk to summer roosting bats. Consequently, Implementation of Alternative Two could impact southeastern myotis in the following way: 1) smoke could enter the cave while winter roosting bats are roosting in the cave during prescribe burning activities, potentially causing forcing bats to vacate the cave, and causing increased winter mortality; 2) the availability of suitable summer roost trees could be altered; and/or 3) the quality of summer foraging habitat could be altered.

Potential Direct Impacts

Prescribed Burning: Prescribed burning has the potential to cause smoke and other particulate matter to enter the cave while bats are hibernating or in torpor. Arousal of bats from exposure to smoke in hibernacula is a concern relative to dormant-season burning conducted between October 1 and April 30. Bats arouse from hibernation periodically as a normal course of affairs, possibly because of the need to rehydrate, but each arousal is

energetically equivalent to many days of hibernations, and extra arousals from smoke exposure or other causes area serious concern (Dickinson et al. 2008). Southeastern myotis are known to enter and exit winter torpor to feed with greater regularity than other bats, so the overall impacts of this action may be less than for other *Myotis* spp.

M. austroriparius, like most other cave-dwelling bats, is particularly sensitive to disturbance in hibernacula (Amelon et al. 2006). Any activity that results in the disturbance to winter roosting bats could adversely affect bats by causing bats to become aroused too frequently, which could lead to a premature depletion of winter fat reserves, ultimately causing starvation and death. The introduction of smoke generated from prescribe burning could cause such an adverse disturbance. However, if smoke would enter into the cave later in the winter/early spring months, in conjunction with warm weather such that flying insects have emerged, disturbed bats could replenish fat reserves by foraging during suitable nights, which would minimize the magnitude of the effects from this disturbance.

Implementation of Design Criteria #4 should reduce the likelihood, to the extent practicable, of smoke generated from prescribed burning entering Equality Cave.

Tree/Shrub Felling: The felling of suitable summer roost trees has the potential for directly impacting roosting bats, potentially causing mortality. The likelihood of this action occurring within the affected project areas is minimized by these factors: 1) southeastern myotis typically select summer roost trees in riverine floodplain areas, and none of this type of habitat will be affected by burning; 2) no suitable dead or live summer roost trees will be felled from April 1 through September 30 (Design Criteria #1 and #2); and, 3) a very small amount of habitat (less than 2 acres total) potentially may be involved each year.

Prime summer foraging habitat is reported to be wetlands, riparian, and/or bottomland hardwood forest. No wetland or bottomland habitat is present within the four areas, so no prime summer foraging habitat will be directly impacted by implementation of Alternative Two. It is possible that *M. austroriparius* could use portions of the affected project area as summer foraging habitat.

It is feasible that this species may utilize more upland habitats present within the Cave Hill, Dennison Hollow, or Stoneface Areas for foraging. It is unlikely that *M. austroriparius* would be using Simpson Barrens, since there are no known records of this species in close proximity to the Simpson area.

Potential Indirect Impacts

Prescribed Burning: Implementation of Alternative Two could result in positive indirect benefits to southeastern myotis summer foraging habitat. This would be accomplished as re-occurring fire reduces the density of the mid and upper canopy, thus allowing a greater degree of solar radiation to reach the forest floor, establishment of a more lush herbaceous vegetative strata on the forest floor, and increased insect numbers.

Tree/Shrub Felling: Additional improvements to summer foraging habitat may result from the creation of small canopy gaps (Grindal and Brigham 1998). However, any potential improvements from this activity is expected to be very small, since such a very minor amount of habitat will be involved. Riverine, wetland, and bottomland hardwood has been reported to represent the most highly suitable habitat for summer roosting sites, using hollow trees. None of this habitat type is available in any of the four areas proposed for restoration. Alternative Two is not expected to have any direct impacts to this species from shrub/tree felling/removal/girdling since no suitable summer roost trees will be felled/removed from April 1 through September 30.

Eastern Small-footed Bat

While there are no EOR's for the project area, suitable habitat is present, and the species is known to occur at Fink Sandstone Barrens, which is located several miles from the project area. This EOR is the only record of this species in Illinois. Illinois is located at the extreme edge of its range. Given the low known occurrence of this species in Illinois, it is unlikely that this species is present within any of the four areas. Additionally, recent bat surveys conducted in Equality Cave have failed to document the presence of this species.

Alternative One:

Implementation of Alternative One should have no direct or indirect impacts to *M. leibii*, since no management action would take place. Since there will be no direct or indirect impacts, there should be no cumulative adverse impacts.

Alternative Two:

Implementation of prescribed burning has the potential to have both direct and indirect impacts to *Myotis leibii* populations and habitat.

Potential Direct Impacts

Implementation of Alternative Two has the possibility that eastern small-footed bats could be directly impacted in the following ways: 1) bats roosting within rocky formations (caves, rock crevices, rock shelters, boulder fields, etc.) during prescribed burns could be directly affected by smoke, disturbance, and/or flames; and, 2) summer roosting bats could be directly affected by the felling of trees.

Prescribed Burning: It is possible that eastern small-footed bats could be present roosting in rock crevices, under rocks or within boulder fields, or in Equality Cave, when prescribed burning activities would be carried out. It is unlikely that bats would be directly harmed, since it is unlikely that any bats would come in direct contact with flames.

Several factors have the potential to minimize the likelihood that *M. leibii* would be directly affected by prescribed burning. Since *M. leibii* has been found to be one of the last to enter hibernacula, seldom entering before mid-November and often departing by early March, it is feasible that any bats roosting in crevices would have already exited from hibernation sites prior to the time that dormant season rescribed burning would take place. Additionally, periods of activity observed during hibernation by this species suggests *M. leibii* may not spend as much time in deep torpor as do other cave-hibernating species (Amelon and Burhans 2006). Consequently, any potential disturbance to any roosting bats present during the time when burning is conducted is likely to be very minimal.

The likelihood of smoke generated from burning entering Equality Cave should be minimal, since burning will only be conducted under the appropriate burning conditions (i.e. prevailing wind) and with a "no-burn" buffer zone established around Equality Cave. Consequently, it is unlikely that implementation of prescribed burning activities will have any direct adverse impacts to individual bats.

Tree/Shrub Felling: The potential exists for summer roosting bats to be directly impacted by the felling of summer roost trees occupied by eastern small-footed bats. The likelihood of this taking place is minimized, to the extent practicable, by implementation of Design Criteria #1 and #2.

Potential Indirect Impacts

Prescribed Burning: Based on the most current literature, it is likely that the density of the tree canopy, and mid and understory shrubs-trees, will be reduced, thus creating a more diverse forest floor flora. This should result in an improvement in foraging habitat quality for *M. leibii*, due to increased insect production. Grindal and Brigham (1998) reported that small forest openings may offer opportunities for bats to forage. Some smaller-diameter snags could catch fire during burning and fall to the ground. However, this loss should be more then offset by a projected increase in snags created by tree mortality associated from burning.

Implementation of burning is expected to have positive indirect habitat benefits by improving foraging habitat, and the creation of additional snags and cavity trees.

Tree/Shrub Felling: The creation of small canopy gaps would be expected to create small forest openings within a somewhat densely canopied forest. The establishment of these small canopy gaps should create additional foraging sites for small-footed bats.

Rafinesque's big-eared Bat

<u>Alternative One:</u>

Implementation of Alternative One should have no direct or indirect impacts to *C. rafinesquii* populations or habitat since no activities will be undertaken that have the potential to adversely affect bats or habitat. Since there will be no direct or indirect effects, there should be no cumulative effects.

Alternative Two:

The species is not known from any of the four areas proposed for burning. All of the records for this species in Johnson County have been summer records and associated with man-made dwellings (i.e. houses/barns). No man-made dwellings are located within the four areas proposed for restoration work. Thus, the likelihood of *C. rafinesquii* being present within any of the proposed affected project areas is less.

Rafinesque's big-eared bats are also known to use rock shelters, cliff-line habitats, and caves. This habitat is present throughout portions of the affected project areas. Rafinesque's big-eared bats could be affected from burning if present within these rocky habitat features.

Equality Cave offers suitable summer and winter roosting habitat, and is the only known cave within the four areas proposed for burning. However, bat surveys (i.e cave surveys and fall swarming surveys) conducted of Equality Cave in 2006, 2007, 2008, and 2009 have failed to document the presence of *C. rafinesquii*.

Potential Direct Impacts

Prescribed Burning: The species could be present within the four areas during summer months, roosting (daytime and/or night-time feeding roosts) in rock shelters and/or hollow trees, or foraging. In Alternative Two, no burning will be conducted during this time of year (May 1-September 1), which should effectively eliminate the possibility of this species being directly impacted by smoke during summer months. No big-eared bats are known to be using Equality Cave, and no other caves are known to be present within the four affected project areas that are used by big-eared bats. No occurrence records exist within the four affected project areas for this species as being present in rock shelters. It is unlikely that big-eared bats would be present within rock shelter or cliff-line habitats during the time when prescribed burning would be carried out.

Tree/Shrub Felling: The felling of standing dead or live trees that have cavities has the potential to direct affect any big-eared bats that might be roosting in those trees, which could result in direct mortality to roosting bats. Under Alternative Two, no suitable roost trees occupied by bats will be felled/removed from April 1-September 30, which should effectively eliminate the possibility of this species being directly impacted by slashing/felling/girdling of trees during summer months

Potential Indirect Impacts

Prescribed Burning: Prescribed burning may have immediate short-term negative indirect impacts in reducing the number of hollow trees as these trees are consumed by fire. However, in the long-term burning should have beneficial indirect impacts by improving summer roosting habitat through the creation of additional hollow tree cavities and snags resulting from fire-associated mortality. Burning should have beneficial short-term and long-term impacts on *C. rafinesquii* foraging habitat as fire reduces canopy density, and increases the diversity and density of the forest floor flora. Grindal and Brigham (1998) reported that small forest openings may offer opportunities for bats to forage. Over time, repeated burning is likely to reduce the density of understory trees and shrubs, which should reduce stand density, thus improving the quality of foraging habitat due to less vegetative clutter.

Tree/Shrub Felling: As more forest openings are created by the creation of small forest gaps from tree/shrub felling, additional open foraging habitat should be created, which will improve the quantity and quantity of summer foraging habitat.

For the aforementioned reasons, implementation of Alternative Two is not likely to have any adverse direct or indirect impacts on *C. rafinesquii* populations or habitat.

Potential Effects To Illinois State-Listed Animal Species

Bobcat

Alternative One

Implementation of this alternative is not expected to have any direct or indirect adverse effects to this species. With no direct or indirect adverse impacts, there should be no cumulative adverse impacts. However, in the absence of some type of management activities that will maintain some component of early seral habitat, habitat quality for bobcats is expected to decline slightly within the project area as the existing abandoned wildlife openings continue to transition from hardwood shrub/sapling habitat to hardwood mature hardwood forested habitat.

Alternative Two

Potential Direct Impacts

Prescribed Burning: Burning is expected to have no direct adverse impacts to bobcats, since they are very mobile and should be able to avoid any direct impacts from fire flames, smoke, or other fire emissions.

Tree/Shrub Felling: The cutting of trees and/or shrubs is not expected to have any direct adverse impacts to individual bobcats.

Potential Indirect Impacts

Prescribe Burning: Dormant season burning is expected to have positive indirect habitat impacts, both in the short-term and long-term. As the overstory, mid, and understory vegetation density is reduced from repeated burning, a more lush and diverse herbaceous forest floor vegetative strata is expected to develop over time, improving habitat for prey species. Improved habitat for prey species, such as rabbits, voles, and mice, should translate into increased prey abundance.

Tree/Shrub Felling: Habitat for prey species should also be improved through the creation of small forest gaps/openings from tree/shrub felling, which should improve habitat quality for bobcats.

Since no new roads or trails will be created by the implementation of either Alternative Two, human-induced disturbance levels are expected to remain virtually the same as present.

No adverse direct or indirect impacts are anticipated to occur from the implementation of either Alternative Two, due to the low level and type of activities occurring on non-National Forest and National Forest lands that would negatively involve suitable bobcat habitat. In the long-term, bobcat habitat quality is expected to increase within the project area, potentially improving habitat capability on the Forest.

Cooper's Hawk and Sharp-shinned Hawk

Alternative One

Implementation of this alternative is not expected to have any direct or indirect adverse impacts to these two raptor species. With no anticipated direct or indirect adverse impacts, there should be no cumulative adverse impacts. Habitat quality and human disturbance levels are expected to remain at current levels.

While most of the four areas do not constitute highly suitable habitat for either Cooper's hawk or sharp-shinned hawk, low to moderate quality habitat is widely distributed throughout portions of the four areas proposed for restoration work.

Alternative Two

Potential Direct Impacts

Potential direct impacts to these two raptor species could include: 1) direct mortality resulting from the felling of standing live trees occupied by nests/nestlings; 2) disturbance to nesting birds from shrub/tree felling and removal operations; and, 3) short-term displacement from the project activity area resulting from shrub/tree felling and removal operations. Occurrence records for both of these raptor species in southern Illinois are very low, thus the likelihood of either of these two species being present within the four affected project areas is considered to be extremely low. While suitable

habitat is present, no EOR's exist for either of these species for any of the four areas proposed for restoration.

Prescribed Burning: Both of these raptor species should be absent from the impacted project areas during the time of year that dormant season burning would be conducted, since burning activities would typically be conducted outside of the nesting or fledging season. The only potential for burning to adversely impact nesting/pair bonding would be if burning was conducted later in the spring. However, the likelihood of this occurring is eliminated to the extent practicable by implementation of Design Criteria #3.

Tree/Shrub Felling: Should either of these species be present during the nesting season, the potential exists that nestlings could be killed, mating pairs displaced from the project activity area, and/or disruption of courtship/nesting activity. The likelihood of direct mortality occurring to nesting birds is minimized to the extent practicable by implementation of Design Criteria # 1 and #7.

The creation of small forest openings will be limited to a very small amount of habitat affected (up to 2 acres per year), and for such a short duration, that neither species should be adversely impacted by shrub/tree felling. While individual birds may be impacted, and/or reproduction interrupted for the immediate nesting season, none of these activities are expected to adversely impact the populations or viability across the Forest for the long-term.

Potential Indirect Impacts

Potential indirect impacts from implementation of either Alternative Two include: 1) positive improvement in habitat quality through the reduction in canopy/stand density. Given that both of these species hunt by soaring within the mid-story, in the short-term, burning should improve the quality of foraging habitat. Improved sunlight to the understory should increase the number of small mammals and birds, and thus improve the availability of prey species..

No cumulative adverse impacts are expected to occur to either Cooper's hawk or sharp-shinned populations or habitat within the project area or across the Forest, due to the relatively low level and type of activities taking place on non-National Forest and National Forest lands that could negatively impact Cooper's hawk or sharp-shinned hawk habitat.

Red-shouldered Hawk

<u>Alternative One</u>

Implementation of Alternative One should have no direct or indirect adverse impacts to this species. With no direct or indirect adverse impacts, there should be no cumulative

adverse impacts. Habitat quality and human disturbance levels are expected to remain at current levels.

Alternative Two

Potential Direct Impacts

Potential direct impacts to this raptor species could include: 1) direct mortality resulting from the felling of standing live trees occupied by nests/nestlings; 2) disturbance to nesting birds from shrub/tree felling operations; and, 3) short-term displacement from the project activity area resulting from burning or shrub/tree felling operations.

Prescribed Burning: This raptor species should be absent from the affected project areas during the time of year that dormant season burning would be conducted, since burning activities would typically be conducted outside of the nesting or fledging season. The only potential for burning to adversely impact nesting/pair bonding would be if burning was conducted later in the spring. However, the likelihood of this occurring is eliminated to the extent practicable by implementation of Design Criteria #3.

Tree/Shrub Felling: The likelihood of direct mortality occurring to nesting birds from shrub/tree felling (Alternative Two) is minimized to the extent practicable by implementation of Design Criteria #1 and #7. The use of gas powered tools to fell/remove shrubs/trees, when carried out during the nesting season, could disturb nesting activity or cause displacement of birds from the immediate activity area. However, such a small amount of area would be impacted (up to 2 acres), and for such a short duration, that any potential adverse direct impacts should be very localized and temporal so as to have no long-term adverse direct impacts. However, even if nesting is disrupted with nest failure or abandonment for one nesting season, this should not result in any discernable impact to overall species productivity, survival, or population viability across the Forest.

Potential Indirect Impacts

Implementation of Alternative Two should have positive indirect habitat impacts. Burning should: 1) maintain the network of abandoned wildlife openings as foraging habitat; 2) reduce canopy and mid-story vegetative density, creating improving foraging habitat, and thus improved habitat for primary prey species; and, 3) create additional open foraging habitat through the creation of small forest openings. The quality of habitat for red-shouldered hawk should increase in both the short-term and the long-term.

Implementation of either Alternative Two or Three is expected to have long-term beneficial cumulative impacts on red-shouldered hawk habitat.

Golden Mouse

The majority of the project area constitutes unsuitable golden mouse habitat. However, pockets of suitable habitat do exist.

Alternative One

Alternative One is not expected to result in any direct or indirect adverse impacts to populations or habitat of golden mouse, since no activities will take place. With no projected direct or indirect adverse impacts, there should be no cumulative adverse impacts. Abandoned agricultural areas/wildlife openings, which represent some of the best golden mouse habitat currently present within the project area, would not be maintained. In the absence of some type of vegetation management, these abandoned wildlife openings would continue to transition from early seral vegetation to mature forest, eventually becoming unsuitable habitat. The availability of suitable golden mouse habitat is expected to decline over time in the absence of any activities that maintain some component of old field shrubby habitat within the four impacted areas.

Alternative Two

Potential Direct Impacts

Prescribed Burning: Implementation of Alternative Two could have a negative direct impact on golden mice. In the event golden mice are present, it is feasible that individual golden mice would be killed from the impacts of approaching fire (direct contact with flames, smoke, and/or heat). However, the magnitude of this occurring would most likely be ameliorated by: 1) a mosaic burn pattern, retaining scattered patches of unburned vegetation; 2) downed logs; and, 3) other potential refugia (rocks, boulder fields, root holes, etc.) to escape the direct effects of the flame front. Nests could be consumed by fire, resulting in the loss of young of the year. The degree of direct mortality would most likely be dependent on the rate of spread of flames. Taylor (1981) reviewed the published works on prescribed fire effects on small mammals. He found that direct mortality was related to rate of spread. If mammals emigrate from burned areas, they return once suitable habitat conditions develop. A major escape mechanism for small mammals is to retreat into holes during burns. It is expected that golden mice would utilize the available escape habitat features (unburned fuels, downed logs, stump holes, etc.) within the four impacted areas to avoid the adverse direct impacts of fire.

Any decrease in mouse population numbers resulting from prescribed burning of abandoned wildlife openings may result in a short-term decrease in the golden mouse population but the population should spring back very quickly in subsequent years due to the improvement of habitat resulting from burning. Golden mice, like most small mammals, would be expected to quickly recover as habitat quality is improved from burning and/or the creation of small forest openings (Alternative Two). However, too frequent of repeated burning could restrict the rate of population recovery.

Tree/Shrub Felling: Implementation of Alternative Two is not expected to have any adverse direct impacts to golden mice populations or habitat.

Potential Indirect Impacts

Prescribed Burning: Conducting dormant season burning could have the following indirect positive impacts: 1) burning would improve and maintain abandoned wildlife openings as suitable habitat; and, 2) burning should reduce the density of overstory, mid-story, and/or understory shrubs and trees which should stimulate the production of a more lush and diverse herbaceous and woody ground cover, and increase the presence of golden mouse food and cover.

Tree/Shrub Felling: The cutting of trees or shrubs could be expected to have the following indirect impacts on golden mice populations and/or habitat: 1) the creation of small forest openings (Alternative Two), and subsequent burning, should result in an increase in suitable habitat.

The positive indirect habitat benefits should be derived both in the short-term (first year following burning) and long-term.

Implementation of Alternative Two may result in some minor direct impacts to individual mice within the immediate project area for the ten year period, but should not adverse impact population viability across the Forest. Prescribed burning and the creation of small forest openings should result in positive short-term indirect impacts by opening up the canopy and development of thicket and brushy vegetation. Subsequent prescribed burning should maintain the quality of golden mouse habitat in the long-term. The amount of suitable golden mouse habitat in southern Illinois is declining, due to loss of habitat and a reduction in activities that maintain early seral vegetation (i.e. lack of disturbance, habitat conversion, plant succession, less burning on private lands, reductions in timber harvesting on non-Forest Service and Forest Service lands, etc.). The improvement in habitat conditions from implementing Alternative Two should be a positive cumulative impact.

Potential Effects to MIS-Animals

Wood Thrush

Given the quality of habitat, and the somewhat contiguous blocks of mature forested habitat present within some of the areas proposed for restoration treatments, it is likely that the wood thrush is present in all four areas proposed for restoration. Preferred habitat is larger blocks of mature forest, nesting in the shrub understory. Wood thrush is one of the more abundant bird species (third in numbers of birds) detected each year at a forest bird monitoring transect located in the Cave Hill area.

<u>Alternative One</u>

There should be no direct or indirect adverse impacts to this species from the selection of the no action alternative. Since there will be no direct or indirect impacts, there should be no adverse cumulative impacts.

Habitat conditions would remain into the future somewhat similar to present conditions. In the long term, as individual trees begin to die out and fall out of the canopy, there should be a small increase in nesting cover available.

Alternatives Two

Potential Direct Impacts

Prescribe Burning: There should be no direct effects to wood thrush from prescribed burning, since burning will be completed prior to nesting and fledging.

Tree/Shrub Felling: The creation of small forest openings (Alternative Two) has the potential to cause direct negative effects to individual birds, through felling of shrubs/trees. It is possible that individual birds could be killed, nests destroyed, or nesting disrupted. However, the likelihood of direct mortality occurring should be mitigated, to the extent practicable, by implementation of Design Criteria #8. Any other direct effects would be very small in magnitude-restricted to a maximum of two acres per year, and of short-term duration such that population viability would not be adversely affected within the project area, nor across the Forest.

Potential Indirect Impacts

Prescribe Burning: Burning is expected to have immediate short-term negative indirect impacts on habitat, since frequent repeated burning could decrease the understory shrub layer (including abandoned wildlife openings). Aquilini et al. (2000) reported that neotropical migrant birds that nest on the ground or in low shrubs were less abundant in burned areas than in adjacent unburned area. Adverse impacts included reduced relative abundance and reduced reproductive success. The study did recommend that habitat for ground and shrub-nesting birds could be maintained by leaving patches of unburned each year. In Alternative Two, habitat for wood thrush would be provided by rotating burn units each year to provide residual shrub cover and burning under conditions that provides a mosaic burn pattern (scattered patches of unburned area), resulting in minimal adverse indirect impacts.

Tree/Shrub Felling: The opening up of the forest canopy through the creation of small forest openings or gaps, is likely to improve habitat quality for post-fledging juvenile wood thrush (Rivera et al. 1998 and Anders et al. 1998), as well as by adults along the edges of treatment areas and in patches where the canopy is not opened up as much.

Any adverse direct or indirect adverse impacts resulting from the proposed project may reduce habitat quality and bird numbers in the project area for the short-term, but these impacts will be for the most part restricted to the immediate project area, relatively short-

term in duration, and should not adversely effect the availability of suitable habitat or population levels across the Forest. Consequently, there should be no cumulative impacts from the implementation of either Alternative.

Worm-eating Warbler

Given the quality of habitat, and the somewhat contiguous blocks of mature forested habitat, it is likely that the worm-eating warbler is present in portions of all four areas proposed for restoration, but in low numbers. Worm-eating warbler is one of the least common bird species detected each year at a forest bird monitoring transect located in the Cave Hill area. Preferred habitat is larger blocks of mature forest having a rich understory of shrubs or saplings. The worm-eating warbler is a ground nester.

Alternative One

There should be no direct or indirect adverse impacts to this species from implementation of the no action alternative. Habitat conditions would remain into the future somewhat similar to present conditions. The best habitat consists of hardwood riparian areas having a shrub understory. In the long term, as individual trees begin to die out and fall out of the canopy, there should be a small increase in suitable habitat.

Alternative Two

Potential Direct Impacts

Prescribe Burning: There should be no direct impacts to worm-eating warbler from prescribed burning, since burning will be completed prior to nesting and fledging.

Tree/Shrub Felling: The potential exists that direct mortality could occur to nesting worm-eating warblers if shrubs and/or trees are felled during the nesting season. However, the likelihood of direct mortality occurring should be mitigated, to the extent practicable, by implementation of Design Criteria #8. Any other direct impacts would be very small in magnitude-restricted to a maximum of two acres per year, and of short-term duration such that population viability would not be adversely impacted within the project area, nor across the Forest.

Potential Indirect Impacts

Prescribed Burning: Prescribed Burning is expected to have immediate short-term negative indirect impacts on habitat, since frequent repeated burning could decrease the understory shrub layer. In the short-term, worm-eating warbler population numbers may be lower than pre-burning. Aquilini et al. (2000) reported that neotropical migrant birds that nest on the ground or in low shrubs were less abundant in burned areas than in adjacent unburned area. Adverse effects included reduced relative abundance and reduced reproductive success. The study did recommend that habitat for ground and shrub-nesting birds could be maintained by leaving patches of unburned each year.

Greenberg et al. (2006) compared the effects of three fuel reduction techniques, one of which was only dormant season burning, and a control on breeding birds during 2001-2005 in western North Carolina. Worm-eating warblers declined temporarily in some or all treatments, likely in response to understory and leaf litter reductions.

Habitat for worm-eating warblers would be provided throughout the four impacted project areas by rotating burn units each year to provide residual shrub cover and burning under conditions that provides a mosaic burn pattern (scattered patches of unburned area), resulting in minimal adverse indirect impacts.

Tree/Shrub Felling: The creation of scattered small forest openings resulting from the creation of small forest openings, is likely to improve habitat quality (positive indirect effects) for worm-eating warblers by creating areas with a greater abundance of understory shrubs and vegetation. A study conducted by Greenberg and Lanham (2001) in the Southern Appalachian Mountains of Western North Carolina found worm-eating warblers to be more abundant in hurricane created canopy gaps then in untreated mature forest.

Any adverse direct or indirect adverse impacts resulting from the proposed project may reduce habitat quality and bird numbers in the project area for the short-term, but these effects will be for the most part restricted to the immediate project area, relatively short-term in duration, and should not adversely impact the availability of suitable habitat or impact population levels across the Forest. Consequently, there should be no cumulative impacts from the implementation of either Alternative Two.

Scarlet Tanager

Scarlet tanagers prefer mature deciduous upland forests, being more abundant in tracts if mature forest greater then 100 ha. However, group selection logging, which creates a mosaic of even-aged patches, may create favorable habitat conditions (The Nature Conservancy 1998). Scarlet tanager is one of the more abundant bird species (fifth in numbers of birds) detected each year at a forest bird monitoring transect located in the Cave Hill area.

<u>Alternative One</u>

There should be no direct or indirect adverse impacts to this species from the selection of the no action alternative. Habitat conditions would remain into the future somewhat similar to present conditions. Scarlet tanagers are canopy nesters, preferring larger blocks of mature hardwood forest, such as is prevalent in all four areas proposed for restoration.

<u>Alternatives Two</u>

Potential Direct Impacts

Prescribed Burning: There should be no direct impacts to scarlet tanagers from prescribed burning, since burning will be completed prior to nesting and fledging.

Tree/Shrub Felling: The creation of small forest openings has the potential to cause direct negative impacts to individual birds, through felling of shrubs/trees if conducted during the nesting season. It is possible that individual birds could be killed, nests destroyed, or nesting disrupted. However, the likelihood of direct mortality occurring should be mitigated, to the extent practicable, by implementation of Design Criteria #8. Any other direct effects would be very small in magnitude-restricted to a maximum of two acres per year, and of short-term duration such that population viability would not be adversely affected within the project area, nor across the Forest.

Potential Indirect Impacts

Prescribed Burning: Burning may result in both short-term and long-term positive indirect habitat impacts for scarlet tanagers, by creating a mosaic of unburned and burned area. Nesting habitat should be relatively unaffected, since tanagers are canopy nesters.

Tree/Shrub Felling: The creation of scattered small forest openings resulting from the creation of small forest openings, is likely to improve habitat quality (positive indirect impacts) for scarlet tanagers by creating areas with a greater abundance of understory shrubs and vegetation.

No cumulative adverse impacts are anticipated to occur to scarlet tanager populations or habitat from implementation of Alternative Two, due to the relatively low level of activities proposed for this project, as well as a low level of activity occurring on non-National Forest and National Forest lands that could involve suitable tanager habitat.

Potential Impacts to Population Viability Concern Species

Gray Treefrog (Hyla chrysoscelis)

There should be no direct, indirect, or cumulative impacts from the implementation of any of the two alternatives, since no restoration activity is proposed to take place during the summer months, and no activities will occur that will potentially impact ponds within the four areas. Should it be necessary to fell/remove shrubs/trees to release rare plants in close proximity to ponds, implementation of Design Criteria #6 will provide for the maintenance of quality aquatic habitat for gray treefrog and other amphibian species.

Redheaded woodpecker (Melanerpes erythrocephalus)

Alternative One

Implementation of Alternative One should have no direct impacts to redheaded woodpecker populations in the project area or across the Forest. However, the continued absence of fire in the four areas will perpetuate, into the future, the un-natural and biologically undesirable closed canopy condition, which perpetuates unsuitable or

marginal habitat for redheaded woodpeckers. Implementation of Alternative One is likely to have negative cumulative impacts to the species.

Alternative Two

Implementation of Alternative Two is not expected to have any direct impacts to redheaded woodpecker populations, since no cavity trees or snags will be felled, and prescribed burning activities will take place outside of the nesting season.

Implementation of Alternative Two is expected to have both negative and positive indirect impacts. Repeated burning is likely to transform substantial portions of the four areas into a more "oak savannah" habitat condition, which represents highly suitable redheaded woodpecker habitat. Burning is likely to reduce the number of snags in the project area in the short-term. However, in the long-term, the number of snags us expected to increase, due to tree mortality from repeated burning. The creation of small forest openings (Alternative Two) is expected to further increase the distribution and abundance of suitable habitat, due to the creation of patches of early seral habitat.

Implementation of either Alternative Two is expected to have positive cumulative impacts for the species within the project area.

Eastern Woodrat (Neotoma floridana)

Since the most recent monitoring data provided by researchers at Southern Illinois University have documented the longest dispersal distance of translocated woodrats as 1 km, it is felt that woodrats are not currently present in any of the four areas proposed for restoration work. Whether or not woodrats eventually colonize any of the four areas proposed for burning is yet to be determined. However, with the current information, there should be no direct effects to the species from implementation of any of the two alternatives.

However, repeated burning over time, should improve habitat conditions in all four areas, making it more likely that eventually woodrats will colonize at least the closest suitable habitat in Cave Hill, Dennison, and Stoneface, since these areas presently have the best habitat connectivity to each other and to the Garden of the Gods release site. The creation of additional early seral habitats should improve habitat conditions for woodrats all four areas.

Since woodrats do not currently exist in any of the four areas proposed for restoration work, implementation of Alternative Two should have no direct, indirect, or cumulative impacts.

American Woodcock (Scolopax minor)

Early seral and old field habitat is for the most part absent from much of the four impacted project areas. Abandoned wildlife openings represent the only potentially suitable habitat in the four areas, which consists of somewhat dense shrub and sapling habitat. It is unlikely that woodcock would be using the four areas as courtship, nesting, or brooding habitat, due to the absence of suitable open early seral habitat. Woodcock

may utilize rich moist riparian streamside zones for foraging. It is unlikely that woodcock would be present within any of the four areas when either prescribed burning or shrub/tree felling/removal.

Alternative One

Implementation of Alternative One should have no direct impacts to woodcock populations in the project area. However, Alternative One is likely to have negative indirect impacts by perpetuating the un-natural and biologically undesirable closed canopy condition. The continued exclusion of fire, or some other vegetative treatment that would set-back succession in the abandoned wildlife openings, will further degrade woodcock habitat quality in the four areas.

Alternative Two

Implementation of Alternative Two should have no direct impacts to woodcock, since it is highly unlikely that woodcock would be present when restoration activities (burning and/or shrub-tree felling). However, over time, repeated burning should have positive indirect habitat impacts by: 1) creating more a more open understory forested condition and, 2) the creation of small forest openings . Given the magnitude of negative habitat trends occurring throughout the range of the American woodcock, the changes in habitat conditions within the four areas is of such a low magnitude so as to have negligible cumulative impacts to the species.

Species of Migratory Birds of Conservation Concern

Potential impacts to redheaded woodpecker, wood thrush, and worm-eating warbler have been previously addressed in earlier sections of this working paper.

Bewick's Wren, Blue-winged Warbler, and Prairie Warbler

All three of these bird species are associated with early successional, shrub-scrub, or old field habitat (Hamel 1992; NatureServe 2009; Kleen et al.2004). The only potentially suitable habitat within the four affected areas consists of widely scattered, and somewhat small abandoned wildlife openings. It is likely that none of these three species are present within the four areas, but the possibility remains that a few individuals could be persisting at these isolated early successional habitats.

Alternative One

There should be no direct impacts from implementation of the "no action alternative". What little remaining marginally suitable habitat that is remaining within the four areas is likely to disappear over time, as these abandoned wildlife openings eventually become dominated by mature hardwood forest. Over time, it is projected that no suitable habitat would remain within these four areas with the absence of burning or some other restoration activities.

Alternative Two

There should be no direct adverse impacts to any of these three avian species from cool dormant season burning, since burning will take place prior to, or after, nesting and fledging. Any tree/shrub felling will also take place outside of the nesting/fledging period.

Conducting prescribed burning is likely to perpetuate an early successional habitat component within the four areas, thus providing at least marginal habitats to support a very low population of these three avian species. Burning is expected to retard forest succession, maintaining a very low level of early successional, scrub/shrub, or old field habitat within a matrix of mature interior forested habitat. These widely scattered pockets of suitable habitat would remain isolated (fragmented) from other suitable habitats on national forest lands and lands under private ownership.

Whip-poor-will

The whip-poor-will is a somewhat common nester in southern Illinois but BBS shows declines in Illinois (NatureServe 2009). Whip-poor-wills typically nest in open coniferous and mixed woodlands, and second-growth or less-than-mature woodlands. They inhabit deciduous or mixed deciduous-coniferous forests with little underbrush not far from open country (Kleen et al. 2004; Hamel 1992). Breeding habitat should include medium growth woodlands of many types (NatureServe 2009).

Alternative One

There should be no adverse direct impacts from implementation of this alternative. The most highly suitable habitat remaining within the four areas is likely to be the abandoned wildlife openings that have rapidly succeeded into a mixture of scattered old field habitat and sapling/pole habitat.

Alternative Two

There should be no direct adverse impacts to this avian species from cool dormant season burning, since burning will take place prior to, or after, nesting and fledging. Any tree/shrub felling will also take place outside of the nesting/fledging period.

Implementation of prescribe burning should have positive indirect impacts from maintain a greater diversity of open mature woodlands and scattered early successional habitats.

Louisiana Waterthrush

This species is typically found in association with moist forests, riparian woodlands, mature deciduous and mixed floodplain, small streams in large forests and occasionally in swamps. The species prefers areas with moderate to sparse undergrowth (NatureServe

2009)). Nesting sites are typically in hollow in a dense root system of a windblown tree or a log along a stream bank (Kleen et al. 2004). Potential threats include forest fragmentation and activities that cause reductions in forest canopy cover or that cause negative impacts to aquatic insect communities (NatureServe 2009).

Alternative One

There should be no adverse direct impacts from implementation of the "no action alternative".

Over time, there should be a net positive indirect impact from the eventual elimination of early successional wildlife openings within a matrix of mature woodlands.

Alternative Two

There should be no direct adverse impacts to this avian species from cool dormant season burning, since burning will take place prior to, or after, nesting and fledging. Any tree/shrub felling will also take place outside of the nesting/fledging period.

Implementation of prescribe burning could have negative indirect impacts from a gradual reduction in tree density, reduced canopy cover, and increased vegetation cover on the forest floor. However, the overall impacts from reduced habitat capability should be minimal along riparian habitats, since it is unlikely that much of the riparian/stream bank areas will burn; and, a projected mosaic burn pattern will perpetuate areas of denser canopy cover and open understory.

Other Wildlife Issues

Hardmast Availability

Shrub and tree felling/removal (Alternative Two) may result in up to two acres less of hardmast producing trees. This action is projected to involve a very small and inconsequential amount of acreage.

Several past studies have shown a correlation between species diversity and population levels of small mammals and avian species dependent upon the availability of hardmast producing forest types (Elias et al. 2004; McShea 2000; Ivan and Swhihart 2000; and McShea and Schwede 1993; Wolff 1996). McShea (2000) demonstrated a negative correlation between mast production and statewide indices for worm-eating warblers and hooded warblers, both understory forest birds, suggesting that some interactions within forest communities may operate at the landscape scale. While a connection between acorn crops, small mammals, and forest birds has been postulated, this study was the first empirical evidence for such connections.

There should be no direct impacts on hardmast availability from implementation of Alternative One. However, implementation of Alternative One is expected to have long-term negative indirect impacts on hardmast availability. While the prevailing dominant forest type in all four areas consists of mixed oak types, the absence of fire has permitted a condition to persist where the advanced hardwood reproduction on the forest floor consists primarily of shade tolerant non-mast producing hardwoods. This condition is becoming very prevalent throughout the Shawnee National Forest, due to the prolonged years of no prescribed fire. In the absence of fire, as individual oak and hickory trees die and fall out from the dominant canopy, the shade tolerant advanced hardwood species will fill the gaps and dominate the canopy, resulting in a gradual reduction in hardmast producing forest types in the long-term. Overtime, it would be expected that the amount of hardmast dominated forest types would decline, having substantial long-term cumulative adverse effects for species that depend on hardmast, such as popular recreational wildlife species such as white-tailed deer, gray squirrel, and wild turkey; as well as species such as flying squirrel, chipmunk, deer mice, wood rats, and neotropical migratory birds.

Prescribed burning may have some very minor short-term direct negative impacts in the number of hardmast producing trees incurred from fire inducted mortality. However, burning is expected to have positive long-term indirect impacts by providing for a diverse forest with a mix of hardmast and non-hardmast producing tree species. Because fire should encourage hardwoods that are adapted to periodic burning, such as oaks and hickory, this alternative is expected to have positive long-term cumulative impacts for wildlife species that rely on hardmast.

Impacts to Animal Biodiversity

Numerous previous studies that have examined the impacts of timber harvesting and prescribed burning on *microclimate and vegetation and litter* (Shure and Phillips 1987), and a variety of animals or animal groups including *small mammals* (Taylor. 1981; Elliot and Root 2006; Kirkland 1977; Kirkland et al. 1996; and Ford et al. 1999), *birds* (Bourque and Villard 2001; Aquilani et al. 2000; Burger et al. 1998; Schulte and Niemi 1998; Alterman et al. 2005; and Rodewald and Smith 1998), *arthropods* (Coyle 1981; Stevenson and Dindal 1982; Greenberg and McGrane 1996; Schowalter et al. 2003; Rieske and Buss 2001; Butterfield et al. 1995; Werner and Raffa 2000; McIver et al. 1992; Ulyshen and Hanula 2009; Gandhi et al. 2008), and *reptiles and amphibians* (Ash 1995; Ford et al. 1999; Ash 1997; Herbeck and Larsen 1998; Floyd et al. 2002; Renken 2005; Renken et al. 2004; Loehle et al. 2005; Russell et al. 1999; and Buhlman et al. 1988), which would suggest that Alternative Two may have both direct and indirect impacts to overall biodiveristy.

The use of prescribed fire and creation of small forest openings (Alternative Two), may have direct, indirect, and/or cumulative impacts on the diversity and abundance of vertebrate and invertebrate species, both short-term and into the future.

Invertebrates-Direct Impacts

Fire can cause high mortality (direct negative impacts) in invertebrate communities, depending on the intensity of the fire, life stage of the arthropod, escape abilities (mobility of the insects), and location of the invertebrate during the fire. Swengel (2001) conducted a literature review of insect responses to fire, and concluded that many insects decline markedly in the immediate period (hours during and after fire) and short-term (0 to 1-2 months), compared to sampling pre-fire or in unburned controls. The degree of reduction appears to relate to the degree of exposure to the flames, with lesser or no decline for species below ground, within or beneath unburned wood, or above flames in treetops, and to mobility of the species or life stage. For less mobile individuals in the herb layer or near the soil surface, reduced exposure to fire due to less intense or more incomplete combustion or presence of entirely unburned areas may lower mortality. Population reduction may not be 100% even with seemingly total vulnerability and exposure.

Ulyshen and Hanula (2009) studied habitat associations of saproxylic beetles in the southeastern United States, comparing forest types, tree species, and wood postures. They concluded that significantly more beetle species emerged from logs than from snags. Activities that reduce the distribution and abundance of downed logs could have an adverse impact on saproxylic beetle diversity.

Hartley et al. (2006) conducted a study in the tallgrass prairie region of Texas to determine the effect of prescribe fire on the diversity and abundance of arthropods. This study concluded that overall, the negative effects of fire on the arthropod community were minor in contrast to the strong positive indirect effects of small-scale burning on arthropod diversity.

Harper et al. (2000) assessed survival and re-colonization to arthropod populations following prescribed burning conducted in the spring in two remnant Illinois prairies. This study concluded that: 1) fire strongly depressed arthropod abundance initially, but that abundance and species richness tended to recover toward the end of the first summer, mostly due to recolonization from adjacent unburned refuges; 2) different arthropod groups were affected differently by fire; and, 3) to preserve native arthropod faunas, land managers should ensure unburned refuges are maintained and that intervals between burns are sufficient to provide for re-colonization of burned areas.

Implementation of Alternative One is not expected to have any direct or indirect cumulative adverse impacts to invertebrates. Invertebrate species assemblages would be expected to remain constant into the future. Implementation of Alternative One would not reduce overall forest stand density, maintaining the somewhat closed canopy mono-typic vegetative communities, and existing invertebrate assemblages. Failure to implement burning would preclude the development of more diverse vegetative communities, and added invertebrate diversity. Consequently, implementation of Alternative One is expected to have negative long-term cumulative impacts on overall invertebrate diversity.

Implementation of Alternative Two may have a negative direct impacts on some invertebrates, being killed from direct contact with flames and/or heat. The likelihood of this occurring is higher due to the frequent re-burning schedule for the first ten year period. Some species may become less abundant, while other species may become more abundant, especially those invertebrates more adapted to the recurring effects from periodic fire. However, burning is not expected to result in the total elimination of any species, due to numerous mitigating factors: 1) burning will be conducted under atmospheric conditions that produce a mosaic burn pattern of burned and unburned fuels, providing for refugia areas for invertebrates to avoid the direct effects of fire, and a source for re-occupying burned areas after areas become vegetated; 2) refugia exist throughout the four areas (i.e. moist areas less likely to burn, downed logs, boulder fields, cliffs, rock shelters, rock outcrops, etc.) that should provide for areas that won't be subject to the direct effects of fire, thus providing scattered areas for invertebrates to persist throughout the four areas; and, 3) additional downed logs are likely to be continually provided as standing trees die from the effects of burning, and fall to the forest floor.

The anticipated mosaic burn pattern, and the time of year in which burning will be carried out should preclude any long-term adverse direct effects from occurring.

Invertebrates-Indirect Impacts

Implementation of Alternative One should have no direct or indirect adverse impacts to the invertebrate community, since no activities will be conducted that could alter species or habitats. Since there will be no direct or indirect adverse impacts, there should be no cumulative adverse impacts.

The opening up of the forest, mid, and understory canopies, and resulting development of a more diverse herbaceous forest floor flora, should create new habitats for a wider range of invertebrates not present under the current somewhat dense canopy hardwood forest. Concurrently, species of invertebrates which prosper in a more closed canopy forest condition are likely to decrease in abundance, but should persist in areas that receive light to no effects from burning.

Burning may have indirect impacts to the invertebrate community in all four areas. Severe disturbance can have varying impacts on the landscape as a result of fragmenting the landscape into patchworks of communities with different ecological characteristics, and microclimate (Ash 1995).

For Alternative Two, burning should have very minor impacts in the short-term in reducing dominant or sub-dominant tree canopy densities. The more likely immediate and short-term effects should be a reduction in the mid-and understory shrub and tree densities.

In the short-term, prescribed burning should have minimal impact in changes to forest litter characteristics. However in the long-term, this may reduce the suitability of portions of treated areas for some species of beetles, land snails, spiders, and other forest floor-dwelling invertebrates.

In the long-term, the opening up of the forest canopy resulting from repeated prescribed burning and/or the creation of small forest openings, has the potential to increase the amount of sunlight reaching the forest floor, and thus a greater degree of drying out of the liter. It would be expected that this effect would be more pronounced in more xeric areas that are more prone to burn hotter, and less pronounced in mesic areas more likely to burn cooler. Numerous research studies have suggested that this type of action is likely to cause a patchy and temporary drying-out of the forest floor organic layer. The degree of drying out of the litter would be less in areas where a greater number of trees remain post-fire or post-silvicultural treatment.

Ash (1995) studied the effects of clear-cutting on litter dry mass, litter depth, and litter moisture on two sites near Highlands, NC in the Southern Blue Ridge Mountains from 1985-1987. He concluded that reductions in litter depth were 70% for one site and 35% for a second site. Litter moisture was always lower on clear-cuts than in adjacent uncut forest.

Werner and Raffa (2000) sampled ground-occurring *Coleoptera* over a two year period in 23 northern hardwood or eastern hemlock-dominated sites representing even-aged, uneven-aged, or old growth forests. No differences in overall species richness or abundance were observed among forest management regimes or habitat types. However, they found substantial differences in species composition. They concluded that conservation of a range of forest types is required in order to maintain the diversity of ground-occurring beetles on a regional scale.

Greenberg and McGrane (1996) compared habitat structural characteristics and relative abundance and biomass of ground-dwelling arthropods among four stand treatments in the xeric and pine scrub habitat of the Ocala National Forest in Florida. They concluded that while their study suggests that silviculturally disturbed, burned and salvaged, and mature sand pine scrub supported a similar biomass and abundance of surface-active ground-dwelling arthropods, differences in the abundance of some taxa among treatments suggest that different taxa and guilds respond differently to unmeasured habitat features related to silvicultural treatment or successional age.

Schowalter et al. (2003) evaluated the response of forest floor invertebrates to variable density thinning of the Douglas-fir forest overstory at Fort Lewis, Washington, during 2000 and 2001. They concluded that variable density thinning affected forest floor invertebrate abundances and community structure differently among species and among treatment units with different management histories. These results suggest that prior land use can have long-term impacts on natural communities, regardless of more recent management.

McIver et al. (1992) studied the effects of, and recovery after, clear-cutting to spiders in different age forest stands that differed along a gradient of moisture availability in western Oregon. They found differences in species guilds for each forest treatment area. They concluded that micro-environmental conditions and the availability and species composition of prey were the most likely factors behind variation in spider species composition among sites. Prey and microenvironment were in turn largely influenced by canopy closure and litter depth.

Coyle (1981) examined the effects of clear-cutting on the spider community of a southern Appalachian forest, spider populations in a mature forest, an adjacent clear-cut site, and two other clear-cut sites during the summer of 1976. Clear-cutting resulted in a marked reduction in spider abundance and a small decrease in the number of spider species. Spider species diversity increased, owing to a marked increase in the evenness component of diversity. While clear-cutting greatly reduced the abundance and number of species of web building spiders, there was little to no reduction in numbers of hunting spiders but actually increased in numbers. This studied postulated that microclimate changes resulting from removal of the forest canopy and reduced litter thickness were primarily responsible for the decline in abundance and diversity of web building spiders.

While the type of dormant season burning proposed for Alternative Two, and potential added impacts from shrub/tree felling, are not expected to have comparable impacts in reducing tree canopy coverage, or impacts to the spider community, as clear-cut timber harvesting, these studies strongly suggest reduced diversity and abundance of spiders associated with activities that open up the canopy that dry out the forest floor.

A reduction of litter, soil moisture, and ground cover, as well as increased soil temperature, may also play a role in long-term population changes of invertebrates (Gaskins 2005; Kalisz and Powell 2000; Sieman et al. 1997). Kalisz and Powell (2000) found a significant (36%) reduction in total dry mass of soil invertebrates that occurred after a prescribed fire in an oak-hickory forest of the Cumberland Plateau in Kentucky. Approximately 95% of the loss was due to significant reductions of invertebrate mass in the forest floor litter. In a Minnesota oak savanna, invertebrate populations were not significantly impacted by fire, but some species abundance in the short-term and in the long-term to fire were negatively correlated, thus species that dropped in abundance immediately after a burn rebounded in the long run and vice versa (Siemann et al. 1997).

Based on the research studies previously referenced, it is likely that implementation of Alternative Two may have varying impacts to different invertebrate species, with a net decrease in the numbers of some invertebrate species, no net change in numbers to some invertebrate species, and a net increase in numbers of other invertebrate species. Since burning should create a mosaic of burned and unburned areas, invertebrate species which favor more open sun-exposed forest floor conditions should be more abundant in areas more influenced by the effects from burning, with invertebrates favoring more shaded and moist areas more abundant in areas less subject to the effects of long-term repeated burning. Such a scenario could provide for a greater diversity of invertebrates across the landscape.

Due to the projected long-term changes in habitat resulting from burning and shrub/tree felling/removal, implementation of Alternative Two is expected to have an overall positive net indirect impact on invertebrate species diversity and abundance.

Reptiles and Amphibians-Direct Impacts

Implementation of Alternative One is not expected to have any direct or indirect impacts to reptiles and amphibians, since no action will take place. Reptile and amphibian species diversity and abundance would be expected to remain constant into the future. Implementation of Alternative One would not reduce overall forest stand density, maintaining the somewhat closed canopy monotypic vegetative communities, and existing reptile and amphibian species assemblages. Failure to implement burning would preclude the development of more diverse vegetative communities, and increased invertebrate diversity. Consequently, implementation of Alternative One is expected to have negative long-term cumulative impacts on overall reptile and amphibian diversity and abundance.

Frequent burning may have direct impacts on the diversity and abundance of reptile and amphibian species within the four affected areas.

Renken (2005) reviewed the current information about the effect of fire on reptiles and amphibians in oak forests of the Eastern and Central United States. He concluded: "*Current data suggest that fire results in little direct mortality of amphibians and reptiles. Fire has no effect on overall amphibian abundance, diversity, and number of species in comparisons of burned and unburned plots, though salamander numbers tend to be greater in unburned plots. Current research also suggests that fire has no effect on reptile abundance, diversity, or number of species except in several studies in which lizard abundance was or tended to be greater in burned plots*".

The scarcity of research examining the impacts of prescribed burning on herpetofauna prompted Russell et al. (1999) to review currently available information concerning effects of prescribed burning on amphibians and reptiles. Russell et al. (1999) found that the immediate response of smaller and less mobile reptiles and amphibians most likely exhibit panic and experience relatively high rates of direct mortality from fires. The moist, permeable skin and eggs of amphibians increase their vulnerability to heat and microhabitat drying. However, some studies show that overall amphibian and reptiles did not appear to be disturbed by approaching fire and responded in adaptive manners that minimized mortality.

Studies show individual herpetofauna respond differently to fire. Many reptiles and amphibians avoid adverse impacts from fire by seeking refuge under surface objects, burrowing into the soil, or simply dispersing from burning areas. One study indicated that fire intensity and seasonality may influence mortality rates of herpetofauna. Russell el al. (1999) concluded that: 1) the currently available research indicates that fire in general has little direct effect on most amphibian and reptiles; 2) prescribed fire is indicated as an

appropriate management tool that can be used with other treatments to benefit herpetofauna by restoring a historical mosaic of successional stages, habitat structures, and plant species compositions; and 3) while fire-induced disturbance may decrease herpetofaunal diversity within a particular patch, a mosaic of successional stages and habitat structures should increase diversity on a broader scale. Floyd et al. (2002) found no significant difference between burned and unburned treatments for abundance, richness, diversity, or evenness of the herpetofauna community from prescribed burning within hardwood forests of the Upper Piedmont of South Carolina.

Implementation of burning (Alternatives Two) may result in direct mortality to some less mobile reptile and amphibian species, resulting in reduced abundance. However, refugia should be widely available to support viable populations of those reptiles and amphibians directly impacted by fire.

Snakes are also susceptible to fire-related mortality. The bullsnake was documented to sustain injury and mortality in prairie habitats in Nebraska and Missouri (Erwin and Stasiak 1979). Means and Campbell (1981) documented mortality to eastern diamondback rattlesnakes, due to prescribed burns in longleaf pine stands Gaskins (2005) recommended that prescribed burning is best conducted during the dormant season, when snakes are in hibernations, to reduce the risk of snake mortality. Alternative Two proposes to conduct prescribed burning during the dormant season, which should satisfactorily minimize potential direct adverse impacts to snakes.

Reptiles and Amphibians-Indirect Impacts

The opening up of the forest canopy, resulting from burning and/or tree/shrub felling (Alternatives Two) may have indirect impacts to habitat for reptiles and amphibians in the four areas.

Buhelman et al. (1988) stated that "*Tree removal affects the terrestrial salamander community in several ways. Removal of canopy cover eliminates the moisture-retaining potential of the soil and leaf litter, allows and increase in insolation (with a concomitant increase in soil temperatures), and increases soil erosion. The use of heavy machinery compacts soil and destroys leaf litter*".

Ash (1997) found that numbers of salamanders on clear-cut plots decreased 30-50% of untreated forested plots in the first year after logging, and were almost zero by the second year. Decreases in standing crop and moisture content of the leaf litter seemed responsible for salamander disappearance. However, salamanders returned to clear-cuts 4-6 years after cutting, and their numbers increased rapidly. Linear regression estimated that salamander numbers on clear-cut plots would equal or exceed numbers on un-harvested forested plots by 20-24 years after cutting. The pattern of salamander return to clear-cuts appeared to closely be associated with the timing of litter layer formation.

Renken et al. (2004) evaluated the impacts of forest management on the relative abundance of amphibians and reptiles in the Missouri's Ozark forests. They reported that within most even-aged management sites, most amphibian species declined and some reptile species increased relative to pre-treatment abundances within clear-cut stands. In general, they concluded that clear-cuts within even-aged management sites locally effected amphibian and reptile species, but, at a larger spatial scale, they did not detect significant effects of even-aged and uneven-aged forest management.

Greenberg (2001) examined the impacts on amphibian and reptile species diversity and abundance in Hurricane induced canopy gaps in the Southern Appalachian Mountains of Western North Carolina. She concluded that the relative abundance of salamanders and American toads, and species richness and diversity of amphibians did not differ between salvage-logged canopy gaps and un-harvested mature forest. In contrast, relative abundance of two lizard species and snakes, and species richness and diversity of reptiles was higher in both salvage logged canopy gaps than in un-harvested mature forest. Results suggested that higher light in gaps positively influenced reptile abundance.

While the type and scale of shrub/tree felling/removal proposed for Alternative Two is not expected to have comparable effects in canopy cover as clear-cut timber harvesting, these studies (Renken et al. 2004; Buehelman et al. 1998; Greenber 2001, and Ash 1997) demonstrate the potential changes that can take place in the diversity and abundance in the reptile and amphibian community from the effects of vegetative treatments that change tree canopy cover and soil litter characteristics.

These research studies suggest a correlation between canopy density, soil moisture levels, depth of leaf litter, and numbers of salamanders. The greater the degree of removal of the forest canopy, the lower the amount of soil moisture and leaf litter, and lower numbers of terrestrial salamanders. Conversely, there appears to be a positive correlation between canopy openings and the diversity and abundance of reptiles.

Repeated long-term burning, in conjunction with the creation of scattered small forest openings, is not expected to cause as drastic change in forest floor moisture or litter depths as clear-cut timber harvesting. However, as tree densities diminish overtime, the gradual reduction in tree density could be expected to reduce soil moisture levels, leaf litter accumulation, and reduce salamander diversity and abundance. Fairly frequent burning may also retard the redevelopment of leaf litter and soil moisture levels by consuming the leaf litter and drying out the organic layer, which impact salamander and other forest-dwelling animal species.

The creation of early successional habitat resulting from burning and shrub/tree felling/removal most likely will result in an increase in species commonly preyed upon by many species of snakes, which in turn will most likely attract a diversity of snake species to treated areas. Burning on a three year rotation may result in individual mortality to some snakes, should weather conditions warm-up unusually early in the spring. Any mortality should be restricted to the first ten year period, to a minimal

number of individuals and should have no adverse impact on diversity or abundance of snakes in the long-term in treated areas.

Based on the research studies previously referenced, it is likely that implementation of Alternative Two may result in reductions in the numbers of some amphibian and reptile species, no impacts to some species, and an increase in numbers of other reptile and amphibian species. Since burning should create a mosaic of burned and unburned areas, amphibian species which favor more shaded and moist areas may be less abundant in some areas, but should have an adequate distribution of refugia (unburned areas, escape areas, etc.) so as to provide for a diversity of amphibian species throughout the four areas. At the same time, many reptile species are expected to increase in diversity and abundance. A scenario of unburned and burned areas, small forest openings and untreated closed canopy forest should provide for a greater diversity of reptiles and amphibians across the landscape. Burning and the creation of small forest openings may have localized indirect negative effects for some species of reptiles and amphibians, and positive indirect effects for other reptile and amphibian species. Consequently, burning and shrub/tree felling should have an overall positive cumulative impact on reptile and amphibian species diversity and abundance.

Small Mammals-Direct Impacts

Implementation of Alternative One is not expected to have any direct or indirect impacts to small mammals, since no action will take place. Small mammal species diversity and abundance would be expected to remain constant into the future. Implementation of Alternative One would not reduce overall forest stand density, maintaining the somewhat closed canopy mono-typic vegetative communities, and existing small mammal species assemblages. Failure to implement burning would preclude the development of more diverse vegetative communities, and increased small mammal species diversity. Consequently, implementation of Alternative One is expected to have negative long-term cumulative impacts on overall small mammal diversity and abundance.

Prescribed burning (Alternative Two) may cause some mortality (direct negative impacts) to small mammals, especially to less mobile species.

Ford et al. (1999) assessed the effects of a community restoration fire on small mammals in the upper slope pitch pine (*Pinus rigida*) sands, neighboring midslope Oak stands, and rhododendron (*Rhododendron maximum*) dominated riparian areas on the Nantahala National Forest in Western North Carolina. They found that for most species of small mammals there were few discernable differences between burned and control (unburned) areas, supporting the contention that high intensity prescribe burns had little overall impact on the terrestrial fauna studied .They found that burns created a mosaic-vegetation pattern with a great deal of micro- and macro-site variability across relatively short distances. Immediate impact of burns on small mammals was slight, as most of the mammal species exhibited varying degrees of fossorial habits. Most of the species of small mammals readily utilized runways under the forest litter, mole tunnels, stump and

root holes, spaces under rock and talus beds, as well as spaces under and within downed coarse woody debris, all of which may have served as refugia during and immediately after burns. They also reported that the rapid recovery of small mammal populations was linked to the rapid regrowth of ground cover within the study area. They concluded "*concern for effects of prescribed fire as a management tool on small mammals in the Southern Appalachians seems unwarranted*".

Kirtland et al. (1995) assessed the impacts of fire in a central Appalachians deciduous forest on the abundance and community structure of small mammals and amphibians by sampling in unburned and burned forest. This study found significant differences in the abundance of rodents and total small mammals between burned and unburned forest. The number and diversity of small mammals was less in burned plots for the first three sampling periods (April-July), but had disappeared by eight months in the burned plots following the burn. Rapid recovery of populations of small mammals in burned forest may be due to the rapid regrowth of ground cover. Small mammal communities in the burned and unburned habitats closely resembled one another. A great number of amphibians were found in the burned plots.

Implementation of shrub/tree felling/removal (Alternative Two) is proposed for a very small amount of acreage (<2 acres annually/10 acres in 10 years). There is a potential that felling trees with cavities or dens could cause direct mortality to more arboreal small mammal species, such as white-footed deer mice, flying squirrel, gray squirrel, fox squirrel, and raccoon. However, the magnitude of this potential direct impact is considered to be so small as to be inconsequential in effects to overall small mammal abundance.

Small Mammals-Indirect Impacts

The implementation of prescribed burning, and shrub/tree felling/removal, may have indirect impacts (both negative and positive) on small mammal habitat diversity. Small mammal abundance and diversity is expected to increase sharply as canopy closure levels are reduced and a more diverse herbaceous forest floor flora develops. Berry and seed producing plants should be more abundant following burning, which should result in increased small mammal numbers.

Kirkland (1977) studied the community and population of small mammals to clear-cutting or northern deciduous and boreal forests in the Monongahela National Forest, West Virginia. He reported that clear-cut timber harvest is followed by increases in small mammal abundance and diversity that persisted until succession returns harvested areas to forest. As succession proceeded to the sapling-young pole stage (6-15 years post-harvest), the abundance and diversity of small mammals decreased, whereas, the relative abundance of species and trophic groups shifted. These changes were interpreted as responses of small mammals to the loss of the well-developed herbaceous layer and the increasing homogeneity of the vegetation in the sapling-pole tree stage. This research by Kirkland (1977) would suggest that implementation of prescribed burning would be

expected to have positive indirect impacts on small mammal diversity and abundance in all four areas.

Burning is expected to result in a greater number and distribution of snags and cavity trees, resulting from the effects of fire. This should translate into a direct positive impact, and increased numbers of small mammals that rely on snags and tree cavities.

Avian Species-Direct Impacts

Burning will be conducted prior to the time that most birds, with the exception of owls and possibly wild turkey, would be nesting or raising young. Consequently, implementation of Alternative Two should have no direct impacts to most avian species. Burning may constitute a disturbance to nesting owls, potentially causing them to temporarily leave the nest while burning activities are being carried out. However, since burning activities would only persist for one day, and only during daylight hours, adult owls should return to the nest once activities cease, and after daylight.

In a spring when warmer then usual weather is experienced, burning conducted later in the spring (early into April), has the potential to cause disturbance to any turkey hens that have initiated nesting/egg laying early. For those hens who have initiated egg laying, fire could directly kill any eggs already laid. The overall impacts to overall turkey population numbers should be ameliorated by several factors. 1) with this type of early nest loss, it is highly likely that hens would re-nest, with second nesting possibly having slightly fewer eggs laid; 2) any reduction in turkey production should be restricted to the immediate burn area; and, 3) a projected mosaic burn pattern should only directly impact a few nests. There should be no direct impacts to turkey poults, since all prescribed burning should have ceased prior to the time that young turkeys would have begun to hatch. For those turkey hens which have not begun to lay eggs, there should be no direct impacts to turkey nesting. Turkeys may be forced to vacate the burn area during the carrying out of burning activity. However, based on previous observations, turkeys should quickly return the burn area once burning activities have ceased. Past observations have also shown that turkeys seem to seek out burned areas, possibly from fire making food materials more accessible on the forest floor.

Shrub/tree felling/removal (Alternative Two), if conducted during the bird nesting season, could result in direct negative impacts (mortality) to bird nestlings, should shrubs/trees that are occupied by nesting birds are cut. However, the impacts from this action would be restricted to an extremely small area each year (less then 2 acres), and for a short time period each year.

Avian Species-Indirect Impacts

A study of thinning and prescribed burning conducted in an Arkansas oak-pine forest found declines in ovenbirds and black-and-white warblers and increased numbers of

eastern wood-pewees and indigo buntings (Wilson et al. 1995). In another Arkansas study, burned plots resulted in increases in flycatcher species, as well as other birds that sally for food, although ground foragers were adversely affected in the short-term (Smith et al. 2004). Greenberg and Lanham (2001) concluded that the creation of small canopy gaps increased avian diversity at a landscape scale by providing habitat patches for some species that require young, second growth forest, and serve as magnets for recruitment and foraging. A study of the effects of the shelterwood-burn technique in southeastern U.S forests showed that a diversity of habitats resulted from the management regime-suitable and attractive to birds inhabiting a broad spectrum of habitats (Lanham et al. 2002). Some avian researchers have suggested that while the shelterwood-burn technique may not be an appropriate conservation tool for all species of birds in all habitats, and note that the technique offers a balance between songbird conservation objectives and timber production in the southeast upland forest region (Gaskins 2005).

Prescribed burning may impact avian species differently. Artman et al. (2001) evaluated the effects of repeated burning on the bird community in a southern Ohio closed canopy, mixed-oak forest. Prescribed burning was done in late March and early April before leaf-out and before the arrival of most neotropical migrant species. This study by Artman et al. (2001) found that four bird species were negatively affected by burning: ovenbird, worm-eating warbler, hooded warbler, and northern cardinal. Ovenbird populations declined in response to burning frequency due to the reduction of leaf litter. Hooded warblers generally nest within 1 meter above the ground in dense shrub thickets, and declined in this study because these thickets were burned in the fire. Northern cardinals were not directly affected by the burn and were uncommon in the treatment units before the burn. Worm-eating warblers nest on the ground, placing their nests in depressions along steep slopes along stream bottoms and other areas with high moisture. Cooler fires were reported to have less of an impact on worm-eating warbler populations. No changes were observed in the overall composition of the breeding bird community and no species was eliminated or added as a result of prescribed burning.

The perpetuation of prescribe burning should have long-term indirect beneficial impacts for species associated with more open “oak savanna” habitat conditions, and species that rely on snags and cavity trees.

Raptors are expected to be more common in the project activity area, as a result of an opening up of the canopy, establishment of a diverse herbaceous ground cover, and increase in prey species. The beneficial effects from the creation of a more “oak savanna” habitat condition should be perpetuated into the long-term by continual prescribe burning.

The creation of small forest openings (Alternative Two) should improve the quality and quantity of turkey brood habitat.

Alternative One will perpetuate the existing poor quality wild turkey habitat into the long-term, until such a time that dominant canopy trees begin to die, thus creating scattered canopy gaps. However, this is not expected to occur in any substantive amounts in the near-term.

Implementation of Alternative Two would result in an increase in important wild turkey cover through the development of more early seral vegetation. In the short-term, potential food sources would be expected to increase substantially, with an abundance of seed-producing plants, succulent green vegetation, berry-producing (softmast) plants, and insects available for use. The edges of treated areas would most likely be heavily used by turkeys for nesting.

Because burning and shrub/tree felling/removal will improve turkey habitat, implementation of Alternative Two should have both positive indirect and cumulative impacts on the turkey population in the four areas. Overall, implementation of burning should improve habitat capability for wild turkey within the four affected project areas.

White-tailed Deer

Prescribed burning (Alternative Two) and shrub-tree felling/removal should improve the quantity and quality of deer browse and forage, improve softmast producing plants (i.e. blackberry, pokeweed, greenbrier, wild strawberry, etc.) that deer relish, and create additional deer cover as a result of the creation of early successional habitat. The quality of deer browse and forage should also increase as a result of burning. These beneficial effects should progressively increase with each successive burn. The improvement in deer cover and food availability could result in a minor increase in deer numbers in the four areas for the short-term. The extent of this increase in deer numbers is uncertain.

Prolonged high white-tailed deer populations have been shown to have the potential for creating multiple biological, botanical, social, and economic problems. As reported in the botanical working paper, no rare plant species are known to be present within the project area, so any increase in deer numbers should have no noticeable effect to any rare plant species. High white-tailed deer populations can result in an increase in the incidence of motor vehicle collisions, depredation to adjacent agricultural areas on private lands, increased depredation rates on residential shrubs and plants, the spreading of non-native invasive plants (Webster et al. 2008), and the incidence of communicable diseases and pathogens to humans (i.e. Lyme's disease). The potential net increase in deer numbers is hard to predict since: (a) it is difficult to predict any response in deer population numbers from burning, and incidental tree/shrub felling; (b) hunters will naturally gravitate to areas with high deer numbers, resulting in increased deer harvests, and a curtailment in noticeable deer numbers. Increased deer numbers should provide increased recreational hunting opportunities in the immediate area. It is believed that overall deer numbers in the project area will increase slightly, but increased hunting pressure and harvests will limit the degree of population expansion and minimize any potential increase in negative effects.

For the aforementioned reasons, implementation of Alternative Two should have both positive indirect and cumulative impacts on white-tailed deer numbers and habitat.

Habitat for Snag and Cavity-Associated Wildlife Species

Snag Habitat

Implementation of Alternative One should have no direct, indirect, or cumulative impacts on the availability of snag habitat, since no actions would be implemented that would affect this wildlife habitat component.

Implementation of burning (Alternative Two) may have both negative and positive short-term impacts in the availability of small to medium sized snags. While fire may reduce the number of some of the existing small to medium snags, due to fire consumption, it is projected that fire will also create additional snags incurred from fire mortality. However, the scope of these direct effects is likely to be minimized by a projected mosaic burn pattern, with areas distributed throughout the burn areas not burning. It projected that there will be no net change in the availability of snag habitat.

Shrub/tree felling/removal should have no direct impacts in the availability of snag habitat, since no snags will be felled/removed.

Implementation of Alternative Two should have positive cumulative impacts on snag habitat availability in the long-term due to repeated burning and creation of new snags.

Cavity Habitat

Implementation of Alternative One should have no direct, indirect or cumulative impacts on cavity wildlife habitat since no actions would be implemented that would impact this wildlife habitat component.

Implementation of Alternative Two should have positive direct impacts on the availability of cavity habitat as a result of fire induced tree mortality. Implementation of Alternative Two is expected to have positive cumulative impacts on tree cavity habitat.

DESIGN CRITERIA

The 2006 Shawnee National Forest Land and Resource Management Plan provides forest-wide and management prescription standards and guidelines designed: to protect, enhance, and sustain viable populations of rare species and their habitats; maintain and enhance habitat and populations for management indicator species; and, to provide for plant and animal species and community diversity. These standard and guidelines would apply when and where needed during various stages of project implementation. These standards and guidelines were reviewed by the US Fish and Wildlife Service during formal consultation for the Amended Forest Plan. In the event any new information is derived that would indicate the presence of other federally listed-proposed, or region nine sensitive species within the project activity area, project activities would be temporarily

suspended, the information would be analyzed, and a determination rendered for any additional project stipulations or mitigation deemed necessary to protect species viability across the Forest.

With regards to federally listed or proposed species, these standards and guidelines were reviewed by the US Fish and Wildlife Service (USFWS) during formal consultation for the Amended Forest Plan. In a letter dated December 3, 2005, the USFWS transmitted the Service's Programmatic Biological Opinion (BO) for the proposed 2006 Forest Plan and the Plans effect on federally listed species. The USFWS concurred with the Biological Assessment prepared for the 2006 Forest Plan, that the Forest Plan is "*not likely to adversely affect the gray bat, bald eagle, least tern, pallid sturgeon, fanshell mussel, fat pocketback pearly mussel, pink mucket pearly mussel, or orange-footed pearly mussel*". With regards to the potential effects on the Indiana bat, the USFWS concluded: "*It is the Service's biological opinion that the 2006 Forest Plan, as proposed, is not likely to jeopardize the continued existence of the Indiana bat*". In addition, the USFWS provided a list of "*Reasonable and Prudent Measures*" which are necessary to minimize the impacts of incidental take of Indiana bats. In order to be exempt from the prohibitions of section 9 of the Endangered Species Act, the Shawnee National Forest must comply with a list of "*Terms and Conditions*", which carry out the reasonable and prudent measures described in the USFWS BO (as listed on pages 88-90 of the BO). All of these terms and conditions will be fully implemented in Alternative Two.

In addition to the implementation of those standards and guidelines referenced above, the following site-specific guidelines will be implemented for this project:

Design Criteria #1: Avoid removal of live suitable Indiana bat roost trees from 4/1 through 9/1 unless necessary for human safety or resource objectives. Removal can only proceed after exit counts have determined non-use by roosting bats. Where feasible, "girdle" live roost trees to serve as future roost trees.

Purpose of Design Criteria: To comply with the USFWS "*reasonable and prudent measures*" as outlined in the December 2005 USFWS Biological Opinion to minimize the impacts of incidental take to Indiana bats.

How we know the mitigation will be Effective: Any live trees needing removed will be inspected by a wildlife biologist to determine suitability for use by roosting bats. If determined to be suitable, exit counts will be conducted to determine use/non-use by roosting bats. If no bats found using tree(s), trees can be removed or girdled. If trees found to be used by roosting bats, trees can only be felled/removed after 9/1.

- **Responsible Person (s):** Wildlife Biologist, Hidden Springs Ranger District

Design Criteria #2: Retain all standing dead trees unless necessary to cut for human safety or to accomplish resource objectives. Dead suitable Indiana bat roost trees

cannot be removed from 4/1 through 9/30 unless they are evaluated to document non-use by roosting bats.

Purpose of Design Criteria: To comply with the USFWS "*reasonable and prudent measures*" as outlined in the December 2005 USFWS Biological Opinion to minimize the impacts of incidental take to Indiana bats.

How We Know the Mitigation Will Be Effective: Where feasible, no snags will be removed between 4/1 and 9/30. A wildlife biologist will conduct exit counts of any snags that must be felled/removed to determine use/non-use by roosting bats. If no bats found using tree(s), trees can be removed. If trees found to be used by roosting bats, trees can only be felled/removed after 9/30.

- Responsible Person (s): Wildlife Biologist, Hidden Springs Ranger District;

Design Criteria #3: To reduce the chances of prescribed burning affecting maternity roosts and foraging habitat, no prescribed burning will be done from 5/1 through 9/1.

Purpose of the Design Criteria: To comply with the USFWS *"reasonable and prudent measures"* as outlined in the December 2005 USFWS Biological Opinion to minimize the impacts of incidental take to Indiana bats and to reduce the chances of affecting Indiana bat summer maternity roosts and summer foraging habitats.

How We Know the Design Criteria Will Be Effective: Seasonal restriction will be included in burn plans.

- **Responsible Person(s):** District Fire Management Officer, Hidden Springs Ranger District, and Wildlife Biologist, Hidden Springs RD Wildlife Biologist.

Design Criteria #4: Burning within the vicinity of Equality Cave will be conducted in such a manner (wind direction, fuel moisture, "no burn" buffer zones, etc.) so as to prevent smoke from entering the cave. From 9/1-4/30, no burning may take place within 500 feet of the entrance to Equality Cave. Burning must be conducted so as to prevent the settling of smoke into the cave after sunset.

Purpose of the Design Criteria: To avoid adverse disturbances, and potential mortality, to Indiana bats and southeastern myotis hibernacula.

How We Know the Design Criteria Will Be Effective: The District Fire Management Office and Wildlife Biologist will collectively work together to determine the most effective and safe methods for preventing smoke from entering Equality Cave. These specific Design Criteria will be included in the burn plan. Burning conditions will be monitored during the execution of burn. Equality Cave will be monitored during the execution of the burn to determine effectiveness of design criteria.

- **Responsible Person(s):** District Fire Management Officer, Hidden Springs Ranger District, and Wildlife Biologist, Hidden Springs Ranger District

Design Criteria #5: No Class One Indiana bat roost trees >9"dbh will be cut/removed from 4/1 through 9/30 unless necessary to release Mead's Milkweed plants. Where it is deemed necessary in order to release Mead's Milkweed, trees will be girdled, not cut/removed.

Purpose of Design Criteria: To maintain quality of Indiana bat summer maternity roosting habitat; and, to improve the availability of suitable maternity roost trees.

How We Know the Design Criteria Will Be Effective: Any potentially suitable live Class One Indiana bat maternity roost trees that need to be felled/removed will be examined by a wildlife biologist. If determined to be a suitable Class One roost tree, trees will be marked to be girdled.

- **Responsible Person(s):** Wildlife Biologist, Hidden Springs Ranger District

Design Criteria #6: Within 50 feet of pond perimeters or dams, any trees to be felled/removed will be directionally felled away from pond or dams.

Purpose of Mitigation Measure: In order to prevent potential adverse effects to amphibian and other aquatic resources present within/around ponds from timber operations and sediment run-off.

How We Know the Design Criteria Will be Effective: In the event any trees need to be felled/removed within 50 feet of ponds, a wildlife biologist will supervise felling/removal.

- **Responsible Person (s):** Wildlife Biologist, Hidden Springs Ranger District

Design Criteria #7: No trees known to contain hawk or owl nests will be felled, girdled, removed from April 1 through August 31.

Purpose of Mitigation Measure: To reduce the overall potential direct effects to migratory birds.

How We Know the Design Criteria Will Be Effective: Any trees needing felled/removed from April 1 through August 31, and containing hawk or owl nests, will be marked by a wildlife biologist.

- **Responsible Person (s):** Wildlife Biologist, Hidden Springs Ranger District

Design Criteria #8: ***No trees or shrubs known to contain bird nests will be felled from April 1 through August 31.***

Purpose of Mitigation Measure: To reduce the likelihood of direct adverse effects (mortality, disturbance, nest abandonment, mortality to fledglings) occurring to nesting neotropical migratory birds.

How We Know the Design Criteria Will Be Effective: Any trees/shrubs needing to be cut/felled during the bird nesting season will be evaluated by a wildlife biologist prior to being cut/felled to insure no presence of nests.

- **Responsible Person (s):** Wildlife Biologist, Hidden Springs Ranger District

MONITORING

The following specific monitoring actions will be conducted to monitor compliance with Forest-Wide and Management Prescription Standards and Guidelines:

Objective: To monitor the effectiveness of mitigation measures to prevent the entry of smoke into Equality Cave resulting from prescribed burning.
Desired Results: There will be no visual evidence of smoke emissions from prescribed burning entering Equality Cave.
Methods: Forest Service personnel will be stationed at the entrance to Equality Cave to monitor temperature, humidity, winds and smoke movement in the vicinity of Equality Cave. A wildlife biologist will be stationed within Equality Cave to monitor any negative response to burning by roosting bats. Burn boss will be kept appraised of any changes in the movement of smoke within the vicinity of Equality Cave throughout the execution of the burn. If any evidence results that suggests that: (a) mitigation measures are not effective in keeping smoke from affecting roosting bats, (b) any changes in wind or other site conditions that increase the likelihood of smoke traveling in the direction of Equality Cave occurs, or (c) any evidence occurs that suggests smoke is entering Equality Cave, the Burn Boss will be immediately notified. Burn boss will take appropriate action to immediately eliminate smoke impacts to Equality Cave. This may include modifying or ceasing ignition, and/or extinguishing burning and smoldering material. Appropriate mitigation measures will be employed to insure that smoke does not enter Equality Cave after sunset. A smoke monitoring machine may be used to monitor smoke emissions. In the event that a smoke monitoring machine is used, the machine will be placed at the entrance to Equality Cave.

Objective: To monitor the status of the use of Equality Cave by southeastern myotis and Indiana bats.
Desired Results: There will be no decrease in the number of bats using Equality Cave, both during the summer as well as winter periods. There will be a progressive increase in the number of southeastern myotis and Indiana bats using Equality Cave during the winter period.

Methods: Cave surveys may be conducted about three times each year: 1) summer surveys (May 15-August 15); 2) winter surveys (January 1-March 15); and, 3) fall swarming surveys-harp trapping (September 20-October 6). The goal is to conduct surveys annually, but a minimum of at least one year out of three years (depending on availability of personnel and funding).
Responsibility: Wildlife Biologist, Hidden Springs Ranger District

Objective: To monitor species diversity and abundance of neotropical migrant birds in the Cave Hill Natural Area.
Desired Results: There will be an increase in bird species diversity, especially species that are more associated with oak savanna and open woodland barrens habitat types.
Methods: Permanent bird points, established along a transect line, will be run once a year, at least once very three years (depending on availability of personnel and funding).
Responsibility: Researchers and cooperators at Southern Illinois University; Wildlife Biologist, Hidden Springs Ranger District.

Table 3. Description, frequency, type, and location of planned monitoring activities.

Frequency	Location	Type	Description	Activity/Output Monitored
Two times per year*	Equality Cave	Implementation monitoring	Population surveys will be conducted two times per year: summer survey (May 15-August 15); and winter survey (January 1-March 15).	Number, age, and gender of bats by species present. Monitor any evidence of white-nosed syndrome.
Once per year*	Equality Cave	Implementation Monitoring	Harp trap surveys during the fall swarming period (September 20-October 6)	Number, age, and gender of bats by species present. Monitor any evidence of white-nosed syndrome.
Once per year*	Cave Hill NA	Implementation Monitoring	Bird point transects	Number and species of birds

*At least once per three years, depending on personnel and funding availability.

Prepared by:

_____ _____

Rod D. McClanahan, Wildlife Biologist Date
Hidden Springs Ranger District

Attachments:

Appendix A: Documentation of Federally Threatened and Endangered (T&E) and Regional Forester Sensitive (S) Wildlife Species OAR Table.
Appendix B: Illinois State Listed (ISS) Wildlife Species OAR Table.
Appendix C: Species of Migratory Birds of Conservation Concern of the Central Hardwoods Bird Conservation (SMBCC) Region OAR Table.

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