Terrestrial Animal Species in the Hoosier-Shawnee Ecological Assessment Area

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ABSTRACT

We reviewed the current status of amphibians, reptiles, birds, mammals, and selected invertebrates within the Hoosier-Shawnee Ecological Assessment Area. Species selected for this evaluation included those most commonly considered with respect to land management, namely threatened and endangered species, those species with viability concerns, the unique community of organisms that use cave and karst habitats, avian species in general, neotropical migrant land birds in particular, and species within the assessment area valued as game species. We evaluated a total of 452 species: 158 birds, 40 mammals, 23 amphibians, 32 reptiles, and 199 invertebrates. Five species listed as either federally threatened or endangered inhabit, or may inhabit, the assessment area. The Hoosier-Shawnee Ecological Assessment Area is particularly notable for its rich cave and karst fauna, and for the diversity of its avian inhabitants.

INTRODUCTION

The Hoosier-Shawnee Ecological Assessment Area is encompassed by the Central Hardwoods Bird Conservation Region (BCR24) and lies within the Highland Rim and Lexington Plain physiographic regions. The amound of land area held publicly, and the importance of these lands for conservation, have resulted in the designation of 13 internationally Important Bird Areas (IBAs) within or adjacent to the assessment area. In addition to a diverse terrestrial fauna, the area supports rare plant communities and a cave and karst fauna that enlarges with each effort to characterize these species. In contrast, at least with respect to the Hoosier and Shawnee National Forests, private lands are widely interspersed throughout these publicly held natural areas. Population centers adjacent to the assessment area include St. Louis, Missouri; Indianapolis, Indiana; and, Louisville, Kentucky. This cursory picture of the assessment area suggests both the importance and challenge of public land management within the context of regional growth and development, recreational use of public lands, and the subject of this chapter, the conservation of terrestrial wildlife.

This chapter documents the current status of terrestrial animal species that occur, or are likely to occur, within the Hoosier-Shawnee Ecological Assessment Area. This evaluation included those amphibians, reptiles, birds, mammals, and selected invertebrates most commonly considered with respect to land

management: namely, threatened and endangered species, those species with viability concerns, the unique community of organisms that use cave and karst habitats, avian species in general, neotropical migrant land birds in particular, and species within the assessment area valued as game species. The first section of this report addresses threatened and endangered species; the remaining species groups follow in turn. We conclude this evaluation with habitat suitability analyses of the assessment area for white-tailed deer (*Odocoileus virginianus*), northern bobwhite quail (*Colinus virginianus*), and bobcat (*Lynx rufus*).

THREATENED AND ENDANGERED SPECIES

Of the species listed as federally endangered within the assessment area (table 1), the Indiana bat (*Myotis sodalis*) is the most broadly distributed; the interior least tern (*Sterna antillarum*) is likely the most restricted of the endangered vertebrates. Of the endangered species within the assessment area, populations of the gray bat (*Myotis grisescens*) have demonstrated the greatest degree of stability or recovery. The eastern massasauga (*Sistrurus catenatus catenatus*), a candidate for federal listing, may now be extirpated within the assessment area. The American burying beetle (*Nicrophorus americanus*) currently has no known records of occurrence within the assessment area. In spite of the acknowledged rarity of these species, most counties in the region have some current record of occurrence of at least one of the five federally listed species (fig. 1).

Table 1. Federally listed threatened or endangered terrestrial animal species present in the Hoosier-Shawnee Ecological Assessment Area.

Scientific name	Common name	Status	Trend[1]
Reptiles			
Sistrurus catenatus catenatus	Eastern massasauga	Candidate	Declining
Birds			
Haliaeetus leucocephalus	Bald eagle	Threatened	Increasing
Sterna antillarum athalassos	Least tern (interior)	Endangered	Stable
Mammals			
Myotis grisescens	Gray myotis	Endangered	Increasing
Myotis sodalis	Indiana bat	Endangered	Decreasing
Invertebrates			
Nicrophorus americanus	American burying beetle	Endangered	Stable

[1] USDI Fish and Wildlife Service (1996).

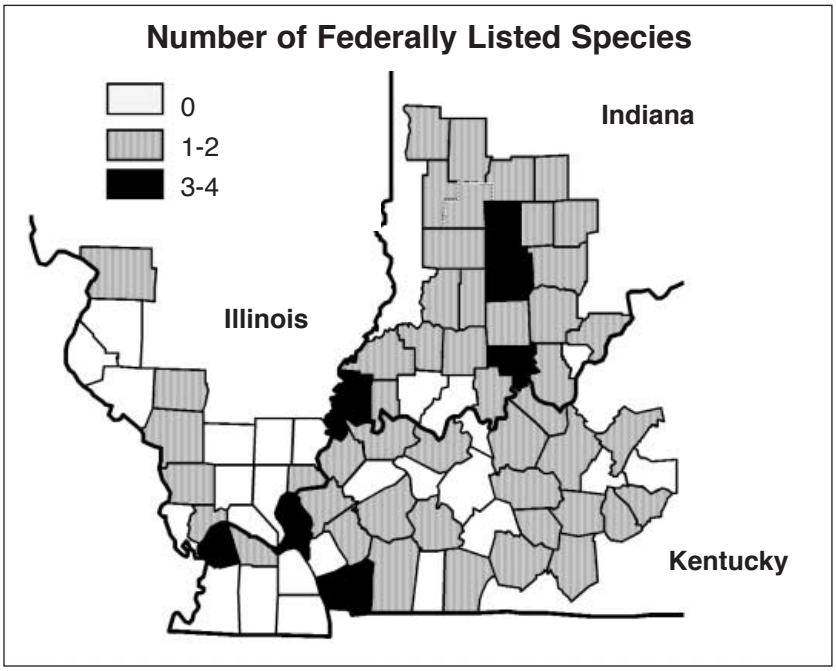

Figure 1. The distribution of federally threatened or endangered terrestrial animal species by county in the assessment area.

Federally Endangered Species

Interior least tern

The interior least tern historically inhabited major Midwest river systems that would have included the Arkansas, Missouri, Ohio, Mississippi, Red, Rio Grande, and Wabash Rivers. Early commercial exploitation in the form of plume hunting, habitat loss due to development, and recreational use of gravel bars used as breeding habitats have been principal factors contributing to the endangerment of the interior least tern.

Subspecies of the least tern were apparently abundant through the late 1880s but were regionally extirpated as a consequence of commercial plume hunting. The Migratory Bird Treaty Act of 1918 subsequently provided this and similar species some protection from

commercial exploitation. However, the association of the least tern with dry exposed gravel bars as nesting habitat, recreational disturbance of these habitats, and the desirability of adjacent areas for housing development led to a rapid decline of tern populations beginning in the 1940s. Susceptibility to predation, river channelization, irrigation diversion, and the construction of dams in the interior United States have also contributed to the loss of tern nesting habitat.

The status of the interior least tern is unclear within the assessment area. Kentucky records include Ballard, Carlisle, Fulton, Hickman, Livingston, and Union Counties along the Ohio River (Kentucky Department of Fish and Wildlife Resources 2001a, NatureServe 2002); in Illinois, terns may be restricted to Alexander, Gallatin, Jackson, and Pope Counties (Herkert 1992, NatureServe 2002). The single remaining Indiana breeding colony uses the gravel-covered dike of Gibson Lake within the property boundaries of the Cinergy Corporation's Gibson Generating Station (Indiana Division of Fish and Wildlife 2003).

Indiana bat

Indiana bats occur throughout the Midwestern and Eastern United States; records of occurrence suggest a current distribution encompassing 27 states. Surveys of hibernacula in 2001 suggest a rangewide population of approximately 380,000 Indiana bats (Clawson 2002). This represents a rangewide population decline of 57 percent, down from 880,000 individuals since surveys began after the Indiana bat was listed in 1967 (Clawson 2002).

Numbers of bats have declined across their range, particularly in Kentucky. Between 1960 and 2001, the number of bats observed in Kentucky hibernacula declined by approximately 200,000 individuals. Outside of Kentucky, however, the number of Indiana bats within the Midwest States appears to have increased within the last decade. Indiana populations increased from approximately 160,000 bats in 1960 to an estimated 173,100 bats in 2001. Over the same period, numbers of Indiana bats increased from an estimated 14,800 to 19,300 in Illinois (Clawson 2002). In the 10 years between 1990 population estimates and 2000/2001 surveys, the number of hibernating Indiana bats declined from an estimated 78,700 to 47,900 in Kentucky, while increasing from 14,900 to 19,300 in Illinois, and from 163,500 to 173,100 in Indiana. These most recent trends suggest some degree of stability of Indiana and Illinois populations.

Currently, half of all known Indiana bats occupy hibernacula within the State of Indiana. Indiana and Kentucky each contain three of the nine Priority One Hibernacula, which contain more than 85 percent of the known population of Indiana bats. Illinois, Indiana, and Kentucky all harbor Priority Two and Priority Three Hibernacula (USDI Fish and Wildlife Service 1999a; table 2). Priority One Hibernacula support more than 30,000 wintering bats; Priority Two Hibernacula support between 500 and 30,000 bats; and, Priority Three Hibernacula support fewer than 500 wintering bats.

Persecution, intentional and inadvertent human disturbance of hibernating bats, and vandalism to caves have all contributed to Indiana bat declines. In Kentucky, the exclusion of Indiana bats from caves and changes in airflow due to improper cave gates and structures have also contributed to declines. Bats inhabiting mines have been lost in the collapse of mine ceilings (Brady et al. 1983). In addition to the bats' apparent sensitivity to cave microclimate, and the role of disturbance, simplification of landscapes (USDI Fish and Wildlife Service 1999a), and accumulation of pesticide residues may also influence Indiana bat populations (Brady et al. 1983).

Gray bat

The gray myotis occurs throughout the cave region of the Eastern and Central United States.

Populations are found in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Fewer populations occur in northwestern Florida, western Georgia, southwestern Kansas, southern Indiana, southern and southwestern Illinois, northeastern Oklahoma, northern Mississippi, and western Virginia.

From the 1960s to early 1980s, this species declined in abundance by at least 50 percent; listing in 1976 arrested its decline (Brady et al. 1982, Tuttle 1979). Although not secure, the rangewide population appears stable and possibly has increased (Bat Conservation International 2001). The status of the gray myotis varies from imperiled to critically imperiled throughout the assessment area, suggesting that the species is particularly vulnerable. Approximately 95 percent of the known population of the gray myotis hibernates in only nine caves. One of these, the Jesse James Cave, is located within the assessment area in southwestern Kentucky. This cave is listed as a Priority One Hibernacula in the Gray Bat Recovery Plan (Brady et al. 1982).

High site fidelity makes the gray myotis particularly vulnerable to the factors that have endangered other bat populations, namely human disturbance and vandalism. The large proportion of the population that now occupies comparatively few sites further endangers this species. Perhaps more so than other bats, the gray myotis may be associated with streams and wetlands (Brady et al. 1982). Consequently, recovery of gray myotis populations may necessitate associated stream and wetland protection or enhancement.

Table 2. Kentucky, Illinois, and Indiana counties within or adjacent to the Hoosier-Shawnee Ecological Assessment Area that contain known Indiana bat hibernacula.

Kentucky		
Adair	Edmonson	Logan
Allen	Fulton	McCracken
Ballard	Grayson	Meade
Barren	Hardin	Taylor
Bullitt	Hart	Trigg
Caldwell	Henderson	Union
Calloway	Hickman	Warren
Carlisle	Jefferson	
Daviess	Livingston	
Illinois		
Alexander	Johnson	Pulaski
Hardin	Perry	Saline
Jackson	Pope	Union
Indiana		
Clark	Jefferson	Owen
Crawford	Lawrence	Washington
Greene	Monroe	
Harrison	Orange	

American burying beetle

The American burying beetle is a large (1.5 inch; 4 cm) strikingly colored member of the carrion beetle family (Silphidae). Adults are a glossy black and bear bright orange wing bands, a similar bright orange shield-like area behind the head, and another bright orange area between their eyes. Carrion beetles function as environmental scavengers that recycle decaying animal material. Reproduction involves the laying of eggs in a chamber formed within a small decaying animal that the beetle subsequently buries. Both sexes attend young. This species formerly occurred throughout temperate eastern North America. American burying beetles once were recorded within at least 150 counties of 35 of the Eastern and Central United States as well as portions of southern Ontario, Quebec, and Nova Scotia. Natural populations of the American burying beetle now occur in only four States: Nebraska, Rhode Island, Oklahoma, and Arkansas. The last known recorded dates of collection for this species within States in the assessment area were 1958 in Illinois, 1965 in Indiana, and 1974 in Kentucky (USDI Fish and Wildlife Service 1991). The American burying beetle is currently thought to be extirpated in the assessment area.

Habitat fragmentation is thought to be a leading cause of extirpation of American burying beetles. Fragmentation of the midwestern landscape has likely resulted in decreased availability of items

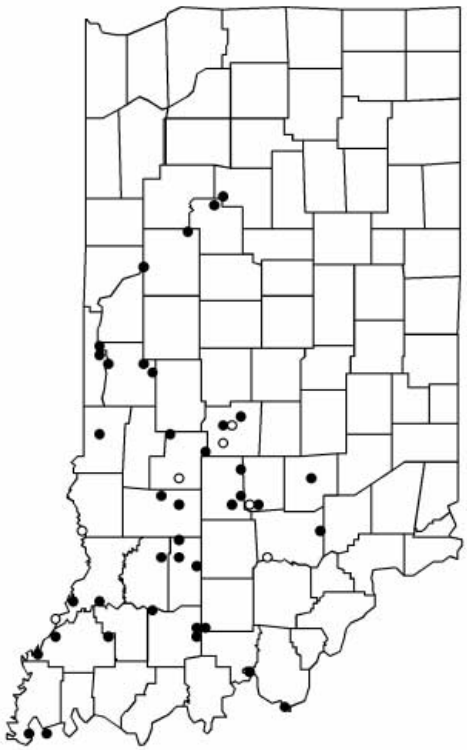

Figure 2. The location of bald eagle nests in the State of Indiana during 2002 (Indiana Division of Fish and Wildlife 2003). During 2002, the state's 26 bald eagle nests fledged a total of 45 young. Closed circles represent nests active during 2002; open circles represent inactive nests.

of small carrion (prey) for the American burying beetle, subsequently influencing the reproductive success of this species. Concurrently, as a result of number of factors, the density of vertebrate mesopredators and scavengers that may compete with the American burying beetle for carrion has likely increased. This would include such species as American crow (*Corvus brachyrhynchos*), raccoon (*Procyon lotor*), opossum (*Didelphis marsupialis*), and striped skunk (*Mephitis mephitis*).

Federally Threatened Species

Bald eagle

Before European settlement, the bald eagle likely nested throughout the Hoosier-Shawnee assessment area. The dependence of settlers on wood products resulted in widespread deforestation that drastically altered and reduced habitat suitable for eagles. Advancing settlement resulted in the extirpation of nesting eagles within Midwestern States by the early 1900s. The widespread use of industrial pesticides, particularly dichloro-diphenyl-trichloro-ethane (DDT) in the 1950s and 1960s, contributed to the further decline of the eagle. The continental ban of the use of DDT in 1972 resulted in improved reproductive performance of eagles across their range. Indiscriminate persecution by shooting (Herkert 1992) and lead poisoning related to the ingestion of shot (Buehler 2000) remain sources of eagle mortality.

Protection of the species, wetland restoration, and wildlife management efforts directed at reintroduction have resulted in a resurgence of eagles. In Indiana, restoration of the bald eagle began within the assessment area in the Lake Monroe watershed. The Indiana Division of Fish and Wildlife released 73 eaglets between 1985 and 1989 in the effort to re-establish a breeding population in Indiana. All three States within the assessment area now support nesting eagles. The first recent record of nesting in Kentucky occurred in 1989 (Kentucky Department of Fish and Wildlife Resources 2001a) ; nest records now include 32 counties in Kentucky. Eagles now nest in 14 Illinois counties; at least 10 nest records occur within the assessment area in Illinois. In 2002, Indiana bald eagles fledged 45 young from 26 nests (Indiana Division of Fish and Wildlife 2003, fig. 2).

Bald eagles remain particularly associated with major river systems such as the Illinois, Mississippi, and Ohio Rivers; most nests in Indiana are located in the riparian areas of the Wabash and White Rivers. Wetland restoration, including restoration of bottomland and floodplain forests, and land use planning designed to ensure the future viability of wetland and riparian areas will likely provide the best long-term support necessary to maintain the resurgence of the bald eagle within the assessment area.

As a result of rangewide resurgence of bald eagle populations, the status of the bald eagle was downgraded from endangered to threatened in 1995 (USDI Fish and Wildlife Service 1995). In 1999, the Fish and Wildlife Service proposed to delist the bald eagle (USDI Fish and Wildlife Service 1999b).

Candidate Species

Eastern massasauga rattlesnake

The range of the eastern massasauga rattlesnake historically extended into southern Illinois and Indiana and included the Midwestern States of Iowa, Michigan, Minnesota, Missouri, Nebraska, New York, Ohio, Pennsylvania, and Wisconsin. There is no current record of occurrence within the assessment area for the eastern massasauga; the most recent record (1986) is that of a declining population in Madison County, Illinois (Szymanski 1998).

Early species accounts suggest that massasaugas were once common throughout the Midwest. Formerly described as extremely abundant in Illinois (Hay 1893), only 7 of 25 historic populations persist. Two of these populations are considered vulnerable, three are declining, and the population trend of the remaining two is unknown (Szymanski 1998). The species occurs across the northern half of Indiana but is no longer known to occur in Indiana's portion of the assessment area. One historical record of occurrence, lacking any supporting documentation, exists for the Hoosier National Forest.

The association of massasaugas with wetlands and wet prairies, combined with the loss of these habitats and fragmentation of remaining habitats, is the greatest contributing factor to the decline of the eastern massasauga rattlesnake. Both Indiana and Illinois have lost at least 85 percent of their presettlement wetlands (Dahl 1990). Upland habitats adjacent to wetlands have also been lost or fragmented, preventing the access to wetland areas necessary to sustain viable massasauga populations. Like other rattlesnakes, this species has also been subject to both persecution and illegal collection.

TERRESTRIAL SPECIES OF VIABILITY CONCERN

Species were considered to be of viability concern based primarily on their Heritage Status Rank (NatureServe 2002). These ranks estimate the relative imperilment of taxa based on the conservation status ranking system developed by The Nature Conservancy and the Natural Heritage Network (table 3). In general, species were considered to be of viability concern if they ranked of global (G1-G3) or state viability concern (S1-S3).

Generalized habitat associations were reported for all species of global viability concern. Multiple habitat associations were listed for species where appropriate, but no attempt was made to rank the relative importance of multiple habitat associations. Generalized habitat associations included wetland/aquatic, savanna/glade, shrub/sapling, forest, grassland, agriculture, outcrops/cliffs, and cave habitats.

Table 3. Conservation status ranking system. Ranks prefaced with G refer to the conservation status of a species across its global range (G1-G5); ranks prefaced with S refer to the conservation status of a species within a state (S1-S5). For example, a species ranked as 'G3S1' would be characterized as globally rare and state critically imperiled.

Qualifier	Explanation
G	Global rank
S	State rank
1	Critically imperiled due to extreme rarity or imperiled due to a biological factor rendering species demonstrably vulnerable to extinction.
2	Imperiled due to rarity or imperiled due to a biological factor rendering species vulnerable to extinction.
3	Rare or localized distributions throughout range, vulnerable to local extirpation.
4	Species apparently secure throughout its range.
5	Species of widespread distribution, abundant, secure.
?	Rank uncertain
U	Unranked
T	Rank of recognized subspecies
B	Species rank within its breeding range
N	Species rank within its non-breeding range
Z	Occurs as state migrant
X	Presumed extirpated
H	Possibly extirpated
R	Reported, unverified
P	Potential, no record of occurrence
A	Accidental occurrence

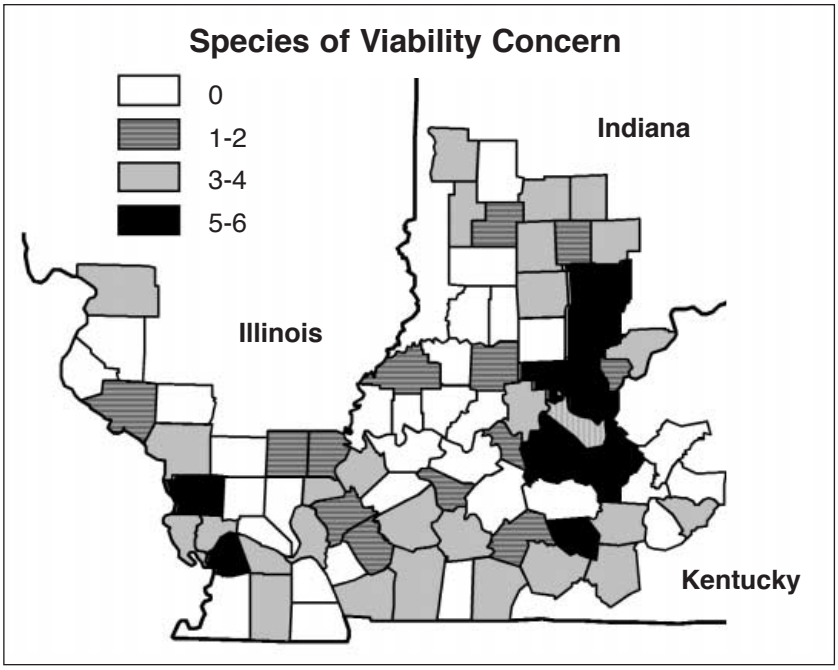

Figure 3. The numbers of terrestrial vertebrate species determined to be of global viability concern based on their Heritage Status Ranks by county in the assessment area.

Descriptions of species distributions within and adjacent to the assessment area relied upon State natural heritage databases. Invertebrate distributions were not reported due to lack of available information for these species.

Species of Global Viability Concern

In total, 41 terrestrial species are considered to be of global viability concern (table 4). These species are ranked as critically imperiled (G1), imperiled (G2), or globally rare (G3). Two amphibians are considered to be of global viability concern: the green salamander (*Aneides aeneus*) and the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*). Reptiles considered to be of global viability concern include four species associated with wetland habitats: Kirtland's snake (*Clonophis kirtlandii*), alligator snapping turtle (*Macroclemys temminkii*), copperbelly watersnake (*Nerodia erythrogaster neglecta*), and eastern massasauga rattlesnake. Except for the Allegheny woodrat (*Neotoma magister*), all mammals considered to be of global viability concern are bats (tables 4, 5).

Of the 14 vertebrate species of global viability concern, 12 have been recorded in counties that include national forest property (fig. 3). The green salamander occurs only in counties associated with the Hoosier National Forest. Counties associated with the Hoosier contain all but three of the terrestrial vertebrate species considered to be of global viability concern: least tern, eastern small footed myotis (*Myotis leibii*), and alligator snapping turtle. There are no records of occurrence on the Shawnee National Forest for the green salamander, Kirtland's snake, eastern massasauga rattlesnake, Bachman's sparrow (*Aimophila aestivalis*), Allegheny woodrat, interior least tern, or eastern small-footed myotis. Of the 14 vertebrates considered to be of global viability concern, 9 have some association with wetland habitats. Five mammalian species of global viability concern are bats.

More so than any other taxa, invertebrates have historically not been considered in conservation planning largely due to the paucity of data regarding their status. At least 159 invertebrates inhabiting the assessment area are of global viability concern (table 4, 5); 134 of these species are associated with cave and karst habitats. With concerted sampling effort, it is likely that these numbers will increase. Of these 159 terrestrial and cave-associated aquatic invertebrate species of global viability concern, 74 were observed within the proclamation boundaries of the Hoosier and Shawnee National Forests. All but 1 of the 74 invertebrate species were located on the Hoosier National Forest. Ten of those invertebrate species are associated with barrens ecosystems on the Hoosier and 60 species (81%) are associated with cave and karst systems. The predominance of bats and invertebrates as species of global viability concern indicates the relative importance of cave and karst habitats within the assessment area.

Species of State Viability Concern

An additional 172 terrestrial species are of viability concern at the State level. These species are considered rare (S3) to critically imperiled (S1) within at least one of the States of the assessment area (Illinois, Indiana, Kentucky).

Table 4. Terrestrial animal species with global viability concern, their global ranks, and associated habitats in the Hoosier-Shawnee Ecological Assessment Area.

Scientific name	Common name	Global rank[1]	Habitat
Amphibians			
Aneides aeneus	Green salamander	G3G4	Rock outcrops/Cliffs, Forest
Cryptobranchus alleganiensis alleganiensis	Eastern hellbender	G3G4T3T4	Wetland/Aquatic
Reptiles			
Clonophis kirtlandii	Kirtland's snake	G2	Wetland/Aquatic
Macroclemys temminckii	Alligator snapping turtle	G3G4	Wetland/Aquatic
Nerodia erythrogaster neglecta	Copperbelly water snake	G5T2T3	Wetland/Aquatic
Sistrurus catenatus catenatus	Eastern massasauga	G3G4T3T4	Wetland/Aquatic
Birds			
Aimophila aestivalis	Bachman's sparrow	G3	Savanna/Glade
Sterna anitllarum athalassos	Least tern (interior)	G4T2Q	Wetland/Aquatic
Mammals			
Myotis austroriparius	Southeastern myotis	G3G4	Habitat generalist, Cave habitats
Myotis grisescens	Gray myotis	G3	Forest, Wetland/Aquatic, Cave habitats
Myotis sodalis	Indiana bat	G2	Forest, Cave habitats
Myotis leibii	Eastern small-footed myotis	G3	Forest, Agriculture, Cave habitats
Neotoma magister	Allegheny woodrat	G3G4	Rock outcrops/Cliffs, Cave habitats
Plecotus rafinesquii	Rafinesque's big-eared bat	G3G4	Forest, Wetland/Aquatic, Cave habitats
Invertebrates			
Amblyscirtes aesculapius	Laced-wing roadside skipper	G3G4	Forest, Wetland/Aquatic
Anguispira kochi	Terrestrial snail	G3[2]	Cave habitats, Forest
Atrytone arogos	Arogos skipper	G3G4	Grassland
Calephelis muticum	Swamp metalmark	G3G4	Wetland/Aquatic
Campodea plusiochaeta	Dipluran	G?	
Catocala marmorata	Marbled underwing moth	G3G4	Forest
Cicindela patruela	A tiger beetle	G3	Forest, Shrub/Sapling, Outcrop/Cliffs
Dorycephalus sp.	Shovel-headed leafhopper	G3G4	Savanna/Glade
Dorydiella kansana	Kansas preacher	G3G4	Savanna/Glade
Dryobius sexnotatus	Six-banded longhorn beetle	G?	
Erora laeta	Early hairstreak	G3G4	Forest
Erynnis martialis	Mottled duskywing	G3G4	Shrub/Sapling, Savanna/Glade
Euphyes dukesi	Scarce swamp skipper	G3	Wetland/Aquatic
Fitchella robertsoni	Robertson's elephant hopper	G2G3	Savanna/Glade
Flexamia reflexa	Indian grass flexamia	G2G3	Savanna/Glade
Hesperia ottoe	Ottoe skipper	G3G4	Grassland
Lytrosis permagnaria	A geometrid moth	G3G4	Forest
Nicrophorus americanus	American burying beetle	G2G3	Shrub/Sapling, Forest, Grassland
Papaipema astute	Astute stoneroot borer moth	G3G4	Savanna/Glade
Papaipema beeriana	Beer's blazingstar borer moth	G3	Savanna/Glade
Papaipema eryngii	Rattlesnake-master borer moth	G1G2	Grassland, Wetland/Aquatic
Paraphlepsius lupalus	Leafhopper	G?	
Parasa indetermina	Wild rose slug moth	G4	Savanna/Glade
Patera laevior	Terrestrial snail	G3[2]	Cave habitats, Rock outcrops/Cliffs
Pieris virginiensis	West Virginia white	G3G4	Forest
Polyamia herbida	Prairie panic grass leafhopper	G2G3	Savanna/Glade
Speyeria idalia	Regal fritillary	G3	Grassland

[1] Based upon Heritage Status Rank reported by NatureServe (2002).
[2] Based upon Heritage Status Rank reported by Lewis (2003).

Table 5. Cave species with global viability concern, their global ranks, and associated habitats in the Hoosier-Shawnee Ecological Assessment Area.

Scientific name	Common name	Global rank[1]	Habitat
Mammals			
Myotis austroriparius	Southeastern myotis	G3G4	Habitat generalist, Cave habitats
Myotis grisescens	Gray myotis	G3	Forest, Wetland/Aquatic, Cave habitats
Myotis sodalis	Indiana bat	G2	Forest, Cave habitats
Myotis leibii	Eastern small-footed myotis	G3	Forest, Agriculture, Cave habitats
Neotoma magister	Allegheny woodrat	G3G4	Rock outcrops/Cliffs, Cave habitats
Plecotus rafinesquii	Rafinesque's big-eared bat	G3G4	Forest, Wetland/Aquatic, Cave habitats
Invertebrates			
Anahita punctulata	Wandering spider	G3[2]	Cave habitats
Anguispira kochi	Terrestrial snail	G3[3]	Cave habitats, Forest
Antroselates spiralis	Shaggy cave snail	G2[2]	Cave habitats, Wetland/Aquatic
Apochthonius undescribed species 1	Undescribed pseudoscorpion	G1[2]	Cave habitats
Apochthonius undescribed species 2	Cave pseudoscorpion	G1[3]	Cave habitats
Apochthonius indianensis	Indiana cave pseudoscorpion	G3	Cave habitats
Arrhopalites ater	Black medusa springtail	G2[2]	Cave habitats
Arrhopalites benitus	Springtail	G3[2]	Cave habitats
Arrhopalites bimus	Two-year cave springtail	G1[2]	Cave habitats
Arrhopalites carolynae	Carolyn's cave springtail	G2[3]	Cave habitats
Arrhopalites lewisi	Lewis' cave springtail	G2[2]	Cave habitats
Arrhopalites undescribed species near lewisi	Cave springtail	G2[2]	Cave habitats
Arrhopalites undescribed species near marshalli	Cave springtail	G1[3]	Cave habitats
Arrhopalites whitesidei	Whiteside's springtail	G2[3]	Cave habitats
Atheta annexa	Rove beetle	G2/G4	Cave habitats
Atheta lucifuga	Light shunning rove beetle	G3[2]	Cave habitats
Bathyphantes weyeri	Weyers Cave sheet-web spider	G2[2]	Cave habitats
Batriasymmodes undescribed species	Patton Cave ant beetle	G1[3]	Cave habitats
Batrisoldes undescribed species 1	Cave ant beetle	G1[2]	Cave habitats
Batrisoldes undescribed species 2	Cave ant beetle	G1[3]	Cave habitats
Caecidotea jordani	Jordan's groundwater isopod	G1[2]	Cave habitats, Wetland/Aquatic
Caecidotea teresae	Teresa's groundwater isopod	G1[2]	Cave habitats, Wetland/Aquatic
Carychium riparium	Floodplain carych	G3[2]	Cave habitats, Wetland/Aquatic
Cauloxenus stygius	Northern cavefish commensal copepod	G1[2]	Cave habitats, Wetland/Aquatic
Chitrella undescribed species	Undescribed cave pseudoscorpion	G1[2]	Cave habitats
Chthonius virginicus	Virginian pseudoscorpion	G3[2]	Cave habitats
Cicurina arcuata	Funnel-web spider	G3[2]	Cave habitats
Contyla bollmani	Bollman's cave milliped	G3[2]	Cave habitats
Crangonxy packardi	Packard's cave amphipod	G3[2]	Cave habitats, Wetland/Aquatic
Crangonxy undescribed species 1	Barr's cave amphipod	G3[2]	Cave habitats, Wetland/Aquatic
Crangonxy undescribed species 2	Indiana cave amphipod	G3[3]	Cave habitats, Wetland/Aquatic
Dactylocythere susanae	Susan's commensal ostracod	G3[3]	Cave habitats, Wetland/Aquatic
Diacyclops jeanneli jeanneli	Jeannel's cave copepod	G2[3]	Cave habitats, Wetland/Aquatic
Dicyrtoma flammea	Flaming springtail	G3[2]	Cave habitats
Entomobrya socia	Social springtail	G2[3]	Cave habitats
Eperigone indicabilis	Sheet-web spider	G1[2]	Cave habitats
Erebomaster flavescens	Golden cave harvestman	G3[2]	Cave habitats
Eumesocampa undescribed species	Campodeid dipluran	G1[2]	Cave habitats
Folsomia candida	White springtail	G3[2]	Cave habitats
Folsomia parus	Small springtail	G3[2]	Cave habitats
Folsomia prima	Primitive springtail	G2[2]	Cave habitats

(table continued on next page)

(table 5 continued)

Scientific name	Common name	Global rank[1]	Habitat
Fontigens cryptica	Hidden spring snail	G1[2]	Cave habitats, Wetland/Aquatic
Glyphyalinia cryptomphala	Glyph snail	G2[2]	Cave habitats
Glyphyalinia latebricola	Ledge glyph	G2[2]	Cave habitats, Wetland/Aquatic
Glyphyalinia lewisiana	Lewis' glyph	G3[2]	Cave habitats, Wetland/Aquatic
Glyphyalinia rimula	Karst glyph	G2[2]	Cave habitats, Wetland/Aquatic
Hesperochernes mirabilis	Wonderful pseudoscorpion	G3[2]	Cave habitats
Hypogastrura gibbosus	Humped springtail	G2[3]	Cave habitats
Hypogastrura helena	Helen's springtail	G1[2]	Cave habitats
Hypogastrura horrida	Bristly springtail	G2[2]	Cave habitats
Hypogastrura lucifuga	Wyandotte cave springtail	G1[2]	Cave habitats
Hypogastrura maheuxi	Maheux springtail	G2[2]	Cave habitats
Hypogastrura undescribed species near succinea	Springtail	G1[3]	Cave habitats
Islandiana cavealis	Iceland cave sheet-web spider	G1[2]	Cave habitats
Isotoma anglicana	Springtail	G3[2]	Cave habitats
Isotoma caerulatra	Blue springtail	G1[2]	Cave habitats
Isotoma christianseni	Christiansen's springtail	G1[2]	Cave habitats
Isotoma nigrifrons	Dark springtail	G2[2]	Cave habitats
Isotoma nixoni	Nixon's springtail	G1[2]	Cave habitats
Isotoma torildao	Springtail	G1[2]	Cave habitats
Isotoma truncata	Truncated springtail	G2[3]	Cave habitats
Isotoma (Desoria)undescribed species	Springtail	G1[2]	Cave habitats
Isotomiella minor	Petit springtail	G3[2]	Cave habitats
Kleptochthonius undescribed species 1	Undescribed pseudoscorpion	G1[2]	Cave habitats
Kleptochthonius undescribed species 2	Undescribed pseudoscorpion	G1[2]	Cave habitats
Kleptochthonius undescribed species 3	Undescribed pseudoscorpion	G1[2]	Cave habitats
Kleptochthonius griseomanus	Gray-handed pseudoscorpion	G1[3]	Cave habitats
Kleptochthonius packardi	Pseudoscorpion	G1[3]	Cave habitats
Litocampa undescribed species	Campodeid dipluran	G2[2]	Cave habitats
Megacyclops undescribed species	Undescribed copepod crustacean	G1[2]	Cave habitats, Wetland/Aquatic
Megacyclops donnaldsoni donnaldsoni	Donaldson's cave copepod	G1[2]	Cave habitats, Wetland/Aquatic
Miktoniscus barri	Barr's terrestrial isopod	G2[2]	Cave habitats, Wetland/Aquatic
Nesticus carteri	Carter cave spider	G3[3]	Cave habitats
Onychiurus reluctus	A springtail	G3[2]	Cave habitats
Onychiurus subtenuis	Slender springtail	G3[2]	Cave habitats
Onychiurus undescribed species 1	Springtail	G1[3]	Cave habitats
Onychiurus undescribed species 2	Paradox springtail	G1[3]	Cave habitats
Onychiurus undescribed species near casus	Springtail	G1[3]	Cave habitats
Onychiurus undescribed species near paro	Springtail	G1[3]	Cave habitats
Oreonetides undescribed species	Sheet-web spider	G1[3]	Cave habitats
Patera laevior	Terrestrial snail	G3[3]	Cave habitats, Rock outcrops/Cliffs
Porhomma cavernicola	Cavernicolous sheet-web spider	G3[2]	Cave habitats
Proisotoma libra	Springtail	G2[3]	Cave habitats
Pseudanophthalmus eremita	Wyandotte Cave ground beetle	G1[2]	Cave habitats
Pseudanophthalmus stricticollis	Marengo Cave ground beetle	G3[2]	Cave habitats
Pseudanophthalmus tenuis	Blue River cave ground beetle	G3[2]	Cave habitats
Pseudanophthalmus undescribed species 1	Undescribed cave ground beetle	G1[2]	Cave habitats
Pseudanophthalmus undescribed species 2	Undescribed cave ground beetle	G1[3]	Cave habitats
Pseudanophthalmus undescribed species 3	Undescribed cave ground beetle	G1[3]	Cave habitats
Pseudanophthalmus youngi	Young's cave ground beetle	G2[2]	Cave habitats
Pseudocandona jeanneli	Jeannel's cave ostracod	G1[2]	Cave habitats, Wetland/Aquatic

(table continued on next page)

(table 5 continued)

Scientific name	Common name	Global rank[1]	Habitat
Pseudocandona marengoensis	Marengo cave ostracod	G1[2]	Cave habitats, Wetland/Aquatic
Pseudosinella collina	Hilly springtail	G2[2]	Cave habitats
Pseudosinella fonsa	Fountain cave springtail	G2[2]	Cave habitats
Pseudosinella undescribed species near fonsa	Springtail	G1[3]	Cave habitats
Pseudosinella undescribed species	Springtail	G1[3]	Cave habitats
Pseudotremia conservata	TNC cave milliped	G1[2]	Cave habitats
Pseudotremia indianae	Blue River cave milliped	G3[2]	Cave habitats
Pseudotremia reynoldsae	Reynolds' cave milliped	G1[3]	Cave habitats
Pseudotremia salisae	Salisa's cave milliped	G1[3]	Cave habitats
Pseudotremia undescribed species 1	Troglobitic milliped	G1[2]	Cave habitats
Pseudotremia undescribed species 2	Troglobitic milliped	G1[2]	Cave habitats
Ptomaphagus cavernicola cavernicola	Cavernicolous fungus beetle	G3[2]	Cave habitats
Rheocyclops indiana	Indiana groundwater copepod	G1[3]	Cave habitats, Wetland/Aquatic
Rheocyclops undescribed species	Undescribed copepod crustacean	G1[2]	Cave habitats, Wetland/Aquatic
Sabacon cavicolens	Cavernicolous harvestman	G3[2]	Cave habitats
Sagittocythere barri	Barr's commensal cave ostracod	G3[2]	Cave habitats, Wetland/Aquatic
Scoterpes undescribed species	Troglobitic milliped	G1[2]	Cave habitats
Sensillanura barberi	Barber's springtail	G2[2]	Cave habitats
Sensillanura caeca	Blind springtail	G3[2]	Cave habitats
Sensillanura undescribed species near bara	Springtail	G1[3]	Cave habitats
Sensillanura undescribed species near illina	Springtail	G1[2]	Cave habitats
Sensillanura undescribed species	Springtail	G1[3]	Cave habitats
Sinella alata	Wingless winged cave springtail	G3[2]	Cave habitats
Sinella avita	Ancestral springtail	G3	Cave habitats
Sinella barri	Barr's cave springtail	G3[2]	Cave habitats
Sinella undescribed species	Cave springtail	G1[2]	Cave habitats
Sminthurides hypogramae	Springtail	G1[2]	Cave habitats
Sminthurides weichseli	Weichsel's springtail	G2[2]	Cave habitats, Wetland/Aquatic
Sminthurinus malmgreni	Malmgren's springtail	G3[2]	Cave habitats, Wetland/Aquatic
Sphalloplana chandleri	Chandler's cave flatworm	G1[2]	Cave habitats
Sphalloplana weingartneri	Weingartner's cave flatworm	G2[2]	Cave habitats
Stygobromus subtilus	Subtle cave amphipod	G2	Cave habitats
Stygobromus undescribed species 1	Amphipod crustacean	G1[2]	Cave habitats, Wetland/Aquatic
Stygobromus undescribed species 2	Amphipod crustacean	G1[2]	Cave habitats, Wetland/Aquatic
Stygobromus undescribed species 3	Amphipod crustacean	G1[2]	Cave habitats, Wetland/Aquatic
Talanites echinus	Sac-web spider	G2[2]	Cave habitats
Tomocerus dubius	Springtail	G3[3]	Cave habitats
T*omocerus elongatus*	Elongate springtail	G3[2]	Cave habitats
Tomocerus (Lethemurus) missus	Relict cave springtail	G2[2]	Cave habitats
Tomocerus undescribed species	Springtail	G1[3]	Cave habitats
Tychobythinus bythinioides	Ant beetle	G3[2]	Cave habitats
Veigaia bakeri	Baker's cave mite	G1[2]	Cave habitats
Veigaia wyandottensis	Wyandotte cave mite	G1[2]	Cave habitats

[1] Based upon Heritage Status Rank reported by NatureServe (2002).

[2] Based upon Heritage Status Rank reported by Lewis (1998).

[3] Based upon Heritage Status Rank reported by Lewis et al. (2003).

Not quite half of these species are birds (81 of 172); 22 are reptiles, 12 are amphibians, 18 are mammals, and 39 are invertebrates (table 6).

Among those species determined to be of state viability concern, 73 have some association with wetland or aquatic habitats, 46 have some association with forest habitats, 49 species have some association with early successional habitat types (grassland, savannah/glade, shrub/sapling), and 20 species are associated with caves.

Due to their predominance as species of global or state viability concern, both cave-associated species (table 5) and avian species (tables 7-9) are considered in greater detail below. Detailed assessments of the status of mammals occurring within the assessment area are presented in table 10, reptiles and amphibians are summarized in table 11, and terrestrial invertebrates are summarized in table 12.

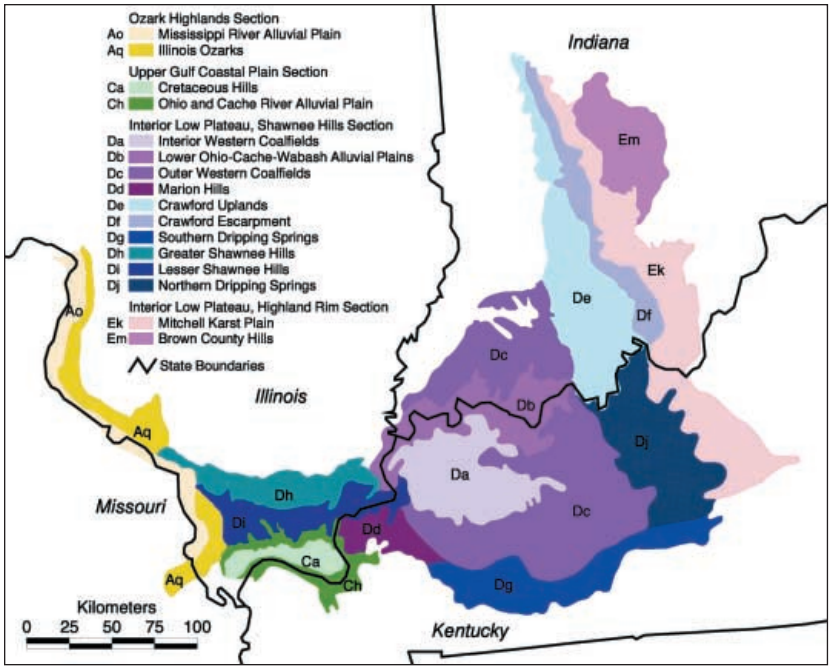

Figure 4. Location of ecological subsections that encompass the Hoosier National Forest. The forest resides primarily within three ecological subsections known to contain extensive components of karst: the Mitchell Karst Plains, Crawford Escarpment, and Crawford Uplands Subsections.

CAVE FAUNA

One of the most striking features of the assessment area is its karst habitat. Karst refers to landscapes characterized by sinkholes, caves, and underground drainages. The majority of this habitat lies within the Mitchell Karst Plain, Crawford Escarpment, and Crawford Uplands subsections of Indiana in which the Hoosier National Forest is located (fig. 4). In addition to the yet unknown number of caves throughout the assessment area, 136 known caves occur on the Hoosier National Forest and 15 occur on the Shawnee National Forest (fig. 5).

The description and inventory of karst fauna within the assessment area is a distinctly recent achievement (Lewis 1994, Lewis 1996, Lewis 1998, Lewis 2002a, Lewis 2002b, Lewis et al. 2002, Lewis et al. 2003). Undertaken to acquire baseline inventories, this work continues to describe species new to the scientific literature and to document new distributions of previously described species. While this work represents

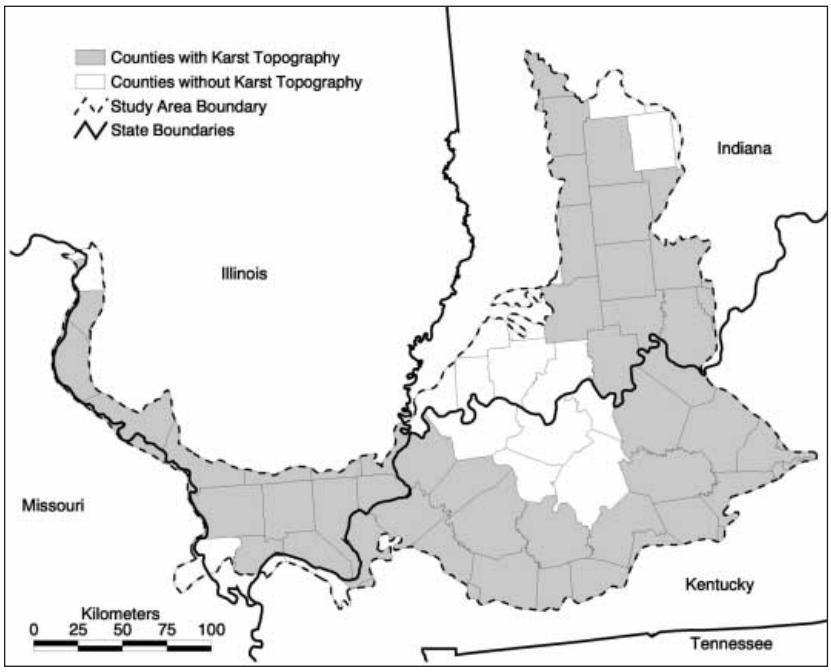

Figure 5. Location of known karst features within the Hoosier and Shawnee National Forests. Currently, 136 known caves occur on the Hoosier National Forest and 15 occur on the Shawnee National Forest .

Table 6. Terrestrial animal species with state viability concerns, other than those previously identified to be of global viability concern (table 4). Included are global and state Heritage Status Ranks (NatureServe 2002), as well as habitat associations for these species in the Hoosier-Shawnee Ecological Assessment Area.

Scientific name	Common name	Global rank	State rank			Habitat
			IL	IN	KY	
Amphibians						
Desmognathus fuscus	Dusky salamander	G5	S2	S4	S5	Wetland/Aquatic
Hemidactylium scutatum	Four-toed salamander	G5	S2	S2	S4	Wetland/Aquatic
Hyla avivoca	Bird-voiced treefrog	G5	S3	-	S2S3	Wetland/Aquatic
Hyla cinerea	Green treefrog	G5	S3	-	S3	Wetland/Aquatic
Hyla gratiosa	Barking treefrog	G5	-	-	S3	Wetland/Aquatic
Hyla versicolor	Gray treefrog	G5	S4	S4	S2S3	Wetland/Aquatic
Necturus maculosus	Mudpuppy	G5	S5	S2	S4	Wetland/Aquatic
Pseudotriton ruber ruber	Northern red salamander	G5T5	-	S1	S5	Wetland/Aquatic
Rana areolata circulosa	Northern crawfish frog	G4T4	-	S2	S3	Grassland, Savanna/Glade, Wetland/Aquatic
Rana blairi	Plains leopard frog	G5	S4	S2	-	Wetland/Aquatic
Rana pipiens	Northern leopard frog	G5	S5	S2	S3	Wetland/Aquatic
Scaphiopus holbrookii holbrookii	Eastern spadefoot	G5T5	-	S2	S4	Wetland/Aquatic
Reptiles						
Agkistrodon piscivorus leucostoma	Western cottonmouth	G5T5	-	S1	S3S4	Wetland/Aquatic
Apalone mutica	Smooth softshell turtle	G5	S3	S4	S3	Wetland/Aquatic
Cemophora coccinea copei	Northern scarlet snake	G5T5	-	S1	S3S4	Forest
Crotalus horridus	Timber rattlesnake	G4	S3	S2	S4	Outcrops/Cliffs, Forest
Elaphe guttata guttata	Corn snake	G5T5	-	-	S3	Outcrops/Cliffs, Forest
Eumeces anthracinus anthracinus	Northern coal skink	G5T5	-	-	S2	Outcrops/Cliffs, Forest
Eumeces inexpectatus	Southeastern five-lined skink	G5	-	-	S3	Forest, Wetland/Aquatic
Farancia abacura reinwardtii	Western mud snake	G5T5	-	SX	S3	Wetland/Aquatic
Heterodon nasicus	Western hognose snake	G5	S2	-	-	Grassland
Kinosternon subrubrum	Eastern mud turtle	G5	S3S4	S2	S3S4	Wetland/Aquatic
Liochlorophis vernalis	Smooth green snake	G5	S3S4	S2	-	Forest, Grassland, Wetland/Aquatic
Masticophis flagellum	Eastern coachwhip	G5	S1	-	SX	Outcrops/Cliffs, Savanna/Glade, Grassland
Nerodia cyclopion	Mississippi green water snake	G5	S1	-	S1	Wetland/Aquatic
Nerodia fasciata confluens	Broad-banded water snake	G5T5	-	-	S1	Wetland/Aquatic
Opheodrys aestivus	Rough green snake	G5	S5	S3	S5	Forest, Grassland, Shrub/Sapling
Ophisaurus attenuatus	Slender glass lizard	G5	S4	S2	S2	Grassland, Savanna/Glade
Pituophis melanoleucus	Northern pine snake	G4	-	-	S2	Forest, Outcrops/Cliffs
Pseudemys concinna	River cooter	G5	S1	S?	S3	Wetland/Aquatic
Tantilla coronata	Southeastern crowned snake	G5	-	S1	S3S4	Outcrops/Cliffs, Forest
Tantilla gracilis	Flathead snake	G5	S2	-	-	Outcrops/Cliffs
Thamnophis proximus	Western ribbon snake	G5	S4	S3	S1S2	Outcrops/Cliffs, Wetland/Aquatic
Thamnophis sauritus	Eastern ribbon snake	G5	S1	S4	S3	Wetland/Aquatic
Birds						
Accipiter cooperii	Cooper's hawk	G5	S3	S3B,SZN	S4B,S4N	Forest
Accipiter gentilis	Northern goshawk[1]	G5	SZN	SZN	SZN	Forest
Accipiter striatus	Sharp-shinned hawk	G5	S1S2	S2B,SZN	S3B,S4N	Forest
Actitis macularia	Spotted sandpiper	G5	S3S4	S4B	S1B	Wetland/Aquatic
Ammodramus henslowii	Henslow's sparrow	G4	S2	S3B,SZN	S3B	Grassland
Anas discors	Blue-winged teal	G5	S3	S4B,SZN	S1S2B	Wetland/Aquatic

(table continued on next page)

(table 6 continued)

Scientific name	Common name	Global rank	State rank			Habitat
			IL	IN	KY	
Anas platyrhynchos	Mallard[1]	G5	S5	S4	S3S4B,S4S5N	Wetland/Aquatic
Anas rubripes	American black duck[1]	G5	-	S1	S4N	Wetland/Aquatic
Ardea alba	Great egret	G5	S3	S1B,SZN	S1B	Wetland/Aquatic
Ardea herodias	Great blue heron	G5	S4	S4B,SZN	S3B,S4N	Wetland/Aquatic
Asio flammeus	Short-eared owl	G5	S1B,S2S3N	S2	S1B,S2N	Grassland, Savanna/Glade
Asio otus	Long-eared owl	G5	S1B,S2N	S2	S1B,S1S2N	Forest, Agriculture
Aythya valisineria	Canvasback[1]	G5	SZN	SZN	S3N	Wetland/Aquatic
Bartramia longicauda	Upland sandpiper	G5	S2S3	S3B	SHB	Grassland, Agriculture
Botaurus lentiginosus	American bittern	G4	S1S2	S2B	SHB	Wetland/Aquatic
Bubulcus ibis	Cattle egret	G5	S3S4	SPB,SZN	S1S2B	Agriculture
Buteo lineatus	Red-shouldered hawk	G5	S2S3	S3	S4B,S4N	Forest, Shrub/Sapling
Buteo platypterus	Broad-winged hawk	G5	S3	S3B,SRFN	S4B	Forest
Buteo swainsoni	Swainson's hawk	G5	S1	-	-	Savanna/Glade, Agriculture
Caprimulgus carolinensis	Chuck-will's-widow	G5	S4	S3B	S4S5B	Forest
Certhia americana	Brown creeper	G5	S3	S2B,SZN	S1S2B,S4S5N	Forest
Chen caerulescens	Snow goose[1]	G5	SZN	SZN	S3S4N	Wetland/Aquatic
Chlidonias niger	Black tern	G4	S1	S1B,SZN	SXB,SZN	Wetland/Aquatic
Chondestes grammacus	Lark sparrow	G5	S5	S3B,SZN	S2S3B	Shrub/Sapling, Grassland
Circus cyaneus	Northern harrier	G5	S2B,S3N	S2	S1S2B,S4N	Grassland, Savanna/Glade
Cistothorus palustris	Marsh wren	G5	S4	S3B, SZN	SZN	Shrub/Sapling, Wetland/Aquatic
Cistothorus platensis	Sedge wren	G5	S3S4	S3B,SZN	S3B	Shrub/Sapling, Wetland/Aquatic
Coragyps atratus	Black vulture	G5	S3	S1N,S2B	S4B,S3S4N	Agriculture
Corvus ossifragus	Fish crow	G5	S2	-	S3B	Wetland/Aquatic
Coturnicops noveboracensis	Yellow rail[1]	G4	SXB,S2N	SZN	SZN	Wetland/Aquatic
Cygnus buccinator	Trumpeter swan[1]	G4	SXB,S2N	SRB	SXN	Wetland/Aquatic
Dendroica caerulescens	Black-throated blue warbler[1]	G5	SZN	SZN	S3S4B	Forest, Shrub/Sapling
Dendroica cerulea	Cerulean warbler	G4	S3	S3B	S4S5B	Forest
Dendroica pinus	Pine warbler	G5	S3S4	S3B	S4S5B,SZN	Forest
Dendroica virens	Black-throated green warbler	G5	SZN	S2B	S4B	Forest
Dendroica fusca	Blackburnian warbler[1]	G5	SZN	-	S1S2B	Forest
Dolichonyx oryzivorus	Bobolink	G5	S4	S4B	S2S3B	Grassland, Agriculture
Egretta caerulea	Little blue heron	G5	S1	SRB,SZN	S1B	Wetland/Aquatic
Egretta thula	Snowy egret	G5	S1	SZN	SZN	Wetland/Aquatic
Elanoides forficatus	Swallow-tailed kite[1]	G5	SX	-	-	Forest, Savanna/Glade
Empidonax minimus	Least flycatcher	G5	S3	S3B	S1B	Forest
Falco peregrinus	Peregrine falcon	G4	S1	S2B,SZN	S1B,SZN	Wetland/Aquatic, Grassland
Fulica americana	American coot	G5	S4	S4B,S2N	SHB,SZN	Wetland/Aquatic
Gallinago delicata	Wilson's snipe[1]	G5	S3	S1S2B,SZN	S3S4N	Wetland/Aquatic
Gallinula chloropus	Common moorhen	G5	S3	S3B	S1S2B	Wetland/Aquatic
Gavia immer	Common loon[1]	G5	SXB,S2N	SXB,SZN	SZN	Wetland/Aquatic
Grus canadensis	Sandhill crane[1]	G5	S3	S2B,S1N	SZN	Wetland/Aquatic, Grassland
Haliaeetus leucocephalus	Bald eagle	G4	S2B,S3N	S2B	S1S2B,S2S3N	Wetland/Aquatic
Helmitheros vermivorus	Worm-eating warbler	G5	S4	S3B	S4S5B	Forest, Shrub/Sapling
Ictinia mississippiensis	Mississippi kite	G5	S2S3	S1B	S2B	Forest
Ixobrychus exilis	Least bittern	G5	S2	S3B	S1S2B	Wetland/Aquatic
Lanius ludovicianus	Loggerhead shrike	G4	S3	S3B,SZN	S4B,S4N	Savanna/Glade, Shrub/Sapling
Laterallus jamaicensis	Black rail	G4	S1	SHB	-	Wetland/Aquatic
Limnothlypis swainsonii	Swainson's warbler	G4	S1	SRB	S3S4B	Shrub/Sapling, Forest

(table continued on next page)

(table 6 continued)

Scientific name	Common name	Global rank	State rank			Habitat
			IL	IN	KY	
Lophodytes cucullatus	Hooded merganser	G5	S2S3	S2S3B,SZN	S1S2B,S3S4N	Wetland/Aquatic
Mniotilta varia	Black-and-white warbler	G5	S2S3	S1S2B	S4S5B	Forest
Nyctanassa violacea	Yellow-crowned night-heron	G5	S1	S2B	S2B	Wetland/Aquatic
Nycticorax nycticorax	Black-crowned night-heron	G5	S2	S1B,SAN	S1S2B	Wetland/Aquatic
Pandion haliaetus	Osprey	G5	S1	S1B,SZN	S1S2B	Wetland/Aquatic
Passerculus sandwichensis	Savannah sparrow	G5	S5	S4B,SZN	S2S3B,S2S3N	Grassland, Agriculture
Phalaropus tricolor	Wilson's phalarope[1]	G5	S1	SHB,SZN	SZN	Wetland/Aquatic
Pheucticus ludovicianus	Rose-breasted grosbeak	G5	S5	S4B	S3S4B	Forest, Savanna/Glade
Podilymbus podiceps	Pied-billed grebe	G5	S3	S3B,SZN	S1B,S4N	Wetland/Aquatic
Pooecetes gramineus	Vesper sparrow	G5	S5	S4B,SZN	S1B,SZN	Shrub/Sapling, Savanna/Glade
Porzana carolina	Sora	G5	S3	S4B,SZN	SZN	Wetland/Aquatic
Rallus elegans	King rail	G4G5	S2	S1B,SZN	S1B	Wetland/Aquatic
Rallus limicola	Virginia rail	G5	S3	S3B,SZN	S1B?,SZN	Wetland/Aquatic
Riparia riparia	Bank swallow	G5	S5	S4B	S3B	Wetland/Aquatic
Sitta pusilla	Brown-headed nuthatch[1]	G5	SR	SRN		Shrub/Sapling, Forest
Sterna antillarum	Least tern[1]	G4	S1	S?	S1S2	Wetland/Aquatic
Sterna forsteri	Forster's tern[1]	G5	S1	SHB,SZN	SZN	Wetland/Aquatic
Sterna hirundo	Common tern[1]	G5	S1	SXB,SZN	SZN	Wetland/Aquatic
Sturnella magna	Eastern meadowlark	G5	S5	S3N,S4B	S5B,S5N	Grassland, Agriculture
Sturnella neglecta	Western meadowlark	G5	S5	S2B	SAB,SZN	Grassland, Agriculture
Thryomanes bewickii	Bewick's wren	G5	S1	S1B,SZN	S3B	Shrub/Sapling
Tyto alba	Barn owl	G5	S1S2	S2	S3	Agriculture
Vermivora chrysoptera	Golden-winged warbler	G4	S1S2	S1B	S2B	Shrub/Sapling, Savanna/Glade
Vireo bellii	Bell's vireo	G5	S4	S3B	S2S3B	Shrub/Sapling
Wilsonia citrina	Hooded warbler	G5	S3S4	S3B	S5B	Forest, Wetland/Aquatic, Shrub/Sapling
Wilsonia canadensis	Canada warbler	G5	S1	S2B	S3B	Forest, Wetland/Aquatic
Xanthocephalus xanthocephalus	Yellow-headed blackbird[1]	G5	S2	S1B	SZN	Wetland/Aquatic
Mammals						
Condylura cristata	Star-nosed mole	G5	SR	S2?	-	Wetland/Aquatic
Geomys bursarius	Plains pocket gopher	G5	S3	S2	-	Grassland
Lutra canadensis	Northern river otter	G5	S2	S?	S3S4	Wetland/Aquatic
Lynx rufus	Bobcat	G5	S3	S1	S4	Habitat generalist
Mustela nivalis	Least weasel	G5	S3	S2?	S2S3	Habitat generalist
Neotoma floridana	Eastern wood rat	G5	S1	-	-	Forest, Wetland/Aquatic, Outcrops/Cliffs
Nycticeius humeralis	Evening bat	G5	S3	S1	S2S3	Forest
Ochrotomys nuttalli	Golden mouse	G5	S2	-	S4	Forest
Oryzomys palustris	Marsh rice rat	G5	S2	-	S4	Wetland/Aquatic
Reithrodontomys megalotis	Western harvest mouse	G5	S4	S2	-	Grassland, Agriculture
Sorex fumeus	Smoky shrew	G5	-	S2	S5	Forest
Sorex hoyi	Pygmy shrew	G5	SH	S2	S4	Habitat generalist
Sorex cinereus	Masked shrew	G5	S5	S4	S3	Habitat generalist
Sorex dispar	Long-tailed shrew	G4	-	-	S1	Forest, Outcrops/Cliffs
Spermophilus franklinii	Franklin's ground squirrel	G5	S4	S2	-	Grassland
Spilogale putorius	Eastern spotted skunk	G5	SR	SX	S2S3	Forest, Grassland, Outcrops/Cliffs
Sylvilagus aquaticus	Swamp rabbit	G5	S3	S1	S3S4	Wetland/Aquatic

(table continued on next page)

(table 6 continued)

Scientific name	Common name	Global rank	State rank			Habitat
			IL	IN	KY	
Taxidea taxus	American badger	G5	S4	S2	SR	Grassland
Invertebrates						
Aleochara lucifiga	Cave rove beetle	G4[3]	-	S3[3]	-	Cave habitats
Amblyscirtes belli	Bell's roadside skipper	G4	S1?	S1S2	S2S3	Grassland, Developed
Amblyscirtes hegon	Salt-and-pepper skipper	G5	SU	S1S3	S4	Savanna/Glade, Forest
Anahita punctulata	Wandering spider	G4	-	S1	-	Cave habitats
Autochton cellus	Golden-banded skipper	G4	S1S3	S1S2	S3	Forest, Wetland/Aquatic
Aleochara lucifiga	Cave rove beetle	G4[3]	S?	S3[3]	-	Cave habitats
Calymmaria cavicola	Cave funnel-web spider	G4[3]	S?	S3[3]	-	Cave habitats
Cambala annulata	Annulate millipede	G5	-	S2	-	Cave habitats
Cambala minor	Millipede	G5	S?	S2	-	Cave habitats
Carychium exile	Ice thorn	G5	S?	S2	S3S4	Cave habitats
Catops gratiosa	Beetle	G4[2]	S?	S2[2]	-	Cave habitats
Celastrina nigra	Sooty azure	G4	S2	S2	S3	Forest
Cicurina pallida	Pallid funnel-web spider	G4[2]	S?	S2	-	Cave habitats
Cycnia inopinatus	Unexpected milkweed moth	G4	-	S2	-	Savanna/Glade
Cyllopsis gemma	Gemmed satyr	G5	SU	S2	S4	Savanna/Glade, Forest
Dolomedes scriptus	Lined nursery web spider	G4[2]	-	S2?[2]	-	Cave habitats, Wetland/Aquatic
Dolomedes vittatus	Nursery web spider	G4[2]	S?	S1	-	Cave habitats
Eidmanella pallida	Pallid cave spider	G5[2]	-	S1	-	Cave habitats
Eosphoropteryx thyatyroides	Pinkpatched looper moth	G4G5	-	S2	-	
Euphydryas phaeton	Baltimore checkerspot	G4	S3	S2S4	S3	Wetland/Aquatic
Euryurus leachii	Leach's millipede	G4[3]	-	S2	-	Cave habitats
Fixsenia favonius ontario	Northern hairstreak	T4	S1S3	-	S1	Savanna/Glade, Forest
Hesperia leonardus	Leonardus skipper	G4	SU	S2	S3	Savanna/Glade, Forest
Hesperia metea	Cobweb skipper	G4G5	S3	S2S3	S3	Shrub/Sapling, Savanna/Glade
Hyperaeschra georgica	A prominent moth	G5	-	S2	-	
Hypogastrura succinea	Girded springtail	G4[2]	-	S1	-	Cave habitats
Ligidium elrodii	Elrod's terrestrial isopod	G4[3]	S?	S4[3]	-	Cave habitats
Necrophilus pettiti	A carrion beetle	G4[2]	-	S2[2]	-	Cave habitats
Onychiurus casus	Fallen springtail	G4[2]	-	S2	-	Cave habitats
Papaipema marginidens	Margined borer moth	G4	-	S1	S?	Savanna/Glade
Papaipema rutila	Mayapple borer moth	G4	S?	S1	-	Savanna/Glade
Polygonia faunus	Green comma	G5	-	-	SH	Forest, Savanna/Glade, Outcrops/Cliffs
Quedius spelaeus	Spelean rove beetle	G5[2]	S?	S2	-	Cave habitats
Satyrodes appalachia appalachia	Appalachian eyed brown	G4T5	-	S1	-	Wetland/Aquatic
Schinia jaguarina	Jaguar flower moth	G4	-	S?	-	Savanna/Glade
Scytonotus granulatus	Granulated millipede	G5	-	S3[3]	-	Cave habitats
Sinella cavernarum	Cavernicolous springtail	G4	S?	S2	S?	Cave habitats
Thorybes confusis	Eastern cloudywing	G4	-	-	S2S3	Forest
Tomocerus bidentatus	Two-toothed springtail	G4[3]	S?	S3	-	Cave habitats
Tomocerus lamelliferus	Layered springtail	G4[2]	-	S1	-	Cave habitats

[1] This is a species of seasonal importance in the assessment area. These species do not necessarily breed locally but may seasonally inhabit the assessment area.
[2] Based upon Heritage Status Rank as reported by Lewis (1998).
[3] Based upon Heritage Status Rank as reported by Lewis et al. (2003).

Table 7. Bird species of management or conservation concern within the Hoosier-Shawnee Ecological Assessment Area, their global and state Heritage Status Ranks, their conservation status within the forests, and their designation as game species within the states of the assessment area.

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Loons	**(Family Gaviidae)**								
Common loon[4]	*Gavia immer*		G5	SXB, S2N	SXB, SZN	SZN			
Grebes	**(Family Podicipedidae)**								
Pied-billed grebe	*Podilymbus podiceps*		G5	T, S3	S3B, SZN	S1B, S4N		FSC	
Cormorants	**(Family Phalacrocoracidae)**								
Double-crested cormorant	*Phalacrocorax auritus*		G5	S2	SHB, SZN	SHB, SZN			
Herons, Bitterns	**(Family Ardeidae)**								
American bittern	*Botaurus lentiginosus*		G4	E, S1S2	E, S2B	SHB		FSC	
Black-crowned night-heron	*Nycticorax nycticorax*		G5	E, S2	E, S1B, SAN	S1S2B		FSC	
Cattle egret	*Bubulcus ibis*		G5	S3S4	SPB, SZN	S1S2B			
Great blue heron	*Ardea herodias*		G5	S4	S4B, SZN	S3B, S4N	WL		
Great egret	*Ardea alba*		G5	S3	S, S1B, SZN	S1B		FSC	
Green Heron	*Butorides virescens*		G5	S5	S4B, SAN	S4S5B			
Least bittern	*Ixobrychus exilis*		G5	T, S2	E, S3B	S1S2B		FSC	
Little blue heron	*Egretta caerulea*		G5	E, S1	SRB, SZN	S1B		FSC	
Snowy egret	*Egretta thula*		G5	E, S1	SZN	SZN		FSC	
Yellow-crowned night-heron	*Nyctanassa violacea*		G5	E, S1	E, S2B	S2B		FSC	
Ducks, Geese Swans	**(Family Anatidae)**								
American black duck[4]	*Anas rubripes*		G5	-	S1	S4N			IL, IN, KY
Blue-winged teal	*Anas discors*		G5	S3	S4B, SZN	S1S2B			IL, IN, KY
Canada goose - giants	*Branta canadensis*		G5	S5	S5	S3S4B, S4N			IL, IN, KY
Canada goose - urban giants[4]	*Branta canadensis*								IL, IN, KY
Canada goose - Southern James Bay Population[4]	*Branta canadensis*								IL, IN, KY
Canada goose - Eastern Prairie Population[4]	*Branta canadensis*								IL, IN, KY
Canvasback[4]	*Aythya valisineria*		G5	SZN	SZN	S3N			IN, KY
Hooded merganser	*Lophodytes cucullatus*		G5	S2S3	S2S3B, SZN	S1S2B, S3S4N			IL, IN, KY
Mallard[4]	*AnAs platyrhynchos*		G5	S5	S4	S3S4B, S4S5N			IL, IN, KY
Snow goose[4]	*Chen caerulescens*		G5	SZN	SZN	S3S4N			IL, IN, KY
Trumpeter swan[4]	*Cygnus buccinator*		G4	SXB, S2N	E, SRB	SXN			
Wood duck	*Aix sponsa*		G5	S5	S4B, S1N	S4S5B, SZN	MIS	MIS	IL, IN, KY
Hawks, Kites, Eagles	**(Family Accipitridae)**								
Bald eagle	*Haliaeetus leucocephalus*	T	G4	T, S2B, S3N	E, S2	T, S1S2B, S2S3N			
Black vulture	*Coragyps atratus*		G5	S3	S1N, S2B	S4B, S3S4N			
Broad-winged hawk	*Buteo platypterus*		G5	S3	S, S3B, SRFN	S4B	FSC, MIS		
Cooper's hawk	*Accipiter cooperii*		G5	E, S3	S3B, SZN	S4B, S4N		FSC	
Mississippi kite	*Ictinia mississippiensis*		G5	E, S2S3	S, S1B	S2B		FSC	
Northern goshawk[4]	*Accipiter gentilis*		G5	SZN	SZN	SZN			
Northern harrier	*Circus cyaneus*		G5	E, S2B, S3N	E, S2	S1S2B, S4N		FSC	
Osprey	*Pandion haliaetus*		G5	E, S1	E, S1B, SZN	S1S2B	FSC	FSC	
Peregrine falcon	*Falco peregrinus*		G4	E, S1	E, S2B, SZN	S1B, SZN			

(table continued on next page)

(table 7 continued)

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Red-shouldered hawk	*Buteo lineatus*		G5	T, S2S3	S, S3	S4B, S4N	FSC	FSC	
Sharp-shinned hawk	*Accipiter striatus*		G5	S1S2	S, S2B, SZN	S3B, S4N	FSC	FSC	
Swainson's hawk	*Buteo swainsoni*		G5	E, S1	-	-			
Swallow-tailed kite[4]	*Elanoides forficatus*		G5	SX	-	-			
Partridges, Grouse, Turkeys	**(Family Phasianidae)**								
Northern bobwhite	*Colinus virginianus*		G5	S5	S4	S5		MIS	IL, IN, KY
Ruffed grouse	*Bonasa umbellus*		G5	S3	S4	S4	MIS		IN, KY
Wild turkey	*Meleagris gallopavo*		G5	S5	S4	S4	MIS	MIS	IL, IN, KY
Rails, Gallinules, Coots	**(Family Rallidae)**								
American coot	*Fulica americana*		G5	S4	S4B, S2N	SHB, SZN			IL, IN, KY
Black rail	*Laterallus jamaicensis*		G4	E, S1	E, SHB	-			
Common moorhen	*Gallinula chloropus*		G5	T, S3	S3B	S1S2B		FSC	IN, KY
King rail	*Rallus elegans*		G4G5	E, S2	E, S1B, SZN	S1B			
Purple gallinule	*Porphrio martinica*		G5	-	-	-		FSC	KY
Sora	*Porzana carolina*		G5	S3	S4B, SZN	SZN			IL, IN, KY
Virginia rail	*Rallus limicola*		G5	S3	E, S3B, SZN	S1B?, SZN			IL, KY
Yellow rail[4]	*Coturnicops noveboracensis*		G4	SXB, S2N	SZN	SZN			
Cranes	**(Family Gruidae)**								
Sandhill crane[4]	*Grus canadensis*		G5	T, S3	S, S2B, S1N	SZN			
Sandpipers, Phalaropes	**(Family Scolopacidae)**								
American avocet[4]	*Recurvirostra americana*		G5	SZN	SXB, SZN	SZN			
American golden-plover[4]	*Pluvialis dominica*		G5	SZN	SZN	SZN			
American woodcock	*Scolopax minor*		G5	S4	S4B, SZN	S4, S5B, SZN	MIS		IL, IN, KY
Black-bellied plover[4]	*Pluvialis squatarola*		G5	SZN	SZN	SZN			
Buff-breasted sandpiper[4]	*Tryngites subruficollis*		G4	SZN	SZN	SZN			
Wilson's snipe[4]	*Gallinago delicata*		G5	S3	S1, S2B, SZN	S3S4N			IL, IN, KY
Dunlin[4]	*Calidris alpina*		G5	SZN	SZN	SZN			
Greater yellowlegs[4]	*Tringa melanoleuca*		G5	SZN	SZN	SZN			
Killdeer	*Charadrius vociferus*		G5	S5	S4	S4S5B, S4N			
Least sandpiper[4]	*Calidris minutilla*		G5	SZN	SZN	SZN			
Marbled godwit[4]	*Limosa fedoa*		G5	SZN	-	-			
Red knot[4]	*Calidris canutus*		G5	SZN	SZN	SZN			
Red-necked phalarope[4]	*Phalaropus lobatus*		G4G5	SZN	SZN	SZN			
Red phalarope[4]	*Phalaropus fulicaria*		G5	-	SZN	-			
Ruddy turnstone[4]	*Arenaria interpres*		G5	SZN	SZN	SZN			
Sanderling[4]	*Calidris alba*		G5	SZN	SZN	SZN			
Semipalmated sandpiper[4]	*Calidris pusilla*		G5	SZN	SZN	SZN			
Short-billed dowitcher[4]	*Limnodromus griseus*		G5	SZN	SZN	SZN			
Solitary sandpiper[4]	*Tringa solitaria*		G5	SZN	SZN	SZN			
Spotted sandpiper	*Actitis macularia*		G5	S3S4	S4B	S1B			
Stilt sandpiper[4]	*Calidris himantopus*		G5	SZN	SZN	SZN			
Upland sandpiper	*Bartramia longicauda*		G5	E, S2S3	E, S3B	SHB			
Western sandpiper[4]	*Calidris mauri*		G5	SZN	SZN	SZN			
Whimbrel[4]	*Numenius phaeopus*		G5	-	-	-			

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(table 7 continued)

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Willet[4]	*Catoptrophorus semipalmatus*		G5	SZN	SZN	SZN			
Wilson's phalarope[4]	*Phalaropus tricolor*		G5	E, S1	SHB, SZN	SZN			
Skuas, Gulls, Terns, Skimmers	**(Family Laridae)**								
Black tern	*Childonias niger*		G4	E, S1	E, S1B, SZN	SXB, SZN			
Common tern[4]	*Sterna hirundo*		G5	E, S1	SXB, SZN	SZN			
Forster's tern[4]	*Sterna forsteri*		G5	E, S1	SHB, SZN	SZN			
Least tern[4]	*Sterna antillarum*	E	G4	E, S1	S?	S1S2			
Least tern (interior)	*Sterna antillarum athalassos*	E	G4T2Q	E, S?	E, S1B, SZN	E, S2B			
Pigeons, Doves	**(Family Columbidae)**								
Mourning dove	*Zenaida macroura*		G5	S5	S5	S5			IL, IN, KY
Yellow-billed cuckoo	*Coccyzus americanus*		G5	S5	S4B	S5B			
Owls	**(Families Tytonidae & Strigidae)**								
Barn owl	*Tyto alba*		G5	E, S1S2	E, S2	S3	FSC	FSC	
Barred owl	*Strix varia*		G5	S5	S4	S5	WL		
Long-eared owl	*Asio otus*		G5	S1B, S2N	S2	S1B, S1S2N		FSC	
Short-eared owl	*Asio flammeus*		G5	E, S1B, S2S3N	E, S2	S1B, SZN		FSC	
Nighthawks, Nightjars	**(Family Caprimuldigae)**								
Chuck-will's-widow	*Caprimulgus carolinensis*		G5	S4	S3B	S4S5B			
Whip-poor-will	*Caprimulgus vociferus*		G5	S5	S4B	S5B			
Swifts	**(Family Appodidae)**								
Chimney swift	*Chaetura pelagica*		G5	S5	S5B	S5B			
Kingfishers	**(Family Alcedinidae)**								
Belted kingfisher	*Ceryle alcyon*		G5	S5	S4	S4S5B, S4N			
Woodpeckers	**(Family Picidae)**								
Hairy woodpecker	*Picoides villosus*		G5	S4S5	S4	S5	WL		
Pileated woodpecker	*Dryocopus pileatus*		G5	S5	S4	S5	MIS	MIS	
Red-headed woodpecker	*Melanerpes erythrocephalus*		G5	S5	S4	S4B, S4N			
Tyrant Flycatchers	**(Family Tyrannidae)**								
Acadian flycatcher	*Empidonax virescens*		G5	S5	S4B	S5B	MIS		
Eastern kingbird	*Tyrannus tyrannus*		G5	S5	S4B	S5B			
Eastern wood-pewee	*Contopus virens*		G5	S5	S4B	S5B			
Great crested flycatcher	*Myiarchus crinitus*		G5	S5	S4B	S5B		MIS	
Least flycatcher	*Empidonax minimus*		G5	S3	S3B	S1B			
Shrikes	**(Family Laniidae)**								
Loggerhead shrike	*Lanius ludovicianus*		G4	T, S3	E, S3B, SZN	S4B, S4N		RFSC	
Vireos	**(Family Vireonidae)**								
Bell's vireo	*Vireo bellii*		G5	S4	S3B	S2S3B			
Red-eyed vireo	*Vireo olivaceus*		G5	S5	S4B	S5B	WL		
White-eyed vireo	*Vireo griseus*		G5	S5	S4B	S5B			

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(table 7 continued)

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Yellow-throated vireo	*Vireo flavifrons*		G5	S4S5	S4B	S5B	WL		
Crows, Jays	**(Family Corvidae)**								
American crow	*Corvus brachyrhynchos*		G5	S5	S5B	S5B, S5N			IL, IN, KY
Fish crow	*Corvus ossifragus*		G5	S2	-	S3B			
Swallows	**(Family Hirundinidae)**								
Bank swallow	*Riparia riparia*		G5	S5	S4B	S3B			
Chickadees, Titmice	**(Family Paridae)**								
Tufted titmouse	*Baeolophus bicolor*		G5	S5	S4	S5			
Nuthatches	**(Family Sittidae)**								
Brown creeper	*Certhia americana*		G5	T, S3	S2B, SZN	S1S2B, S4S5N		FSC	
Brown-headed nuthatch	*Sitta pusilla*		G5	SR	SRN	-			
White-breasted nuthatch	*Sitta carolinensis*		G5	SRN, S4	S5		WL		
Wrens	**(Family Troglodytidae)**								
Bewick's wren	*Thryomanes bewickii*		G5	E, S1	E, S1B, SZN	S3B	FSC	FSC	
Warner Valley Bewick's wren	*Thryomanes bewickii bewickii*		G5T?	-	-	-			
Marsh wren	*Cistothorus palustris*		G5	S4	E, S3B, SZN	SZN			
Sedge wren	*Cistothorus platensis*		G5	S3S4	E, S3B, SZN	S3B			
Gnatcatchers	**(Family Silviidae)**								
Blue-gray gnatcatcher	*Polioptilla caerulea*		G5	S5	S4B	S5B			
Thrushes	**(Family Turdidae)**								
Eastern bluebird	*Sialia sialis*		G5	S5	S4B, SZN	S5B, S5N			
Wood thrush	*Hylocichla mustelina*		G5	S4	S4B	S5B	MIS	MIS	
Mockingbirds, Thrashers	**(Family Mimidae)**								
Brown thrasher	*Toxostoma rufum*		G5	S5	S4B, SZN	S4S5B, SZN			
Wood Warblers	**(Family Parulidae)**								
American redstart	*Setophaga ruticilla*		G5	S5	S4B	S4S5B	WL	MIS	
Black-and-white warbler	*Mniotilta varia*		G5	S2S3	S, S1S2B	S4S5B	MIS		
Blackburnian warbler[4]	*Dendroica fusca*		G5	SZN	S3N	S1S2B			
Black-throated blue warbler[4]	*Dendroica caerulescens*		G5	SZN	SZN	S3S4B			
Black-throated green warbler	*Dendroica virens*		G5	SZN	S2B	S4B	WL		
Blue-winged warbler	*Vermivora pinus*		G5	S4	S4B	S4S5B			
Canada warbler	*Wilsonia canadensis*		G5	S1	S2B	S3B			
Cerulean warbler	*Dendroica cerulea*		G4	S3	S, S3B	S4S5B	RFSS, WL	MIS, RFSS	
Golden-winged warbler	*Vermivora chrysoptera*		G4	S1S2	E, S1B	S2B			
Hooded warbler	*Wilsonia citrina*		G5	S3S4	S, S3B	S5B	FSC		
Kentucky warbler	*Oporornis formosus*		G5	S5	S4B	S5B	WL	MIS	
Louisiana waterthrush	*Seiurus Motacilla*		G5	S4	S4B	S5B	MIS		
Northern parula	*Parula americana*		G5	S5	S4B	S4S5B	WL		
Ovenbird	*Seiurus aurocapillus*		G5	S4	S4B	S5B	WL		

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(table 7 continued)

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Pine warbler	*Dendroica pinus*		G5	S3S4	S3B	S4S5B, SZN	MIS	MIS	
Prairie warbler	*Dendroica discolor*		G5	S4	S4B	S5B	MIS	MIS	
Prothonotary warbler	*Protonotaria citrea*		G5	S5	S4B	S5B		MIS	
Swainson's warbler	*Limnothlypis swainsonii*		G4	E, S1	SRB	S3S4B		RFSS	
Worm-eating warbler	*Helmitheros vermivorus*		G5	S4	S, S3B	S4S5B	FSC, MIS	MIS	
Yellow-breasted chat	*Icteria virens*		G5	S5	S4B	S5B	MIS	MIS	
Yellow-throated warbler	*Dendroica dominica*		G5	S5	S4B	S4S5B			
Tanagers	**(Family Thraupidae)**								
Scarlet tanager	*Piranga olivacea*		G5	S5	S4B	S5B	MIS	MIS	
Summer tanager	*Piranga rubra*		G5	S5	S4B	S5B			
Emberizids	**(Family Emberizidae)**								
Bachman's sparrow	*Aimophila aestivalis*		G3	SXB, SHN	E, SXB	S1B		RFSS	
Eastern towhee	*Pipilo erythrophthalmus*		G5	S5	S4B	S5B, S5N			
Field sparrow	*Spizella pusilla*		G5	S5	S4	S5B, S5N			
Grasshopper sparrow	*Ammodramus savannarum*		G5	S5	S4B, SZN	S4B			
Henslow's sparrow	*Ammodramus henslowii*		G4	E, S2	E, S3B, SZN	S3B	FSC, RFSS	RFSS	
Lark sparrow	*Chondestes grammacus*		G5	S5	S3B, SZN	S2S3B			
Savannah sparrow	*Passerculus sandwichensis*		G5	S5	S4B, SZN	S2S3B, S2S3N			
Vesper sparrow	*Pooecetes gramineus*		G5	S5	S4B, SZN	S1B, SZN			
Cardinals	**(Family Cardinalidae)**								
Dickcissel	*Spiza americana*		G5	S4	S4B	S4S5B			
Indigo bunting	*Passerina cyanea*		G5	S5	S4S5B	S5B			
Painted bunting[4]	*Passerina ciris*		G5	SR	-	-			
Rose-breasted grosbeak	*Pheucticus ludovicianus*		G5	S5	S4B	S3S4B			
Blackbirds	**(Family Icteridae)**								
Bobolink	*Dolichonyx oryzivorus*		G5	S4	S4B	S2S3B			
Eastern meadowlark	*Sturnella magna*		G5	S, S5	S3N, S4B	S5B, S5N			
Western meadowlark	*Sturnella neglecta*		G5	S5	S2B	SAB, SZN			
Yellow-headed blackbird[4]	*Xanthocephalus xanthocephalus*		G5	E, S2	E, S4B	SZN			

[1] Based upon Heritage Status Rank as reported by NatureServe (2002).

[2] Species identified by the Hoosier National Forest as Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[3] Species identified by the Shawnee National Forest as Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[4] Species regarded as of seasonal importance in the assessment area. These species may not breed locally but may occur seasonally.

Table 8. Bird species of management or conservation concern and their status and trends within the Hoosier-Shawnee Ecological Assessment Area. Management concern is based on presence of the species on various species conservation lists.

Common name	Federal[1]	State[2]	FWS[3]	FS[4]	GAME	Audubon Watch List	Partners In Flight Priority Tier Score for Breeding[5]	Shorebird Conservation Assessment	Severity of threats on breeding[6]	Importance of Midwest Region to species[7]	Population trends (%/yr) 1966-2000[8]	
											Highland Rim	Lexington Plain
Common loon[9]				X								
Pied-billed grebe							(3)					
Double-crested cormorant			X									
American bittern		X	X				(3)					
Black-crowned night-heron		X		X			(3)					
Cattle egret							(3)					
Great blue heron							(1)				+ 9.1%	+18.2%
Great egret		X					(3)					
Green heron							(5), IIA				-2.2%	-3.5%
Least bittern		X	X	X			(3)					
Little blue heron							(4)					
Snowy egret							(3)					
Yellow-crowned night-heron		X					(3)					
American black duck[9]			X		X	X						
Blue-winged teal			X		X		(3)					
Canada goose - giants			X		X		(1)				+11.9%	16.3%
Canada goose - urban giants[9]			X		X							
Canada goose - SJB pop[9]			X		X							
Canada goose - EPP pop[9]			X		X							
Canvasback[9]			X		X							
Hooded merganser					X		(3)					
Mallard[9]			X		X		(1)				+9.3%	+14.9%
Snow goose[9]			X		X							
Trumpeter swan[9]		X	X	X		X						
Wood duck			X		X		(1)					
Bald eagle	X	X	X	X			(3)					
Black vulture							(1)				+11.7%	
Broad-winged hawk		X					(2)		3	4		
Cooper's hawk							(1)					
Mississippi kite		X					(3)		4	3		
Northern goshawk[9]			X	X								
Northern harrier		X		X			(3)					
Osprey		X					(3)					
Peregrine falcon		X	X	X			(3)		3	1		
Red-shouldered hawk		X	X	X			(2)					
Sharp-shinned hawk		X					(3), IIA					
Swainson's hawk						X			4	2		
Swallow-tailed kite[9]							(5), I					
Northern bobwhite					X		(5), IIA				-3.1%	-3.9%
Ruffed grouse					X		(3)					
Wild turkey					X		(1)				+27.2%	+6.68%
American coot					X		(3)					
Black rail		X	X			X						
Common moorhen					X		(3)					
King rail		X		X			(3)					
Purple gallinule												
Sora					X		(3)					

(table continued on next page)

(table 8 continued)

Common name	Federal[1]	State[2]	FWS[3]	FS[4]	GAME	Audubon Watch List	Partners In Flight Priority Tier Score for Breeding[5]	Shorebird Conservation Assessment	Severity of threats on breeding[6]	Importance of Midwest Region to species[7]	Population trends (%/yr) 1966-2000[8]	
											Highland Rim	Lexington Plain
Virginia rail		X					(3)					
Yellow rail[9]			X	X		X						
Sandhill crane[9]		X										
American avocet[9]								3				
American golden-plover[9]						X		4				
American woodcock			X		X	X	(3), I	4				
Black-bellied plover[9]								3				
Buff-breasted sandpiper[9]								4				
Common snipe[9]					X		(3)	3				
Dunlin[9]								3				
Greater yellowlegs[9]								3				
Killdeer							(1)	3			+1.6%	+1.5%
Least sandpiper[9]								3				
Marbled godwit[9]								4				
Red knot[9]								4				
Red-necked phalarope[9]								3				
Red phalarope[9]								3				
Ruddy turnstone[9]								4				
Sanderling[9]								4				
Semipalmated sandpiper[9]								3				
Short-billed dowitcher[9]								4				
Solitary sandpiper[9]								4				
Spotted sandpiper							(3)	2				
Stilt sandpiper[9]								3				
Upland sandpiper		X		X			(3), IIC	2	4	5		
Western sandpiper[9]								3				
Whimbrel[9]								4				
Willet[9]								3				
Wilson's phalarope[9]				X		X		4				
Black tern		X	X	X								
Common tern[9]			X	X								
Forster's tern[9]												
Least tern[9]	X						(3)					
Least tern (interior)	X	X	X									
Mourning dove					X		(2)					
Yellow-billed cuckoo							(4), IIA				-1.8%	-2.8%
Barn owl		X					(3)					
Barred owl							(2)					
Long-eared owl												
Short-eared owl		X		X		X	(3), IIC					
Chuck-will's-widow							(2), IIIB		2	3		
Whip-poor-will							(4), I		3	4	-3.0%	-9.8%
Chimney swift							(4), IIA				-2.2%	-2.1%
Belted kingfisher							(4), IIA				-2.5%	
Hairy woodpecker							(2)					
Pileated woodpecker							(2)					+5.9%
Red-headed woodpecker						X	(2), IIIB					
Acadian flycatcher							(2), I		3	4		

(table continued on next page)

(table 8 continued)

Common name	Federal[1]	State[2]	FWS[3]	FS[4]	GAME	Audubon Watch List	Partners In Flight Priority Tier Score for Breeding[5]	Shorebird Conservation Assessment	Severity of threats on breeding[6]	Importance of Midwest Region to species[7]	Population trends (%/yr) 1966-2000[8]	
											Highland Rim	Lexington Plain
Eastern kingbird							(4), IIA		2	3	-0.7%	-1.9%
Eastern wood peewee							(4), IIA		2	4	-0.9%	-2.0%
Great crested flycatcher							(4), IIA		2	4		
Least flycatcher							(3)		2	4		
Loggerhead shrike		X	X				(5), IIC				-7.0%	
Bell's vireo						X	(4), I		3	3		
Red-eyed vireo							(2)		2	4		+1.5%
White-eyed vireo							(4), I		3	3	-0.7%	-3.1%
Yellow-throated vireo							(3), I		3	4		
American crow					X		(2)					+1.5%
Fish crow							(3)					
Bank swallow							(3)					
Tufted titmouse							(2), IIIA					
Brown creeper							(3)					
Brown-headed nuthatch[9]						X	(3), I					
White-breasted nuthatch							(1)				+3.8%	+4.9%
Bewick's wren		X					(5), IIC				-11.4%	-12.0%
Marsh wren		X					(3)					
Sedge wren		X	X				(3), IIC					
Blue-gray gnatcatcher							(4), IIA		2	3		-4.1%
Eastern bluebird							(2), IIIA				+1.9%	-2.0%
Wood thrush			X			X	(5), I		4	3		
Brown thrasher							(4), IIA				-0.9%	
American redstart							(5)		3	3	-6.0%	
Black-and-white warbler		X					(3)		3	4	-7.7%	
Blackburnian warbler[9]									3	4		
Black-throated blue warbler[9]				X					3	3		
Black-throated green warbler							(3)		3	4		
Blue-winged warbler						X	(5), I		2	4	-3.1%	-8.6%
Canada warbler						X			3	4		
Cerulean warbler		X	X	X		X	(5), I		4	5	-5.3%	-11.5%
Golden-winged warbler		X	X			X			3	5		
Hooded warbler		X					(2)		3	3		
Kentucky warbler						X	(2), I		3	4		
Louisiana waterthrush							(3), I					
Northern parula							(1)		3	3		
Ovenbird							(2)		3	5	+3.3%	
Pine warbler							(1)				+8.6%	
Prairie warbler				X		X	(5), I		3	3	-2.5%	-2.2%
Prothonotary warbler						X	(3), I		3	3		
Swainson's warbler				X		X	(3), I		4	2		
Worm-eating warbler		X				X	(3), I		3	3		
Yellow-breasted chat							(5), I		3	3	-2.5%	-4.2%
Yellow-throated warbler							(1), IIB		3	3	+4.3%	
Scarlet tanager							(1)		3	4	+2.9%	+4.6%
Summer tanager							(2), IIB		3	3		-1.5%
Bachman's sparrow		X		X		X	(5), I					
Eastern towhee							(4), IIA				-1.8%	-1.9%

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(table 8 continued)

Common name	Federal[1]	State[2]	FWS[3]	FS[4]	GAME	Audubon Watch List	Partners In Flight Priority Tier Score for Breeding[5]	Shorebird Conservation Assessment	Severity of threats on breeding[6]	Importance of Midwest Region to species[7]	Population trends (%/yr) 1966-2000[8]	
											Highland Rim	Lexington Plain
Field sparrow							(5), I				-2.5%	-4.3%
Grasshopper sparrow			X				(5), IIA		4	5	-4.1%	-11.7%
Henslow's sparrow		X	X	X		X	(1), I					
Lark sparrow							(5)		3	2		
Savannah sparrow							(3)					
Vesper sparrow							(4)					
Dickcissel			X			X	(3), IIC		3	5		
Indigo bunting							(4), IIIA		2	4	-1.3%	-2.7%
Painted bunting[9]						X	(3), IIC		2	1		
Rose-breasted grosbeak							(3)		2	4		
Bobolink			X	X			(3), IIC		3	4		
Eastern meadowlark			X				(4), IIA				-2.3%	-1.9%
Western meadowlark		X					(3)					
Yellow-headed blackbird[9]		X							3	4		

[1] Federally listed as endangered and threatened.
[2] State listed as endangered or threatened.
[3] USDI Fish and Wildlife Service Region 3 conservation priority species.
[4] Hoosier or Shawnee National Forest: Forest Species of Concern, Management Indicator species, or Regional Forester Sensitive Species.
[5] Partners In Flight 30-year breeding population trend for the Central Hardwoods Bird Conservation Region (BCR24); rank of 1 corresponds to large increase, rank of 5 corresponds to a large decrease.
[6] Severity of threats on the breeding ground, adapted from Thompson et al. (1992) as follows: 1 = no threats, 2 = minor threats, 3 = moderate threats, 4 = severe threats, and 5 = extirpation or extinction likely.
[7] Importance of the Midwest Region to each species adapted from Thompson et al. (1992) as follows: 1 = <1% of population in region, 2 = 1-10% of population in region, 3 = 11-25% of population in region, 4 = 26-50% of population in region, and 5 = >50%.
[8] Number in parentheses is the estimated trend within the physiographic region, summarized as % change per year from 1966 to 2000 ($P < 0.10$).
[9] Species regarded as of seasonal importance in the assessment area. These species may not breed locally but may occur seasonally.

Table 9. Habitat associations of Midwest neotropical migrant birds, mean Management Concern Score of neotropical migrants, and total number of neotropical migrant species with respect to their habitat asociations (adapted from Thompson et al. 1992). Management Concern was based upon the mean score of seven criteria including global abundance, winter distribution, severity of threats on wintering grounds and migration routes, area of breeding range, severity of threats on the breeding grounds in the Midwest, importance of the Midwest Region to species, and population trend in the Midwest region based upon Breeding Bird Survey data from 1966 to 1991. A score of 5 denotes the greatest management concern and 1 the least.

Habitat type	Management Concern Score				Number of species	Mean Mgmt. Concern Score
	1 – 1.9	2 – 2.9	3 – 3.9	4 – 5		
Lowland deciduous forest—bottomland deciduous forest	0	0	4	1	5	3.57
Young coniferous forest—upland coniferous forest 12 to 30 years old	1	0	1	1	3	3.19
Mature deciduous forest—upland deciduous forest >30 years old	0	8	13	1	22	3.18
Grassland—prairie, hayfield, pasture, cultivated grasses	0	5	7	0	12	3.07
Shrub-sapling—shrub swamp, upland old field, seedling–sapling forest <12 years old	2	11	10	1	24	3.02
Mature coniferous forest—upland coniferous forest >30 years old	0	10	6	0	16	3.00
Young deciduous forest—upland deciduous forest 12 to 30 years old	0	3	4	0	7	3.00
Lowland coniferous forest—bottomland coniferous forest	0	3	3	0	6	2.88
Developed—urban, suburban, rural development	0	3	1	0	4	2.75
Wetland—sedge meadow, fen, cattail marsh	0	1	0	0	1	2.71
Agricultural-woodland edge—woody fence-rows, shelterbelts, and forest edge in agricultural landscapes	0	5	0	0	5	2.69
Primary—ledges, cliffs, caves, banks, etc.	0	5	0	0	5	2.29
TOTAL	**3**	**54**	**49**	**4**	**110**	

a remarkable achievement in the description of karst species and their distribution, little is understood of the life histories and vulnerabilities of karst species. In particular, little work has been conducted within the caves of the Shawnee National Forest or within the Kentucky portion of the assessment area.

Of the 173 species of global viability concern within the assessment area, 140 (81%) use cave and karst habitats. This includes 134 invertebrates and 6 mammals, 5 of which are bats (table 5). Many of these invertebrates are endemic to the karst region of south-central Indiana or to specific river drainages within that area (Lewis 1998, Lewis et al. 2002, Lewis et al. 2003). Examples include the Reynolds' cave millipede (*Pseudotremia reynoldsae*), known from one location within the Hoosier National Forest (Lewis et al. 2003, Lewis 2003), and Young's cave ground beetle (*Pseudanophthalmus youngi*), another endemic of the south-central Indiana karst region (Lewis et al. 2003).

Of the 39 invertebrates determined to be of state viability concern, 21 of these species (54%) are either terrestrial or aquatic cave-associated fauna. In total, 161 species or 36 percent of all of the species identified as of global or State viability concern in the assessment area are cave or karst associated species. In addition, four cave or karst systems within the assessment area are considered global subterranean hot spots: the Binkley Cave System, Wyandotte Cave System, Lost River Cave System, and the Tincher Karst Area (Lewis 1998, Lewis et al. 2002, Lewis et al. 2003). A cave system is given this rating when it contains 20 or more obligate subterranean species. The four areas are located within Indiana; the Lost River Cave System and Tincher Karst Area occur partly within the Hoosier National Forest.

The private ownership of cave and karst areas can further complicate the conservation of cave-associated species. Conservation groups, including The Nature Conservancy and Indiana Karst Conservancy, have partnered with the Hoosier National Forest and Indiana State agencies to actively acquire some of these locations as they become available. Recent acquisitions include the 213-acre Blanton property, purchased by The Nature Conservancy. Adjacent to the Wesley Chapel Special Area on the Hoosier National Forest, these two properties contain multiple entrances and miles of passage of the Lost River Cave System. The Lost River Cave System is currently the third longest in the State of Indiana. It contains the most extensive fauna found in any Indiana cave, among which are a community of obligate subterranean fauna of global significance (Lewis et al. 2003).

The comparatively high number of cave-associated species with global and state viability concerns underscores the importance of this habitat type within the assessment area. Karst ecosystems are perhaps the least understood habitat type within the area. The species inhabiting karst ecosystems are unique, understudied, and to some extent, undiscovered. Many of the cave species within the assessment area are known from only a single or a handful of locations (Lewis 1998, Lewis et al. 2002, Lewis et al. 2003). Some of these caves and their associated fauna are threatened by development, road construction, runoff, sewage, and human visitation (Lewis 2002a, Lewis 2002b, Lewis et al. 2003).

BIRDS OF CONSERVATION CONCERN

In addition to global and state Heritage Status rankings (table 7), evaluation of birds identified as species of viability concern was expanded to include those species identified as USDI Fish and Wildlife Service Region 3 conservation priority species (USDI Fish and Wildlife Service 2002), species identified in the National Shorebird Conservation Plan (Brown et al. 2001), Audubon Watch List species

(National Audubon Society 2002), and those listed by Partners in Flight as either tier I, II, or III conservation priority species (Panjabi 2001). Avian species identified as Regional Forester Sensitive Species, Forest Species of Concern, and Management Indicator Species were similarly considered (table 8). Neotropical migrant land birds were considered in particular because of the pervading concern for conserving these species.

Population trend data were considered for the Highland Rim and Lexington Plain physiographic regions; both regions encompass portions of the assessment area (fig. 6). Long-term population trends (1966–2000) were based upon the North American Breeding Bird Survey, a standardized survey conducted across North America to provide continental, regional, and route-specific assessment of bird populations (Peterjohn 1994, Sauer et al. 2001).

Thompson et al. (1992) identified 110 neotropical migrants that breed in the Midwest and developed conservation priority rankings for those species based upon seven criteria (table 9). Two of these criteria, breeding ground threats and importance of the Midwest to these species, are listed to provide a broader perspective of conservation issues within the Midwest (table 7). Threats on breeding grounds included habitat loss and fragmentation, cowbird parasitism, predation, contamination, and human disturbance among others. Thompson et al. (1992) determined the importance of the Midwest to each species based upon the extent to which the breeding range of each species was encompassed by the region.

Of the 160 birds identified as of management or conservation concern within the assessment area (tables 7, 8), North American Breeding Bird Survey data were sufficient to identify 40 species with regional long-term population trends. From 1966 to 2000, 14 species increased in abundance in either, or both, the Highland Rim or Lexington Plain physiographic regions; 27 species decreased in abundance (table 8). In the case of the eastern bluebird (*Sialia sialis*), numbers of this species declined within the Lexington Plain but increased in the Highland Rim physiographic region.

The limitations of analyses based upon Breeding Bird Survey data have been previously discussed (Thompson et al. 1992). The inability to identify significant long-term population trends for many of these species is predominantly a function of their current or continued rarity. The inability to calculate population trends for certain species should in no way suggest any measure of species stability or abundance. For example, the Hoosier-Shawnee avifauna include such species as the Henslow's sparrow (*Ammodramus henslowii*) and Bell's vireo (*Vireo bellii*), of which there is insufficient data with which to identify regional population trends, yet these species are recognized to be of conservation concern by multiple organizations or agencies.

Neotropical Migrant Birds

Neotropical migrant birds make up approximately a third of the avian species of conservation concern in the assessment area. Of the 21 neotropical migrants with sufficient data with which to determine regional population trends, 16 declined while 5 species increased from 1966 to 2000 (table 7). Considering the habitat associations of the 16 regionally declining species (Thompson et al. 1992, table 9), one species is associated with agricultural edge, one with developed lands, one with grasslands, five with shrublands, two with young deciduous forest, and six with mature deciduous forest. Of the five species with increasing populations trends, one species is associated with mature conifer forest (pine warbler, *Dendroica pinus*) and four are associated with mature deciduous forest (red-eyed vireo, *Vireo olivaceus*; ovenbird, *Seiurus aurocapillus*; yellow-throated warbler,

Dendroica dominica; and scarlet tanager, *Piranga olivacea*).

A growing body of evidence suggests that numerous passerines have declined in abundance over the last 50 years, particularly those species collectively known as neotropical migrants (Askins 1995, Robbins et al. 1989, Robbins et al. 1992, Robinson 1996, Sauer and Droege 1992, Thompson et al. 1996). As many as 143 species of neotropical migrants breed in North America and winter south of the United States. At least 110 of these species breed in the Midwest (Thompson et al. 1992), suggesting the importance of the region in the conservation of neotropical migrant birds.

The American Bird Conservancy has led an effort to identify critical habitats for these species, formally designating these sites as globally Important Bird Areas (IBAs). Sites are designated as Important Bird Areas if they contain significant populations of a federally listed species, species on the Partners In Flight Watch List, or species with restricted ranges, or if the site provides habitat for large concentrations of migratory birds. Relative to the remainder of the Midwest, the assessment area contains a substantial number of globally Important Bird Areas (table 13).

A diverse group, neotropical migrants utilize a variety of habitat types including wetlands, agricultural-woodland edge, grasslands, shrub-sapling, swamp, upland old fields, seedling-sapling forest, lowland coniferous forest, lowland deciduous forest, young deciduous forest, mature deciduous forest, coniferous forest, mature coniferous forest, caves, banks, and even developed areas. Within the Midwest, shrub-sapling habitats, mature upland deciduous forest, mature upland coniferous forests, and grasslands have the highest species richness (Thompson et al. 1992).

Although significant tracts of habitat remain within the assessment area, conservation of neotropical migrants is nonetheless a complex task because of the diverse life history of these species and the multiple threats that likely influence their success.

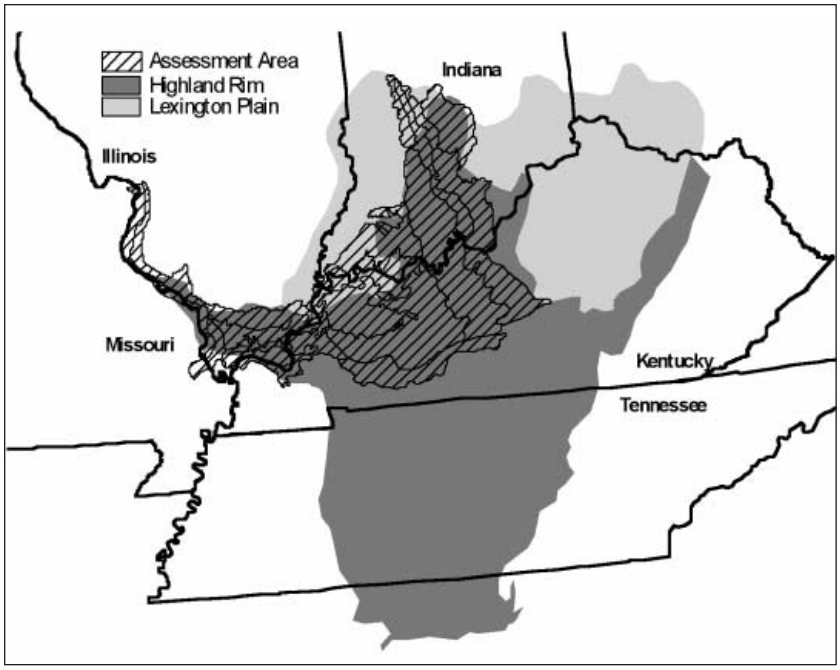

Figure 6. Location of the assessment area in relation to the Highland Rim and Lexington Plain physiographic regions. Evaluation of bird population trends was based upon North American Breeding Bird Survey data from these two physiographic regions that encompass the assessment area.

Among the most taxing of issues regarding the conservation of neotropical migrants is the growing recognition that many of these species are dependent upon the use of periodically disturbed habitats. Some of these species are, in fact, obligate early successional species, including such species in the assessment area as the Henslow's sparrow, Bell's vireo, and yellow-breasted chat (*Icteria virens*). The decline of these species is likely related to the loss of grasslands, old fields, and shrublands (Herkert 1991, Herkert et al. 1996). But this should not detract from the effort directed toward species associated with other habitats such as mature deciduous forest; it does, however, reveal the difficulty in managing for diversity within a limited landscape. The association of species with disturbance and the difficulty in managing these habitats has been the subject of recent reviews (Askins 2001, Gobster 2001, Hunter et al. 2001, Thompson and DeGraaf 2001). Not only may some species require multiple habitat types, but the same factors impinging upon forest obligate species may likely influence the

Table 10. Mammal species of management or conservation concern found within the Hoosier-Shawnee Ecological Assessment Area.

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS		Game species
				IL	IN	KY	HO[2]	SH[3]	
Allegheny woodrat	*Neotoma magister*		G3G4	-	E, S2	S4	RFSS		
American badger	*Taxidea taxus*		G5	S4	E, S2	SR	RFSS		IL
American beaver	*Castor canadensis*		G5	S5	S4	S5	WL		IL, IN, KY
American mink	*Mustela vison*		G5	S5	S4	S5			IL, IN, KY
Bobcat	*Lynx rufus*		G5	S3	E, S1	S4	RFSS, MIS	FSC	KY
Common gray fox	*Urocyon cinereoargenteus*		G5	S5	S4	S4			IL, IN, KY
Common raccoon	*Procyon lotor*		G5	S5	S4	S5	MIS		IL, IN, KY
Coyote	*Canis latrans*		G5	S5	S4	S5			IL, IN
Eastern cottontail	*Sylvilagus floridanus*		G5	S5	S4	S5			IL, IN, KY
Eastern fox squirrel	*Sciurus niger*		G5	S5	S4	S5			IL, IN, KY
Eastern gray squirrel	*Sciurus carolinensis*		G5	S5	S4	S5	MIS	MIS	IL, IN, KY
Eastern small-footed myotis	*Myotis leibii*		G3	-	-	S2			
Eastern spotted skunk	*Spilogale putorius*		G5	SR	SX	S2S3			
Eastern woodrat	*Neotoma floridana*		G5	E, S1	-	-		RFSS	
Evening bat	*Nycticeius humeralis*		G5	S3	E, S1	S2S3	RFSS		
Franklin's ground squirrel	*Spermophilus franklinii*		G5	S4	E, S2	-			
Golden mouse	*Ochrotomys nuttalli*		G5	T, S2	-	S4		FSC	
Gray myotis	*Myotis grisescens*	E	G3	E, S1	E, S1	E, S2			
Indiana bat	*Myotis sodalis*	E	G2	S1	E, S1	E, S1S2			
Least weasel	*Mustela nivalis*		G5	S3	S, S2?	S2S3			IL, KY
Long-tailed shrew	*Sorex dispar*		G4	-	-	S1			
Long-tailed weasel	*Mustela frenata*		G5	S4	S4	S4			IL, IN, KY
Marsh rice rat	*Oryzomys palustris*		G5	T, S2	-	S4		FSC	
Masked shrew	*Sorex cinereus*		G5	S5	S4	S3			
Muskrat	*Ondatra zibethicus*		G5	S5	S4	S5			IL, IN, KY
Northern river otter	*Lutra canadensis*		G5	T, S2	E, S?	S3S4	RFSS	FSC	
Plains pocket gopher	*Geomys bursarius*		G5	S3	S, S2	-			
Pygmy shrew	*Sorex hoyi*		G5	SH	S, S2	S4			
Rafinesque's big-eared bat	*Plecotus rafinesquii*		G3G4	E, S1	S, SH	S3		FSC	
Red fox	*Vulpes vulpes*		G5	S5	S4	S5			IL, IN, KY
Smoky shrew	*Sorex fumeus*		G5	-	S, S2	S5			
Southeastern myotis	*Myotis austroriparius*		G3G4	E, S1	E, S1	S1S2	RFSS	RFSS	
Southern flying squirrel	*Glaucomys volans*		G5	S5	S4	S5			
Star-nosed mole	*Condylura cristata*		G5	SR	S, S2?	-			
Striped skunk	*Mephitis mephitis*		G5	S5	S4	S5			IL, IN, KY
Swamp rabbit	*Sylvilagus aquaticus*		G5	S3	E, S1	S3S4			IL, KY
Virginia opossum	*Didelphis virginiana*		G5	S5	S4	S5			IL, IN, KY
Western harvest mouse	*Reithrodontomys megalotis*		G5	S4	S2	-			
White-tailed deer	*Odocoileus virginianus*		G5	S5	S5	S5	WL	SRI	IL, IN, KY
Woodchuck	*Marmota monax*		G5	S5	S4	S5			IL, IN

[1] Based upon Heritage Status Rank as reported by NatureServe (2002).

[2] Species identified by the Hoosier National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[3] Species identified by the Shawnee National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

Table 11. Reptile and amphibian species of conservation concern found within the Hoosier-Shawnee Ecological Assessment Area.

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Salamanders								
Green salamander	*Aneides aeneus*		G3G4	-	E, S?	S4	RFSS	
Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*		G3G4 T3T4	E,	E, S1	S3		
Dusky salamander	*Desmognathus fuscus*		G5	E, S2	S4	S5		FSC
Four-toed salamander	*Hemidactylium scutatum*		G5	T, S2	E, S2	S4		
Mudpuppy	*Necturus maculosus*		G5	S5	S, S2	S4		
Northern red salamander	*Pseudotriton ruber ruber*		G5T5	-	E, S1	S5		
Frogs & Toads								
Bird-voiced treefrog	*Hyla avivoca*		G5	T, S3	-	T, S2S3		RFSS
Green treefrog	*Hyla cinerea*		G5	S3	-	S3		
Barking treefrog	*Hyla gratiosa*		G5	-	-	S3		
Gray treefrog	*Hyla versicolor*		G5	S4	S4	S2S3		
Northern crawfish frog	*Rana areolata circulosa*		G4T4	-	E, S2	S3		
Plains leopard frog	*Rana blairi*		G5	S4	S, S2	-		
Bullfrog	*Rana catesbeiana*		G5	S5	S4	S5		
Green frog	*Rana clamitans*		G5	S4	S?	S5		
Northern leopard frog	*Rana pipiens*		G5	S5	S, S2	S3		
Eastern spadefoot	*Scaphiopus holbrookii holbrookii*		G5T5	-	S2	S4		
Illinois chorus frog	*Pseudacris streckeri illinoensis*			T, -				
Turtles								
Smooth softshell turtle	*Apalone mutica*		G5	S3	S4	S3		
Spiny softshell turtle	*Apalone spiniferus*		G5	S5	S4	S5		
Common snapping turtle	*Chelydra serpentina*		G5	S5	S4	S5		
Eastern mud turtle	*Kinosternon subrubrum*		G5	S3S4	E, S2	S3S4		
Alligator snapping turtle	*Macroclemys temminckii*		G3G4	E, S1	E, S1	T, S2		FSC
River cooter	*Pseudemys concinna*		G5	E, S1	E, S?	S3		FSC
Ornate box turtle	*Terrapene ornata ornata*		G5T5	-	E, -	-		
Lizards								
Collared lizard	*Crotaphytus collaris*		G5	-	-	-		
Northern coal skink	*Eumeces anthracinus anthracinus*		G5T5	-	-	S2		
Southeastern five-lined skink	*Eumeces inexpectatus*		G5	-	-	S3		
Slender glass lizard	*Ophisaurus attenuatus*		G5	S4	S2	S2		
Snakes								
Western cottonmouth	*Agkistrodon piscivorus leucostoma*		G5T5	-	E, S1	S3S4		
Northern scarlet snake	*Cemophora coccinea copei*		G5T5	-	E, S1	S3S4		
Kirtland's snake	*Clonophis kirtlandii*		G2	T, S2	E, S2	S2		
Timber rattlesnake	*Crotalus horridus*		G4	T, S3	E, S2	S4	RFSS	RFSS
Corn snake	*Elaphe guttata guttata*		G5T5	-	-	S3		
Western mud snake	*Farancia abacura reinwardtii*		G5T5	-	SX	S3		
Western hognose snake	*Heterodon nasicus*		G5	T, S2	-	-		
Milk snake	*Lampropeltis triangulum*		G5	S?	S?	S5		
Smooth green snake	*Liochlorophis vernalis*		G5	S3S4	E, S2	-		

(table continued on next page)

(table 11 continued)

Common name	Scientific name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Eastern coachwhip	*Masticophis flagellum*		G5	E, S1	-	SX		
Mississippi green water snake	*Nerodia cyclopion*		G5	T, S1	-	S1		FSC
Copperbelly water snake	*Nerodia erythrogaster neglecta*	T, (north. pop.)	G5T2T3	S2	E, S2	S3		RFSS
Broad-banded water snake	*Nerodia fasciata confluens*		G5T5	E, -	-	S1		
Rough green snake	*Opheodrys aestivus*		G5	S5	S, S3	S5		
Northern pine snake	*Pituophis melanoleucus*		G4	-	-	S2		
Eastern massasauga	*Sistrurus catenatus catenatus*		G3G4 T3T4	E, S2	E, S2	-		
Western pygmy rattlesnake	*Sistrurus miliarius streckeri*		G5T5	-	-	S3		
Southeastern crowned snake	*Tantilla coronata*		G5	-	E, S1	S3S4		
Flathead snake	*Tantilla gracilis*		G5	T, S2	-	-		
Western ribbon snake	*Thamnophis proximus*		G5	S4	S, S3	S1S2		
Eastern ribbon snake	*Thamnophis sauritus*		G5	E, S1	S4	S3		FSC

[1] Based upon Heritage Status Rank as reported by NatureServe (2002).

[2] Species identified by the Hoosier National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[3] Species identified by the Shawnee National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

Table 12. Terrestrial invertebrate species of conservation concern found within the Hoosier-Shawnee Ecological Assessment Area.

Scientific name	Common name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Amphipods								
Crangonyx packardi	Packard's cave amphipod		G3[4]	S1	S3[4]	S4S5	RFSS	
Crangonyx undescribed species 1	Barr's cave amphipod		G3[4]	-	S3[4]	S?		
Crangonyx undescribed species 2	Indiana cave amphipod		G3[5]	-	S3[4]	-		
Stygobromus subtilus	Subtle cave amphipod		G2	S2	-	-		RFSS
Stygobromus undescribed species 1	Amphipod crustacean		G1[4]	-	S1[4]	-		
Stygobromus undescribed species 2	Amphipod crustacean		G1[4]	-	S1[4]	-		
Stygobromus undescribed species 3	Amphipod crustacean		G1[4]	-	S1[4]	-		
Beetles								
Aleochara lucifiga	Cave rove beetle		G4[5]	-	S3[3]	-	RFSS	
Atheta annexa	Beetle		G3	-	S1	-		
Atheta lucifuga	Light shunning rove beetle		G3[4]	-	S3[4]	-		
Batriasymmodes undescribed species	Patton Cave ant beetle		G1[5]	-	S1[5]	-		
Batrisoldes undescribed species 1	Cave ant beetle		G1[4]	-	S1[4]	-		
Batrisoldes undescribed species 2	Cave ant beetle		G1[5]	-	S1[5]	-		
Catops gratiosus	Beetle		G4[4]	S?	S2[2]	-		
Cicindela patruela	A tiger beetle		G3	-	S3	-		
Dryobius sexnotatus	Six-banded longhorn beetle		G?	-	T, S?	S1		
Necrophilus pettiti	A carrion beetle		G4[4]	-	S2[4]	-		
Nicrophorus americanus	American burying beetle	E	G2G3	SH	SH	SH		
Pseudanophthalmus eremita	Wyandotte Cave ground beetle		G1[4]	-	S1[4]	-		
Pseudanophthalmus stricticollis	Marengo Cave ground beetle		G3[4]	-	S3[4]	-	RFSS	
Pseudanophthalmus tenuis	Blue River cave ground beetle		G3[4]	-	S3[4]	-		
Pseudanophthalmus undescribed species 1	Undescribed cave ground beetle		G1[4]	-	S1[4]	-		
Pseudanophthalmus undescribed species 2	Undescribed cave ground beetle		G1[5]	-	S1[5]	-		
Pseudanophthalmus undescribed species 3	Undescribed cave ground beetle		G1[5]	-	S1[5]	-		
Pseudanophthalmus youngi	Young's cave ground beetle		G2[4]	-	S2[4]	-	RFSS	
Ptomaphagus cavernicola	Cavernicolous fungus beetle		G3[4]	-	S1[4]	-		
Tychobythinus bythinioides	Ant beetle		G3[4]	-	S2[4]	-		
Quedius spelaeus	Spelean rove beetle		G5[4]	S?	S2	-		
Butterflies and Moths								
Amblyscirtes aesculapius	Laced-wing roadside skipper		G3G4		S1			
Amblyscirtes belli	Bell's roadside skipper		G4	S1?	S1S2	S2S3	RFSS	
Amblyscirtes hegon	Salt-and-pepper skipper		G5	SU	S1S3	S4		
Atrytone arogos	Arogos skipper		G3G4	E, S1	-	-		
Autochton cellus	Golden-banded skipper		G4	S1S3	S1S2	S3		
Calephelis mutica	Swamp metalmark		G3G4	E, S1	S2S3	S2	RFSS	
Catocala marmorata	Marbled underwing moth		G3G4	S?	S1	SU		
Celastrina nigra	Sooty azure		G4	S2	S2	S3		
Cycnia inopinatus	Unexpected milkweed moth		G4	-	S2	-		
Cyllopsis gemma	Gemmed satyr		G5	SU	S2	S4		
Eosphoropteryx thyatyroides	Pinkpatched looper moth		G4G5	-	T, S2	-		
Erora laeta	Early hairstreak		G3G4	-	-	S1		
Erynnis martialis	Mottled duskywing		G3G4	S1	T, S3	SU	RFSS	
Euphydryas phaeton	Baltimore checkerspot		G4	S3	S2S4	S3		

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(table 12 continued)

Scientific name	Common name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Euphyes dukesi	Scarce swamp skipper		G3	S1	S2	S1		
Fixsenia favonius ontario	Northern hairstreak		G4	S1S3	S2S4	S1		
Hesperia leonardus	Leonardus skipper		G4	SU	S2	S3		
Hesperia metea	Cobweb skipper		G4G5	T, S3	T, S2S3	S3		
Hesperia ottoe	Ottoe skipper		G3G4	T, S2	E, S1	-		
Hyperaeschra georgica	A prominent moth		G5	-	T, S2	-		
Lytrosis permagnaria	A geometrid moth		G3G4	-	T, S2	E, S1		
Papaipema astute	Astute stoneroot borer moth		G3G4	-	S?	-		
Papaipema beeriana	Beer's blazingstar borer moth		G3	S?	S?	-		
Papaipema eryngii	Rattlesnake-master borer moth		G1G2	E, S1	SX	S1		
Parasa indetermina	Wild rose slug moth		G4	-	S?	-		
Papaipema marginidens	Margined borer moth		G4	-	S1	S?		
Papaipema rutila	Mayapple borer moth		G4	S?	S1	-		
Pieris virginiensis	West Virginia white		G3G4	S?	S3	S4	RFSS	
Polygonia faunus	Green comma		G5	-	-	SH		
Satyrodes appalachia appalachia	Appalachian eyed brown		G4	-	E, S1	-		
Schinia gloriosa	Glorius flower moth		G4	E, -	SU	-		
Schinia jaguarina	Jaguar flower moth		G4	-	S?	-		
Speyeria idalia	Regal fritillary		G3	T, S2	S1	S2S3		
Thorybes confusis	Eastern cloudywing		G4	-	S1?	SU		
Copepods								
Cauloxenus stygius	Northern cavefish commensal copepod		G3	-	S1	-	RFSS	
Diacyclops jeanneli jeanneli	Jeannel's cave copepod		G2[5]	-	S2[5]	-		
Megacyclops undescribed species	Undescribed copepod crustacean		G1[4]	-	S1[4]	-	RFSS	
Megacyclops donnaldsoni donnaldsoni	Donaldson's cave copepod		G1[4]	-	S1[4]	-		
Rheocyclops indiana	Indiana groundwater copepod		G1[5]	-	S1[5]	-		
Rheocyclops undescribed species	Undescribed copepod crustacean		G1[4]	-	S1[4]	-		
Diplurans								
Campodea plusiochaeta	Dipluran		G1	-	S1	-		
Eumesocampa undescribed species	Campodeid dipluran		G1[4]	-	S1[4]	-		
Litocampa undescribed species	Campodeid dipluran		G2[4]	-	S2[4]	-		
Isopods								
Caecidotea jordani	Jordan's groundwater isopod		G1[4]	-	S1[4]	-		
Caecidotea teresae	Teresa's groundwater isopod		G1[4]	-	S1[4]	-		
Ligidium elrodii	Elrod's terrestrial isopod		G4[5]	S?	S4[5]	-		
Miktoniscus barri	Barr's terrestrial isopod		G2[4]	-	S2[4]	-		
Leafhoppers								
Dorycephalus sp.	Shovel-headed leafhopper		G3G4	-	S?	-		
Dorydiella kansana	Kansas preacher		G3G4	-	S1	-		
Fitchiella robertsoni	Robertson's elephant hopper		G2G3	-	S1	-		
Flexamia reflexa	Indian grass flexamia		G2G3	-	S2S3	S?		
Paraphlepsius lupalus	Leafhopper		G?	E, S1	-	-		
Polyamia herbida	Prairie panic grass leafhopper		G2G3	-	S?	S?		

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(table 12 continued)

Scientific name	Common name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Millipedes								
Cambala annulata	Annulate millipede		G5	-	S2	-		
Cambala minor	Millipede		G5	S?	S2	-		
Conotyla bollmani	Bollman's cave milliped		G3[4]	-	S3[4]	-	RFSS	
Euryurus leachii	Leach's millipede		G4[5]	-	S2	-		
Pseudotremia conservata	TNC cave milliped		G1[4]	-	S1[4]	-		
Pseudotremia indianae	Blue River cave milliped		G3[4]	-	S3[4]	-		
Pseudotremia reynoldsae	Reynolds' cave milliped		G1[5]	-	S1[5]	-		
Pseudotremia salisae	Salisa's cave milliped		G1[5]	-	S1[5]	-		
Pseudotremia undescribed species 1	Troglobitic milliped		G1[4]	-	S1[4]	-		
Pseudotremia undescribed species 2	Troglobitic milliped		G1[4]	-	S1[4]	-		
Scoterpes undescribed species	Troglobitic milliped		G1[4]	-	S1[4]	-		
Scytonotus granulatus	Granulated millipede		G5	-	S3[5]	-	RFSS	
Ostracods								
Dactylocythere susanae	Susan's commensal ostracod		G3	-	S3	S?		
Pseudocandona jeanneli	Jeannel's cave ostracod		G1[4]	-	S1[4]	-		
Pseudocandona marengoensis	Marengo cave ostracod		G1[4]	-	S1[4]	-		
Sagittocythere barri	Barr's commensal cave ostracod		G4	-	S3	S?		
Pseudoscorpions								
Apochthonius indianensis	Indiana cave pseudoscorpion		G1[5]	-	S1[5]	-		
Apochthonius undescribed species 1	Undescribed pseudoscorpion		G1[4]	-	S1	-		
Apochthonius undescribed species 2	Cave pseudoscorpion		G1[5]	-	S1	-		
Chitrella undescribed species	Undescribed cave pseudoscorpion		G1[4]	-	S1[4]	-		
Chthonius virginicus	Virginian pseudoscorpion		G3[4]	-	S1[4]	-		
Hesperochernes mirabilis	Wonderful pseudoscorpion		G3[4]	-	S2[4]	S?	RFSS	
Kleptochthonius griseomanus	Gray-handed pseudoscorpion		G1[5]	-	S1[5]	-		
Kleptochthonius packardi	Pseudoscorpion		G1[5]	-	S1[5]	-		
Kleptochthonius undescribed species 1	Undescribed pseudoscorpion		G1[4]	-	S1[4]	-		
Kleptochthonius undescribed species 2	Undescribed pseudoscorpion		G1[4]	-	S1[4]	-		
Kleptochthonius undescribed species 3	Undescribed pseudoscorpion		G1[4]	-	S1[4]	-		
Snails								
Anguispira kochi	Terrestrial snail		G3[4]	S?	S?	S2		
Antroselates spiralis	Shaggy cave snail		G2	-	S2	S2		
Carychium exile	Ice thorn		G5	S?	T, S2	S3S4	RFSS	
Carychium riparium	Floodplain carych		G3[4]	-	S3[4]	-		
Fontigens cryptica	Hidden spring snail		G1[4]	-	S1[4]	-		
Glyphyalinia cryptomphala	Thin glyph		G4	-	S1[5]	S2S3		
Glyphyalinia latebricola	Ledge glyph		G2[4]	-	S1[4]	-		
Glyphyalinia lewisiana	Lewis' glyph		G3[4]	-	S1[4]	-		
Glyphyalinia rimula	Karst glyph		G2[4]	-	S1[4]	-		
Patera laevior	Terrestrial snail		G3[5]	-	S1[5]	SU		
Stenotrema (Euchemotrema) hubrichti	Carinate pill snail		G1					RFSS
Spiders								
Anahita punctulata	Wandering spider		G4	-	S1	-		
Bathyphantes weyeri	Weyers Cave sheet-web spider		G2[4]	-	S1[4]	-		

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(table 12 continued)

Scientific name	Common name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Aleochara lucifiga	Cave rove beetle		G4[5]	S?	S3[5]	-		
Calymmaria cavicola	Cave funnel-web spider		G4[5]	S2	S3[5]	-		
Cicurina arcuata	Funnel-web spider		G3[4]	-	S1	-		
Cicurina pallida	Pallid funnel-web spider		G4[4]	S?	S2	-		
Dolomedes scriptus	Lined nursery web spider		G4[4]	-	S2[4]	-		
Dolomedes vittatus	Nursery web spider		G4[4]	S?	S1	-		
Eidmanella pallida	Pallid cave spider		G5[4]	-	S1	-		
Eperigone indicabilis	Sheet-web spider		G1[4]	-	S1[4]	-		
Erebomaster flavescens	Golden cave harvestman		G3[4]	-	S2[4]	-	RFSS	
Islandiana cavealis	Iceland cave sheet-web spider		G1[4]	-	S1[4]	S1		
Nesticus carteri	Carter cave spider		G3[5]	-	S1[5]	-	RFSS	
Oreonetides undescribed species	Sheet-web spider		G1[5]	-	S1[5]	-		
Porhomma cavernicolum	Cavernicolous sheet-web spider		G4	S?	S2[5]	S?	RFSS	
Sabacon cavicolens	Cavernicolous harvestman		G3[4]	-	S1[4]	-		
Talanites echinus	Sac-web spider		G2[4]	-	S1	-		
Springtails								
Arrhopalites ater	Black medusa springtail		G1[4]	-	S1[4]	-		
Arrhopalites benitus	Springtail		G1	-	S1	-		
Arrhopalites bimus	Springtail		G3G4	-	E, S1	S?		
Arrhopalites carolynae	Carolyn's cave springtail		G2[5]	-	S1[5]	-		
Arrhopalites lewisi	Lewis' cave springtail		G2[4]	-	S2[4]	-		
Arrhopalites undescribed species near lewisi	Cave springtail		G2[4]	-	S2[4]	-		
Arrhopalites undescribed species near marshalli	Cave springtail		G1[5]	-	S1[5]	-		
Arrhopalites whitesidei	Whiteside's springtail		G2[5]	S?	S1[5]	-		
Dicyrtoma flammea	Flaming springtail		G3[4]	-	S1	-		
Entomobrya socia	Social springtail		G2[5]	-	S2[5]	-		
Folsomia candida	White springtail		G3[4]	S?	S3[4]	-		
Folsomia parvus	Small springtail		G3[4]	-	S1[4]	-		
Folsomia prima	Primitive springtail		G2[4]	S?	S1	-		
Hypogastrura gibbosus	Humped springtail		G2[5]	-	S1	-		
Hypogastrura helena	Helen's springtail		G1[4]	-	S1	-		
Hypogastrura horrida	Bristly springtail		G2[4]	-	S1[4]	-		
Hypogastrura lucifuga	Wyandotte cave springtail		G1[4]	-	S1[4]	-		
Hypogastrura maheuxi	Maheux springtail		G2[4]	-	S1	-		
Hypogastrura succinea	Girded springtail		G4[4]	-	S1	-		
Hypogastrura undescribed species near succinea	Springtail		G1[5]	-	S1[5]	-		
Isotoma anglicana	Springtail		G3[4]	-	S1[4]	-		
Isotoma caerulatra	Blue springtail		G1[4]	-	S1[4]	-		
Isotoma christianseni	Christiansen's springtail		G1[4]	-	S1	-		
Isotoma nigrifrons	Dark springtail		G2[4]	-	S1[4]	-		
Isotoma nixoni	Nixon's springtail		G1[5]	-	S1[5]	-		
Isotoma torildao	Springtail		G1[4]	-	S1[4]	-		
Isotoma truncata	Truncated springtail		G2[5]	-	S2[5]	-		
Isotoma (Desoria) undescribed species	Springtail		G1[4]	-	S1[4]	-		
Isotomiella minor	Petit springtail		G3[4]	-	S2	-		
Onychiurus casus	Fallen springtail		G4[4]	-	S2	-		

(table continued on next page)

(table 12 continued)

Scientific name	Common name	Federal status	Global[1] rank	State status & rank			FS	
				IL	IN	KY	HO[2]	SH[3]
Onychiurus reluctus	A springtail		G3[4]	-	S2[4]	-		
Onychiurus subtenus	Slender springtail		G3[4]	-	S1	-		
Onychiurus undescribed species 1	Springtail		G1[5]	-	S1[5]	-		
Onychiurus undescribed species 2	Paradox springtail		G1[5]	-	S1[5]	-		
Onychiurus undescribed species near casus	Springtail		G1[5]	-	S1[5]	-		
Onychiurus undescribed species near paro	Springtail		G1[5]	-	S1[5]	-		
Proisotoma libra	Springtail		G2[5]	-	S1[5]	-		
Pseudosinella collina	Hilly springtail		G2[4]	-	S1[4]	-		
Pseudosinella fonsa	Fountain cave springtail		G2[4]	-	S2[4]	-	RFSS	
Pseudosinella undescribed species	Springtail		G1[5]	-	S1[5]	-		
Pseudosinella undescribed species near collina	Springtail		G1[4]	-	S1[4]	-		
Pseudosinella undescribed species near fonsa	Springtail		G1[5]	-	S1[5]	-		
Sensillanura barberi	Barber's springtail		G2[4]	-	S1	-		
Sensillanura caeca	Blind springtail		G3[4]	-	S1	-		
Sensillanura undescribed species	Springtail		G1[5]	-	S1[5]	-		
Sensillanura undescribed species near bara	Springtail		G1[5]	-	S1[5]	-		
Sensillanura undescribed species near illina	Springtail		G1[4]	-	S1[4]	-		
Sinella alata	Wingless winged cave springtail		G3[4]	-	S3[4]	-	RFSS	
Sinella avita	Ancestral springtail		G3	S?	S1	S?		
Sinella barri	Barr's cave springtail		G3[4]	S?	S1[4]	S?		
Sinella cavernarum	Cavernicolous springtail		G4	S?	S2	S?	RFSS	
Sinella undescribed species	Cave springtail		G1[4]	-	S1[4]	-		
Sminthurides hypogramae	Springtail		G1[4]	-	S1[4]	-		
Sminthurides weichseli	Weichsel's springtail		G2[4]	-	S1[4]	-		
Sminthurinus malmgreni	Malmgren's springtail		G3[4]	S?	S3	-		
Tomocerus bidenatus	Two-toothed springtail		G4[5]	S?	S3	-	RFSS	
Tomocerus dubius	Springtail		G3[5]	-	S1[5]	-		
Tomocerus elongatus	Elongate springtail		G3[4]	-	S1[4]	-		
Tomocerus lamelliferus	Layered springtail		G4[4]	-	S1	-		
Tomocerus (Lethemurus) missus	Relict cave springtail		G2[4]	S?	S1[4]	S?		
Tomocerus undescribed species	Springtail		G1[5]	-	S1[5]	-		
Miscellaneous								
Sphalloplana chandleri	Chandler's cave flatworm		G1[4]	-	S1[4]	-		
Sphalloplana weingartneri	Weingartner's cave flatworm		G2[4]	-	S2[4]	-		
Veigaia bakeri	Baker's cave mite		G1[4]	-	S1[4]	-		
Veigaia wyandottensis	Wyandotte cave mite		G1[4]	-	S1[4]	-		

[1] Based upon Heritage Status Rank as reported by NatureServe (2002).

[2] Species identified by the Hoosier National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[3] Species identified by the Shawnee National Forest as a Forest Species of Concern (FSC), Management Indicator Species (MIS), or Regional Forester Sensitive Species (RFSS).

[4] Based upon Heritage Status Rank as reported by Lewis (1998).

[5] Based upon Heritage Status Rank as reported by Lewis et al. (2003).

Table 13. Globally Important Bird Areas within or adjacent to the Hoosier-Shawnee Ecological Assessment Area.

Illinois
Crab Orchard National Wildlife Refuge
Lower Cache River Complex
Rend Lake State Fish and Wildlife Area
Shawnee National Forest
Union County Conservation Area
Indiana
Big Oaks National Wildlife Refuge
Brown County State Park
Hoosier National Forest
Monroe Reservoir
Morgan-Monroe State Forest
Reclaimed Coal Mine Grasslands
Yellowwood State Forest
Kentucky
Fort Campbell
Reelfoot Lake Wildlife Management Area

success of disturbance dependent or early successional neotropical migrants as well: habitat fragmentation, composition of habitats within a landscape matrix, area dependence, edge, floral composition of habitat, parasitism, source-sink dynamics, and predation (Ambuel and Temple 1983, Andren 1992, Andren 1995, Angelstam 1986, Askins 1993, Blake and Karr 1984, Bond 1987, Brawn and Robinson 1996, Donovan et al. 1995, Faaborg et al. 1995, Hawrot and Niemi 1996, Heske 1995, Pulliam 1988, Pulliam and Danielson 1991, Robinson 1992, Robinson 1996, Robinson et al. 1995, Thompson 1994).

Neotropical migrants may acquire growing importance as indicators of ecosystem health, exemplifying the need to manage on larger spatial scales than previously recognized (Maurer 1993, Villard and Maurer 1996). Land managers may need to strategically identify habitat areas of sufficient extent, type, and successional stage to maintain a desired composition of neotropical species within the assessment area. This may require the selective acquisition and restoration of areas likely to be detrimental to neotropicals, e.g., agricultural in-holdings, as well as acquisitions designed to extend contiguous acreages.

KEY GAME SPECIES

Bobwhite Quail

Bobwhite quail have steadily declined across their range since at least the mid-1950s. From 1980 to 1999, populations of this grassland-old field representative declined by approximately 65 percent within the Central Hardwood Bird Conservation Region (BCR 24), which encompasses the assessment area (Dimmick et al. 2002; figs. 7, 8). The loss of native grasslands, the transition from pastoral land use to clean rowcrop agriculture, and the progressive consolidation of farms into larger, cleaner blocks of land have resulted in the rangewide decline of numerous species dependent on early successional and open-land habitats. This trend, combined with increased rural development, has aggravated habitat loss by further fragmenting open lands (Herkert et al. 1996). Additionally, existing grasslands in the assessment area are pervasively dominated by tall fescue (Kentucky 31, *Festuca arundinacea*), which has limited value as avian habitat (Barnes et al. 1995, Madej and Clay 1991, Roseberry and David 1994, Washburn et al. 2000). A highly invasive exotic species, tall fescue was widely used in CP-1 plantings (Introduced Grasses) of the Conservation Reserve Program throughout the Eastern United States (Osborn et al. 1995).

Bobwhite quail occur in the assessment area where the physical features of the landscape have limited the expansion of rowcrop agriculture and where substantial old fields characterized by woody invasion persist. For example, comparatively stable numbers of quail, albeit low compared to historic levels, occur throughout southern Indiana. The southwest and southeastern areas of the State, however, provide more suitable habitats than do the more heavily forested regions (McCreedy 2002).

Although bobwhite quail are unlikely to approach their historic levels, integrating them into public and private joint grassland recovery efforts may help this and other open-land species (Fenwick and Pashley 2002). In the assessment area, grassland birds may accrue some benefit from the wildlife-related conservation measures of the Farm Bill, the reclamation of minelands, and where appropriate, the restoration of native savannahs and grasslands on public and private lands.

American Woodcock

In addition to the North American Breeding Bird Survey conducted by the U.S. Geological Survey, the U.S. Fish and Wildlife Service annually evaluates rangewide American woodcock (*Scolopax minor*) breeding populations through the use of a singing ground survey (Kelley 2002). Rangewide, Breeding Bird Survey results suggest a 1.02 percent annual decline in woodcock numbers between 1966 and 2000 (Sauer et al. 2001; figs. 9, 10). Results from the Woodcock Singing Ground Survey, timed to take advantage of the male courtship display, suggest a rangewide annual decline of 1.8 percent from 1968 to 2002 (Kelley 2002). In the Central Management Region, which encompasses Illinois and Indiana, results suggest an annual decline of 1.6 percent over the same period and a 1.5 percent annual decline from 1992 to 2002 (Kelley 2002). The Fish and Wildlife Service does not survey singing ground routes in Kentucky; too few routes, with too few woodcock detected per route, are conducted in either Indiana or Illinois to produce statistically reliable results for these States.

In addition to changes in land use, woodcock have declined in association with the maturation of mesic forests and the loss of periodic disturbance necessary to maintain early successional mesic forest types. In the Central Plains States (Illinois, Indiana, Iowa, Missouri) approximately 15 percent of forested acres

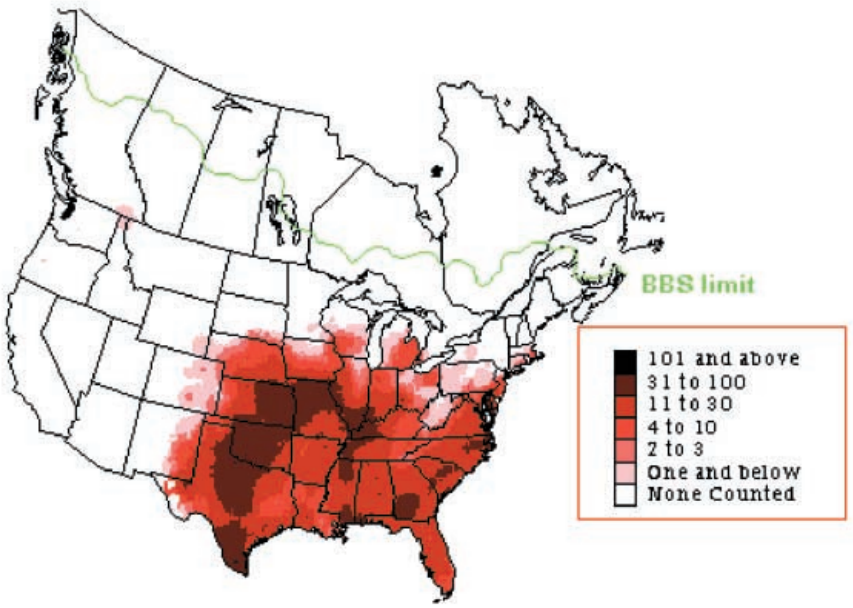

Figure 7. Current rangewide distribution and relative abundance of the northern bobwhite quail based on North American Breeding Bird Survey counts between 1982 and 1996 (Sauer et al. 2001).

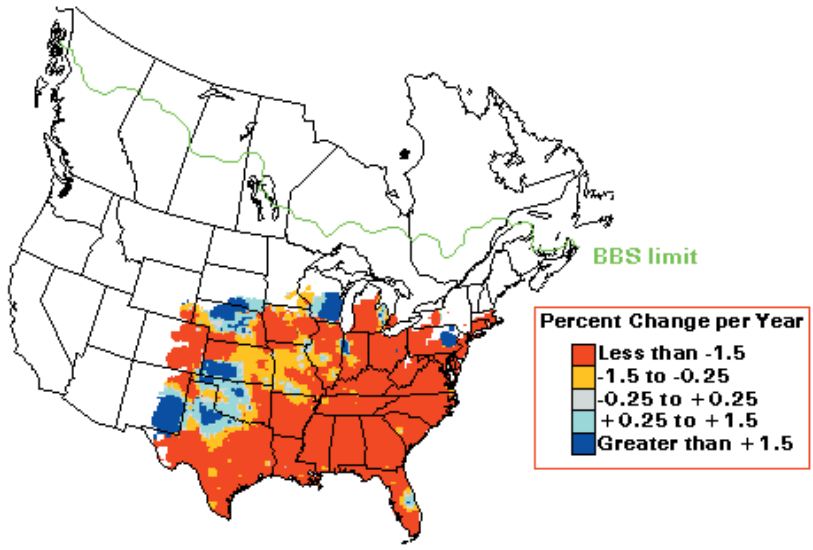

Figure 8. Regional population trends of the northern bobwhite quail over 1980 to 1999 based on results of the North American Breeding Bird Survey (Sauer et el. 2001).

were classified as seedling-sapling in the most recent forest inventory (Trani et al. 2001). Only 3 percent of Illinois forests (1998) and 6 percent of Indiana forests (1998) were characterized as seedling-sapling. In the approximately 15 years between forest inventories in Central Plains States, forest acreage increased by 600,000 hectares while early successional forest acreage declined by approximately

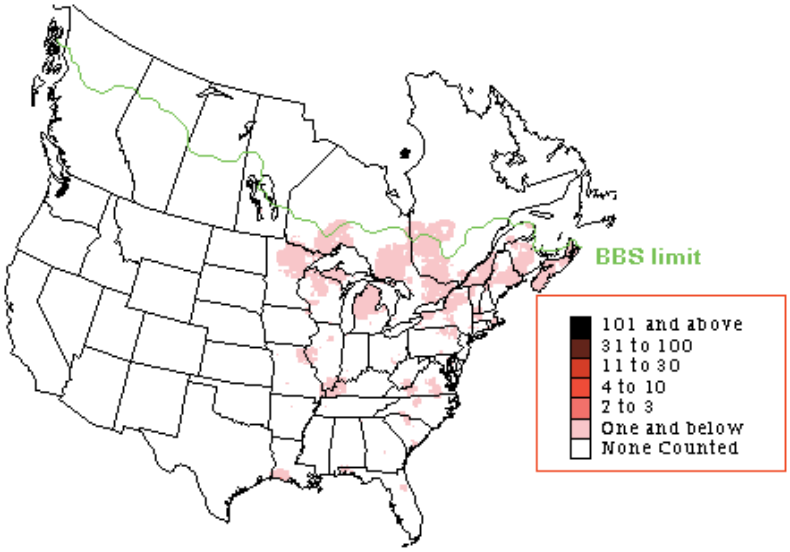

Figure 9. Current rangewide distribution and relative abundance of the American woodcock based on North American Breeding Bird Survey counts between 1982 and 1996 (Sauer et al. 2001).

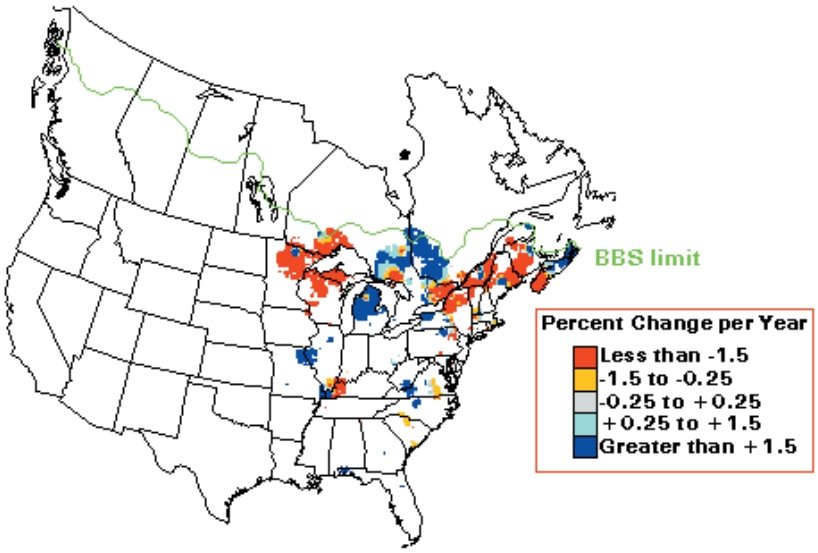

Figure 10. Regional population trends of the American woodcock over 1966 to 1996 based on results of the North American Breeding Bird Survey (Sauer et al. 2001).

300,000 hectares. Of those States in the assessment area, the forests of Kentucky, surveyed in 1988, contained the highest percentage of seedling-sapling stage timber (16%; Trani et al. 2001). The vast majority of seedling-sapling timber acreage in these States, however, is in private ownership, approximately two-thirds of which may be contained in average blocks of less than 8 hectares (Birch 1996). Given these considerations, concern for the conservation of woodcock and other disturbance-dependent birds (Hunter et al. 2001, Thompson and Dessecker 1997) has grown as has the appreciation for the difficulty in incorporating disturbance in forest management (Askins 2001, Thompson and DeGraaf 2001).

Historically, at least before wide-scale efforts in flood control, periodic flooding served to maintain early successional bottomland forests. Apart from consideration of either the use of fire or silviculture, the restoration of wetland habitats in the assessment area, ongoing within the national forests, may provide a disturbance regime capable of maintaining a limited acreage of early successional bottomland forest of benefit to the American woodcock.

Ruffed Grouse

The ruffed grouse (*Bonasa umbellus*) is the most widely distributed of North America's resident game birds, historically occurring throughout Illinois, Indiana, and Kentucky. These birds persist in the assessment area as remnant resident or reintroduced populations of restricted distribution. Only in eastern Kentucky, outside the assessment area, do substantial numbers of grouse now occur. State wildlife agencies in both Illinois and Kentucky have previously attempted reintroductions in the assessment area.

Two of twelve recent western Kentucky reintroductions have been reported as successful: reintroductions at the Pennyrile Forest Wildlife Management Area in Christian and Hopkins Counties and those at the Fort Knox Military Reservation encompassing portions of Bullitt, Hardin, and Meade Counties (Kentucky Department of Fish and Wildlife Resources 2001b; fig. 11). Results of the Illinois Breeding Bird Atlas suggest that grouse possibly persist in Jackson and Union Counties in the Shawnee National Forest. Grouse numbers continue to decline in south-central Indiana counties where they were once trapped for reintroduction in Illinois and Kentucky (fig. 12).

Results of the North America Breeding Bird Survey depict notable heterogeneity in the status and distribution of ruffed grouse across their range (figs. 13, 14), and this most likely reflects the declining availability of early successional forest habitats. In midwestern oak-hickory forest types, ruffed grouse favor 7- to 15-year-old regeneration stands where this type makes up at least 10 to 20 percent of total stand area (Kubisiak 1985, Thompson and Dessecker 1997, Wiggers et al. 1992). The public unpopularity of these habitats and the continued likely loss of early successional acreage on non-industrial private forests suggests that habitats for early successional forest species may continue to decline in the assessment area (Askins 2001, Dessecker and McAuley 2001). Within the assessment area, those species dependent upon early successional upland forest may derive limited benefit from the conversion of nonnative pines to native hardwoods or through silvicultural practices intended to benefit other rare or declining species.

Eastern Wild Turkey

The three States in the assessment area share a common history with respect to the fate and recovery of the eastern wild turkey (*Meleagris gallopavo*). Before European settlement, wild turkeys were widely distributed throughout the forested Eastern United States. As the wave of early settlement advanced across the Midwest, clearing of the eastern deciduous hardwood forest restricted the distribution of them. Concurrently, unregulated subsistence hunting took an increasing toll on them. At the turn of the last century, wild turkeys were reduced to remnant populations inhabiting only those areas unfavorable for settlement, namely the remote Adirondacks, Ozarks, and southern swamps. Public support for harvest regulation, reforestation, and the successional advancement of abandoned lands formed the early foundation for the recovery of this species throughout its former range.

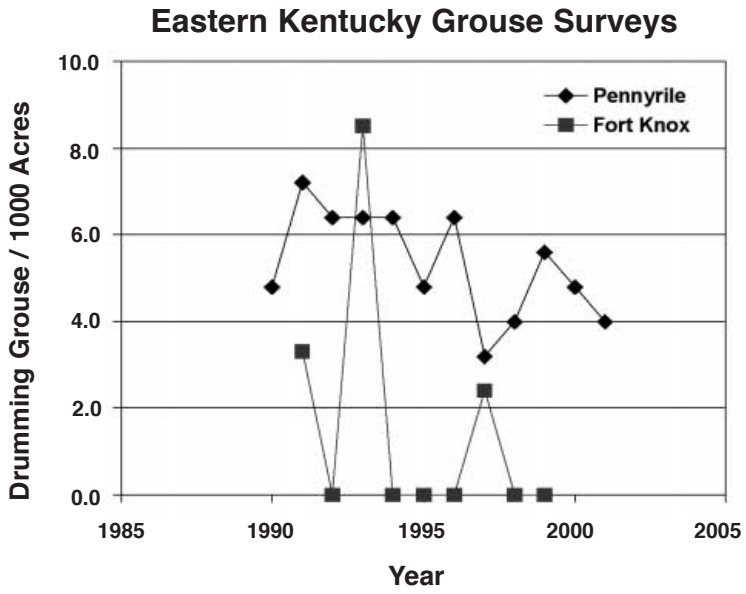

Figure 11. Results of ruffed grouse drumming count surveys on two eastern Kentucky sites within the assessment area. Reintroductions at Pennyrile Forest Wildlife Management Area and the Fort Knox Military Reservation represent 2 successes out of 12 attempts to reintroduce grouse to areas of their former range in Kentucky.

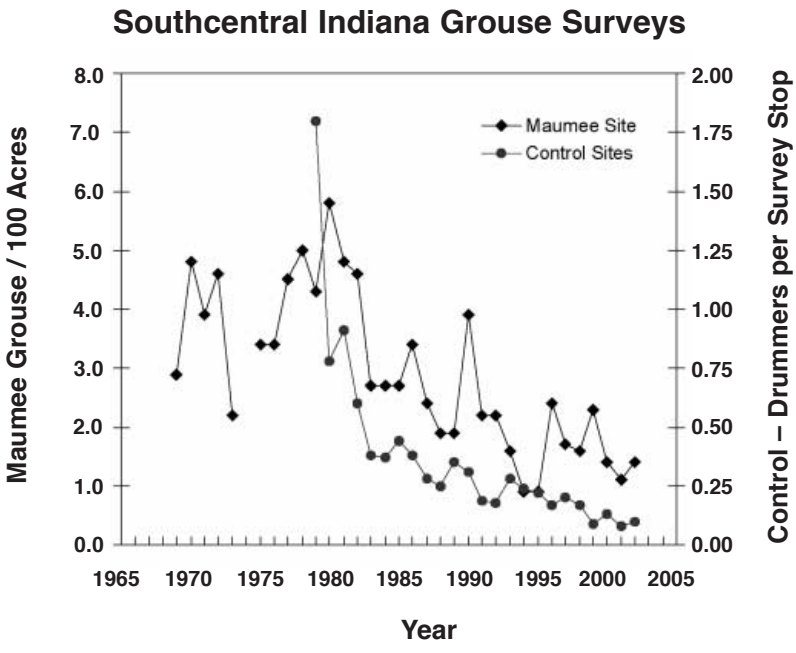

Figure 12. Results of ruffed grouse drumming count surveys conducted in south-central Indiana within or near the assessment area (Backs 2002). Results of drumming count surveys on the Maumee Study Area (Jackson and Brown Counties) are expressed as densities of grouse per 100 acres and assume a 1:1 sex ratio. Drumming count surveys on sites that serve as controls for the Maumee study are conducted within Brown, Greene, Jackson, Jefferson, Lawrence, Martin, Monroe, Morgan, Orange, Owen, Perry, and Putnam Counties. Data for control routes are expressed as the number of drumming males per survey stop.

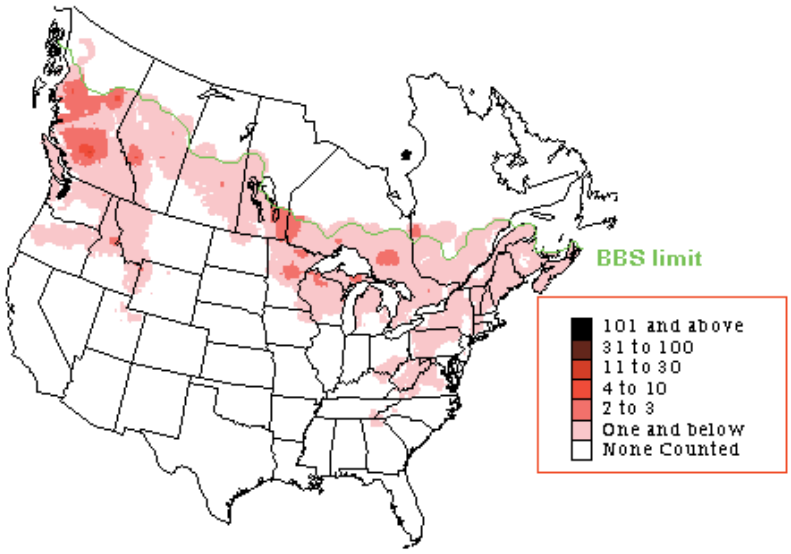

Figure 13. Current rangewide distribution and relative abundance of the ruffed grouse as determined by results of the North American Breeding Bird Survey between 1982 and 1996 (Sauer et al. 2001).

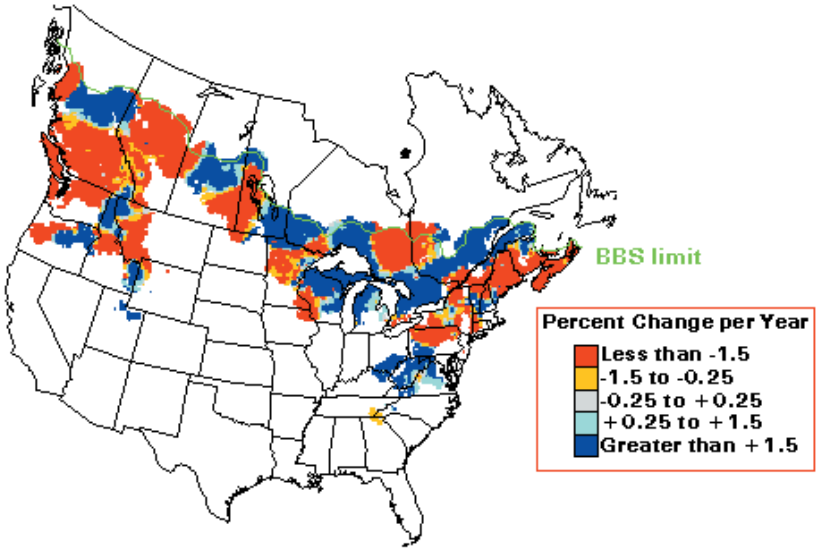

Figure 14. Regional population trends of the ruffed grouse over 1966 to 1996 based on results of the North American Breeding Bird Survey (Sauer et al. 2001).

Indiana's effort to restore turkeys to their former range began in 1960 following Illinois' initial restoration effort in 1958 (Backs 1999). Wild turkeys persisted as a remnant population in Kentucky until substantial effort began in 1978 to restore them to their former range. Indiana's Division of Fish and Wildlife has reintroduced a cumulative total of 2,639 turkeys, Illinois has reintroduced a total of 4,768 of these birds, and the Kentucky Department of Fish and Wildlife Resources has released a total of 7,600 turkeys since beginning restoration efforts. Annual hunt harvest of wild turkeys now exceeds 10,000 birds in Indiana, 14,000 in Illinois, and 28,000 in Kentucky.

Hunt participation and harvest of wild turkeys in Indiana is reasonably representative of the recovery and growth of turkey populations within the three-State region as well as the assessment area (fig. 15). Within the nine-county area in which the Hoosier National Forest is located (Brown, Crawford, Dubois, Jackson, Lawrence, Martin, Monroe, Orange, and Perry Counties), hunters harvested 2,451 turkeys of a statewide total of 10,575 in 2002 (Backs and Walker 2002). Within the Purchase and Green River Regions of western Kentucky, approximately 11,550 turkeys, of a statewide total of 28,210, were harvested during the spring 2002 Kentucky turkey season (Kentucky Department of Fish and Wildlife Resources 2003). Southern region hunters in Illinois harvested 5,293 turkeys of a statewide total of 14,314 birds in 2002 (Illinois Department of Natural Resources 2003).

Extensive mature hardwood forest within the assessment area, embedded to some degree within a matrix of agricultural land use, has provided this species with habitat conditions conducive to population growth and range expansion (Lewis 1992, Porter 1992). It is likely that the eastern wild turkey now occupies the majority of suitable habitats in the three-State region as well as the assessment area proper.

White-tailed Deer

The States of Kentucky, Illinois, and Indiana share much of the history common to midwestern white-tailed deer management. Settlement of the Midwest brought dramatic changes in land use, and unregulated exploitation resulted in near extirpation of white-tailed deer in all

three States between 1850 and the turn of the century. Beginning in the 1930s, both the States of Indiana and Illinois sought to restore their deer herds through restocking programs (Indiana Division of Fish and Wildlife 1997, Thomas 2000). The State of Kentucky began a similar effort soon thereafter. Indiana opened its first post-restoration deer hunting season in 1951 and Illinois followed with its first season in 1957. Consistent with the effort to restore deer herds, Indiana and Kentucky hunters were allowed to harvest only bucks during this period of intended herd growth. Beginning in the mid-1980s, managers recognized the need to temper public demand for deer-related recreation with concern for the societal (Hardin 1986) and ecological impacts of growing deer herds (fig. 16). Consequently, management now emphasizes controlling herd growth by shifting harvest to antlerless deer (Indiana Division of Fish and Wildlife 1997, Yancy 2002). All three States within the assessment area now manage deer with localized county harvest quotas intended to influence, increasing where necessary, the proportion of females in the harvest.

The harvest of white-tailed deer throughout the assessment area reflects the adaptability of this species to a forested landscape fragmented by both agriculture and expanding rural development (see below: Habitat Suitability Analyses). Using average county harvests from the 2000 hunt season for comparison, counties within the assessment area had greater per county harvests than did their respective counties outside of the assessment area (fig. 17). In Illinois and Indiana, this likely reflects the regional extent of woody cover compared to that available in the prairie counties of these States. In Kentucky, this may reflect the comparatively greater extent of agricultural land use in this part of an otherwise heavily forested State.

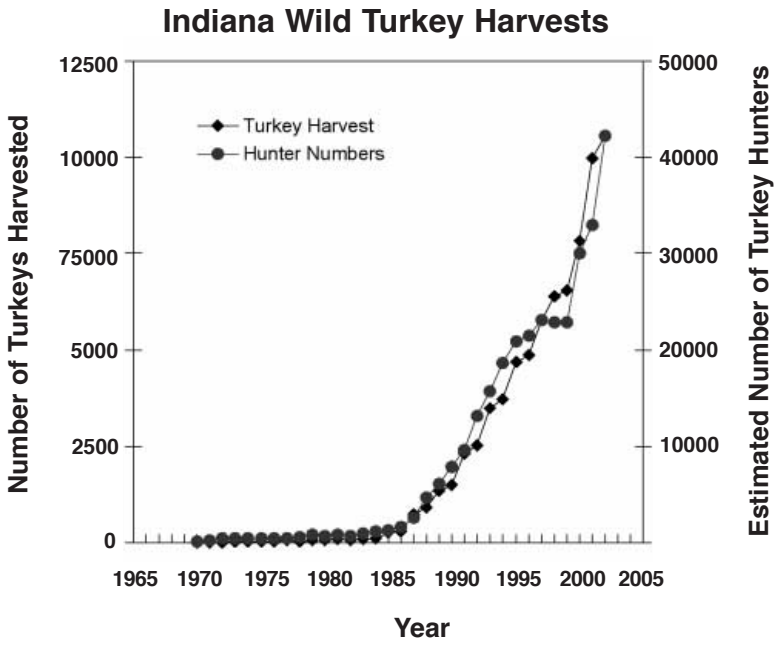

Figure 15. Annual wild turkey harvest and growth of hunt participation in Indiana (Backs 2002b). Indiana is representative of the history of turkey restoration and hunt participation in most Midwestern States, including those of the assessment area.

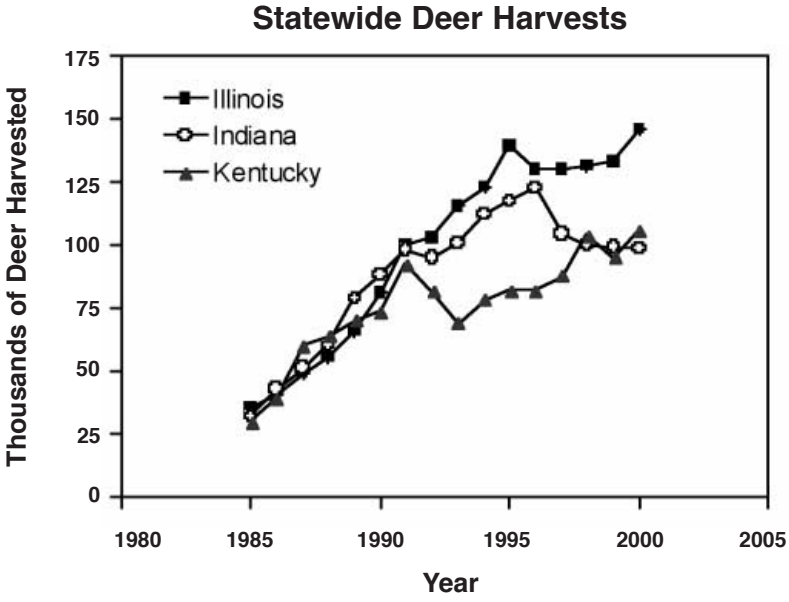

Figure 16. Regional white-tailed deer harvests within the States of Illinois, Indiana, and Kentucky. The three states within the assessment area share common histories with respect to deer management: restoration, herd growth, and subsequent localized harvest management intended to control herd growth through harvest of antlerless deer.

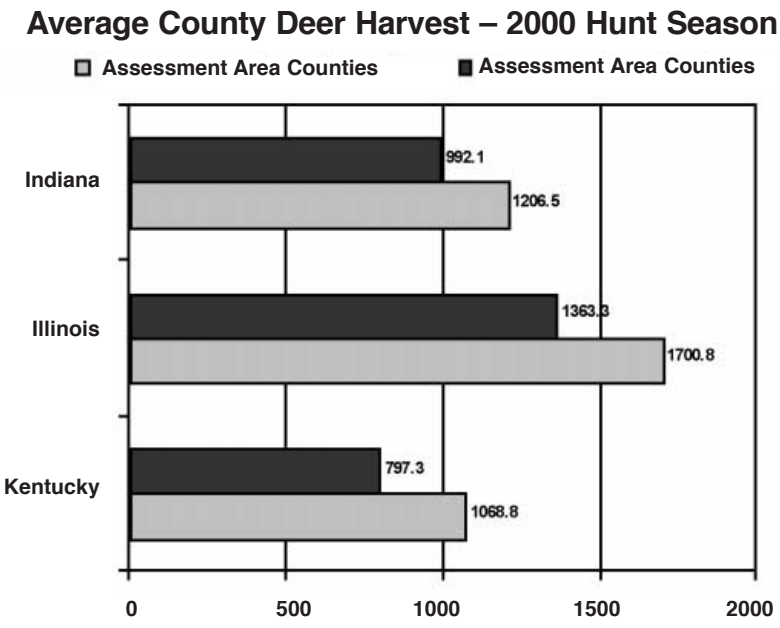

Figure 17. Regional comparisons of white-tailed deer harvests within the states of Illinois, Indiana, and Kentucky relative to counties within and outside of the Hoosier-Shawnee Ecological Assessment Area. Greater harvests within assessment area counties reflects suitability of habitat for white-tailed deer relative to other areas of the respective states.

HABITAT SUITABILITY ANALYSES FOR SELECTED SPECIES

Habitat management remains the most consistently effective means by which land management agencies approach the conservation of terrestrial animal species. The use of Geographic Information Systems (GIS) and the capability to correlate landscape attributes with indices of animal abundance have furthered the ability of land managers to evaluate habitat suitability for any number of species for which these data are available. Spatial habitat suitability was evaluated for three species endemic to the assessment area: the bobcat, the northern bobwhite quail, and the white-tailed deer. These species were selected on the basis of their widespread interest to conservationists, the range of habitats they use, and the availability of regional habitat suitability models for these species.

Habitat Suitability Analysis: Bobcat

The State of Indiana currently considers the bobcat an endangered species; Illinois recently removed the bobcat from its threatened or endangered species list. The State of Kentucky manages the bobcat as a harvested species. The range and numbers of bobcats in the Midwest appears to have increased in the last decade (Woolf and Hubert 1998), a trend noted in both Illinois (Woolf et al. 2000) and Indiana (Indiana Division of Fish and Wildlife 2003).

Habitat model

Habitat suitability analysis for bobcats followed a variation of the model developed by Nielsen and Woolf (2002); this model evaluates landscape similarity to known features of bobcat core range areas. Nielsen and Woolf (2002) constructed this model using data from bobcats in southern Illinois; this sort of explicit spatial model, given that the western portion of the assessment area encompasses southern Illinois, should be reasonably representative of the assessment area.

Woolf et al. (2002) found that bobcats occurred in a variety of habitats, but most often in areas with greater proportional forest cover and larger forest patch size, and in smaller grassland and agricultural areas than were available across the broader landscape. These relationships were mapped by apportioning the assessment area into hexagons equivalent to bobcat home range core areas (4.5 km^2). The habitat composition and configuration of each hexagon across the landscape were estimated and compared to bobcat habitat characteristics observed in southern Illinois. Areas that were most similar to actual areas used by bobcats were assumed to be the highest quality habitat for bobcats. High quality bobcat habitat occurs throughout the assessment area; the greatest concentration is in the southwestern portion of the assessment area (fig. 18).

Habitat Suitability Analysis: Northern Bobwhite Quail

Bobwhite quail primarily occur in open grasslands with interspersed woody edge. These habitats were widespread during the first half of the 20th century as a result of farm abandonment,

predominance of pastoral agriculture, and silvicultural practices compatible with the bobwhite's life history. With the advent of clean rowcrop agriculture and the loss of native grasslands, bobwhite quail have steadily declined across their range since at least the mid-1950s (Dimmick et al. 2002). Bobwhite quail currently occur across the assessment area, although populations within the larger Central Hardwoods Region (BCR24) have declined by approximately two-thirds since the early 1980s (Dimmick et al. 2002).

Habitat model

Northern bobwhite habitat suitability was evaluated using a model developed by Roseberry and Sudkamp (1998). Their model characterizes high quality quail habitat as containing 30 to 65 percent row crops, 15-30 percent grasslands, <30 m/ha of woody edge, and habitat contagion values <65 percent. This latter parameter, habitat contagion, measures the degree of interspersion or juxtaposition of habitat types. The original model by Roseberry and Sudkamp (1998) considered latitude an important component of bobwhite habitat. However, because the critical latitude above which bobwhite are impacted by weather is north of the assessment area, latitude was not considered in this suitability analysis.

The majority of the landscape within the assessment area (75%) appears to be of marginal value to bobwhite quail; 11 percent of the land area could be considered suitable for quail. The majority of these habitats occupy the eastern half of the assessment area, particularly in Kentucky. In Indiana, scattered areas of suitable habitat frame the larger area of the Hoosier National Forest (fig. 19).

If only on a coarse level, it is evident that the proportion and distribution of suitable habitat for quail correspond with patterns of land use across the assessment area. The lack of suitable quail habitat is consistent with the assumption

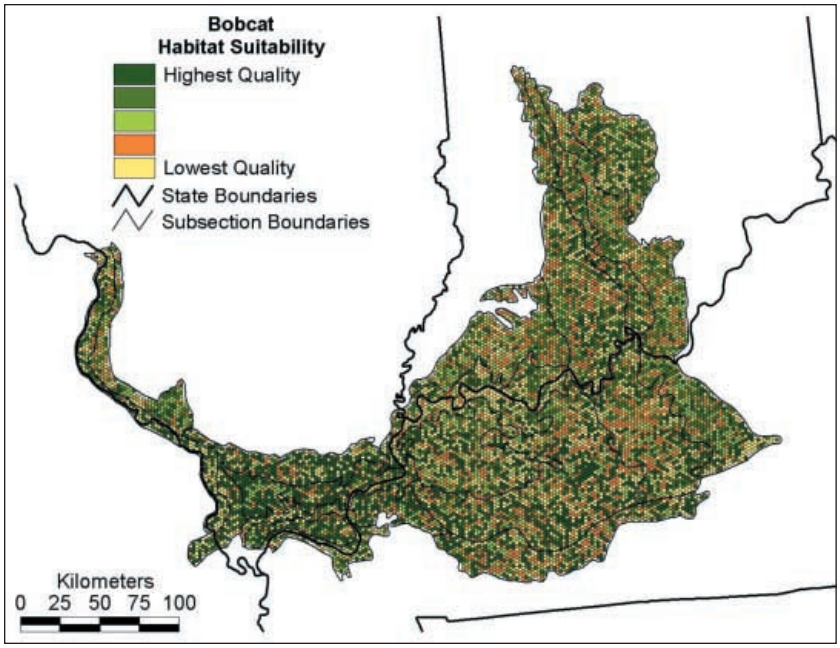

Figure 18. Suitability of habitats for bobcat in the assessment area based on a model by C. Nielsen (2000). Figure courtesy of G. Mohr and C. Nielsen, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL.

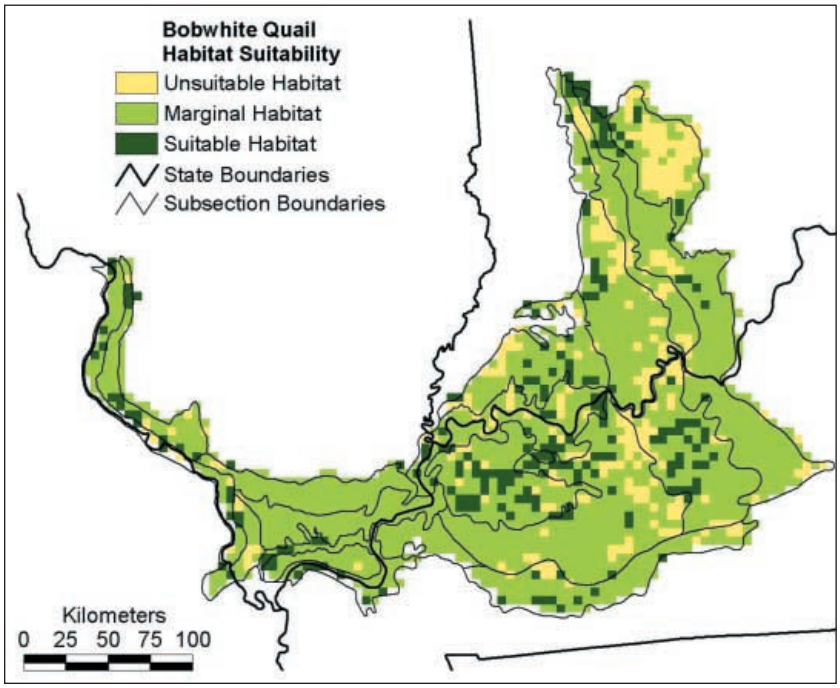

Figure 19. Suitability of habitats in the Hoosier-Shawnee Ecological Assessment Area for northern bobwhite based on a model by Roseberry and Sudkamp (1998). Figure courtesy of G. Mohr, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL.

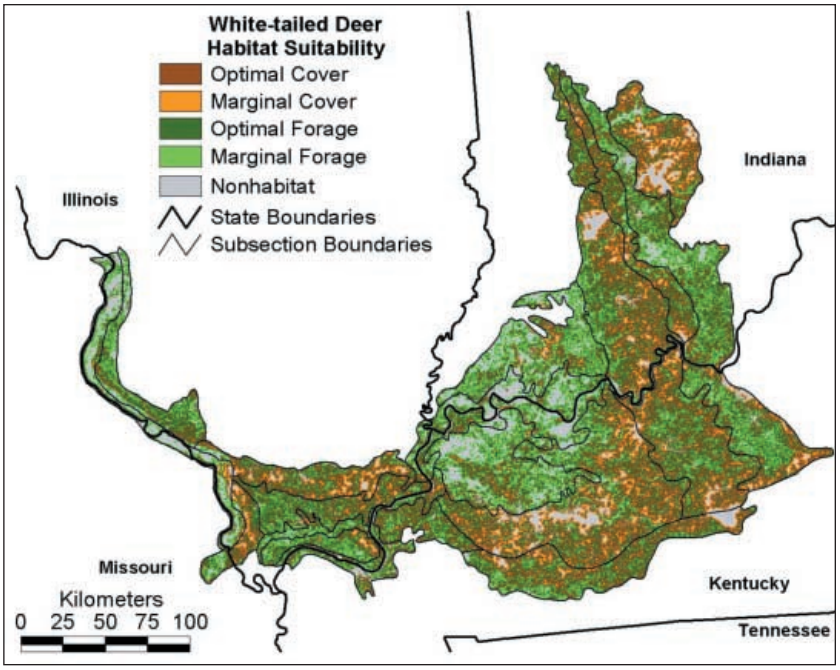

Figure 20. Distribution of white-tailed deer habitats in the Hoosier-Shawnee Ecological Assessment Area based on a model by Roseberry and Woolf (1998). Figure courtesy of G. Mohr, Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, IL.

that declining quail populations are related to the availability of suitable habitat.

While the proportion of the land area suitable for grassland species is low relative to other cover types, at least some opportunity exists to pursue the restoration of these native habitats. Given the distribution of the most suitable of these habitats, public–private partnerships that span ownerships may provide some benefit to this declining community of species that has only recently received widespread attention among conservationists (Askins 2001, Hunter et al. 2001).

Habitat Suitability Analysis: White-tailed Deer

Particularly within the last half century, white-tailed deer have benefited substantially from deliberate efforts to restore the species across its former range, from the protection afforded a publicly desirable game species, and from its apparent tolerance of wide-scale change in patterns of land use across its range. Concurrently, the undeveloped land base suitable for conservation has diminished with the advancement of rural development and human population growth. Consequently, land managers now face the realistic challenge of assessing and managing the ecological impact of deer herds that may approach levels inconsistent with other conservation objectives (deCalesta 1994, McCabe and McCabe 1997, McShea et al. 1997, Waller and Alverson 1997).

White-tailed deer share a common history among the states within the assessment area: near extirpation at the turn of the century as a result of unregulated exploitation and changes in land use associated with settlement; subsequent protection; concerted restoration; and liberalized take to control contemporary herds.

Habitat model

A habitat suitability model developed for white-tailed deer in Illinois by Roseberry and Woolf (1998) was used to assess habitat suitability within the assessment area. This model equates row crops, small grains, rural and urban grasslands, orchards, and nurseries as foraging habitat for deer. The model identifies forests, shrublands, and woody wetlands as protective cover for deer. Using proximity to forage to define the relative value of protective cover, optimal deer cover was defined as that occurring less than 200 m from foraging habitats. Marginal protective cover was defined as that occurring from 200 to 500 m from foraging habitats. Similarly, optimal foraging habitat was defined as that occurring within 500 m of protective cover, while marginal foraging habitats occurred from 500 to 1,000 m from protective cover. In other words, the highest quality deer habitats occurred where protective cover and foraging habitats were highly juxtaposed.

Approximately 35 percent of the assessment area is composed of optimal protective cover for white-tailed deer; approximately 26 percent of the land area provides optimal foraging habitats for deer (fig. 20). An additional 19 percent of the assessment area contains marginal deer habitats. As rural development

expands, and as the density of human land use increases across rural landscapes, managers will be further challenged to balance the recreational value of white-tailed deer, consumptive and non-consumptive, with societal and ecological concerns related to deer populations perceived to be overabundant.

KEY FINDINGS

- Five species in the Hoosier-Shawnee Ecological Assessment Area are federally listed as threatened or endangered: the bald eagle (threatened), the interior least tern (endangered), the gray bat (endangered), the Indiana bat (endangered), and the American burying beetle (endangered). Although unlikely, one other species that is a candidate for listing may occur within the assessment area: the eastern massasauga rattlesnake.

- Of global viability concern are 173 species inhabiting the assessment area. Of these species, 14 are vertebrates and 159 are either terrestrial invertebrates or cave-associated aquatic invertebrates. These species are considered rare to critically imperiled throughout their global ranges.

- An additional 172 terrestrial species are of viability concern at the state level; 81 of these species are birds. These species are considered rare to critically imperiled within at least one of the states of the assessment area.

- Cave and karst systems provide habitat for some of the rarest species within the assessment area. Of the 173 species determined to be of global viability concern, 140 (81%) use cave and karst habitats (134 invertebrates and 6 mammals). An additional 21 species determined to be of state viability concern are also associated with cave systems. In total, 161 species of viability concern within the assessment area are cave or karst-associated species. In addition, four cave and karst systems within the assessment area are considered to be globally significant from the standpoint of their obligate subterranean fauna.

- Of the 160 birds identified as of conservation concern within the assessment area, North American Breeding Bird Survey data were sufficient to identify 40 species with regional long-term population trends. From 1966 to 2000, 14 species increased in abundance in either, or both, the Highland Rim or Lexington Plain physiographic regions; 27 species decreased in abundance. In the case of the eastern bluebird, numbers of this species declined within the Lexington Plain but increased in the Highland Rim physiographic region.

- Neotropical migrant birds make up approximately a third of the avian species of conservation concern in the assessment area. Of the 21 neotropical migrants with sufficient data to determine regional population trends, 16 declined while 5 species increased from 1966 to 2000.

- Game species evaluated included the white-tailed deer, eastern wild turkey, ruffed grouse, American woodcock, and northern bobwhite. White-tailed deer and eastern wild turkey populations are common to abundant throughout the assessment area. Ruffed grouse and woodcock populations are locally restricted, and numbers of both species have declined substantially across the assessment area. Northern bobwhite quail populations vary from locally stable to declining across the assessment area; current populations have been reduced to a third of those present in the early 1980s.

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