

**Programmatic
Biological Assessment
Land and Resource Management Plan**

**Hoosier National Forest
1 March 2000**

Abstract: Documents potential effects of continued implementation of the existing Hoosier National Forest Plan as amended on the federally endangered and threatened species and their respective habitats.

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Summary of Biological Assessment and Request for Formal Consultation

Indiana bat - Because there is potential for adverse impacts which cannot be removed through informal consultation, continued implementation of the Forest Plan MAY AFFECT - LIKELY TO ADVERSELY AFFECT populations of Indiana bat using the Hoosier National Forest.

A MAY AFFECT - NOT LIKELY TO ADVERSELY AFFECT determination is also made since there will be potential BENEFICIAL effects on Indiana bat habitat through continued implementation of the Forest Plan, as amended.

It is impossible for the Forest to acquire enough foraging habitat to guarantee the survival of bat populations. If all of the Hoosier National Forest were optimum foraging habitat, it would still not guarantee stabilization or an increase in Indiana bat populations. Habitat must be present on other ownerships to help Indiana bat population stabilize and eventually increase. However, the Forest Service is committed to providing quality habitat on the Hoosier National Forest for all native species, including Indiana bat. The Forest Service will also continue to cooperate with other agencies, individuals, and organizations to take actions to conserve listed species.

In each current project, effects to Indiana bat were assessed. It was determined that the effects to Indiana bat were insignificant or discountable in each project, and USDI Fish and Wildlife Service concurred with this finding.

Present or reasonably foreseeable future activities on NFS land include the conversion of non-native pines to native hardwoods either naturally or through vegetation management such as timber harvest. Native hardwood stands provide better foraging and roosting habitat than pine plantations, so this conversion should be beneficial for Indiana bat.

Removing potential roost trees could decrease the amount of summer roost and maternity roost habitat, and cutting a standing tree could inadvertently cause a taking of Indiana bats currently roosting in it. However, with implementation of the recommended mitigation measures, these effects will be insignificant (cannot meaningfully be measured) or discountable (unlikely to occur).

The Hoosier National Forest has some of the best Indiana bat habitat in Indiana. Riparian corridors are primarily forested and subject to natural forces with a minimum of human manipulation.

Standing snags and den trees are available throughout the Forest and are retained in all Forest activities, ensuring a plentiful supply of potential roost trees into the future. There are a vast number of potential roost trees of all sizes and species available across the Forest.

Since the entire Hoosier National Forest is within the range of Indiana bat, it is possible that Indiana bats could be anywhere on the Forest during spring through fall. The probability of encountering male roosting Indiana bats may be higher close to known hibernacula during the fall swarming period.

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Therefore, the potential for accidental direct take through removal of a male roost tree exists in any project which removes trees, and may be higher the closer the activity is to a hibernacula.

Similarly, the potential for accidental direct take of a maternity colony exists on the Forest. The risk of direct take for both occupied male and maternity roost trees is extremely low considering the vast number of potential roost trees available, the small percent of NFS land affected by tree removal in a given year, the availability of forest lands other than Hoosier National Forest, and the fact that some tree-removal activities occur during the winter months when Indiana bats would be hibernating. However insignificant or discountable the possibility is, it still exists and cannot be removed through informal consultation.

The potential for indirect effects, by removal of potential roost trees or stressing roosting bat(s) by activities near their roosts exists across the Forest. However, the potential for this type of impact is considered to be even less likely than the potential for direct take. There are an abundance of potential roost trees across the Forest, and removal of some of these each year would be offset by creation of new potential roost trees through natural mortality and fire. The potential for indirect effects is so low that it is considered discountable or insignificant.

Gray bat - Continued implementation of the Forest Plan and projects predicated upon it have a MAY AFFECT, NOT LIKELY TO ADVERSELY AFFECT determination on gray bat habitat and populations.

There will be no conversion of forested riparian corridors to other uses. Some currently non-forested riparian corridors will be planted to bottomland hardwood trees or allowed to succeed naturally to a forested condition. Forested corridors from known caves to foraging areas are provided. Riparian foraging areas are primarily forested and will be allowed to age naturally, with natural disturbances determining future forest structure.

Activities which occur on Hoosier National Forest are designed to minimize soil movement off-site, thereby not adding to the sediment load of area waterways. Road and trail construction and maintenance will have no effect on gray bats.

The possibility that gray bats would be harmed by smoke or noise outside caves is so remote as to be considered discountable.

Bald eagle - Continued implementation of the Forest Plan, as amended, MAY AFFECT - NOT LIKELY TO ADVERSELY AFFECT bald eagle wintering habitat.

Forest activities will have a BENEFICIAL EFFECT on habitats traditionally used by eagles on the Forest. Activities with potential adverse impacts are conducted in such a manner as to remove those potential impacts. Forest activities are NOT LIKELY TO ADVERSELY AFFECT nests since only one is known to occur on the Forest, and that receives protection from a Forest closure order.

Recreational use of NFS lands and some administrative activities may result in temporary disturbance to individual birds. However, due to management restrictions, patterns of recreation use, and timing of administrative activities, the possibility that individual eagles would actually be harmed in some way by being flushed along riparian corridors or along lakeshores is considered so remote as to be discountable. In the general forest area, the possibility of individual eagles being flushed at all is considered so remote as to be a discountable impact. In addition, this type of effect would be essentially unmeasurable and so would be an insignificant impact.

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With the small amount of harvest or tree removal done in areas where eagles are likely to roost, protection of snags across the Forest, the large amount of mature forest cover on the Hoosier National Forest, the availability of a large number of alternate roost trees, and field inspections of project sites, it is highly unlikely that inadvertent harvest of a communal night roost tree would occur.

Most recreation and administrative use occurs during the day, making it extremely unlikely that eagles on communal night roosts would be disturbed. Most recreation use takes place spring-summer when wintering eagles have already left the area. Most administrative use takes place outside of forested riparian corridors where eagles are most likely to be during the day.

The continued availability of food will more than likely be the determining factor in future eagle use and population expansion. Forest Plan direction as implemented through management direction and guidance, protects and enhances riparian areas, potential roost trees, water quality, and eagle food sources, and ensures good quality habitat for continued eagle recovery. Riparian areas are primarily forested and will be allowed to age naturally, with natural disturbances determining future forest structure. Watersheds of streams and lakes on the forest are protected from soil loss or contamination. There is no use of pesticides on the Forest which would affect either the eagles or their fish prey.

Fanshell Mussel - A MAY AFFECT-NOT LIKELY TO ADVERSELY AFFECT determination is made for habitat of the fanshell mussel.

No projects implemented under the current Forest Plan would alter channel structure or substrate composition in the mainstem of the East Fork of the White River, or its tributaries. Forest cover would be maintained in riparian areas along streams where they pass along NFS lands. The potential for introduction of pesticides or hazardous materials into waterways flowing into the East Fork mainstem is small due to stringent protection measures outlined in the Forest Plan. The potential for sedimentation from forest management activities to reach the mainstem of the East Fork is very small and the potential for excess sediment to be enough to adversely affect fanshell habitat is so remote as to be discountable.

Programmatic Biological Assessment Hoosier National Forest Land and Resource Management Plan

Purpose and Need

The purpose of this programmatic Biological Assessment (BA) is to document potential effects of continued implementation of the existing Hoosier National Forest Land and Resource Management Plan, as amended (Forest Plan), on the federally endangered gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*) and fanshell mussel (*Cyprogenia stegaria*), and the threatened bald eagle (*Haliaeetus leucocephalus*), and their respective habitats on the Hoosier National Forest. This is to ensure that management decisions can be made with the benefit of the latest knowledge concerning these species. The BA will also provide, if necessary, the basis for a Forest Plan amendment. Over 200 species recorded in Indiana or Kentucky and listed in the Federal Register as being considered for federal listing were analysed for inclusion in this assessment (Appendix A).

The objectives of this BA are to:

1. Comply with requirements of the Endangered Species Act (ESA) of 1973, as amended, that actions by federal agencies not jeopardize the existence of these species or adversely modify their critical habitat;
2. Document that current management direction and guidance being implemented on the Hoosier National Forest benefits these species;
3. Determine actions which should be implemented on the Hoosier National Forest to contribute toward the short- and long-term recovery of these species; and
4. Provide biological input to ensure USDA Forest Service compliance with the National Forest Management Act, Forest Service Manual 2670, Forest Service Handbook 2609.13, and the ESA.

There is a need to document management measures currently being used to protect the species considered, and to determine if additional conservation measures are required to move any of these species toward recovery. There is an additional need to review ecological information acquired from the scientific community since adoption of the Forest Plan in 1985 about these species to determine whether adjustments to the existing management direction and guidance are necessary for the protection and management of these species.

Since adoption of the Forest Plan, bald eagles have begun nesting within the Forest boundary, including one pair on National Forest System (NFS) land. Gray bat and fanshell mussel have been found within the Forest proclamation boundary. Hibernating populations of Indiana bat have increased within the state of Indiana and summering male Indiana bats have been found at nine sites on the Hoosier (Figure 1).

Current research and surveys are refining knowledge of habitat needs of federally listed species. The most important new information concerns male Indiana bats roosting in trees during summer months. The most conservative approach the USDA Forest Service can take to protect and provide quality habitat for Indiana bat is to evaluate the combined potential for incidental take during ongoing projects in this BA. Bald eagle,

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gray bat, and fanshell mussel will be given the same consideration although their populations on the Forest are much more limited in distribution and numbers.

Figure 1: Endangered and threatened species locations on and near the Hoosier National Forest.

Consultation History

The first purpose listed in ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 USC § 1531). Under the ESA, the policy of Congress is that "all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act" (section 2(c)(1)). In addition, Federal agencies shall carry out "programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act" (section 7(a)(1)). The Hoosier National Forest has been and is committed to the preservation and recovery of endangered and threatened species. Existing Forest Plan management direction and guidance were developed specifically to meet agency responsibility under these two sections. Other management direction and guidance was developed specifically to perpetuate and enhance the types of habitats and communities with which native Indiana wildlife species, including threatened and endangered species, evolved.

Federal agencies are required to consult with the USDI Fish and Wildlife Service on projects which may affect species federally listed as threatened or endangered (section 7 (a)(2)).

In September 1984, formal consultation was completed between the USDA Forest Service and the USDI Fish and Wildlife Service for the newly developed Hoosier National Forest Plan (see Appendix B). Peregrine falcon (*Falco peregrinus*), bald eagle, gray bat, and Indiana bat were covered during this consultation (USDI Fish and Wildlife Service 1984). The opinion was that:

"... the proposed activities are not likely to jeopardize the continued existence of any of the listed species. However, standards and guidelines designed to promote the conservation of the species are provided.

"The Forest Service has a continuing responsibility to review its actions in light of Section 7 and to re-initiate this consultation if new information becomes available which identifies that the proposed Hoosier National Forest PLAN may affect listed species, critical habitat is designated that may be affected by the PLAN, or a new species is listed that may be affected by the PLAN."

No Incidental Take statement was issued with this opinion.

In June 1989, the USDA Forest Service requested a review of endangered, threatened, proposed, and candidate or Category 1 species occurring in the counties of the Hoosier National Forest from the USDI Fish and Wildlife Service, Bloomington Field Office. The request was made as work began on a significant amendment to the Forest Plan. In June 1989, the USDI Fish and Wildlife Service responded that Indiana bat, bald eagle, and pink mucket pearl mussel (*Lampsilis abrupta*) were known species from those counties (USDI Fish and Wildlife Service 1989a). Later, in December 1989, the USDI Fish and Wildlife Service added gray bat to the list of known species in the area (USDI Fish and Wildlife Service 1989b). Again, no Incidental Take statement was issued.

In 1995, the Hoosier National Forest requested a review of endangered, threatened, and proposed species with USDI Fish and Wildlife Service on an administrative update of federally listed species having recent or extant records within the proclamation boundary of the Forest. The USDI Fish and Wildlife Service responded that only Indiana bat and bald eagle were documented as occurring within the Forest proclamation boundary (USDI Fish and Wildlife Service 1995). As a result of no documented occurrences at that time,

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gray bat and pink mucket pearl mussel were deleted from the list in the 1991 Forest Plan amendment. However, since December 1995, documented occurrences of gray bat and fanshell mussel within the Forest proclamation boundary have been confirmed, and these species have been discussed in all subsequent biological evaluations.

From 1985 through 1998, there have been one significant and three non-significant¹ amendments to the Forest Plan approved (Table 1). There is also one non-significant amendment in progress dealing with special area designation.

Table 1. Forest Planning Consultation.

Amendment	Action	Date	Type	NEPA documentation	Consultation
Off-Road Vehicle Use Areas	No ORV use areas	April 3, 1987	Non-Significant	Environmental Impact Statement Supplement	Informal (letter from Hudak, 11/6/85)
Plan Amendment	Replaced the 1985 Plan	April 8, 1991	Significant	Environmental Impact Statement	Informal (USDI Fish and Wildlife Service 1989a,b)
Amendment 3	Changed Charles C. Deam Wilderness Guidance	June 23, 1994	Non-Significant	Environmental Assessment	Not documented
Amendment 4	Changed Trail Management Guidance	June 23, 1994	Non-Significant	Environmental Assessment	Not documented

¹ A non-significant amendment is a minor change to forest plan direction which involves only minor changes to forest plan objectives or guidelines, has limited impact on forest land allocation, requires only small adjustment to forest plan outputs, services or prescriptions, and has no irreversible effects [36 CFR 219.10G and FSH 1909.12-5.32(3)].

Description of Affected Area

General

Non-public lands make up about 85 percent of Indiana's timberland (USDA Forest Service, in press). These are owned by individuals, corporations, partnerships, organizations, and universities. All of these owners have different goals and objectives for their properties. Land use activities on these ownerships are determined by the landowner. Some land use practices on these properties will benefit listed species, some will have no effect, and some will be detrimental.

The Draft Environmental Impact Statement for the Forest Plan (Chapter 3) describes the general area and resources of the Hoosier National Forest. The Forest encompasses 196,484 acres in nine Indiana counties (as of September 30, 1999). Elevation ranges from 383 feet along the Ohio River to 959 feet at Bald Knobs near Houston. The region is well dissected by weathering. Most of the Forest is on uplands which are strongly sloping to very steep. About 10 feet of loess is deposited in some uplands near the Ohio River, but it is thinner over the remainder of the area, often two to three feet thick. Bottomlands along rivers are often subjected to periods of flooding. These lands are nearly level.

There are currently about 3,500 acres of lakes, ponds and waterholes within the boundaries of the Hoosier National Forest. Of that total, about 925 acres are wholly on National Forest System (NFS) land. There are 1,464 miles of intermittent and perennial streams within the Forest boundary, about 512 miles on NFS land. In addition, there are many roads across the Forest which have one or more mudholes and ruts which provide water seasonally, some holding water year round. Seeps and springs occur throughout the Forest.

Indiana has over 2,500 known caves. There are nearly 100 known caves on NFS lands, ranging from small, shallow rock shelters to complex caves with over one mile of passage, and can be found on both districts of the Forest. Many of the Forest's caves have active streams, but others are dry.

Ecological Units on the Hoosier National Forest

The Hoosier National Forest lies within the Eastern Broadleaf Forest Province of the National Hierarchical Framework of Ecological Units (McNab and Avers 1994; Figure 2). Most of the Forest is in the Interior Low Plateau, Shawnee Hills Section, but the area to the northeast of Bedford is in the Interior Low Plateau, Highland Rim Section (Keys *et al.* 1995).

The Crawford Uplands Subsection consists of large areas of Pennsylvanian-age sandstone bedrock in the west, but Mississippian-age formations of sandstone and limestone are at lower elevations and in most of the eastern part. There are Quaternary and recent deposits along the Ohio River and its tributaries throughout the area. The area from west of Williams (Lawrence County), south to the west of Paoli (Orange County) extending to the Ohio River are in this subsection.

The Crawford Escarpment Subsection has bedrock of Mississippian-aged sandstones, shales, and limestones. There are Quaternary and recent deposits along the Ohio River and its tributaries in the area. The area east of Williams through east of Paoli are in this subsection.

The Brown County Hills Subsection is underlain by Mississippian-aged siltstones. The Mt. Carmel fault runs north to south near the western edge of the area where limestone is exposed. There is a sizeable area of unconsolidated Quaternary-age material in the eastern third of the unit. Recent-aged sedimentary deposits

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are found along the length of the Salt Creek drainage. The area northeast of Bedford is entirely within this subsection.

The Mitchell Karst Plain Subsection has geologically significant caves and other karst feature in Mississippian-aged limestone. The Karst Plain is characterized by karst topography, with well-eroded rolling hills, springs, caves, sinkholes, losing streams, and karst windows. On the Mitchell Karst Plain, springs have little relationship to surface water drainage, because so much water movement is underground.

Figure 2: Hoosier National Forest Ecoregions in Indiana and Kentucky.

Forest Community Composition

The majority of the Hoosier National Forest is located within the Humid Temperate Domain, Hot Continental Division, Eastern Broadleaf Forest Province, Shawnee Hills Section (McNab and Avers 1994). The Forest is located where the eastern mesophytic hardwood forests meet midwestern oak-hickory forests (Braun 1950). There are also barrens areas having prairie affinities. There are many different types of natural communities and species present, some on the edges of their geographical ranges (Table 2).

Table 2. Animal and plant species diversity on the Hoosier National Forest.

Number of species of major animal and plant groups documented within the Forest boundary		
	Native species on Forest	Non-native species on Forest
Animals		
mammals ¹	42	2
birds ²	275 (114 breed)	4
reptiles ³	27	0
amphibians ³	26	0
fish ⁴	105	5
mussels ⁵	16	1
Plants⁶		
ferns and allies	33	0
conifers	2	4
monocots	162	28
dicots	421	55
Primary sources of species distribution information		
1 - Mammals of Indiana (Mumford and Whitaker 1982)		
2 - The birds of Indiana (Mumford and Keller 1984); Atlas of breeding birds of Indiana (Castrale, Hopkins and Keller 1998)		
3 - Amphibians and reptiles of Indiana (Minton 1972)		
4 - Distribution and life history notes for fishes of the Hoosier National Forest, Indiana (McComish and Brown 1980)		
5 - A freshwater mussel inventory of the Tell City Ranger District, Hoosier National Forest, Perry and Crawford counties, Indiana (Ecosearch, Inc. 1999)		
6 - Hoosier National Forest herbarium reference collection		

Historic and natural disturbances in the oak-hickory and mixed mesophytic forests include fairly frequent low intensity fires, infrequent stand replacement fires; windstorms and tornados; insect and disease mortality; occasional summer drought or late spring frost; ice storms; and flash flooding in intermittent drainages and permanent streams. These disturbances formed a mosaic of successional stages of the forests. Small openings resulting from windthrow, insect and disease, or natural mortality were probably frequent. Larger openings caused by stand-replacement fires, drought, frost, and tornados were probably infrequent across the landscape. Natural soil fertility also determined species composition and density of vegetation. Poorer soils generally had lower tree densities and more herbaceous ground cover, while richer soils had a higher tree density and diversity, and a varied understory of shrubs, small trees, and more shade-tolerant herbaceous ground cover. In order to better understand and manage these ecosystems, the Forest has

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sponsored, collaborated with, or conducted research in a variety of topics related to forest communities (Appendix C).

Cultural History

The earliest inhabitants (10,000 to 12,000 years before present) of this area were generally restricted to uplands (McNab and Avers 1994). Later prehistoric populations foraged over the area seasonally collecting plant foods including nuts, seeds, fresh greens, and tubers, exploiting a rich faunal resource, and using local minerals. Caves and rock shelters were used as temporary homes. Early agricultural populations (500 to 1,000 years before present) inhabited bottomlands of the Ohio River valley, although they continued to use other local resources found in the uplands of the region. Because human populations were relatively low and use was not concentrated at one site for a long time, there would have been relatively little impact to the environment. It is probable that fires set by Native Americans maintained an open character to the oak forests of the region (Olson 1996).

From the time of the first European settlers, about 1700 AD, humans have altered the natural landscape (McNab and Avers 1994). The earliest European-American settlements were generally located along major transportation routes including river corridors and overland trails. Later, they spread into the adjacent uplands using local resources for housing, food, tools, and fuel. Surface mining, removal of forests for agriculture, burning the woods for pest control and grass production, and open grazing all modified the forest. Diverse past agricultural practices caused locally severe erosion. These early land uses were followed by networks of roads, railroads, utility corridors, and urban settlements. Most of the original forest was completely cut over by the early 1900's. As the population increased and the amount of arable land decreased, ridgetops and hillsides were increasingly cleared for agricultural. This continued until the land was so depleted it was no longer possible to produce a viable crop.

Starting in the 1930's, worn-out land was acquired by state and federal governments. Protection from annual burning, open range grazing, and indiscriminate logging resulted in regrowth of the forest communities. A variety of non-native pines were planted in many abandoned fields. Closure of hunting seasons, protection of habitat, and active restoration programs brought several game species and furbearers, among others, back from the brink of extirpation. Fire suppression since the 1930's has led to changes in plant community types, and species composition in many areas of the Forest. Closed-canopy forests have replaced more open woodlands. Understories have closed in with subcanopy trees and poles of canopy species. Eastern redcedar (*Juniperus virginiana*) and hardwood trees have invaded open areas.

Current Forest Composition

Today, as shown in Table 3 the Hoosier National Forest land base is about 96.5 percent forest cover ($188,453/195,216 = 0.965$). Oak-hickory forest at various successional stages is the dominant community comprising about 47 percent of the Hoosier. Yellow poplar stands comprise about 15 percent of the Forest. Another 15 percent is mixed upland hardwood (mostly sugar maple-beech or cove hardwood forest) communities and 17 percent is in pine plantations. Elm-ash-cottonwood and other bottomland hardwood forest communities comprise only about one percent of the Forest. The remaining 3.5 percent of the Forest is in open habitats, although only 2.58 percent of the acreage is maintained for those conditions.

Since acquisition of the majority of the Forest in the mid 1930's to late 1950's, when many trees were young saplings or poles, the forest has grown older and more dense. Today, approximately 65 percent of the forest stands are 61 years old or older. About 46 percent is over 80 years old. Regenerating forest (age 0 to 9 years) comprises less than one percent of today's Hoosier National Forest. Another 19 percent is young forest from 11 to 40 years old (Table 3).

Table 3. Forest types and age class distribution of forest stands on the Hoosier based on Forest compartment records as of January 24, 2000.

Forest Type	Stand Age (years)						All Age	Total
	0-10	11-20	21-40	41-60	61-80	80+		
Mixed pine	76	1,390	14,108	14,758	3,298	283	24	33,937
Black/red oak	135	545	763	1,826	7,470	21,959	108	32,806
White oak	190	1,255	389	410	4,982	25,858	153	32,237
Other oak	137	2,099	3,165	1,190	4,664	16,148	63	27,466
Yellow poplar	251	1,566	3,366	2,208	6,279	15,578	5	29,253
Black Walnut	0	35	288	43	0	0	0	366
Ash/cherry	3	215	514	197	152	0	0	1,081
Mixed upland hardwoods	207	3,647	3,315	2,370	4,654	9,802	4,392	28,387
Mixed bottomland hardwoods	199	389	342	501	324	141	24	1,920
Total by age class	1,198	11,141	26,250	23,503	31,823	89,769	4,769	188,453*
Forest openings, utility corridors, roads, facilities, water						6,763		
Subtotal (acres within Combined Data System)						195,216		
Uninventoried National Forest System land (1/24/00)						1,267		
National Forest System land (9/30/99)						196,484		

There has been considerable change in the amount of forested land in Indiana over recent years. Table 4 demonstrates timber land from forest inventory data (excludes reserved areas such as wilderness) in each Indiana county with NFS land. The figures in the forest inventory data are estimates only. "A measure of reliability of these figures is given by sampling errors. These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the result would have been within the limits indicated" (USDA Forest Service 1986). The 1998 data is from Indiana's Forests in 1998 (USDA Forest Service, in press).

Table 4. Acres of forest cover by Indiana county within the Hoosier NFS purchase units.

County	Sampling error	Year			
		1950	1967	1986	1998
Brown	3.02	150,000	133,000	131,000	136,900
Crawford	3.17	102,000	113,000	119,000	129,600
Dubois	3.59	86,000	97,000	93,000	77,200
Jackson	3.15	121,000	122,000	121,000	111,100
Lawrence	3.09	125,000	125,000	125,000	122,500
Martin	6.52	126,000	111,000	126,000	130,500
Monroe	3.20	132,000	133,000	118,000	121,800
Orange	3.05	123,000	118,000	129,000	140,000
Perry	2.80	161,000	143,000	153,000	165,100
HOF counties total		1,126,000	1,095,000	1,115,000	1,134,700
State-wide total		4,086,000	3,896,000	4,296,000	4,501,300

Forest Plan Goals

The 1991 Forest Plan Amendment established goals by examining contemporary issues, the capabilities of the Forest, and the role that the Forest can, or should, play in meeting the challenges people want from their national forests. The goals are interrelated.

Protect and Manage Ecosystems

This goal recognizes the inherent value of natural ecosystems which have evolved over time and of which we are a part. Their variety adds value to our lives and reflects the power and permanence of our natural world. Their variety is a barometer of the quality of land management. Ecosystems including their natural variety of species, genetic make-up, and ecological processes, are key in providing the diversity needed to be resilient in the face of environmental disturbances.

This goal includes the protection and management of rare and unique plant and animal species and communities and their habitats. Ecosystems will be recognized and considered; both those that are rare, and those that are common. The capabilities of each site will be identified and the basic integrity of soil, air, and water resources protected. Restoration of native plant and animal communities and natural ecosystems that meet people's needs are a major goal.

Protect our Cultural Heritage

Cultural and historic resources are important reminders of the ways native Americans and early settlers coped with the world. Remnants of how civilization interacted with the environment in the past provide insight for today and the future. Together they give us our perspective of life on earth. By protecting and interpreting these resources, we preserve our heritage, are more aware of the forces that shape our lives, and will be more sensitive to our influence on natural resources in the future.

Proposed Action and Management Opportunities

Our Nation's cultural resources provide opportunities for unique recreation experiences, enhanced interpretation, public education, development of a conservation ethic, and an appreciation of our common links with the past.

Provide for Visually Pleasing Landscape

People expect a forest to be scenic. Forest activities, roads, and facilities must blend with their settings. With design, timing, and care we can ensure that our presence in the Forest results in minimal disturbance and does not disrupt the natural setting.

The natural world has patterns of color, symmetry, and tones that we will pattern our activities after. The effects of activities and projects which might otherwise appear harsh, such as powerlines, can be softened through proper location, design, and by repeating patterns found in nature.

Natural-appearing landscapes will be emphasized, with attention given to views from roads, trails, and use areas. Wherever possible, big trees, flowing water, moss-covered rock outcrops, butterflies, flowers, and wildlife are to be highlighted to make the Forest more special to our publics.

Provide for Recreation Use in Harmony with Natural Communities

The Forest is managed for people. Our challenge is to provide ways for people to enjoy and view the Forest and its many ecosystems in harmony with the natural communities existing there. The Forest should provide opportunities for a wide variety of personal choices.

The Hoosier has the potential to provide recreation opportunities not available elsewhere. Though a wide spectrum of recreation uses might be provided from developed campsites to wilderness, those types of use which are unique to the Forest will be emphasized.

No one answer or type of management addresses what all forest visitors want from the Forest. No single solution will be compatible with all forest ecosystems. The evolution of a recreation strategy must show a commitment to both caring for the land and serving people.

Provide a Useable Landbase

The Forest needs to provide a landbase that provides better potential for achieving desired biological diversity, enhances recreation opportunities, is easier for the public to find, and increases management efficiency. Information needs to be provided to users on what the Forest has available and where people can find opportunities of interest to them.

Forest managers will provide for parking and legal, identifiable public access to all areas of the Forest so that visitors can enjoy the lands and resources we are entrusted to manage for them. The Forest is committed to a viable acquisition and exchange program to consolidate National Forest lands. We need to be good neighbors to the landowners and communities around us, and contribute to the quality of life in our local area and region.

Provide for Human and Community Development

Proposed Action and Management Opportunities

There are many individual, community, and national needs that the Forest meets. The knowledge that the Forest is there and that natural wild places are preserved and available is important to many people, whether or not they ever visit the Hoosier.

Communities depend on the Forest for economic balance and to provide products, commodities, and services to people. The nation looks to the Forest to provide for national needs such as minerals, timber, clean water, and recreation. Each of these needs should be met to the fullest extent possible considering holistic use and stewardship of the resource.

Management Areas

To achieve the goals listed above, we developed different management strategies to manage various areas on the Forest. The ten areas are described below, each allows for certain activities which move the area toward the desired future condition. Table 5 illustrates the distribution of NFS lands to each management area.

Table 5. Land Allocation by Management Area on the Hoosier NF (as of September 30, 1999).

Management Area designation	Management Area Acres	Percent of Forest
2.4	16,600	8.45
2.8	100,365	51.08
5.1	12,953	6.60
6.2	20,355	10.36
6.4	24,900	12.67
7.1	6,205	3.16
8.1	88	0.04
8.2	12,802	6.52
8.3	630*	0.32
9.2	1,586	0.80
Total	196,484	

* earlier records showed this area to be 632 acres. There was no actual change in area boundaries or size, change to 630 acres is an adjustment due to the accuracy of acreage values.

Management Area 2.4

Management Area 2.4 is associated with canoeable and fishable streams, rivers, lakes, and reservoirs. The desired future condition is characterized by forested shorelines or corridors up to one mile or more in width, with an appearance of an unbroken canopy of large-diameter trees of a variety of species. It protects and enhances water-based recreation opportunities, visual quality, and riparian values. Human activities are evident, but most blend in well with the natural environment. Interaction among visitors is frequent.

Habitat in these areas is best suited to plants and animals of closed-canopy, hardwood forests with large trees, including bottom land species. A variety of tree species is present, including mixed bottom land hardwoods on the bottom lands along the streams and lakes.

Proposed Action and Management Opportunities

Viewing scenery, hunting, trapping, fishing, canoeing, boating, and hiking are key recreation activities. The Forest is generally accessible by canoeable streams or lakes, foot travel, and state and county roads.

Management Area 2.8

Management Area 2.8 is associated with a variety of forest plant communities. It has a high degree of vertical and horizontal vegetative diversity. These areas include many scattered blocks of Forest land. Site-specific decisions will result in many variations within this management area. Visual quality and recreation opportunities are protected and enhanced.

The area is general forest land with the appearance of large areas of old forests with scattered openings. There is ample evidence of human activities, but most blend in well with the natural environment. Interaction among visitors is frequent.

A variety of tree species is present, but shade-tolerant species may dominate some forest communities over time. A natural variety of other tree species intermediate in shade tolerance will be perpetuated and dominate in other forest communities. This area will provide a variety of forest types, reflecting different ecological sites and management activities.

Openings in the canopy result in different canopy levels and animal communities associated with vertically diverse, shade-tolerant vegetation, as well as different successional stages of vegetation. There is a higher percentage of edge habitat in this management area than in most of the Forest.

Habitat in these areas is best suited to animals that use large hardwood trees and a mosaic of different-aged hardwood forests. There is also more early successional habitat in these areas than in most other areas of the Forest.

Viewing scenery, hunting, fishing, gathering forest products, and hiking are key recreation activities. Some of the areas are landlocked by private lands, but most are generally accessible by foot travel, and state and county roads.

Management Area 5.1

This Management Area is for the Congressionally designated Charles C. Deam Wilderness. It is "managed to promote and perpetuate the wilderness character of the land and its specific values of solitude, physical and mental challenge, scientific study, inspiration and primitive recreation..." (Eastern Wilderness Act, P.L. 93-622).

In the future there will be extensive areas of old-growth vegetation. Stands will be characterized by large, mature or overmature trees. Some younger trees and openings occur as a result of natural processes.

There is little evidence of human development except trails, old roads, stone walls, cellar holes and the like which have been overgrown and dilapidated by natural forces. There are existing cemeteries in the area, of which one (Terril Cemetery) is maintained.

The size of the area is sufficient to allow users to be reasonably isolated from the sights and sounds of people. There may be occasional interaction between users.

Management Area 6.2

Proposed Action and Management Opportunities

Management Area 6.2 creates a physical setting which provides an opportunity for solitude and a feeling of closeness to nature. The area is general forest land with the appearance of extensive stands of forest dominating the landscape. Many of these areas are in backcountry.

Over time the area will be characterized by extensive stands of natural-appearing forests. Stands will be dominated by large mature and overmature trees. Some younger trees and openings will occur as a result of natural causes. There will be no commercial timber management or surface-disturbing mineral activity.

Habitat in these areas emphasizes wildlife species found in mature forests.

Viewing scenery, hunting, trapping, fishing, and hiking are key recreation activities. The Forest is generally accessible by foot travel, and from county or state roads around the perimeter of these areas. Roads in the interior of these areas are closed to public motorized vehicles.

Interaction between users is low, and there is only subtle evidence of other users. Tranquility and solitude are probable experiences.

Management Area 6.4

Management Area 6.4 creates a physical setting which provides an opportunity for solitude and a feeling of closeness to nature. The forest is natural appearing and provides much of the backcountry identified on the Forest. Habitat is provided for plant and animal communities found in undisturbed, mature forests.

Over time, the area will be characterized by extensive natural forest comprised of native plant and animal communities. The forest will be moving towards an old growth (climax) condition. Natural barrens, glades, wetlands, and dry forest which contain unique species and plant communities may be restored and perpetuated. Some existing forest openings, ponds, and lakes may be retained. Foot trails which blend in with the natural backcountry setting will gradually replace existing roads to lace together natural features, places of recreational interest, and sites requiring maintenance.

Viewing scenery and wildlife, hunting, trapping, fishing, and hiking are principal recreation activities. Visitors will find a natural landscape accessible by foot travel and roads open to public motorized vehicles around the perimeter of the area.

Interaction between users is low, and there is only subtle evidence of other users. Tranquility and solitude are probable experiences.

Management Area 7.1

Management Area 7.1 is established to provide for recreation facilities and highly developed areas. These areas include campgrounds, visitor centers, swimming beaches and other areas intended to serve large numbers of people.

The areas vary from 50 acres to 2,500 acres or larger in size. Fees are collected for some uses at most of these areas. Use in these areas is high-density, destination-type use. These areas affect and are affected by the management of nearby lands.

Proposed Action and Management Opportunities

Developments are evident and may dominate the landscape. Design, building materials, and placement of facilities and structures are such that they are in harmony with the environment. Barrier-free access is provided at most facilities.

Management Areas 7.1 recreation areas include: Hardin Ridge, German Ridge, Tipsaw Lake, Celina Lake, Springs Valley, Indian Lake, Buzzard Roost, Saddle Lake, Blackwell Horse Camp, and Blackwell Pond.

Management Area 8.1

Management Area 8.1 is the designation for Research Natural Areas (RNAs). This designation allows unique ecosystems to follow natural processes for scientific purposes. Research may be conducted in these areas to better understand natural processes and improve forest benefits.

These nationally significant areas may be designated after having been recommended by a review committee and approved by the Chief of the Forest Service. An area must meet one or more of the following criteria:

1. Contributes to the diversity of plant communities and wildlife habitat.
2. Typifies important forest, shrubland, grassland, alpine, aquatic, or geologic types.
3. Represents special or unique characteristics of scientific interest and importance.
4. Helps carry out provisions of laws, such as providing habitat for endangered species.
5. Protects or maintains special aquatic, geologic, cultural resources, or potential natural communities.

The size of the area, type of vegetation, wildlife and recreation opportunities provided depends on the uncommon or outstanding characteristics to be protected. A natural-appearing condition exists although evidence of humans is occasionally noticeable.

Rare or outstanding values of the areas are the primary consideration. Other resource values and uses are secondary to the protection of the areas' special values for public education and enjoyment.

The only designated Research Natural Area on the Hoosier National Forest is the Pioneer Mothers Memorial Forest, an 88-acre virgin hardwood forest.

Management Area 8.2

Management Areas 8.2 are designated Special Areas which include unique or unusual ecological, botanical, zoological, geological, scenic, historic, prehistoric, and other areas which merit special recognition and management. Management of these areas will emphasize the protection, perpetuation, or restoration of their special features and values. Candidate Research Natural Areas (RNA's) may be included until such time that they are accepted as RNA's.

These regionally or locally significant areas must meet one or both of the following criteria:

1. Be representative of unique or unusual geological, ecological, cultural or other scientific values
2. Have the potential to be a regional or national landmark based on natural or cultural values.

There are 12 designated special areas encompassing 12,803 total acres and ranging in size from 10 acres to over 6,200 acres. A Forest Plan amendment currently in progress will likely adjust the acreage and

Proposed Action and Management Opportunities

boundaries of several of these areas. Special Areas are found throughout the Forest where unique or special characteristics occur. They include a variety of ecosystems, forest conditions, and cultural history, scientific, and scenic values. Plant and animal species and communities will vary depending upon the characteristics of each area.

The rare or outstanding values of the areas are the primary consideration. Other resource values and uses are secondary to the protection, maintenance, and restoration of an area's special values for public education, enjoyment, and study.

Management Area 8.3

Management Area 8.3 provides for research and scientific study of forest ecosystems.

At present the only Experimental Forest on the Hoosier National Forest is the Paoli Experimental Forest, a 632-acre area located southwest of Paoli on the Tell City Ranger District.

Management Area 9.2

Management Area 9.2 emphasizes the protection and maintenance of environmental values associated with unique ecosystems. This designation serves as a holding category until further study and recommendations on specific designation can be made. A Forest Plan amendment currently in progress will likely adjust the acreage and boundaries of several of these areas.

As described in the current Forest Plan (page 2-58), "These areas have natural characteristics which are potentially significant. They have been nominated by recognized authorities. Management is directed at protecting these lands until the areas can be studied for designation as Research Natural Areas (M.A. 8.1), Special Areas (M.A. 8.2), other general forest management areas, or possible designation as State Natural Areas or National Natural Land marks."

The primary benefits are scientific values derived from protected examples of unique ecosystems. Other benefits may include hiking, hunting, and nature study.

Core Areas

There are 23 core areas on the Forest ranging from 225 acres (Pioneer Mothers) to 12,380 acres (two separate areas within the Charles C. Deam Wilderness). Together these 23 areas total about 32,500 acres. Core areas are designed to provide undisturbed, potential old-growth habitat and interior forest habitat beneficial for area- and human-sensitive species. These areas are not contained in any particular management area and may be located across management area boundaries.

Land Allocation

Land allocation into management areas "was designed to provide large areas of continuous, closed-canopy forest as well as to provide linkages to tie them together and with forested areas of other ownerships" (Forest Plan, Record of Decision p. 13). Conscious decisions were made during land allocation to allow natural disturbances to operate in many parts of the Forest (Figure 3). These areas provide certain types of recreation experiences and habitats which are created by natural forces (including prescribed fire) operating on native ecosystems. These include special areas (8.2 and 9.2 MAs) and large backcountry areas (5.1, 6.2, and 6.4 MAs). Riparian corridors (2.4 MA) provide connections between these. Other areas are actively managed through a variety of methods to provide different recreation experiences, wildlife habitats, and products used by the American people usually on smaller, less contiguous tracts of federal land (2.8 MA).

The management areas identified on these maps and the management direction defined in the Forest Plan apply to National Forest System lands only, they do not apply to any lands in state, county, private, or other ownership.

Figure 3. Hoosier National Forest Management Area maps.

- a. Pleasant Run Unit..... page 18
- b. Lost River Unit..... page 19
- c. Patoka River Unit..... page 20
- d. Tell City Unit..... page 21

Proposed Action and Management Opportunities

The National Forest Management Act of 1976 sets out a process of developing, adopting, and revising land and resource management plans. "The resulting plans shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long term net public benefits in an environmentally sound manner" (36 CFR § 219.1). The Hoosier National Forest developed its Land and Resource Management Plan (Forest Plan) using these principles in 1985. There was a significant amendment to this Forest Plan in 1991. The proposed action discussed in this Biological Assessment is the continued implementation of the Hoosier National Forest Land and Resource Management Plan (as amended) and projects predicated upon it. The proposed action includes ongoing and future projects designed to meet reasonable and prudent measures and terms and conditions associated with a non-Jeopardy Opinion to be described in a USDI Fish and Wildlife Service Biological Opinion, rendered at the completion of formal consultation on species with a "Likely to Adversely Affect" determination.

The Forest Plan is not a list of mandatory activities which must be carried out during the planning period. The Forest Plan does not authorize, fund, or carry out any project activity. It merely provides the framework for future activities which will move conditions on the Forest toward its desired future conditions (described for each Management Area in the Forest Plan). Forest Plan management direction and guidance are simply constraints on future management proposals.

The Forest must comply with the requirements of the National Environmental Policy Act (NEPA) prior to implementing management activities. Projects which implement the Forest Plan have been ongoing from 1985 to the present. These projects were designed to meet both general Forest Plan management direction and specific guidance for the management areas in which the project was located. Environmental analysis, which includes extensive public involvement and considers a range of alternatives to the proposed action, is completed and documented prior to project implementation. For decisions which were made prior to implementation of the present formal consultation, the potential effects of those projects were evaluated and documented in individual biological evaluations (BE) prepared by USDA Forest Service biologists. Projects with determinations of "Not Likely to Adversely Affect" were submitted to the USDI Fish and Wildlife Service for informal consultation. Projects which are ongoing either have a "No Effect" determination or USDI Fish and Wildlife Service has concurred with USDA Forest Service determinations of "Not Likely to Adversely Affect" (see Appendix D). The original determinations are accurate and the informal consultation process fulfills the USDA Forest Service's legal obligations under section 7 of the Endangered Species Act (ESA).

Forest Resource Management Programs

The Forest Service is directed to consider plant and animal communities in its activities [36 CFR § 219.27 (a)(5), (a)(6), and (g)]. The Hoosier National Forest is managed to perpetuate the natural communities and ecosystems which have developed in southern Indiana. A major emphasis on this Forest is management, "to provide a diversity of habitats for the flora and fauna of the area. Special management attention is given to the needs of endangered, threatened, and sensitive species..." (Forest Plan, Record of Decision p. 6). Even where resources other than wildlife are emphasized, management direction and guidance to protect and maintain all resources, including endangered and threatened species, are part of the management objectives. "No destruction or adverse modification of critical habitat and no actions likely to adversely affect any Federally listed species will occur as a result of National Forest management decisions" (Forest Plan, Appendix C).

Proposed Action and Management Opportunities

A projected five-year estimate of management activities causing modification of habitat on the National Forest is shown in Table 6.

Table 6. Acres affected by Management Activities.

Management Activity	Forested Acres Affected
Timber harvest	2,700
Prescribed fire	7,000
Wildlife habitat improvement	3,311
Timber stand improvement	2,264
Soil and water improvement	135
Special uses	286
Road construction	16

The Forest Plan is developed around six interrelated goals to assure that management is environmentally sound and meets the needs of the public. Within the framework of those goals, 19 management opportunities were identified. In the context of management goals and opportunities, the following paragraphs briefly describe activities which have occurred on the Forest from 1994 through 1998. Also mentioned are projects which are reasonably likely to occur during the next five years on the Forest, and major activities on lands of other ownerships. After each section is a table which compares measurable accomplishments in the relevant area with projected plan accomplishments.

Protect and Manage Ecosystems

Promote Natural Processes of Forest Succession - Several MAs on the Hoosier (2.4, 5.1, 6.2, 6.4, 8.1, 8.2, and 9.2) allow forests to succeed towards climax conditions without significant human influence (45.3 percent of the Forest). Additionally, management direction and guidance allows natural processes to occur in streamside management zones. Continued protection of forested riparian corridors (2.4 MA) will maintain these areas in structurally diverse riparian forest communities. Potential old-growth areas are primarily subject to the forces of nature. The rate of canopy closure depends on natural growth rates and disturbances. The majority of these areas will have canopy closure approaching 100 percent. Table 7 compares past projections with actual attainments and future projections.

Each year, part of the Forest is affected by strong winds, tornados, or other natural disturbances. These events leave small to very large areas of dead, down or severely damaged trees. These are generally left to naturally decay in the areas listed above.

Snags, or standing dead trees, are generally retained for wildlife purposes except where they pose a hazard to public safety (see "Provide Trails for Hiking, Horseback, and Bicycling" and "Provide Road Access"). Snags are retained in all timber harvests and other Forest activities to at least meet Forest Plan management direction and guidance (see "Use Timber Harvest to Manage Forests").

The Forest cooperates with other federal and state agencies, as well as universities and other organizations to conduct research to help us make better management decisions. Among recent research projects have been the development of an ecological classification system for the Forest (Van Kley *et al.* 1994) and a survey for the presence of Bachman's sparrow (Jackson 1993).

Few landowners, except Indiana State Parks and The Nature Conservancy, manage for mature forest conditions. Private land owners may not harvest timber, but few tracts are large enough to provide old-growth conditions.

Table 7. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Promoting Natural Succession.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>OLD GROWTH (acres)</i>				
Core areas	18,000	32,500	32,500	32,500
Potential old-growth forest	28,600	96,400	96,400	96,400
<i>NATURAL APPEARING FOREST (acres)</i>	28,600	96,400	104,000	104,000

Protect Unique Features - The Forest has 12 designated special areas (MA 8.2) encompassing 12,803 total acres (6.5 percent of the Forest), ranging in size from 10 acres to over 6,200 acres. There are also 1,586 acres (0.8 percent of the Forest) in MA 9.2 (candidate special areas). Each of these has its own unique characteristics and has management guidelines developed specifically to perpetuate those special attributes. Activities which occur within special areas, such as prescribed fires and timber harvest, are done to further the goals of the area. Sites which include barrens communities have each been subjected to prescribed fire at least once during the last five years. Subsequent fires are needed to maintain these rare communities (see "Manage Plant Communities Through Prescribed Burning"). Some special areas have pine plantations within them. Because pines tend to invade the high quality natural areas, these stands are priorities for potential timber harvest (see "Use Timber Harvest to Manage Forests"). Table 8 compares habitat type past projections with actual attainments and future projections.

Pioneer Mother's Memorial Forest is the Hoosier's only designated research natural area encompassing 88 acres of mature mesic hardwood forest. This is set aside for non-manipulative research. The research natural area is surrounded by a 170-acre special area.

Caves on the Hoosier are available for recreational caving. None are commercialized, although many have been used by humans for a variety of purposes in the past. Cave locations are protected under the Federal Cave Resources Protection Act of 1988 (16 USC § 4301-4309). Much of the Forest where caves are likely to occur has been surveyed for their presence. About 100 caves are known on the Hoosier. There is an on-going effort to map their interiors and inventory their fauna.

Continued implementation of the Forest Plan will maintain forest structure and composition around each cave similar to what it is currently. The forest communities are generally a mosaic of ages and size-classes of oak-hickory and sugar maple-beech communities. Activities may be proposed and implemented near, but not in close proximity to, cave entrances.

Studies of the effects of noise outside caves were done at Fort Leonard Wood, Missouri (USDI Fish and Wildlife Service 1996). This study determined that activities were barely detectable from inside caves. Sounds created by activities allowed by the Forest Plan such as vehicles, chainsaws, boat motors, recreationists, hunters and other types of noise, are unlikely to surpass in intensity or duration the military operations evaluated for Fort Leonard Wood.

The small patches occupied by the rare plant communities which define barrens are being diminished by encroachment of woody understory plants and by shading from overstory hardwoods and eastern redcedars. Some areas are being affected by exotic species associated with a nearby pipeline right-of-way and pastures. Treatment objectives for barrens are: reduce woody plant encroachment on barrens vegetation; stimulate growth and vigor of barrens and dry forest communities; and reduce invasive exotic species by converting to native plants through tilling, burning, and seeding. Barrens areas and their surrounding matrix of dry forest will be treated through prescribed burning (see "Manage Plant Communities Through Prescribed Burning") and girdling.

The need for girdling will be determined by post burn surveys of barrens areas. Girdling will occur primarily with eastern redcedar and occasionally with hardwoods immediately adjacent to patches of barrens. To limit the risk of further encroachment by exotics, log skidding and new road construction will not occur within barrens.

Over 190,000 acres of the Forest have been surveyed for threatened and endangered plants since 1989 (Olson *et al.* 1990, Olson *et al.* 1991, Scott *et al.* 1996, Brewer and Lane 1996). About 112 miles of Ohio River tributary streams were surveyed for mussels in 1998 (EcoSearch, Inc. 1999), and 106 miles of streams in the East Fork White River, Lost River, and Patoka River were surveyed for mussels in 1999 (Ecosearch, Inc., in prep). Over 3,000 acres have had mist net surveys for the presence of Indiana and gray bats (3D/International 1998). Similar surveys have been conducted by other agencies. Individual caves are surveyed for the presence of hibernating bats every two or more years. Bald eagle nests are monitored annually in cooperation with IDNR. Project areas will continue to be reviewed for BE clearance before project implementation.

Few land owners, except Indiana State Parks, Nature Preserves, and The Nature Conservancy, manage for special features including caves and barrens. Private land owners may or may not acknowledge the presence of unusual features on their property.

Table 8. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Protecting Unique Features.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>HABITAT TYPE (acres)</i>				
Maintained forest openings	4,500	4,000	3,170	3,311
Barrens	1,247	1,131	1,344	1,344
Reverting openings	448	830	962	1,000
Utility corridor*	286	286	837	912
Redcedar	250	250	240	240
Lakes/ponds	794	874	874	874
Streams/rivers	119	119	119	120
Marsh/waterholes	165	160	160	185
Other non-forest	2,751	2,867	2,867	2,867
0-9 yrs. hardwood	9,883	4,853	1,483	641
10-19 yrs. hardwood	8,358	8,363	9,579	3,912
20-39 yrs. hardwood	17,913	17,913	10,940	9,988
40-59 yrs. hardwood	16,442	16,442	9,963	10,647

Proposed Action and Management Opportunities

60-79 yrs. hardwood	42,586	43,076	31,653	16,470
80+ yrs, hardwood	57,084	60,857	81,850	104,006
0-9 yrs. pine	91	94	0	0
10+ yrs. pine	24,975	25,777	31,484	31,288

* Utility corridor acreage for the 1985 and 1991 Plan was determined from Forest compartment records. The 1994 to 1998 data was derived from special use permits.

Establish Plant Communities - The Hoosier is currently harvesting timber well below its allowable sale quantity. Reforestation is usually accomplished by natural regeneration, which occurs when new trees sprout from the stumps of harvested trees or when seedlings naturally establish themselves. Many old fields and pastures are being allowed to naturally succeed to hardwood forest. Some areas have been supplemented by planting. Planting of desired species is practiced where natural regeneration is below acceptable levels and may also occur on recently acquired tracts. Other planting may be done where soil has been stabilized to control erosion. Planting of trees is accomplished by hand work, but there is some potential for machine planting in the future. When necessary, activities on these sites includes tree planting and site preparation by removing stems of undesirable species to enhance regeneration of desired species. This may include prescribed burning (see "Manage Plant Communities Through Prescribed Burning"). Reforestation has been accomplished on an average of 55 acres per year since 1994, and may increase to 200 acres per year in the near future. Such projects will continue as opportunities arise. Table 9 compares past projections with actual attainments and future projections for various plant community types.

Table 9. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Establishing Plant Communities.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>Vegetative Diversity (%)</i>				
Barrens	0.66	0.60	0.68	0.68
Redcedar	0.13	0.13	0.12	0.12
Other non-forest	1.46	1.53	1.53	1.53
<i>Vegetative Composition (%)</i>				
Mixed hardwoods	19.5	18.9	14.2	14.3
Ash/cherry	2.9	2.8	0.5	0.5
Black walnut	0.3	0.3	0.2	0.2
Yellow poplar	10.8	10.7	15.0	15.0
Other oak	13.2	13.1	15.2	15.2
White oak	20.0	20.0	17.9	17.9
Red/black oak	19.8	19.7	18.4	18.4
Mixed pine	13.5	14.5	18.6	18.5

A combination of tilling and seeding may be used to restore native plant species in areas adjacent to barrens currently dominated by tall fescue (*Festuca arundinacea*) and exotic forbs. Tilling and seeding with burning to follow will assist with establishment of native grassland communities. Any seeding would utilize a mix of native forbs and warm season grasses of locally collected genotypes. About 600 acres of degraded barrens and dry forest communities have been identified for initial restoration efforts.

Proposed Action and Management Opportunities

Converting openings dominated by non-native fescue to native warm-season grasses is accomplished by plowing the fescue to expose actively growing roots to the drying influences of the sun and wind. No herbicides have been used. Conversion of fescue-dominated openings to native warm-season grasses is done when local seed sources are available.

An average of 27 acres are treated each year to directly benefit soil and water resources. This work includes filling abandoned water wells with stone, cleaning up garbage dumps, and road and trail rehabilitation (see "Provide Trails for Hiking, Horseback, and Bicycling" and "Provide Road Access"). Similar activities will continue as necessary.

Water quality monitoring information shows that implementation of Forest management direction and guidance designed to minimize erosion and protect water quality has been effective.

A program for discovery, identification, and disposal of hazardous materials is in place on the Hoosier.

Lands administered by the U.S. Army Corps of Engineers around Monroe and Patoka lakes are managed by IDNR for a variety of wildlife species. Other landowners establish a wide variety of plant communities, especially in agricultural and residential settings. When timber is harvested, little effort is placed on reforestation other than natural regeneration or influencing species composition through prescribed burning.

Use Timber Harvest to Manage Forests - A variety of harvest methods under both the even-aged and uneven-aged systems are used to meet management objectives. Even-aged systems are appropriate where a single-aged stand is desired, or to give desired shade intolerant regeneration an advantage over shade tolerant species. Uneven-aged systems maintain the appearance of continuous forest canopy and create multiple-aged stands. The Forest Plan, Appendix B, describes the various harvest methods used on the Forest in greater detail.

Even-aged harvests (clearcut, shelterwood, and seedtree) may result in canopy closures below 50 percent. These types of early successional forest provide an abundance of annual and perennial plants which support a varied insect community. Cavity trees and standing dead trees are not removed unless they pose a safety hazard to the public or the timber operator.

Uneven-aged harvest by either the single-tree or group selection methods results in less dense canopy closures and an area of various ages and sizes of trees (including old, large diameter trees). Group selection also creates small openings (up to 1 acre in size) where young trees can sprout and grow in the sunlight.

Even-aged harvest has not occurred on the Forest since 1994. Uneven-aged harvest by either the single-tree or group selection methods has occurred on 51 acres since 1994 (less than 0.03 percent of the Forest), averaging 10.2 acres per year.

About 33 percent of the Hoosier National Forest is considered suitable and appropriate for timber production. The Hoosier National Forest timber program is based on an 80 to 90 year rotation cycle for hardwoods and 40 to 60 years for pines.

The reasons for timber harvest include: developing vigorous, multi-layered mixed hardwood stands resistant to adverse effects from insects or disease; increasing the vigor, economic value, and resiliency of residual trees by removing weakened trees, trees with poor crown development, and suppressed trees; harvesting the wood of shorter-lived species (such as black oak) to provide useful products and ensuring these species are well represented in the landscape in the future; replacing non-native pine plantations with native mixed

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hardwood communities that have a diverse mix of oaks, hickories, and other fire adapted plants; and providing habitat for early seral forest plant and animal species.

The predominant treatment for hardwood stands is stand improvement cutting using best tree selection. Small group selections will be used to regenerate pockets of senescent trees which exist within these stands. About 90 stands covering approximately 2,700 acres (1,300 hardwood acres and 1,400 pine acres) have been identified for possible treatment over the next five years in the Buzzard Roost and German Ridge areas.

Trees with thick, flaky, or scaly bark will be preferred as leave trees. Trees to be removed will be individually marked. Shagbark and shellbark hickories (*Carya ovata* and *Carya laciniosa*) are minor stand components and will not be cut. The following species will be given priority for retention in order of preference: green ash (*Fraxinus pennsylvanica*), bitternut hickory (*Carya cordiformis*), cottonwood (*Populus deltoides*), post oak (*Quercus stellata*), white oak (*Q. alba*), red oak (*Q. rubra*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), black locust (*Robinia pseudoacacia*), and silver maple (*Acer saccharinum*). The largest, most vigorous trees within spacing guidelines will be left. Tree vigor assessments will be based on stem size, crown condition, crown position, and exterior disease indicators. Dominant or codominant trees will be left on each microsite.

Hardwood stands will be thinned to residual densities of 60 square feet of basal area on average. The spacing guidelines in Table 10 will achieve that density. Spacing variation of plus or minus 25 percent is allowed to provide flexibility in selecting leave trees with best tree characteristics. Spacing will vary based on the average diameter of leave trees. Pine stands are thinned based on average diameter and other existing conditions. Stocking guides are used to determine the appropriate residual basal area for pine stands.

Table 10. Spacing guidelines for targeted basal area.

		BA=60 sq. ft.		BA=80 sq. ft.	
Leave Tree DBH	BA/stem	TPA	Spacing	TPA	Spacing
12"	0.785 sq. ft.	76	24 ft.	102	21 ft.
14"	1.068 sq. ft.	56	28 ft.	75	24 ft.
16"	1.396 sq. ft.	43	32 ft.	57	28 ft.
18"	1.766 sq. ft.	34	36 ft.	45	31 ft.
20"	2.181 sq. ft.	28	39 ft.	37	34 ft.

BA = Stem basal area at breast height

DBH = stem diameter at breast height

TPA = Trees Per Acre

Spacing and TPA are rounded to nearest tree and foot. Twenty-five percent spacing fluctuation is allowed so "best" tree will be left.

Standing dead trees (snags) will be retained to provide habitat for wildlife. Snags are retained except where the pose a hazard to safety of the operator. Trees left for this purpose will not be considered for spacing purposes. Long term snag recruitment will be provided by leaving a portion of the senescing trees, such as black oak or scarlet oak to die over a period of years. Following harvest, a survey of the area will determine

stands with low numbers of snags. Areas with less than six snags over nine inches in diameter per acre may be prioritized for snag creation through girdling of live trees. Snag creation activity will concentrate on areas with low snag density and a lack of species characterized by exfoliating bark. If deemed beneficial, girdling will target large hardwood trees (with at least 2 trees per acre 20 inches or larger where available). In areas with no hardwoods, pine snags may be substituted. Enough trees will be girdled to bring the stands to at least six snags per acre.

Group Selection: Small group selections (one acre or less) will be used to regenerate senescent hardwood species. All merchantable live trees within each group will be removed. Groups will be located on microsites within each stand which are dominated by short-lived species. Every third group will be retained to provide gradual inputs of snags over time. Existing snags will be retained unless safety considerations preclude keeping them.

Pine: Shortleaf pine (*Pinus echinata*) and mixed pine stands will be treated with a mix of shelterwoods and thinning. Predominantly white pine (*Pinus strobus*) stands will be thinned using best tree selection guidelines. Any hardwood tree greater than four inches in diameter will be left and these trees will be considered as "best trees" for spacing purposes. The largest, most vigorous tree will be left on each microsite and released by removing competing pine trees around it. White pine will be preferred as a leave tree over shortleaf pine. Existing snags will be retained unless it is unsafe to do so. Stands will be thinned from below, using best tree selection, to a density of 60 to 80 square feet per acre. Nearly 700 acres of pine for various treatments were identified in the German Ridge project area (498 acres of clearcut with reserves, 80 acres clearcut, and 101 acres thinning). An additional 698 acres of pine were identified in the Buzzard Roost project area (391 acres of shelterwood, and 307 acres of thinning).

Overstory Removal: Overstory densities will be reduced to a minimum of 16 trees per acre (52 foot spacing) in pine shelterwoods. Residual basal areas will vary from 10 to 20 square feet per acre depending on average stem size. Areas within each stand which have some hardwood stocking may exceed this target since most hardwoods will not be cut.

The Paoli Experimental Forest covers 632 acres of upland hardwood forest. There has been one 4.7-acre timber sale there in the last five years. The objective of this sale was to remove the overstory for a research study on increasing the presence of white oak by planting. The study looked at various root and top treatments on white oak seedlings.

Each year, part of the Forest is affected by strong winds, tornados, or other natural disturbances. These events leave small to very large areas of dead, down, or severely damaged trees. After review and appropriate analysis, a decision is made whether or not to remove merchantable portions of the affected trees. In areas of windthrow, salvage generally involves removing dead, downed, severely damaged (cracked or broken boles, less than 20 percent live crown remaining from branch loss), or weakened trees (signs of root upheaval, twisting of the bole, or leaning more than 15 degrees from vertical). Healthy trees are not removed except for safety and operations. Specific trees to be cut are determined visually during marking or under a "designation by description". Merchantable portions of downed trees would be harvested, leaving the remainder of tops, limbs, foliage, and non-merchantable parts of the bole on the site for wildlife cover. The Hoosier has salvaged 324 acres (0.17 percent of the Forest) and done sanitation harvest on 584 acres (0.30 percent) over the last five years.

Permits are issued for collection of miscellaneous forest products including pine house logs, firewood, fence posts, medicinal herbs, and grapevines. Collection of miscellaneous forest products is permitted only in the 2.8 MA. House log sales are infrequent. They average about three acres per year. Pine house logs are cut

from selected pine plantations. Usually there is advanced hardwood regeneration within the stands. Removing the pines hastens the conversion of the stand to hardwoods.

In the last five years, 173 firewood permits were issued, totalling about 350 cords of firewood. Most firewood taken from the Hoosier National Forest is downed material. In addition, some permits are given to private landowners to remove dead or leaning trees which are likely to fall on their fences. Collection of medicinal herbs is not permitted for species listed by the state as endangered or threatened, or when listed by the Forest as "unique".

Timber harvest is occurring widely on private land. Timber harvest on private land are mostly diameter-limit cuts, removing trees of value which are over 12 inches in diameter.

According to USDA Forest Service (in press) "Selective harvesting methods used in hardwood stands throughout the Central Hardwood Region do not cause the large-scale disturbances that are needed to reclassify the timberland as sapling-seedling-sized stands." "Average annual net growth of growing stock exceeded harvest by a 2.5 to 1 margin between 1986 and 1997. As a result of the expanding resource and growing more than harvesting, the volume of trees growing in Indiana continued to increase" (USDA Forest Service, in press).

Use Intermediate Silvicultural Techniques to Manage Forests - Tools to manage the composition and structure of forest stands include pruning, tree release, thinning, and understory treatment. They are used to meet plant and animal community objectives based on site-specific needs (Table 11).

Even-aged thinning is similar to single-tree uneven-aged harvest without creating any noticeable openings in the canopy. Thinning reduces canopy density temporarily until the remaining tree crowns grow together again. Timber stand improvement to improve the quality of young forest trees has averaged about 30 acres per year (less than 0.02 percent of the Forest) in the past five years. About 57 acres has been thinned since 1994, averaging 11.4 acres per year. The Forest Plan, Appendix B, describes the various methods used on the Forest. Two projected projects include timber stand improvement follow-up after all harvest operations with the exception of thinning, totalling 2,264 acres. Prescribed burning has also been proposed for timber stand improvement in this area.

On private land, very few pre-harvest treatments are used.

Table 11. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Using Timber Harvests and Intermediate Silvicultural Techniques to Manage Forests.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>Vegetative Diversity (percent)</i>				
0-9 yrs. hardwood	5.26	2.58	0.76	0.33
10-19 yrs. hardwood	4.45	4.45	4.88	1.99
20-39 yrs. hardwood	9.53	9.53	5.59	5.09
40-59 yrs. hardwood	8.75	8.75	5.08	5.43
60-79 yrs. hardwood	22.67	22.93	16.14	8.40
80+ yrs. hardwood	30.38	32.39	41.74	53.02
0-9 yrs. pine	0.05	0.05	0.00	0.00
10+ yrs. pine	13.29	13.72	16.05	15.95

<i>Timber Volume (MMBF)</i>				
Hardwood	84	33	5.4	0.46
Pine	10	10	4.1	6.67
Hardwood - salvage *			4.9	--
Pine - salvage *			2.8	--
<i>Timber Quantity (acres)</i>				
Suitable timber land	117,200	62,000	62,000	62,000
Clearcut	6,530	2,000	0	578
Shelterwood	1,770	840	255	391
Group selection	10,350	8,500	0	777
Single tree selection	4,290	1,110	0	518
Thinning	0	100	285	408
<i>Timber Stand Improvement (acres)</i>	3,490	2,500	57	2,264

* 1994 to 1998 salvage volume is added from outside Forest Plan projected volume.

Provide Openings & Shrubland - Most forest openings and shrublands were cropland, pasture, or home sites before acquisition by the federal government. They benefit species which require early successional vegetation and various sized areas of grassland. There are a total of 3,311 acres of maintained openings on the Forest (1.69 percent of NFS land). As additional land is acquired, some existing portions of that acreage may be maintained in an open condition. Projections and attainments for opening and shrublands by type are listed in Table 12.

Forest openings are maintained to perpetuate early successional conditions by various means including brushhogging, edge maintenance chainsaw work, and prescribed burning (see "Manage Plant Communities Through Prescribed Burning"). Forest opening maintenance may occur in most parts of the Forest except the Deam Wilderness, 6.2 MAs, and in the interior of 6.4 MAs. Maintained forest openings are usually smaller than five acres, but some of up to about 100 acres are kept open. Most work is done in late summer through autumn. Nearly 3,500 acres of openings have been treated in the last five years, some using more than one method, and are therefore double-counted. Volunteer organizations and Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife, will continue to work with the Forest to maintain habitat conditions.

Lands administered by the U.S. Army Corps of Engineers around Monroe and Patoka lakes are managed by IDNR for a variety of wildlife species including those that use openings. The majority of private lands in an open condition are agricultural, whether cultivated in row crops or pastured and mown for hay. Relatively few areas are left fallow. These do not necessarily provide appropriate habitat for many plant and wildlife species.

Table 12. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Providing Openings and Shrublands.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>Vegetative Diversity (percent)</i>				
Maintained forest openings	2.39	2.13	1.62	1.69

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Barrens	0.66	0.60	0.68	0.68
Reverting openings	0.24	0.44	0.49	0.51
Utility corridor*	0.15	0.15	0.43	0.43
Redcedar	0.13	0.13	0.12	0.12
Other non-forest	1.46	1.53	1.55	1.55
0-9 yrs. hardwood	5.26	2.58	0.76	0.33
0-9 yrs. pine	0.05	0.05	0.00	0.00

* Utility corridor acreage for the Forest Plan and the 1991 Amendment was determined from Forest compartment records. The 1994 to 1998 data was derived from special use permits.

Provide Aquatic Ecosystems - The aquatic and riparian ecosystems, including all stream channels whether perennial, intermittent, or ephemeral, are protected through Forest Plan management direction and guidance. Streamside management zones are the lands having alluvial and colluvial soils within the final break of the slope adjacent to stream channels. Protection of water quality and preventing water pollution or siltation of waterways are also concerns since some forest activities have potential to create soil movement. Activities outside of riparian corridors will be designed and implemented to minimize soil movement. Water quality is generally good across the Forest. The Indiana Department of Environmental Management has stream invertebrate reference sites on some Hoosier National Forest streams.

There are 512 miles of intermittent and perennial streams on NFS land within the Forest proclamation boundary. Several watersheds have been surveyed for baseline information on invertebrate and fish species composition. Other watersheds will also be surveyed. Activities associated with these habitats include structures providing cover for aquatic animals and streambank stabilization. Stream management favors native aquatic and riparian communities. Forest Plan guidance prohibits removing sand, gravel, or other common variety minerals from streams except to improve fish and wildlife habitat. The Forest has not done mechanical or structural work in streams in the last five years and it is unlikely to occur in the near future, however there has been unauthorized rock removal from streams. The banks of a stream in a Forest special area are likely to be stabilized to protect the significant feature of the site. The free-flowing condition of springs is protected to maintain their functional integrity.

Portions of the Little Blue and Lost Rivers have been determined to be potentially eligible in the Wild and Scenic Rivers System. Lost and Little Blue Rivers study areas have one quarter mile on both sides of the rivers. No timber harvest or other vegetation manipulation (see "Use Timber Harvest to Manage Forests" and "Provide Openings & Shrubland") would occur in this corridor unless needed for public safety, salvage, or endangered species habitat improvement.

Aquatic habitats such as wetlands, marshes, ponds, streams, and rivers occupy a small part of the Hoosier, but occur in all parts of the Forest (Table 13). There are approximately 925 acres of lakes, ponds, and waterholes on the Hoosier (0.47 percent of the Forest). Of this, there are 56 lakes and ponds over five acres totalling 751 acres. Celina, Indian, Saddle, Tipsaw, and Springs Valley lakes are all man-made structures over 40 acres and are entirely on NFS land. Maumee and Lutheran lakes are on private land but are within one mile of NFS land. Monroe and Patoka lakes are Corps of Engineers projects which the Hoosier manages only a small portion of the shoreline. Most have an effective life of 50 years or more. Activities associated with these habitats include pond construction and dam maintenance, and structures providing cover for aquatic animals.

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A five-acre lake (Sundance Lake) was constructed recently and there are tentative plans for another. Fish stocking is done in cooperation with IDNR, and fish habitat improvement structures such as used Christmas trees and clay drain tiles have been placed in some lakes and ponds. Triploid grass carp were introduced into five ponds to control extensive growth of aquatic vegetation (Ponds and numbers of fish stocked: Sulphur - 4 fish, Timber Lake - 10, White Oak - 4, Maines - 10, Henderson - 18). Local application of herbicides may be used to control aquatic weeds around recreation beaches and boat launches (see "Apply Integrated Pest Management").

An approximately 25-acre wetland was restored in the Lost River area, and another 30 to 40 acres has been identified for near future restoration work. Wetland restoration of this type includes using heavy construction equipment to locate and remove any field drain tiles, repair natural levees by filling and armoring them as necessary, and constructing low dykes with water level control structures at natural outlets to facilitate maintenance and repair work. Construction is done during the drier part of the year to avoid soil compaction. Seeding and mulching immediately follow construction to mitigate soil erosion. Trees and shrubs appropriate to the area may be planted.

Most soils on Hoosier National Forest contain some amount of rock within the upper ten inches of the profile and on the surface. This, plus natural forest debris (fallen logs, leaf litter, etc.), logging slash (tree tops and tree boles left in the woods), and unharvested filter strips along drainages, trap soil moving off-site before it can reach ephemeral or intermittent streams.

Important factors for keeping the sediment losses low in watersheds include the high rock content of the soils, which "armors" the soil, the fine root content along the soil surface minimizing soil loss by preventing detachment of soil particles, and residual slash acting as soil cover, reducing the amount of bare mineral soil exposed within the cutting units. Given that soil loss caused by timber harvest is well within the allowable limits set in the Forest Plan, and that management direction and guidance for buffer and filter strips are applied along streams, excess sedimentation of area waterways has not occurred as a result of timber harvest as practiced on Hoosier National Forest in the past ten years.

Land use activities which occur on other ownerships can also affect water quality in rivers which pass through NFS lands. Streams on state land are generally protected to maintain their quality. Many waterways on private lands are occasionally cleared of vegetation to increase water flow, particularly where they cross pastures or row crop fields. Those in woodland settings are usually unmanaged. Small ponds are often constructed on private land to water livestock and provide recreation.

Table 13. Comparisons of 1985, 1991 Plan, and Actual Accomplishments in Providing Aquatic Ecosystems.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>HABITAT TYPE (acres)</i>				
Lakes/ponds	794	874	879	885
Streams/rivers	119	119	119	120
Marsh/waterholes	165	160	185	215
<i>Diversity (percent)</i>				
Lakes/ponds	0.42	0.47	0.45	0.45
Streams/rivers	0.06	0.06	0.06	0.06
Marsh/waterholes	0.09	0.09	0.09	0.11

Manage Plant Communities Through Prescribed Burning - Prescribed fires are performed for a variety of reasons, including wildlife habitat improvement, forest regeneration, and hazardous fuel reduction. The prescribed fire program helps keep fuel amounts relatively low, thus reducing the chance that mature or old growth forest would be damaged or destroyed by stand-replacing fires. If low-intensity, litter-reducing fires are not allowed, stand-replacing, high-intensity fires can result. The Hoosier is attempting to duplicate conditions where there are large areas of mature, large-diameter trees which are widely-spaced, and with a grassy or shrubby understory. This is being accomplished with a combination of selective commercial timber harvest (see "Use Timber Harvest to Manage Forests") and prescribed burning to suppress beech and sugar maple regeneration, and encourage growth of a native herbaceous understory. Prescribed burning maintains a mosaic of forest conditions. Understory closure is gradually reduced with successive burns until it reaches a desired level. Prescribed burns may increase the potential for soil movement off-site, for increased release of nutrients, and increased run-off and sedimentation of nearby waterways (see "Provide Aquatic Ecosystems"). Slope percent, fire intensity, soil type, and frequency of burning help determine the severity of effects to soil and water resources (Wade and Lunsford 1988, Wells *et al.* 1979, Tiedman *et al.* 1979).

Fire lines may be rotovated, but many are hand constructed with leaf rakes and leaf blowers removing vegetation and leaf litter to the mineral soil. Construction of rotovated firelines is a potential source of soil movement and sedimentation of area waterways. Trails, roads, and creeks are used as fire breaks to keep hand line construction to a minimum.

The number of prescribed fires has decreased, but the average size of individual prescribed burns has increased over the past several years. In the past five years, about 10 prescribed fires were conducted annually for a total of about 2,000 acres (about one percent of the Forest per year). Totals shown in Table 14 reflect most of the areas having been burned twice (none were burned three times), so less than three percent of the Forest was burned in that time. Areas have been identified in the German Ridge, Buzzard Roost, and Mogan Ridge areas which could be put on a rotation which would account for a 1,500 acres per year rotation for five years. There are also potential prescribed burn areas (hazardous fuel reduction) in the vicinity of Indian, Celina, and Tipsaw lakes recreation areas. Nearly 3,100 acres were identified for prescribed burning in association with hardwood timber harvest and barrens restoration. Another 2,200 acres was identified for prescribed burning in the German Ridge project area. Small prescribed fires of less than 50 acres will also continue.

Prescribed burns on the Hoosier National Forest take place mostly in the late winter and spring months. Summer burns have not been conducted. Prescribed burns are generally of the type, size, intensity, location, frequency and execution that there is little, if any, soil exposed after the burn is completed. Control lines for prescribed burns are laid out along natural fuelbreaks (such as existing roads, drainages, and trails) where possible, minimizing the need for line construction. Prescribed burns have been conducted only when predicted and actual conditions have allowed for adequate smoke dispersal. Trees and snags which may fall across fire lines are cut as necessary.

The majority of prescribed burns on the Forest have a layer of duff covering the soil in a prescribed burn unit after the fire. Only rarely are conditions extreme enough to result in areas of bare soil, even then, the amount of bare soil exposed rarely exceeds 20 percent of the prescribed burn unit. Areas adjacent to permanent streams which are within prescribed fire units generally contain live herbaceous vegetation which tends to stay green and burn less readily than leaf litter, leaving an unburned strip of vegetation between the main body of the prescribed fire and any permanent streams in or adjacent to the unit.

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Each stand will be evaluated for prescribed burning based on site specific existing and desired future conditions. Stands will be added to those prescriptions so that safe and efficient burns can be made which incorporate stand by stand prescriptions into landscape treatments. Burn plans will be designed to reduce the density of understory trees and shrubs less than two inches in diameter, reduce small diameter fuels in areas affected by timber harvest and the surrounding forest matrix, favor species adapted to fire and other disturbances by reducing their competitors and creating favorable light and moisture conditions, favor regeneration of oaks and associated species in pine shelterwoods and hardwood group selections, and limit adverse effects of burning on visuals, especially near trails, roads, and viewpoints.

Burning will occur under conditions which would generally result in low intensity underburns. Post treatment evaluations will determine if repeated burning would further resource objectives. Some areas may be burned routinely over time.

Prescribed fires are implemented on state properties where they meet management objectives. Prescribed fire is being encouraged on private land by the USDA Natural Resources Conservation Service.

Table 14. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Managing Plant Communities through Prescribed Burning.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>HABITAT TYPE (acres)</i>				
Maintained forest openings	not available	not available	240	602
Barrens	1,247	1,131	1,344	1,344

Apply Integrated Pest Management - Silvicultural techniques are used to maintain the health of forest stands which makes individual trees less susceptible to the effects of insects and disease. If outbreaks occur, then pesticides may be used to reduce the adverse effects of pests.

Pine plantations are monitored because of local mortality from natural senescence and infestations of introduced pine sawfly (*Diprion similis*). About 50 acres of pines have been salvaged in the last few years because of mortality induced by off-site planting resulting in poor nutrient and moisture uptake (Table 11). There were secondary infections of these stands by turpentine beetles (*Dendroctonus valens*), introduced pine sawfly and *Armillaria* fungi. As outbreaks occur, additional salvage may be conducted (see "Use Timber Harvest to Manage Forests"). Gypsy moth (*Lymantria dispar*) is not anticipated to arrive in this area for about 15 years at the current rate of spread.

The only insecticides used on the Forest are small quantities of commercially available household insect sprays to control wasp infestations in recreation areas and administrative sites.

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Herbicide use on the Forest is expected to remain at the current low levels. Herbicide use is limited to outstanding rights of overhead rights-of-way targeting woody species. Approved herbicides for right-of-way maintenance are picloram; 2,4-D; 4-DP; triclopyr; and dicamba. Other herbicides used on the Forest are primarily glyphosate, diclobenil, and mefluidide for developed site housekeeping. Application methods for all these purposes has been low-volume ground spray. To control aquatic weeds, especially algae blooms and naiads at swimming beaches and boat launches, diquat and Cleargate (a copper compound) are used.

Both herbicides and insecticides are widely used in agriculture within the Forest boundary on private land.

Protect Our Cultural Heritage

Heritage resource surveys are required for all soil disturbing projects. The amount of land surveyed annually varies widely, ranging from around 700 acres in 1998 to over 4,000 acres in 1997. Reviews of projects ensure mitigation and protection measures are correctly applied for ground disturbing activities. Potentially significant sites are evaluated for listing on the National Register of Historic Places. National Register listed sites and potentially significant sites are protected and monitored. Discussion of heritage resources will not be carried further because actions involved with this are inventory and protection, and will have no effect on federally listed species.

Provide for Visually Pleasing Landscape

Apply the Visual Resource Management System - Projects are designed and monitored during execution to ensure visual quality objectives are being met. Visual objectives may restrict some activities in some places, for example prescribed burning may require mitigations including leaf blower and hand raked lines in developed recreation areas, and only ecological processes cause change in MAs 5.1 and 8.1. Discussion of visual resources will not be carried further because actions involved with this are effectiveness and implementation monitoring, and will have no effect on federally listed species.

Provide for Recreation Use in Harmony with Natural Communities

Provide Remote Recreation Habitat - The Hoosier comprises about 27 percent of the public land in Indiana available for recreation (Forest Plan EIS). As shown in Table 15, several MAs provide large areas for remote recreation activities (5.1, 6.2, 6.4, and 8.2).

Rockshelters where resource damage has occurred have been closed to overnight camping and open fires by Forest Orders.

Some forest activities generate moderate amounts of noise. Recreationists travelling on roads with trucks and cars, or on forest lakes and rivers with motorboats all create some noise. Hunters may discharge firearms during hunting seasons. There are also hunters which may illegally hunt outside established hunting seasons. Target shooting also occurs sporadically across the landscape. These types of noise also occur on private and other ownerships adjacent to National Forest System lands. Discussion of remote recreation activities will not be carried further because actions involved with this are light impact activities, and will have no effect on federally listed species.

Few landowners, except Indiana state parks and forests have tracts large enough to provide remote areas for recreation.

Table 15. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Providing Remote Recreation Habitat.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>RECREATION USE (RVD/yr.)</i>				
Dispersed	265,570	267,211	440,000	450,000
<i>BACKCOUNTRY (acres)</i>	13,000	53,000	54,380	55,000

Develop and Maintain Recreation Facilities - There are ten developed recreation areas on the Forest, including campgrounds, picnic areas, and access points on lakes used by the public (Table 16). Accessible fishing piers have been constructed. Drinking water is provided at some recreation facilities. Facilities are being upgraded to meet federal standards. Several buildings in developed areas have undergone repair and maintenance due to deferred maintenance schedules. Vegetation manipulation at developed recreation sites consists of mowing of existing campgrounds, picnic sites, and boat launches, and removal of trees which may pose a public safety hazard. Similar activities occur around developments on state parks and forests.

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Solid waste generated and collected from NFS lands are disposed appropriately. Carry-in/carry-out disposal methods are emphasized and promoted. Further discussion of public health will not be carried further because actions involved with this are administrative and will have no effect on federally listed species.

Table 16. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Developing and Maintaining Recreation Facilities.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>RECREATION USE (RVD/yr.)</i>				
Developed	120,332	120,332	198,000	200,000

Provide Trails for Hiking, Horseback, and Bicycling - The Forest has about 233 miles of hiking and multiple-use trails, accounting for about 275 acres (0.14 percent of the Forest). Vegetation manipulation for trails is limited to removal of trees which may pose a public safety hazard, and brushing, limbing, pruning or removing small trees along the trail corridor. Such maintenance is done annually or as necessary. Construction and reconstruction of trails is accomplished by covering tread surfaces with crushed stone and water diversion structure placement. About 40 miles of new construction, relocation and special use trails have been constructed in the past five years (Table 17). About 35 miles of construction and reconstruction are anticipated over the next ten years.

Forest Plan amendments and subsequent forest orders restricted horses and bicycles to designated trails, and motor vehicles to roads only.

Some forest activities generate moderate amounts of noise which may be distracting to some Forest visitors. Timber harvest operations create noise from vehicle use and chainsaws.

Few landowners, except Indiana state parks and forests have tracts large enough to provide recreational trails. Trails have also been developed in state forests and parks to similar standards as on the Hoosier. Private landowners may have short trails, but are less likely to be hardened with stone.

Table 17. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Providing Trails.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>TRAIL CONSTRUCTION (miles)</i>				
Hiking only	99	99	0	0
Multiple use (hiking, horse, mountain bike)	40	40	40	15

Provide a Useable Landbase

Manage a Public Landbase - The Hoosier National Forest manages over 196,000 acres in nine southern Indiana counties (Table 18). The gross area of the Forest proclamation boundary, inside which lands may be

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acquired, encompasses approximately 644,129 acres. Thus, NFS lands are surrounded by and intermixed with lands owned by many other parties. Other federal lands within the Forest proclamation boundary are managed by U.S. Army Corps of Engineers. State-owned lands in the area are managed by Indiana Department of Natural Resources. The remaining land inside the Forest boundary is owned by universities, municipalities, corporations, and private individuals. Although these lands are within the boundary of Hoosier National Forest, land use activities occurring on those lands are controlled by the landowner, and not the USDA Forest Service.

Consolidating NFS land ownership through land purchase or exchange helps improve the efficiency of Forest Service management. Land acquisition also brings unique ecosystems into public land ownership and provides a way to acquire habitat for endangered and threatened species. However, land exchange may affect federally listed species if suitable habitat removed from public ownership is not off-set by acquisition of other suitable habitat. It is Forest Service policy to not exchange lands with known occurrences of federally listed species. Exchanges are value-for-value not necessarily acre-for-acre, for example a recent exchange involved trading mineral rights for several tracts of land. About 400 acres per year are likely to be acquired, and a net gain of 40 acres per year is likely through land exchanges.

In the past five years over 25 miles of landline have been located. It is likely that the rate of landline location will be somewhat accelerated in the next few years. Discussion of landlines will not be carried further because actions involved with this will have no effect on federally listed species.

The majority of privately-owned lands are in tracts of less than 80 acres. There is a recent trend for these to be subdivided and sold for development of single family dwellings.

Table 18. Hoosier National Forest - acres by County in Purchase Unit (as of September 30, 1999).

Ranger District	Purchase Unit	County	Acres
<i>Brownstown</i>			95,622
	Pleasant Run		67,655
		Brown	18,065
		Jackson	22,900
		Lawrence	7,693
		Monroe	18,997
	Lost River		27,967
		Lawrence	8,101
		Martin	9,142
		Orange	10,724
<i>Tell City</i>			100,862
	Patoka River		20,276
		Crawford	972
		Orange	19,304
	Tell City		80,586
		Crawford	22,117
		Dubois	411
		Perry	58,058
Total Acres			196,484

Provide Road Access - The majority of roads within the Forest boundary are under county or state jurisdiction and are maintained to jurisdictional standards. Nearly all public roads on the Forest originated as local roads prior to the creation of the Hoosier. There are 236 miles of paved and 198 miles of gravel roads on NFS land within the Forest boundary. Arterial and collector roads are open to public use at all times. Because of the fragmented land ownership pattern, there are many additional roads which cross federal land to provide access to adjacent private lands. The quality of these roads is extremely variable. The Forest has limited control over these especially when the road existed prior to federal acquisition.

Private vehicles which are in compliance with state motor vehicle licensing laws may be operated on open forest roads (Table 19). Counties may allow ATV operators on county roads. Vehicles are not allowed off forest system roads. However, illegal use does occur and in some places can be a problem. Law enforcement officers patrol forest roads and ticket drivers who are operating vehicles off open forest roads.

There are currently about 105 miles of inventoried road maintained by the Hoosier National Forest (due to an on-going survey, this mileage is likely to increase dramatically in the near future). Most road work done by the USDA Forest Service consists of maintaining or reconstructing existing roadways. Activities consist of surface grading, minor realignment of existing roadways, cleaning out ditches, waterbarring, adding gravel, and pruning or removing trees encroaching on right-of-way. These activities have some potential for soil movement off-site. However, if maintenance is not done, studies have shown that erosion from poorly maintained roads can continue for many years. In addition, "soil loss can be cut in half through proper planning and maintenance" (Scoles *et al.* 1995). In the past ten years, only 1.5 miles of new permanent road has been constructed on Hoosier National Forest and another 2.0 miles is anticipated (access roads for U-38 and Celina dams). The Buzzard Roost project, if approved, would construct another 1.5 mile of temporary and 7.7 miles of system road. Temporary roads are constructed to access timber harvest units. Locating the roads on gentle slopes, grading breaks at frequent intervals on steep grades, using culverts and temporary bridges to protect streams at road crossings, gravelling roads, leaving vegetation along the stream to trap sediment and construction of properly placed dips, water bars or turnouts to divert water off roads and back to the forest are standard designs. The majority of Hoosier National Forest roads are located on or very near to ridgetop landscape positions. These roads contribute very little to sedimentation of the watershed.

About six gravel surfaced dispersed parking areas have been developed on the Tell City Ranger District and a similar number on the Brownstown Ranger District. Additional sites may also be identified.

Table 19. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Providing Road Access.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>Roads Constructed (miles)</i>				
All-weather	23	22	1.5	7.7
Dry-weather	275	118	0	3.5

Close Roads - Roads may be closed to protect resources such as soil, water, and wildlife; reduce maintenance costs; and limit access to edges of large tracts. Activities include gate or mound installation, and seeding and mulching earthwork to prevent erosion. Recontouring and revegetating abandoned roadbeds may also occur.

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About 20 road closure structures have been installed on the Tell City Ranger District between 1994 and 1998 and a similar number on the Brownstown Ranger District. Additional closures will be installed as necessary.

The Forest coordinates road related activities with local governments and landowners so that there are no adverse affects on legal access across NFS lands. New requests for access easements are handled on a case-by-case basis. Discussion of outstanding rights will not be carried further because actions involved with this are administrative and will have no effect on federally listed species.

Provide for Human and Community Development

Manage Wildfire - Unplanned fires that threaten life and private development are suppressed. Suppression activities include hand-worked fireline construction and burning out. Presuppression activities, such as constructing firebreaks by hand or machine and fuel load reduction, are designed to reduce acreage affected by wildfires (see "Manage Plant Communities Through Prescribed Burning").

Arson and escaped fires from private land continue to be the primary cause of wildfires on the Hoosier National Forest, with an average of six fires burning 30 acres of NFS land each year based on Forest records.

Wildfires may occur anywhere in the area on both public and private land.

Manage Oil, Gas & Minerals - Mineral production on the Hoosier National Forest has included limited amounts of oil, natural gas, coal, gypsum, and common variety minerals. Mineral operations are compatible on 15,300 acres or about 7.75 percent of the Hoosier (Table 20). There are currently no active mineral leases, no prospecting permits, and no prospecting permit applications filed with the USDI Bureau of Land Management (which manages all federal minerals). Surface facilities in support of mineral exploration and development would include drill sites and access roads. Existing roads would be used where possible to reduce the number of new temporary roads needed.

There are a few stone quarries in operation near the Forest. Deep gypsum mines are located near Shoals, IN.

Table 20. Comparisons of 1985 and 1991 Plan, and Actual Accomplishments in Managing Oil, Gas, and Minerals.

	Projected 1985 Plan	Projected 1991 Plan	Attainments 1994-1998	Projected 5 yrs.
<i>MINERALS</i> (acres)				
Compatible	117,200	15,300	15,300	15,300
Incompatible	70,800	172,700	180,700	180,700

Permit Special Uses - Most permits for special uses on the Hoosier National Forest are for utility rights-of-way or road access into private lands adjoining national forest. Currently there are about 206 miles (837 acres or 0.43 percent of the Forest) of special use utility rights-of-way or roads under permit or easement (Table 12). Some of these utilities are within other existing NFS rights-of-way, so some of this acreage is double counted. Maintaining these corridors generally involves pruning or limbing overhanging tree branches, mowing or brushhogging, road blading, and occasional removal of a tree which poses a hazard to permit holders. Construction of new rights-of-way or road access entails clearing vegetation from a corridor

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from eight feet wide for buried communications cables to about 100 feet wide for major powerlines. Each year, approximately 15 acres of new corridor are cleared for special use permits on the Forest.