

Patoka River

National Wildlife Refuge and Management Area

Comprehensive Conservation Plan Approval

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Patoka River

National Wildlife Refuge & Management Area

Comprehensive Conservation Plan

Chapter 1: Introduction and Background	1
Introduction	1
Purpose and Need for Plan	1
Establishment of the Refuge	3
Refuge Purposes	4
Refuge Vision	4
The U.S. Fish and Wildlife Service	4
The National Wildlife Refuge System	4
Legal and Policy Guidance	6
Compatibility Policy	6
Biological Integrity, Diversity, and Environmental Health Policy	7
Other Guidance	7
Existing Partnerships	7
Volunteers and Friends Group	8
Museums and Repositories	8
Chapter 2: The Planning Process	9
Public Scoping	9
The Comments	9
Internal Scoping	10
Preparation, Publishing, Finalization and Implementation of the CCP	11
Summary of Issues, Concerns and Opportunities	11
Chapter 3: Refuge Environment and Management	14
Introduction	14
Wetland Loss in Indiana	14
The Ohio River Valley Ecosystem	16
Other Units Administered	20
Migratory Bird Conservation Initiatives	20
North American Waterfowl Management Plan	20
Partners In Flight	21
U.S. Shorebird Conservation Plan	21
Waterbird Conservation for the Americas	22
North American Bird Conservation Initiative	23
Region 3 Fish and Wildlife Conservation Priorities	24
Indiana Comprehensive Wildlife Strategy	24
Other Recreation and Conservation Lands in the Area	24
Sugar Ridge Fish & Wildlife Area	24
Glendale Fish & Wildlife Area	24

Pike State Forest	24
Ferdinand State Forest	26
Other Recreation and Conservation Lands	26
Socioeconomic Setting	26
Population	26
Employment	26
Income and Education	27
Potential Refuge Visitors	27
Climate	27
Climate Change	28
Observed Climate Trends	29
Scenarios of Future Climate	29
Midwest Key Issues	29
Reduction in Lake and River Levels	29
Agricultural Shifts	30
Changes in Semi-natural and Natural Ecosystems	30
Air Quality	31
Geology and Soils	32
Geology	32
Minerals	32
Oil	32
Gas	32
Coal	33
Soils	33
Bottomland Soil Associations	33
Upland Soil Associations	34
Water and Hydrology	35
Refuge Resources	37
Plant Communities	37
Wetlands	37
Open Water	38
Uplands	38
Invasive Plant Species	38
Threatened and Endangered Plants	39
Fish and Wildlife Communities	39
Birds	39
Mammals	41
Game Mammals	41
Furbearers	42
Nongame mammals	43
Amphibians and Reptiles	43
Fish	44
Invertebrates	45
Insects	45
Molluscs	45
Threatened and Endangered Species	46
Threatened and Endangered Flora	46
Threatened and Endangered Fauna	46
Whooping Crane (<i>Grus Americana</i>)	46

Bald Eagle (<i>Haliaeetus leucocephalus</i>)	46
Least Tern (<i>Sterna antillarum</i>) (Interior Population)	48
Fat Pocketbook (<i>Potamilus capax</i>)	48
Indiana Bat (<i>Myotis sodalist</i>)	48
Copperbelly Water Snake (<i>Nerodia erythrogaster neglecta</i>)	49
Threats to Resources	49
Invasive Species	49
Contaminants	52
Interstate 69	55
Administrative Facilities	56
Archeological and Cultural Values	56
Current Management	57
Habitat Management	57
Forested Wetlands (Bottomland Forest)	57
Emergent Wetlands	60
Lakes and Ponds	60
Patoka River, Oxbows, and Patoka Tributaries	60
Water Quality	60
Moist Soil Units	60
Grasslands	60
Upland Forests	60
Cropland	61
Upland Openings	61
Invasive Plant Species	61
Interior Least Tern Nesting Habitat	61
Private Lands and Watershed Management	61
Farm Services Administration Conservation Easements	61
Land Acquisition	62
Wildlife Management	62
Threatened and Endangered Species	62
Migratory and Resident Birds	62
Native Resident Wildlife	62
Fish and Other Aquatic Species	62
Interior Least Terns	62
Pest Management	62
Fish and Wildlife Monitoring	62
Visitor Services	63
Hunting	63
Fishing	63
Wildlife Observation and Photography	65
Interpretation	65
Environmental Education	65
Friends and Volunteers	65
Outreach	65
Archeological and Cultural Values	65
Special Management Areas	65
Wilderness Review	65

Chapter 4: Management Direction	66
Goals, Objectives and Strategies	66
Chapter 5: Plan Implementation	82
New and Existing Projects	82
Construct Visitor Parking Lots	82
Completion of Observation Deck	82
Reconnect Oxbows on Patoka River	82
Maintenance and Construction of Storage Facilities	82
Macrotopography Wetlands	82
Future Staffing Requirements	83
Partnership Opportunities	83
Step-down Management Plans	84
Archeological and Cultural Values	84
Monitoring and Evaluation	85
Plan Review and Revision	85
 Appendix A: Finding of No Significant Impact	 87
Appendix B: Glossary	91
Appendix C: Species Lists	97
Appendix D: Resource Conservation Priorities, Ohio River Valley Ecosystem	119
Appendix E: Compliance Requirements	125
Appendix F: Mailing List	131
Appendix G: Compatibility Determinations	137
Appendix H: List of Preparers	139
Appendix I: Literature Cited	143
Appendix J: Priority Refuge Operational and Maintenance Needs	151
Appendix K: Response to Comments on the Draft CCP	155

List of Figures

Figure 1: Location of Patoka River NWR & MA	2
Figure 2: Patoka River NWR & MA Delineations	5
Figure 3: Acquisition Authority, Patoka River NWR & MA	15
Figure 4: Ohio River Valley Ecosystem	17
Figure 5: Bird Conservation Region in Which Patoka River NWR & MA is Located	23
Figure 6: Other Conservation Lands in the Area of Patoka River NWR & MA	25
Figure 7: Hydrology at Patoka River NWR & MA	36
Figure 8: Projected Route of Interstate 69	56
Figure 9: Current Landcover (West), Patoka River NWR & MA	58
Figure 10: Current Landcover (East), Patoka River NWR & MA	59
Figure 11: Current Visitor Facilities, Patoka River NWR & MA	64
Figure 12: Long-term (100 Years) Landcover, Patoka River NWR & MA (East)	67
Figure 13: Long-term (100 Years) Landcover, Patoka River NWR & MA (West)	68
Figure 14: Current and Future Concept of Patoka River Channel	69
Figure 15: Current Staffing Chart, Patoka River NWR	83
Figure 16: Staffing Required to Fully Implement Plan	83

List of Tables

Table 1: Status of Land Acquisition, Patoka River NWR & MA	16
Table 2: Endangered, Threatened, or Rare Vascular Plants in Gibson and Pike Counties, Indiana, as of 2005	47
Table 3: Endangered, Threatened, or Rare Fauna in Gibson and Pike Counties, Indiana, as of 2005	50
Table 4: Invasive Plants and Animals at Patoka NWR/MA	53
Table 5: Step-down Management Plan Schedule	84

Chapter 1: Introduction and Background

Introduction

Patoka River National Wildlife Refuge and Management Area (NWR & MA) is a work in progress. Established in 1994, approximately one-fourth of the total area approved for acquisition is presently part of the Refuge. Acquiring additional lands within the approved boundary is an ongoing effort. The Refuge is the 502nd refuge within the National Wildlife Refuge System and second refuge established in the State of Indiana.

The Patoka River had long been recognized for its wetland and wildlife values on a local, statewide and regional basis. In the late 1980s and early 1990s, the Service proposed establishing a national wildlife refuge/wildlife management area along the Patoka River in Pike and Gibson Counties of southwestern Indiana (see Figure 1). The portion of the river included in the proposal contains one of the few remaining expanses of bottomland hardwood forest wetlands in Indiana and the midwestern United States.

The area provides some of the best Wood Duck production habitat in all of Indiana. In all there are more than 380 species of wildlife on the Refuge, including the federally-listed endangered Indiana bat.

The area's natural resources face considerable challenges. Along the Patoka River, ditching, diking and channelization dating back to the early 1900s contributed to wetland losses. Water quality in the Patoka River drainage was diminished by over 20,000 acres of abandoned coal mine lands, oil well development activities, intensive agricultural operations, and community effluent.



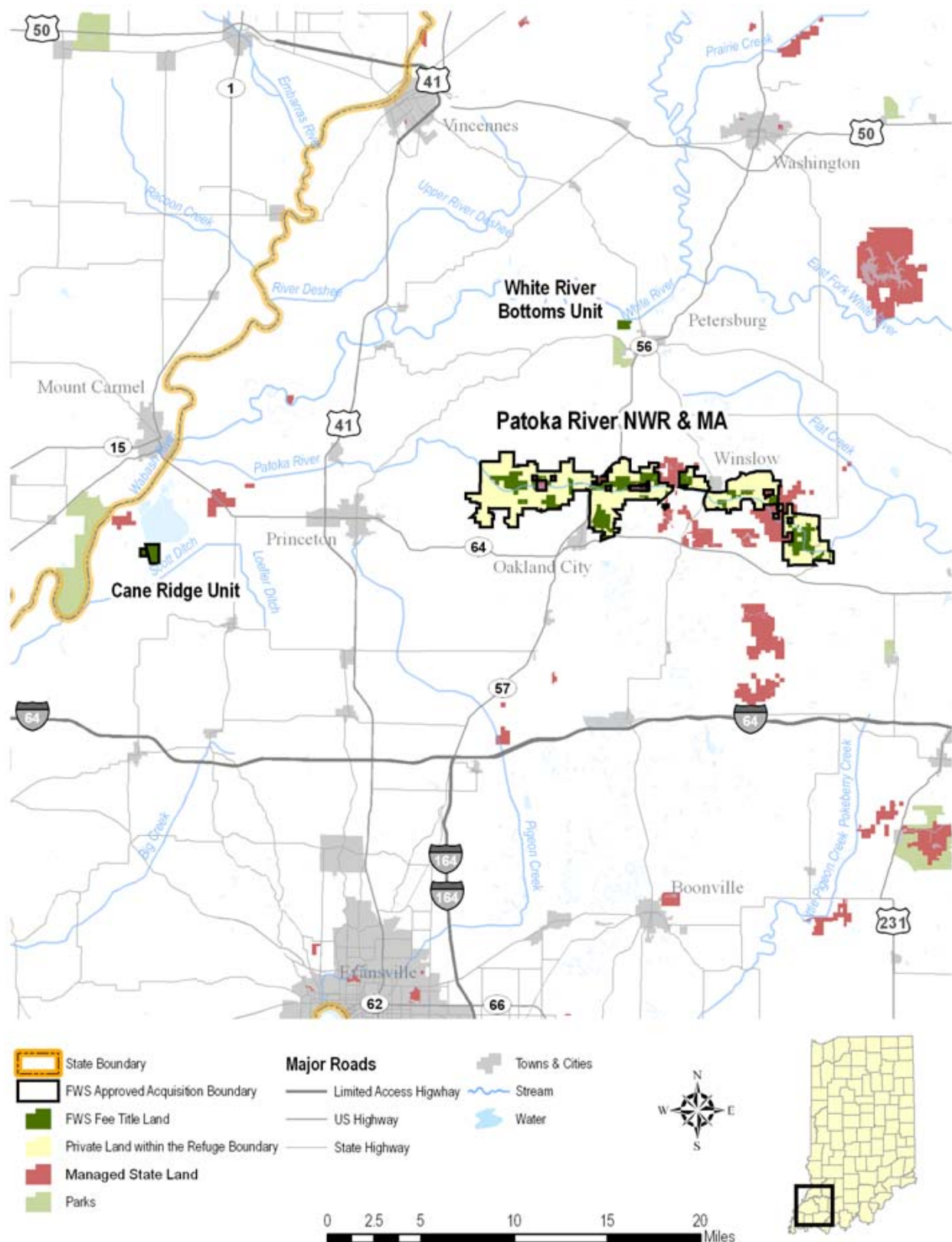
*Migrating Trumpeter Swans. Patoka River NWR & MA.
Photo credit: USFWS*

Purpose and Need for Plan

This Comprehensive Conservation Plan (CCP) articulates the management direction for Patoka River NWR & MA for the next 15 years. Through the development of goals, objectives, and strategies, the CCP describes how the Refuge contributes to the overall mission of the National Wildlife Refuge System. Several legislative mandates within the National Wildlife Refuge System Improvement Act of 1997 have guided the development of this plan. These mandates include:

- Wildlife has first priority in the management of refuges.
- Wildlife-dependent recreation activities: namely hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation are priority public uses of refuges. We will facilitate these activities when they do not interfere with our ability to fulfill the refuges' purpose or the mission of the Refuge System.

Figure 1: Location of Patoka River NWR & MA



- Other uses of the Refuge will only be allowed when determined appropriate and compatible with Refuge purposes and mission of the Refuge System.

The plan will guide the management of Patoka River NWR & MA by:

- Providing a clear statement of direction for the future management of the Refuge.
- Making a strong connection between Refuge activities and conservation activities that occur in the surrounding area.
- Providing Refuge neighbors, users, and the general public with an understanding of the Service's land acquisition and management actions on and around the Refuge.
- Ensuring the Refuge actions and programs are consistent with the mandates of the National Wildlife Refuge System.
- Ensuring that Refuge management considers federal, state, and county plans.
- Ensuring that Refuge management considers the preservation of historic properties.
- Establishing long-term continuity in Refuge management.
- Providing a basis for the development of budget requests on the Refuge's operational, maintenance, and capital improvement needs.

Establishment of the Refuge

In 1986, the Emergency Wetlands Resources Act (Act) was enacted by Congress to promote the conservation of America's wetlands by intensifying



Mallard nest, Patoka River NWR & MA. Photo credit: USFWS

cooperative efforts among federal agencies, states, local governments, and private interests for conservation, management, and acquisition of wetlands.

The Department of the Interior developed a National Wetlands Priority Conservation Plan as directed by Section 301 of the Act, and in the Midwest Region a Regional Wetlands Concept Plan (USFWS, 1990) was prepared to provide a framework for protecting priority wetlands in the eight states that make up the Region: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin. The Regional Wetlands Concept Plan provided the focus for acquisition, restoration and renewal of valuable wetlands, emphasizing those areas where losses are highest.

The stretch of the Patoka River running through Pike and Gibson Counties in southern Indiana was identified as a focus area within the 1990 Regional Wetlands Concept Plan. The area is part of the middle Mississippi River and lower Ohio River drainage and is characterized by rich bottomland hardwood wetlands that historically provided prime breeding and wintering habitat for species such as Wood Ducks, Mallards and Bald Eagles.

Patoka River NWR & MA was established in 1994. The authorized boundary (also known as the "acquisition boundary") – which delineates where the Service can acquire property from willing sellers – encompasses 23,743 acres of wetlands, floodplain forest, and upland buffer along 30 miles of the Patoka River corridor. Management objectives are identical for the National Wildlife Refuge, authorized at 6,970 acres, and the Management Area (MA), authorized for the remaining 15,847 acres. The separate designations avoid legal conflicts with the Surface Mining Control and Reclamation Act (SMCRA) of 1977.

SMCRA prohibits surface mining within national wildlife refuges. Legally, this was interpreted to apply to all lands within the authorized boundary of a national wildlife refuge regardless of ownership. Much of the land along the Patoka River corridor is privately owned and underlain by surface and/or underground minable coal reserves. Designating the entire area within the boundary as a National Wildlife Refuge would have prohibited surface mining and required compensating land owners for the value of this property right.

To find a solution to this dilemma, the U.S. Office of Surface Mining was contracted to complete a coal study to determine which lands within the acquisition boundary were underlain by potentially min-

able coal reserves. The areas with coal deposits were delineated and identified as a “selection area” for the acquisition of Wildlife Management Areas instead of being identified as an acquisition area for the National Wildlife Refuge. Figure 2 shows the distribution of these areas within the Refuge boundary. This naming convention was done to avert a conflict with the SMCRA and to avoid the unintentional taking of surface minable coal rights of private land owners. It has no implications for the management of these areas.

Refuge Purposes

Refuge purposes are specified or derived from the law, proclamation, Executive Order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. Patoka River NWR & MA has the following refuge purposes:

“... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ...” 16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

“... particular value in carrying out the national migratory bird management program. 16 U.S.C. 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife)

“... (1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries.” 16 U.S.C. 4401-4413 (North American Wetlands Conservation Act)

Refuge Vision

The Patoka River National Wildlife Refuge and Management Area restores, protects and manages a diverse bottomland hardwood forest ecosystem and associated habitats for migratory

birds, threatened and endangered species, and indigenous fish and wildlife, while striving to develop citizen understanding and support for the protection of natural resources by providing wildlife-related education and recreation opportunities.

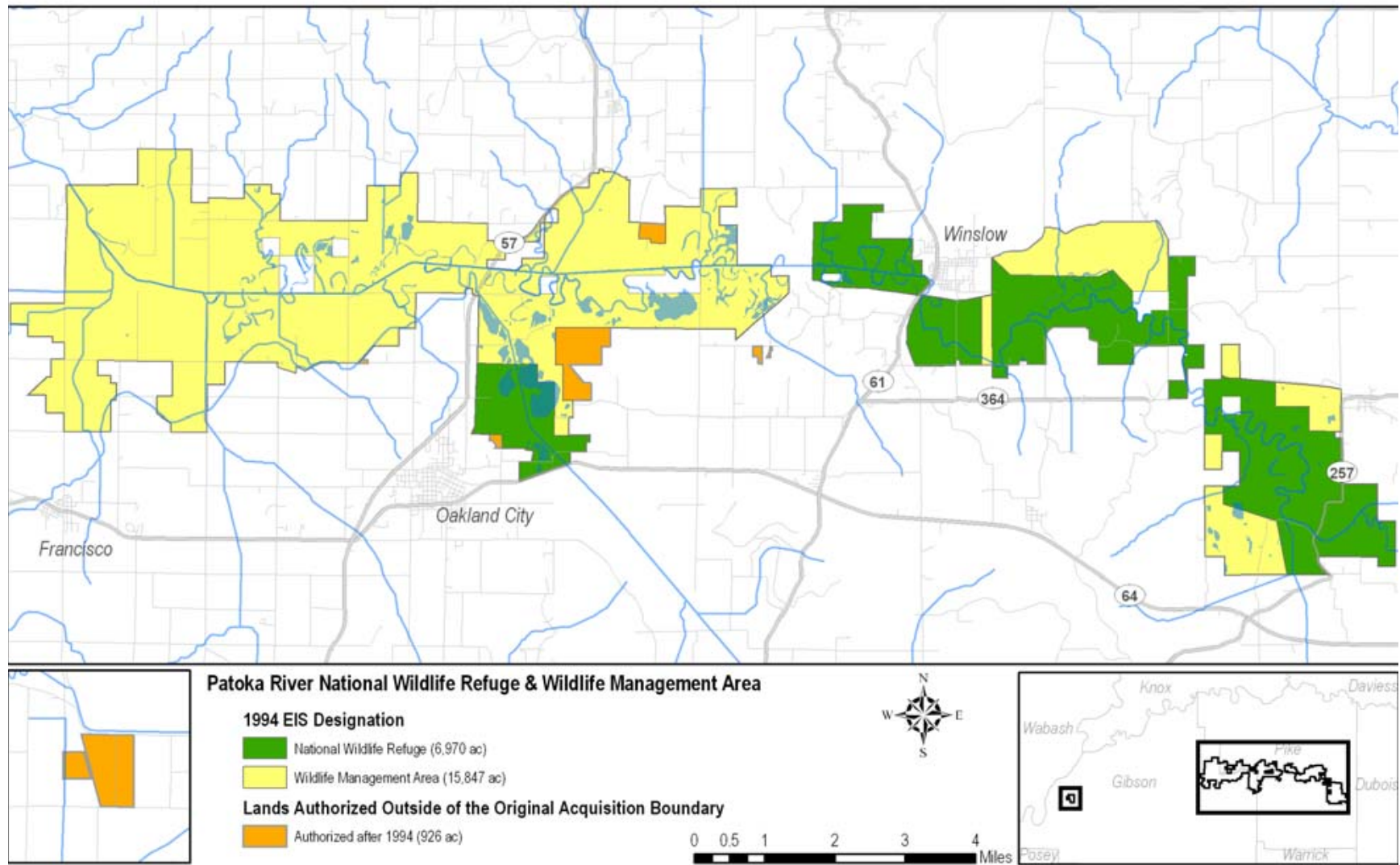
The U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (Service) is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife populations and their habitats. The Service administers the lands of the National Wildlife Refuge System, oversees the enforcement of federal wildlife laws, management and protection of migratory bird populations, restoration of nationally significant fisheries, administration of the Endangered Species Act, and the restoration of wildlife habitat such as wetlands.

The National Wildlife Refuge System

Refuge lands are part of the National Wildlife Refuge System, which was founded in 1903 when President Theodore Roosevelt designated Pelican Island in Florida as a sanctuary for brown pelicans. Today, the System is a network of more than 540 refuges covering more than 93 million acres of public lands and waters. Most of these lands (82 percent) are in Alaska, with approximately 16 million acres located in the lower 48 states and several island territories. The National Wildlife Refuge System is the world's largest collection of lands specifically managed for fish and wildlife. Overall, it provides habitat for more than 5,000 species of birds, mammals, fish, and insects. As a result of international treaties for migratory bird conservation as well as other legislation, such as the Migratory Bird Conservation Act of 1929, many refuges have been established to protect migratory waterfowl and their migratory flyways from their northern nesting grounds to southern wintering areas. Refuges also play a vital role in preserving endangered and threatened species. Among the most notable is Aransas National Wildlife Refuge in Texas, which provides winter habitat for the Whooping Crane. Likewise, the Florida Panther NWR protects one of the nation's most

Figure 2: Patoka River NWR & MA Delineations





Snakey Point fishing pier, Patoka River NWR & MA.
Photo credit: USFWS

endangered predators, and the Mississippi Sandhill Crane NWR an endangered, non-migratory species of the Sandhill Crane.

Refuges also provide unique opportunities for people. When it is compatible with wildlife and habitat conservation, they are places where people can enjoy wildlife-dependent recreation such as hunting, fishing, wildlife observation, photography, environmental education, and environmental interpretation. Many refuges have visitor centers, wildlife trails, automobile tours, and environmental education programs. Nationwide, approximately 39.5 million people visited national wildlife refuges in 2003.

The National Wildlife Refuge System Improvement Act of 1997 established several important mandates aimed at making the management of national wildlife refuges more cohesive. The preparation of comprehensive conservation plans is one of those mandates. The legislation directs the Secretary of the Interior to ensure that the mission of the National Wildlife Refuge System and purposes of the individual refuges are carried out. It also requires the Secretary to maintain the biological integrity, diversity, and environmental health of the National Wildlife Refuge System.

The goals of the National Wildlife Refuge System are to:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and

carefully managed to meet important life history needs of these species across their ranges.

- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

Legal and Policy Guidance

The National Wildlife Refuge System Improvement Act of 1997 established several important mandates aimed at making the management of national wildlife refuges more cohesive. The preparation of CCPs is one of those mandates. The Act directs the Secretary of the Interior to ensure that the mission of the National Wildlife Refuge System and purposes of the individual refuges are carried out. The 1997 Refuge Improvement Act requires the Secretary to maintain the biological integrity, diversity, and environmental health and to identify the archeological and cultural values of the National Wildlife Refuge System. The Act deals with compatibility of uses on refuges and directs the Secretary of Interior to issue regulations for compatibility determinations. The Act also directs that compatible wildlife-dependent uses should be facilitated. Since passage of the Act, the Service has adopted policies that implement direction of the Act.

Compatibility Policy

Service policy says that no uses for which the Service has authority to regulate may be allowed on a unit of the Refuge System unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge. Managers must complete a written compatibility determination for each use, or collection of



Foxglove beard-tongue, Patoka River NWR & MA. Photo credit: USFWS

like uses, that is signed by the manager and the Regional Chief of Refuges in the respective Service region.

Biological Integrity, Diversity, and Environmental Health Policy

The Service is directed in the Refuge Improvement Act to “ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans...” The biological integrity policy helps define and clarify this directive by providing guidance on what conditions constitute biological integrity, diversity, and environmental health; guidelines for maintaining existing levels; guidelines for determining how and when it is appropriate to restore lost elements; and guidelines in dealing with external threats to biological integrity, diversity and health.

Other Guidance

In addition to the Refuge’s establishing executive orders, authorizing legislation, and the National Wildlife Refuge System Improvement Act of 1997,

several Federal laws, executive orders, and regulations govern administration of the Refuge. Appendix E contains a partial list of the legal mandates that guided the preparation of this plan and those that pertain to Refuge management activities.

Existing Partnerships

Working with others through intra- and inter-agency partnerships is essential to accomplishing the mission of the Fish and Wildlife Service as well as assisting Patoka River NWR & MA in achieving its purposes and vision. Partnerships with other federal and state agencies and with a diversity of public and private organizations are increasingly important. Other agencies can provide invaluable assistance in research and maintenance. Private groups and non-profit organizations greatly enhance public involvement in the Refuge, building enthusiasm and support for its mission.

Within the Ohio River Valley ecosystem in which Patoka River NWR is located, the Service partners with a number of other agencies and institutions, both governmental and non-governmental. These include:

- State conservation and natural resources agencies, including the Indiana Department of Natural Resources (Indiana Wildlife and Fisheries);
- Federal agencies, including the U.S. Forest Service, U.S. Environmental Protection Agency, National Park Service, U.S. Geological Survey Biological Resources Division, and Natural Resources Conservation Service;
- Local governments;
- Institutions of higher learning;
- Local landowners and businesses
- Non-governmental conservation organizations

Besides the partnerships that the Fish and Wildlife Service holds on the national and regional (ecosystem) level, Patoka River NWR maintains formal and informal working partnerships with the following agencies, non-governmental conservation organizations, and businesses:

- Indiana Department of Natural Resources
- Division of Fish and Wildlife
- Division of Mining and Reclamation
- Division of Oil and Gas
- Division of Nature Preserves

- Indiana Heritage Trust
- Indiana Department of Transportation
- USDA Natural Resources Conservation Service (NRCS)
- Gibson County Coal
- Duke Energy (an electric utility operating the Gibson Generating Station)
- Ducks Unlimited
- Evansville Chapter of the National Audubon Society
- Waterfowl U.S.A.
- Quail Unlimited
- National Wild Turkey Federation
- National Fish and Wildlife Foundation
- PRIDE – Refuge Friends
- Izaak Walton League
- U.S. Army Corps of Engineers- Louisville
- U.S. Office of Surface Mining and Reclamation

Volunteers and Friends Group

The Refuge also relies on the selfless dedication of volunteers to extend the efforts of staff. Volunteers play an important role in the management and maintenance of the fish and wildlife resources on Patoka River Wildlife Refuge. In an era of flat or declining budgets, it is more important now than ever that volunteers step forward to help protect and preserve our natural resource heritage for present and future generations to enjoy.

Patoka River NWR also has an informal Friends group that has helped implement projects like construction of the fishing pier and trail at Snakey Point and the South Fork Fishermans Trail.

Museums and Repositories

The Refuge has no reported museum property on- or off-site; no natural history specimens, no artwork, nor historic documents or photographs nor any other kind of historical material. The several cultural resources surveys conducted on the Refuge have produced no archeological collections.

Chapter 2: The Planning Process

Patoka River NWR's CCP has been written with input and assistance from citizens, non-governmental conservation organizations (NGOs), and other government agencies. The participation of these stakeholders is vital and all of their ideas have been valuable in determining the future direction of the three refuges. Refuge and regional staff – indeed, the entire U.S. Fish and Wildlife Service – are grateful to all of those who have contributed time, expertise and ideas throughout the comprehensive conservation planning process. We appreciated the enthusiasm and commitment expressed by many for the lands and living resources administered by Patoka River NWR.

Public Scoping

Work on the comprehensive conservation plan began with a public scoping meeting held on October 14, 2004 at the Indiana Department of Natural Resources' Sugar Ridge Fish and Wildlife Area Office, south of Winslow, Indiana. More than 30 people attended the meeting to offer their ideas for the Refuge's management.

People attending the meeting were offered a variety of ways to submit their comments. Refuge staff and regional planners were available to talk about issues, and staff used a computer to write a short summary of the conversation so that it would be recorded. Attendees could also use a survey form or index card to submit written comments. In addition, staff prepared questions about Refuge management to post throughout the room, and people attending the meeting were invited to use red or green stickers to indicate whether they supported a given idea or not.

Staff also invited people to record their experiences on Patoka River NWR on a timeline.



Canada Geese, Patoka River NWR & MA. Photo credit. USFWS

The Comments

There were a number of comments about land acquisition. Most were supportive of additional land acquisition with some noting frustration with the land appraisal process. Others mentioned that insufficient funds were hampering acquisition efforts. Two comments opposed additional funding for land acquisition.

Some comments expressed concern about management of lands presently owned by the Refuge citing the need for additional money and staff to carry out proper management. Trespassing from Refuge lands onto adjoining private lands was seen as a problem by some, and a number supported increased law enforcement presence.

Opinion on hunting was mixed, with some people supporting additional hunting opportunities. Others said that hunting should not be allowed on some

portions of the Refuge; some were interested in limiting hunting to encourage wildlife and others were interested in preserving portions of the Refuge for wildlife observation even during hunting seasons. There was support and some opposition to establishing sanctuary areas where no hunting would occur.

A number of individual comments supported allowing a variety of uses including night fishing, harvesting nuts, berries, and mushrooms, and trapping.

There was strong support for a visitor center. Additional trails as well as user fees were supported by some and opposed by others.

A number of people expressed concern about the potential construction of Interstate 69 and the effect it may have on the Refuge.

Another survey question asked whether there should be more trails on the Refuge. Most of the comments supported additional trails, with one person saying he or she supported more trails except where they might inhibit wildlife. One commenter said the Refuge does not need additional trails, and another said that the existing trails need greater visibility in the community.

Concern about the effect the Interstate 69 project might have on the Refuge was expressed in responses to a survey question asking what changes might help or challenge the Refuge. Two people expressed reservations about the project's effect on the Refuge and a third person said that depending on how it's done the highway project could have either a good or bad effect on the Refuge.

Problems facing the Refuge were described as funding for acquisition, funding in general, all-terrain vehicles, and visibility.

Nine people attending the meeting supported an entrance or user fee while two people indicated that they did not support a fee.

Internal Scoping

On April 19, 2005 the Regional Office held an internal scoping meeting on the development of the Patoka River NWR Comprehensive Conservation Plan. People attending the meeting included the Deputy Regional Director, the Deputy Chief of Refuges, the Chief of Engineering, and staff from the Division of Conservation Planning, the Division of Migratory Birds, the Division of Ecological Services, the Division of Visitor Services, the Division of Realty, and the North American Waterfowl Management Plan.



Flooded river oxbow, Patoka River NWR & MA. Photo credit: USFWS

Regional Office staff identified several issues that should be addressed in the comprehensive conservation plan:

- How will the Interstate 69 project affect the Refuge? The location of exits, a rest stop and a pull off all have positive and negative aspects for the Refuge.
- What is a reasonable acquisition goal for next 15 years?
- Land acquisition is difficult for the Service right now because of funding issues.
- Is there potential for increasing the number of accesses to the Refuge?
- Are there opportunities for moving the Refuge's Headquarters to property owned by the Service or other government agency instead of continuing to lease space?
- More law enforcement presence is needed. Is there any potential for an agreement with the State Conservation Officers?
- The Refuge needs greater local visibility.
- Are there funding sources available that would help the Region get enough money to buy larger properties?
- There is potential for improving fishery habitat in a variety of ways, including connecting oxbows, increasing the hydrology of the oxbows, possibly cleaning out some of the oxbows that are filling in. The Refuge currently cannot afford these projects, but staff should develop a fisheries management plan in the event that the Service is able to acquire necessary tracts.

- Increasing fishing opportunities is of considerable local interest.
- There are several endangered species in the area, including the copperbelly watersnake. The copperbelly watersnake conservation agreement area encompasses a large part of the Refuge area; nine coal companies signed this agreement; it kept the Service from listing the copperbelly watersnake if the areas in the conservation area are not mined.

Preparation, Publishing, Finalization and Implementation of the CCP

The Draft CCP and Draft Environmental Assessment (EA) for Patoka River NWR & MA were prepared by a contractor with a great deal of input, review and support from Refuge staff and the Service's Regional Office. The Draft CCP/EA was published in two phases and in accordance with the National Environmental Policy Act (NEPA). The Draft EA (Appendix A of the Draft CCP) presented a range of alternatives for future management and identified the preferred alternative, which formed the basis of the Draft CCP. A 30-day public review period, which included a public meeting, followed release of the draft CCP. Verbal and written comments received by the Service have been incorporated where appropriate.

The alternative that was ultimately selected has become the basis of the ensuing Final CCP.



Channelized section, Patoka River, Patoka River NWR & MA. Photo credit: USFWS

This document then, becomes the basis for guiding management on the Refuges and the management areas over the coming 15-year period. It will guide the development of more detailed step-down management plans for specific resource areas; it will underpin the annual budgeting process through project submittals to the Service Asset and Maintenance Management System (SAMMS). Most importantly, it lays out the general approach to managing habitat, wildlife, and people at Patoka River NWR and Wildlife Management Area that will direct day-to-day decision-making and actions.

The Draft CCP/EA was released for public review and comment on October 17, 2007. A Draft CCP/EA or a summary of the document was sent to more than 416 individuals, organizations, and local, state, and federal agencies and elected officials. An open house event was held on November 7, 2007, at the Sugar Ridge Fish and Wildlife Area headquarters following release of the draft document. We received a total of 18 comment letters and e-mails during the 45-day review period. Appendix K of the CCP summarizes these comments and our responses. Several of the comments resulted in changes in the CCP.

Summary of Issues, Concerns and Opportunities

Issue Statement

The Service often cannot compete with other buyers for properties within the Refuge's acquisition boundary due to lack of funds. This makes it difficult to grow the Refuge at a time when interest in and demand for public land is increasing.

Background: Since the Refuge was established in 1994, the Service has acquired 6,162 out of 23,743 acres within the acquisition boundary. The Land Protection Plan groups land parcels within the acquisition boundary into four priority classes:

- Bottomlands supporting natural habitat and parcels essential to the restoration of a woodland corridor along the length of the Patoka River within the Project boundary;
- Bottomland farmland in the floodplain;
- Upland forest and reclaimed land; and
- Upland farmland and other lands, such as abandoned mine lands.

There are more willing sellers than funds available, and acquisition budgets are declining as land values around the Refuge rise. Economic growth and the potential construction of Interstate 69 are likely to continue to drive up land values. Many scoping respondents supported additional land acquisition. The Refuge continues to work with partners such as Ducks Unlimited to acquire property.

Issue Statement

Local public support of the Refuge has been closely tied to hunting and fishing. There is demand to provide areas for other wildlife-dependent uses and for wildlife sanctuary, which could reduce the amount of the Refuge open to hunting and fishing.

Background: All but 606 acres of the 6,162 acres of Refuge lands are open to hunting and fishing consistent with Indiana DNR regulations. Hunting is prohibited on about 5 acres surrounding a trail and boat launch, and within a single 113-acre block of reclaimed mine land. This block will be open to hunting when the lands meet reclamation criteria and the bond collected from the mining company is released. Hunting also is prohibited on the 488-acre Cane Ridge Wildlife Management area 24 miles west of the Refuge office. The number of other wildlife-dependent uses is growing and facilities constructed to support these uses are popular with visitors. During scoping, respondents suggested providing additional trails and other facilities as well as designating a portion of the Refuge as a waterfowl sanctuary free of hunting. Others opposed any reduction of lands open to hunting and fishing.

Issue Statement

There is demand for additional public use on the Refuge. Some of the uses are not wildlife-dependent.

Background: Local residents grew accustomed to recreating on private lands because absentee landowners, usually coal companies, did little to enforce against trespass. Today, these landowners are leasing the land and more aggressively enforcing trespassing laws. With fewer places to recreate, use has shifted to Refuge lands. Also, economic prosperity within the region has drawn more people to the area. Some of these newcomers also recreate on Refuge lands. The Refuge is open to the priority wildlife-dependent uses noted in the 1997 Refuge Improvement Act (hunting, fishing, wildlife observation, wildlife photography, environmental educa-



*Community involvement, Patoka River NWR & MA.
Photo credit: USFWS*

tion, and environmental interpretation). Other uses have been authorized through a special use permit system at the discretion of the Refuge Manager. A number of scoping comments suggested that recreation opportunities on the Refuge could make it a tourist destination. Others requested specific uses of Refuge lands.

Issue Statement

Refuge habitats are at risk from a number of threats such as agricultural runoff, coal mining, potential construction of Interstate 69, illegal uses such as All-Terrain Vehicles (ATV's), and development of lands not yet acquired.

Background: Most of these threats to land and resources in the area preceded establishment of the Refuge in the 1990s. They are long-term threats to the quality and quantity of terrestrial and aquatic wildlife habitat in the area. Water quality impairment from agricultural runoff and coal mining may have improved somewhat since the Refuge's establishment. Construction of Interstate 69 has not yet occurred, but continues to loom ever closer. Land development – both residential and commercial, and to some extent industrial – has accelerated in recent years as the area's amenities (accessible outdoors, semi-rural/small town lifestyle, low housing prices and cost of living) have attracted outsiders and returning native-born residents alike.

Issue Statement

The patchwork of public and private lands within the Refuge boundary can be confusing to visitors and may lead to conflicts with adjoining private land owners.



American lotus, Patoka River NWR & MA. Photo credit: USFWS

Background: Approximately 75 percent of the lands within the Refuge's acquisition boundary are not owned by the Service. The Refuge has a small scale map showing ownership, but Refuge boundaries are not posted and the patchwork of public and private lands within the acquisition boundary could easily confuse visitors. One scoping respondent expressed concern about trespass from neighboring Refuge lands.

Issue Statement

Demand for visitor services, facilities, information, and environmental education exceeds existing supply and/or the capacity of existing staff and budgets.

Background: Refuge visitation continues to climb and is currently estimated at 21,221 visitors per year. Presently, the Refuge has maps and fact sheets available during business hours at the Refuge office. The staff and volunteers deliver off-Refuge environmental education programs several times per year, but there is additional demand that is not being met. A number of scoping respondents requested additional Refuge information, environmental education, or facilities.

Issue Statement

Some Visitor Services facilities do not meet U.S. Fish and Wildlife Service standards.

Background: As a relatively new Refuge with no park ranger or public use/visitor services specialist on site, Patoka River NWR has not yet developed facilities or visitor services on a par with many older refuges. During scoping, many participants called attention to a need for greater information about the Refuge and what it has to offer to be made avail-

able to the public via e-mail, the Internet, newsletters, signage, and so forth. Respondents expressed unawareness of the existence of trails for wildlife observation, for example. There is no visitor center on the Refuge to provide information, interpretation, and environmental education.

Issue Statement

Refuge ecosystems and the effects of management activities (including public use) are not well understood.

Background: Sustaining wildlife populations is central to the mission of the National Wildlife Refuge System, but in many cases information is lacking regarding the success of management activities or the effect of public uses on Refuge wildlife. This hampers managers' ability to adapt habitat management practices or modify public uses in ways that best sustain wildlife numbers. Presently, the Refuge monitors the Least Terns at Cane Ridge WMA, conducts seasonal waterfowl, shorebird and breeding songbird counts, bands Wood Ducks, and contributes to the Indiana DNR's annual turkey call survey. Monitoring of uses as well as management activities is necessary to determine success or thresholds.

Issue Statement

Productivity (fishery) is declining in some oxbow lakes along the channelized portion of the Patoka River.

Background: In the 1920s area residents channelized a portion of the Patoka River in an attempt to drain nearly 100,000 acres of forested wetlands for farming. Known as Houchin's Ditch and beginning at the town of Winslow, the project replaced 36 miles of natural, meandering river with about 17 miles of dredged, straight ditch. The dredged spoil deposited on both sides of the ditch cut off 19 miles of natural river meanders on the north and south sides of the new ditch main channel. Water exchange within these cut off oxbows is now limited to periods of high water. Heavy sediment loads during these periods result in increased deposition in the oxbows. Consequently, the oxbows are becoming shallower and hold water for a shorter duration. Although this process occurs in all natural riverine systems, new oxbows are continually being created as river meanders are severed from the main channel. In the case of Houchins's Ditch, these oxbows are not being replaced and the associated wetland habitat is being lost.

Chapter 3: Refuge Environment and Management

Introduction

Established in 1994, the Patoka River National Wildlife Refuge and Management Area is located in Pike and Gibson counties in southwestern Indiana. It was created under authority of the Emergency Wetlands Resources Act in part to protect one of two remaining intact floodplain forest systems within Indiana. The river corridor project encompasses 30 miles of the Patoka River and 19 miles of oxbows with a total of 12,700 acres of existing wetlands.

Presently, the acquisition boundary for the NWR & MA includes 23,743 acres. This differs from the 22,083 acres included in the Record of Decision for the 1994 Environmental Impact Statement (EIS) that established the Refuge & MA. There are two reasons for this difference. The first is that past methods of calculating acres (e.g. summing acres found in tax records or plat books) have given way to computerized Geographic Information Systems (GIS) that rely on standardized data which provide greater uniformity of acreage values. It is important to note that for legal transactions deed acres remain the legal standard, but habitat acreage figures throughout this document are based on GIS generated values. In the EIS the area within the acquisition boundary was stated at 22,083 acres. The same boundary is calculated to contain 22,817 acres using GIS protocols. The second reason for the acreage difference is that an additional 926 acres have been authorized for acquisition since the original boundary was established, bringing the total area authorized for acquisition to the present figure of 23,743 acres. The Refuge also administers a 219-acre parcel transferred to the Service from the Farm Ser-



Great Horned Owl nest, Patoka River NWR & MA. Photo credit: USFWS

vices Agency now known as White River Bottoms. Although managed by Refuge staff, and part of the National Wildlife Refuge System it is not included as part of the Patoka River NWR & MA and does not figure in the total acreage. See Figure 3 and Table 1.

Most of the information in this chapter comes from the Environmental Impact Statement (EIS) prepared in conjunction with the establishment of the Patoka River National Wetlands Project (USFWS, 1994). The wetlands project led to the creation of Patoka River National Wildlife Refuge and Management Area.

Wetland Loss in Indiana

The 20th century witnessed a dramatic decline in the acreage of America's wetland habitat that is so critical to maintaining migratory bird and other

Figure 3: Acquisition Authority, Patoka River NWR & MA

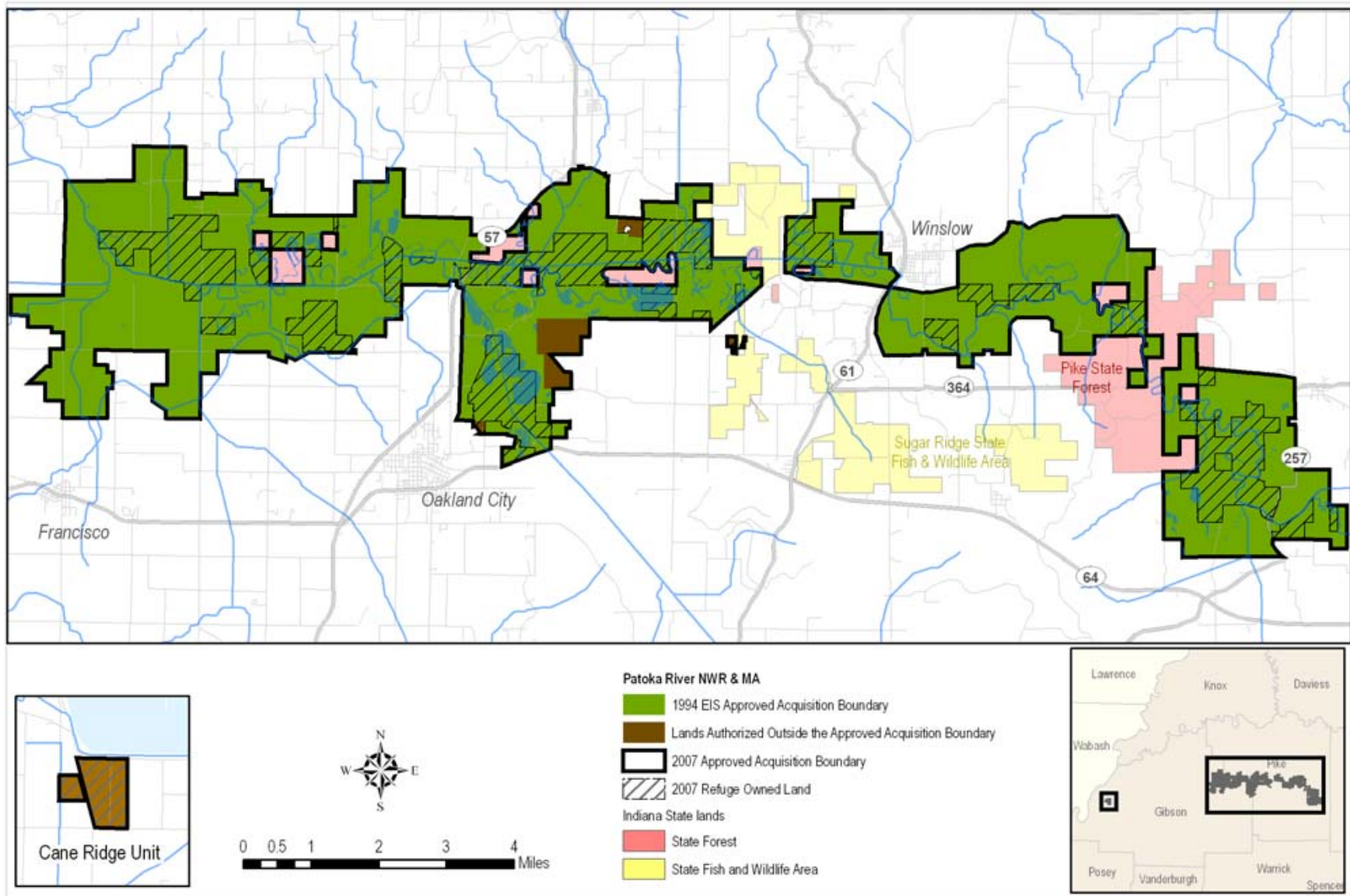


Table 1: Status of Land Acquisition, Patoka River NWR & MA

Description	Acres Cited in 1994 EIS	Current GIS Acres
Establishment acquisition boundary	22,083	22,817
Additional lands approved for acquisition	--	926
Total acres authorized for acquisition	--	23,743
FSA Lands (White River Bottoms)	--	219

wildlife populations. By the close of the century and the dawn of the new millennium, the U.S. Fish and Wildlife Service estimated that nationally, only 103 million acres (less than half) remained of the estimated 221 million acres of wetlands that existed in the lower 48 states at the time of Euro-American settlement.

In the State of Indiana, long-term wetland loss has been even more dramatic. Of the estimated 5.5 million acres of wetlands that existed in Indiana at the time of settlement, only 813,000 acres (15 percent) remained by the 1990s (Rolley, 1991), according to the most recent and complete analysis of the state's wetland resources (Indiana WETlands, 2004). Historically, about 85 percent of this wetland loss has been for agricultural purposes with the remainder attributable to urban and industrial development (IDNR, 1988). In the mid-1990s, the Indiana Division of Fish and Wildlife and the USFWS estimated an annual loss of 5 percent of remaining wetlands. However, wildlife biologists and conservationists held hope that compliance with the "Swampbuster" provisions of the 1985 and 1990 farm bills, alongside with increasing awareness by farmers of the importance of wetlands, could moderate future wetland losses due to agricultural conversion.

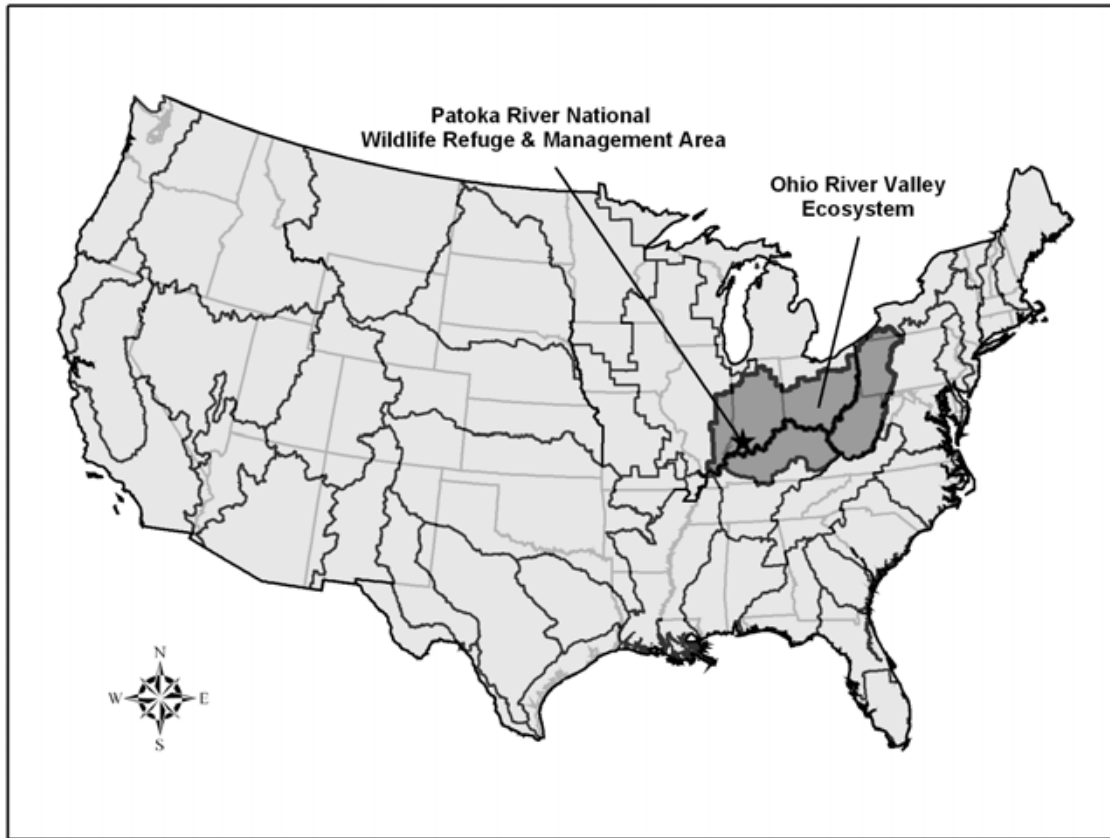
Of the wetlands remaining in Indiana, only a small percentage remains as they existed 200 years ago. Few of the state's natural wetlands now support their original complement of plants and animals. This biological diversity has been degraded as a result of impacts to water quality, alterations of water levels and upstream watersheds and other surface disturbances. The seriousness of this loss is best recognized by the fact that over 120 different plants that occur naturally in wetlands and over 60 species of wetland-dependent animals are listed as either endangered, threatened or of special concern by the Indiana Department of Natural Resources (IDNR). Of all wetland types, the palustrine forested wetlands (bottomland hardwoods) have been identified in Indiana as the "state wetland priority

type." This means priority for protection is based on the historical pattern of loss and alterations occurring in Indiana and the multiple values they have to fish, wildlife and plant resources (IDNR, 1988).

The Ohio River Valley Ecosystem

The U.S. Fish and Wildlife Service has adopted an ecosystem approach to conservation because we cannot look just at an individual animal, species, or fragment of land in isolation from all that surrounds it. The Service has recognized some 53 ecosystems in the conterminous 48 states. We recognize that we are not going to achieve conservation within the boundaries of a National Wildlife Refuge, or restore aquatic resources with a National Fish Hatchery, and that listing an endangered species is not going to conserve the system on which it depends. The ecosystem approach thus strives to be comprehensive. It is based on all of the biological resources within a watershed (the total land area from which water drains into a single stream, lake, or ocean) and it considers the economic health of communities within that watershed landscape. An ecosystem approach to fish and wildlife conservation means protecting or restoring the function, structure, and species composition of an ecosystem while providing for its sustainable socioeconomic use.

Patoka River NWR & MA is located within the Ohio River Valley Ecosystem (ORVE) as currently defined by the U.S. Fish and Wildlife Service. This ecosystem drains a total area of approximately 141,000 square miles and includes portions of 10 states. The Ohio River, which is the backbone of this ecosystem, is formed by the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania and flows 981 miles in a southwesterly direction to its confluence with the Mississippi River at Cairo, Illinois (ORVET, no date).

Figure 4: Ohio River Valley Ecosystem

The Ohio River ecosystem bisects three regions of the Deciduous Forest Formation of eastern North America: the Mixed Mesophytic Forest Region (upper basin, roughly upstream of Portsmouth, Ohio), the Western Mesophytic Forest Region (lower basin from Portsmouth, Ohio, to Paducah, Kentucky), and the Mississippi Alluvial Plain Section of the Southeastern Evergreen Forest Region (lowermost portion of the basin from Paducah, Kentucky, to Cairo, Illinois (USFWS, 1999). (See Figure 4)

The mixed mesophytic and western mesophytic forests have been classified broadly as a tulip poplar-oak region. The dense, mixed mesophytic forest contains a fair abundance of two indicator species, white basswood and yellow buckeye, in a total group of 15 to 20 dominant species. The western mesophytic forest is marked by a transition from extensive mixed mesophytic communities in the east to extensive oak and oak-hickory communities in the

west. The western mesophytic forest is less dense, has few dominants, and usually lacks the two indicator species of the mixed mesophytic forest.

In the lower, downstream portion of the ecosystem, near Paducah, Kentucky, the Ohio River enters the northernmost extension of the Mississippi Alluvial Plain. In this alluvial region, three subdivisions of "bottomland forest" (i.e., palustrine forested wetland) are recognized: swamp forest, hardwood bottoms, and ridge bottoms. The swamp forest, consisting principally of cypress and tupelo gum, occupies land on which water stands throughout the year except during periods of extreme drought. The hardwood bottoms contain a large number of species, frequently flood, and generally remain covered with water through the late winter and spring. Ridge bottoms contain some of the tree species of hardwood bottoms, but have a larger number of oaks and hickories; occurring at slightly higher elevations than hardwood bottoms, these areas are covered by water only during floods (USFWS, 1999).

The rich flora and fauna of the ORVE reflect its diverse physiography and unique geologic past. Numerous Service trust resources occur in the ecosystem, including many federally listed endangered/threatened plants, mussels, fishes, birds and mammals; waterfowl and other migratory water birds; and neotropical migratory land birds.

The unusually rich and diverse fauna found in the ecosystem is the product of a multitude of biotic and abiotic factors which have evolved over time. Throughout geologic time, changes in such factors as topography, climate, and geomorphology have formed, modified, and eliminated habitats and consequently have had a profound effect upon the distribution of the faunal assemblages in the ecosystem. Due to the ecosystem's central geographical location in the eastern United States, some species with northern affinities and others with southern affinities occur in the ecosystem in addition to those common to the central region of the country (USFWS, 1999).

Over the past few centuries of Euro-American settlement and industrialization, the Ohio River Valley ecosystem has been subjected to many environmental stresses which have diminished the bounty of its living resources. Much of the region's economic activity – agriculture, lumbering, mining, energy production, manufacturing, and recreation – is based on the watershed's natural resources. Sustaining most of these activities requires maintenance of a healthy ecosystem. Stress from human activities has adversely affected the ecological integrity of the ORVE, and there are indications that this stress is increasing.

Environmental alteration and degradation are continuing challenges to the maintenance of a productive and healthy ORVE. Resources of the area are threatened by land conversion, poor land-use practices, direct and indirect physical alteration of the area's rivers and streams, acid mine drainage and acid precipitation, destruction of wetland habitats, and both point- and nonpoint-source discharges of pollutants. Herbicides, insecticides, nutrients, and sediment are significant components of the agricultural runoff that adversely affect aquatic systems throughout the area. Acid precipitation from sulfur dioxide and nitrous oxides from power plants and other airborne pollutants are having dramatic effects on aquatic and terrestrial communities, particularly at high elevations (USFWS, 1999).



Restoring habitat through partnerships Patoka River NWR & MA. Photo credit: USFWS

Natural resources are further threatened by an expanding human population and its increased demand for renewable and nonrenewable resources. Contamination of both aquatic and terrestrial systems through acid mine drainage and the accidental release of toxic chemicals is a continuing threat. Operation and maintenance of the inland navigation system and the recent invasion of the non-native zebra mussel are having significant adverse impacts on native flora and fauna of the area's rivers and streams. Other non-native species are threatening native components of aquatic and terrestrial systems throughout the area. The expansion of urban and suburban areas within the ecosystem and the concurrent loss of forest, wetlands, agricultural lands, and other types of open space associated with this expansion have reduced the quantity and quality of natural habitats available to fish and wildlife.

The Service published a strategic plan on conserving the trust resources of the ORVE in 1999 (USFWS, 1999). The plan set forth four goals:

1. Protect, restore and enhance habitats and essential processes necessary to maintain healthy native animal and plant populations.
2. Protect, restore and enhance diversity of native flora and fauna.
3. Promote and support compatible and sustainable uses of the ecosystem's resources and utilize existing laws, regulations, and influence to control incompatible and unsustainable uses of these resources.
4. Develop public awareness and support for ecosystem resource issues.

The strategic plan also identified seven resource priorities:

Resource Priority 1: In cooperation with partners, reverse the decline of native aquatic mollusks within the Ohio River Valley Ecosystem with emphasis on endangered, threatened and candidate species and species of concern.

Resource Priority #2: In cooperation with partners, reverse the decline and achieve stable, viable populations of migratory landbirds and other bird species of concern.

Resource Priority 3: In cooperation with partners, reverse the decline of native fishes with emphasis on interjurisdictional listed and candidate species and species of concern.

Resource Priority 4: In cooperation with partners, protect and restore karst/cave habitat supporting listed and candidate species and species of concern.

Resource Priority 5: In cooperation with partners, protect and restore wetland, riverine and riparian habitat in the Ohio River watershed for the protection and enhancement of migratory waterbirds and other wetland dependant species of concern.

Resource Priority 6: In cooperation with partners, reduce the decline and promote the recovery of rare resources identified as listed/proposed threatened and endangered species, candidate species and species of concern not otherwise addressed in Resource Priorities 1- 5 (e.g. plants, reptiles, amphibians, etc.).

Resource Priority 7: In cooperation with partners, achieve the necessary level of protection for those high priority areas within the Ohio River Valley Ecosystem that would help meet the goals of the ORVE Team. In particular, emphasis will be placed on the objectives of Resource Priorities 1 through 6 and Public Use Priority 1.

A number of action strategies accompanied these resource priorities in the strategic plan. In addition, the plan contained one public use priority:

Public Use Priority 1: In cooperation with partners, promote and support sustainable fish and wildlife-oriented recreational uses while maintaining the long-term health of the ecosystem and the Service's trust resources.

The Service's ORVE Team has several important roles. Primary among them is serving as an advocate at the field level for federal trust fish and wildlife resources within the Ohio River watershed. This includes reviewing the Team's resource priorities and charting a direction for the Team to ensure it addresses the highest priority resource needs. To facilitate accomplishment of the Team's on-the-ground efforts, the Team actively seeks funding, explores expansion of existing partnerships and establishment of new ones, and seeks ways to involve all interested stakeholders (USFWS, 1999).

The ORVE Team is comprised of representatives of each of the Service's field offices located within the Region 3 (Midwest), 4 (Southeast), and 5 (Northeast) portions of the Ohio River Valley watershed. In addition, representatives from the respective Service regional offices, as well as several state fish and wildlife agencies, participate as Team members. Typically, the Team meets three times per year at various locations within the ecosystem.



Snowy Egret. Photo credit: USFWS

The Team's seven Sub-groups are the primary mechanisms for conducting activities on the ground. The Sub-groups correspond to the Team's resource priorities, i.e., fish and wildlife and associated habitats, and its public use priority. They are, in no priority order: native aquatic mollusks; migratory land birds and other bird species of concern; native fishes; karst/cave habitat; wetland, riverine, and riparian habitat; declining and rare species; and fish and wildlife-oriented recreational use. In addition to the Sub-groups, the Team has established four Standing Committees to conduct activities that generally cut across all priority resources. The Standing Committees address GIS needs and activities, outreach, acid mine drainage and valley fills, and land protection (USFWS, 1999).

Other Units Administered

The staff of Patoka River NWR & MA administers two units apart from the main body of the Refuge: Cane Ridge and White River Bottoms. Both units are part of the National Wildlife Refuge System, but White River Bottoms is not officially included as part of the total acreage comprising the Patoka River Refuge & MA.

The 488-acre Cane Ridge Wildlife Management Area lies 24 miles west of the Refuge headquarters near the confluence of the White, Patoka, and Wabash Rivers, a traditional waterfowl migration and wintering area. Acquired by a coalition of conservation partners, the property became part of Patoka River NWR & MA in 1999. The area includes 193 acres of moist soil wetlands in four management units, 180 acres of reforested bottomland hardwoods, and a 59-acre deep water impoundment with nesting islands that provide habitat for the federally endangered Least Tern. Cane Ridge WMA is a Globally Important Bird Area.

The 219-acre White River Bottoms Wildlife Management Area lies 9 miles to the north of Oakland City. This WMA lies just to the northwest of Petersburg on the south side of the White River. Although not officially included as part of Patoka River NWR & MA, White River Bottoms became part of the National Wildlife Refuge System when control of the land was transferred to the Service in 1994 from the Farm Services Agency. It has been restored from agricultural fields by being planted to bottomland hardwood trees.

Migratory Bird Conservation Initiatives

Over the last decade, bird conservation planning has become increasingly exciting as it has evolved from a largely local, site-based focus to a more regional, landscape-oriented perspective. Significant challenges include locating areas of high-quality habitat for the conservation of particular guilds and priority bird species, making sure no species are inadvertently left out of the regional planning process, avoiding unnecessary duplication of effort, and identifying unique landscape and habitat elements of particular tracts targeted for protection, management and restoration. Several migratory bird conservation initiatives have emerged to help guide the planning and implementation process. Collectively, they comprise a tremendous resource as Patoka River National Wildlife Refuge and Management Area engages in comprehensive conservation planning and its translation into effective on-the-ground management.

North American Waterfowl Management Plan

Signed in 1986, the North American Waterfowl Management Plan (NAWMP) outlines a broad framework for waterfowl management strategies and conservation efforts in the United States, Canada, and Mexico. The goal of the NAWMP is to restore waterfowl populations to historic levels throughout the continent. The NAWMP is designed to reach its objectives through key joint venture areas, species joint ventures, and state implementation plans within these joint ventures.

Patoka River NWR & MA is in the Upper Mississippi River-Great Lakes Joint Venture. The boundaries of this joint venture extend across Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, and Michigan. They include important migration and staging areas that were converted to agriculture. The purpose of the Upper Mississippi River-Great Lakes Joint Venture is to increase populations of waterfowl and other wetland wildlife by protecting, restoring, creating, and enhancing wetlands and associated upland habitats. Joint venture partners include private landowners, the National Fish and Wildlife Foundation, state agencies, and the U.S. Fish and Wildlife Service. Partners are endeavoring



Nesting Interior Least Tern. Photo credit: USFWS

to increase public awareness through information and education and are providing incentives to private landowners (Graziano and Cross, 1993).

The 1998 NAWMP Update established a habitat objective for the Upper Mississippi – Great Lakes Joint Venture of protecting 1,329,000 acres of waterfowl and wetland habitat and restoring or enhancing another 605,200 acres (NAWMP, 1998).

A 2004 update to the NAWMP set a target of conserving 758,572 additional acres of waterfowl and wetland habitat in the Upper Mississippi – Great Lakes Joint Venture through a combination of securement, protection, restoration, enhancement, and management (NAWMP, 2004).

Partners In Flight

Formed in 1990, Partners in Flight (PIF) is concerned primarily with landbirds and has developed Bird Conservation Plans for numerous *Physiographic Areas* across the U. S. (see <http://www.partnersinflight.org>). These plans include priority species lists, associated habitats, and management strategies. Patoka River NWR lies within PIF Physiographic Area 14, the Interior Low Plateaus Area.

The Interior Low Plateaus form a diverse landscape consisting of six distinct subregions that extends from north Alabama across central Tennessee and Kentucky into southern Illinois, Indiana, and Ohio. Its hilly topography sets it apart from the Coastal Plain to the south and Prairie Peninsula to the north. To the west, the Mississippi River valley separates the Interior Low Plateaus from the Ozark Highlands. Western mesophytic, oak-hickory, and beech-maple forests were historically the most abundant cover types. There were also tallgrass

prairie elements in the north and northwest, oak savannahs in the Bluegrass and other northern sections, barrens and glades in central regions, and forested wetlands along major waterways (PIF, no date).

Habitat loss through conversion to agriculture and other uses and the fragmentation and reduced quality of what remains are the biggest conservation challenges in this area. Grasslands and savannahs have been converted to cool season pasture. Many glades and barrens have become urban areas, and others have been overtaken by woody vegetation due to fire suppression. Floodplain forests have largely been either inundated by reservoirs or converted to row crops. Conservation objectives vary by subregion, but in general, in order to perpetuate existing high priority species and to create an opportunity to re-establish two extirpated species (Greater Prairie-Chicken and Swallow-tailed Kite), the following actions should be implemented:

- Sustain existing forested acreage, with about 80 percent in hardwoods and the remainder in short-rotation pine management;
- Manage about 400,000 ha of that hardwood forest in long rotation patches of about 4,000 ha each;
- Consolidate an additional 90,000 ha of forested wetland;
- Additionally, restore 40,000 ha of native warm season grass and oak savannah habitat; and
- Incorporate bird conservation into ongoing barren and glade conservation projects.

U.S. Shorebird Conservation Plan

Partners from state and federal agencies and NGOs from across the country combined their resources and expertise to develop a conservation strategy for migratory shorebirds and their habitats. The plan provides a scientific framework to determine species, sites, and habitats that most urgently need conservation action. Main goals of the U.S. Shorebird Conservation Plan, which was completed in 2000, are to ensure that adequate quantity and quality of shorebird habitat is maintained at the local level and to maintain or restore shorebird populations at the continental and hemispheric levels. Separate technical reports were developed for a conservation assessment, research needs, a comprehensive monitoring strategy, and education and outreach. These national assessments were used to step down goals and objectives into 11 regional conserva-

tion plans. Although some outreach, education, research, monitoring, and habitat conservation programs are being implemented, accomplishment of conservation objectives for all shorebird species will require a coordinated effort among traditional and new partners. The U. S. Shorebird Conservation Plan Council serves as the steering committee for the U. S. Shorebird Conservation Plan and oversees the implementation of the regional, national, and international goals of the Plan. Meetings of the Council are held twice a year (USFWS, no date).

Under the Shorebird Conservation Plan, Patoka River NWR is located in the Upper Mississippi Valley/Great Lakes Region (UMVGL), which is covered by a regional plan prepared in 2000 and updated in 2006 (de Szalay et al., 2006). The UMVGL region is a diverse area that includes five Bird Conservation Regions and provides important habitat for shorebirds, especially migrants. Thirty-two shorebird species occur in the region, with 25 being common or abundant. Twenty-three species are of moderate or higher concern in the region. High-priority species include: greater yellowlegs, whimbrel, buff-breasted sandpiper, short-billed dowitcher, marbled godwit, Wilson's phalarope, upland sandpiper, American woodcock, and the Federally-listed piping plover; the latter five species breed in the region.

Various habitats within the region, including natural and managed wetlands, river floodplains, lake shoreline, sand and gravel bars, reservoirs, and flooded agricultural fields, provide the shallow water and sparsely-vegetated conditions required by foraging shorebirds. However, like other interior areas, the UMVGL region experiences dynamic climatic conditions, making habitat conditions for shorebirds unpredictable. Moreover, loss of wetlands from urban development, river dredging and diking, and agriculture has reduced the amount of habitat in the region. A primary goal of this UMVGL regional shorebird plan is to ensure the availability of shorebird foraging and nesting sites over a range of climatic conditions by protecting, restoring, and managing a variety of habitat types throughout the UMVGL region.

Waterbird Conservation for the Americas

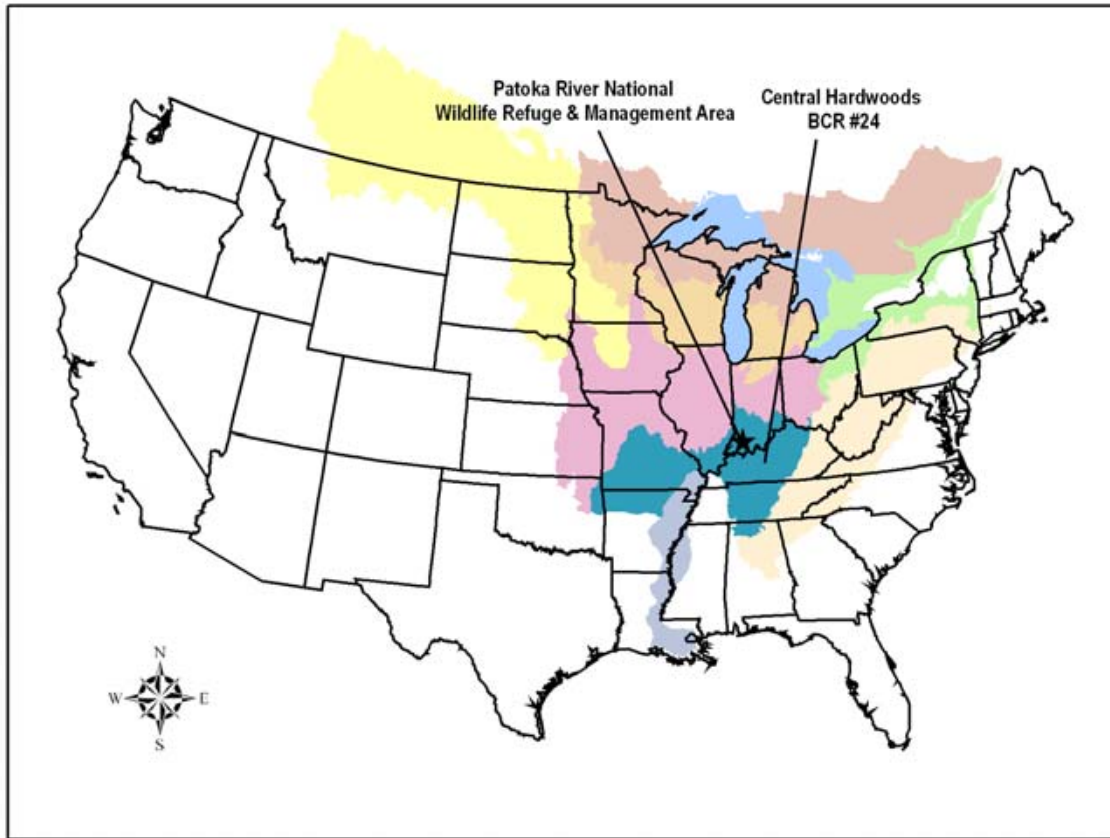
Formerly known as the North American Waterbird Conservation Plan, Waterbird Conservation for the Americas (WCA) is an independent, international, broad-based, and voluntary partnership created to link the work of individuals and institutions

having interest and responsibility for conservation of waterbirds and their habitats in the Americas (WCA, 2005a). WCA's vision is that the distribution, diversity, and abundance of populations and habitats of breeding, migratory, and nonbreeding waterbirds are sustained or restored throughout the lands and waters of North America, Central America, and the Caribbean. The geographic extent of the WCA initiative includes North America, Central America, the islands and waters of the Caribbean, the Pacific Ocean including the U.S.-associated Pacific Islands, and the western Atlantic Ocean including Bermuda. The WCA includes the interests of 29 nations.

The term "waterbird" refers to bird species dependent on aquatic habitats to complete portions of their life cycles. It includes seabirds, coastal waterbirds, wading birds, and marsh birds. The WCA focuses these groups. Shorebirds and waterfowl, while indeed waterbirds, are the subject of their own initiatives (discussed above).

Under WCA, planning regions were created to allow planning at a scale that is practical yet provides landscape-level perspective. Regional boundaries are based on a combination of both political and ecological considerations. Patoka River NWR is situated in the Upper Mississippi Valley/Great Lakes (UMVGL) Region, within a subregion known as Bird Conservation Region (BCR) 24, the Central Hardwoods. Like the NAWMP, WCA has also established joint ventures, and that of BCR 24 is called the Central Hardwoods Joint Venture (CHJV).

The UMVGL Region provides a wide variety of waterbird nesting, roosting and foraging habitats, including marshes, ponds, creeks, streams, sloughs, lake shorelines, islands (especially in the Great Lakes), shoals, river floodplains (especially along the Mississippi, Illinois, Missouri, and Ohio Rivers), and reservoirs. Forty-six waterbird species regularly occur in the region during at least one portion of the year, including loons, grebes, pelicans, cormorants, herons, night-herons, egrets, bitterns, rails, moorhens, coots, cranes, gulls and terns, and 19 of these species are of high conservation, stewardship or management concern. In the context of the continental, the region is extremely important for many of these waterbird species. Though the UMVGL Region has experienced major declines in wetland habitat over the last 200 years, the northern portion of the UMVGL Region still contains large amounts of wetlands and the Great Lakes are a stronghold for island breeders (WCA, 2005b).

Figure 5: Bird Conservation Region in Which Patoka River NWR & MA is Located

A Regional Plan for waterbird management and conservation is currently being prepared and Patoka River National Wildlife Refuge figures in that plan, which described the Refuge as, “one of the most significant bottomland hardwood forests remaining in the Midwest.”

North American Bird Conservation Initiative

In a continental effort, the North American Waterfowl Management Plan, Partners in Flight, U.S. Shorebird Conservation Plan, and Waterbird Conservation for the Americas planning efforts are being integrated under the umbrella of the North American Bird Conservation Initiative (NABCI). The goal of NABCI is to facilitate the delivery of the full spectrum of bird conservation through regionally-based, biologically-driven, landscape-oriented partnerships (see <http://www.dodpif.org/nabci/index.htm>). The NABCI strives to integrate the conservation objectives for all birds in order to optimize the effectiveness of management strategies.

NABCI also uses BCRs as its planning units. BCRs are becoming increasingly common as the unit of choice for regional bird conservation efforts; as it does for the WCA initiative, Patoka River NWR lies within BCR 24, the Central Hardwoods for the purposes of the NABCI (see Figure 5).

Each of the above four bird conservation initiatives has a process for designating conservation priority species, modeled to a large extent on the PIF method of calculating scores based on independent assessments of global relative abundance, breeding and wintering distribution, vulnerability to threats, area importance (at a particular scale, e.g. PA or BCR), and population trend. These scores are often used by agencies in developing lists of bird species of concern; e.g., the U. S. Fish and Wildlife Service based its assessments for its 2001 list of nongame Birds of Conservation Concern primarily on the PIF, shorebird, and waterbird status assessment scores.

Region 3 Fish and Wildlife Conservation Priorities

Every species is important. But the number of species in need of attention exceeds the resources of the Service. To focus effort effectively, Region 3 of the Fish and Wildlife Service compiled a list of Resource Conservation Priorities. The list includes:

- all federally listed threatened and endangered species and proposed and candidate species that occur in the Region
- migratory bird species derived from Service wide and international conservation planning efforts
- rare and declining terrestrial and aquatic plants and animals that represent an abbreviation of the Endangered Species program's preliminary draft "Species of Concern" list for the Region.

Appendix D includes 116 Resource Conservation Priority species within the Ohio River Valley Ecosystem and notes those known to occur on the Refuge.

Indiana Comprehensive Wildlife Strategy

The Indiana Comprehensive Wildlife Strategy completed in 2006 identifies conservation priorities within Indiana. Patoka River NWR & MA staff contributed to the plan and the Refuge provides habitat for more than 50 of the birds, mammals, reptiles, and amphibians listed in the Strategy as conservation priorities (see Appendix C: Species Lists).

Other Recreation and Conservation Lands in the Area

Sugar Ridge Fish & Wildlife Area

Sugar Ridge Fish & Wildlife Area, owned and managed by the Indiana Department of Natural Resources (IDNR), is unique in that much of the land has been strip-mined for coal and since reclaimed. Sugar Ridge (Figure 6) is made up of six separate areas, totaling approximately 8,100 acres, interspersed with the USFWS's Patoka River NWR holdings. The strip-mined land now features about

100 pits and lakes, along with rows of overburden from the mining operation. The land that has not been mined is mostly rough and rolling. A large part of the land which is now Sugar Ridge Fish and Wildlife Area (Areas I, II and III) was once leased from Amax Coal Company. Leasing began in 1964 and continued until 1980 when most of the land was donated to the Division of Fish and Wildlife (IDNR, no date-a).

Sugar Ridge is open to various forms of outdoor recreation by the public, including hunting (deer, squirrel, and wild turkey are common); fishing on 145 acres in 24 major fishing pits for such sport fish as bluegill, redear, channel catfish, and largemouth bass; trapping (by drawing only); and wildlife watching on upland game habitat, wooded reclaimed mine areas and stripper pits which attract a wide variety of song birds, woodpeckers, hawks, and waterfowl. In addition, mushrooms, berries and nuts may be gathered. A written permit is required to remove plants, animals, rocks and fossils (IDNR, no date-a).

Glendale Fish & Wildlife Area

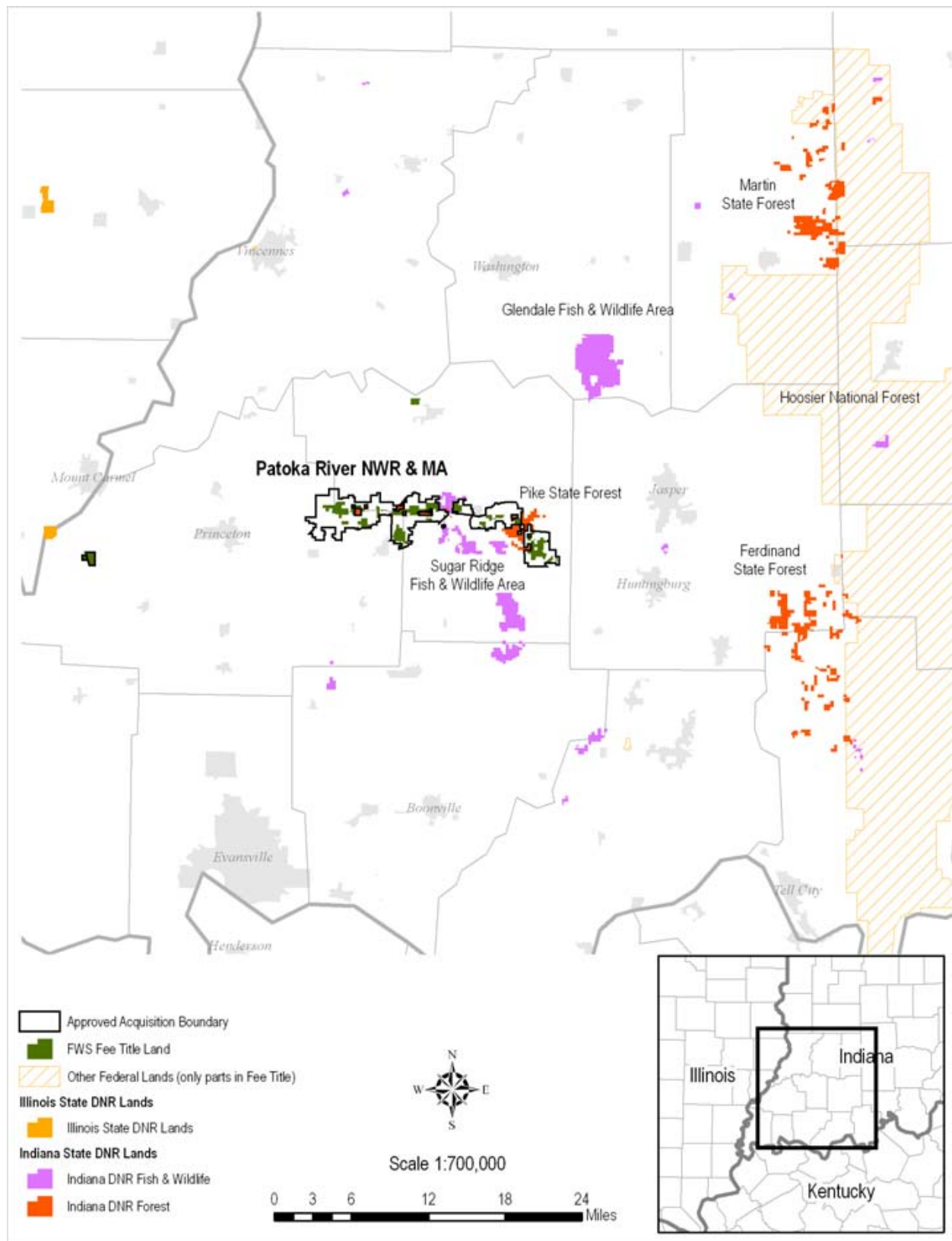
The Indiana DNR's Glendale Fish & Wildlife Area maintains 8,060 acres of land and over 1,400 acres of lakes and impoundments about 12 miles north of Patoka River NWR. These lands and waters provide quality hunting and fishing opportunities for the public, as well as wildlife watching and camping in designated areas. Wetland trapping is available by drawing only (IDNR, no date-b).

Acquisition began in 1956, and land purchases were made through the 1960s. Several minor purchases were made in the 1970s. The construction of the dam that formed Dogwood Lake began in 1963 and was completed in 1965. The lake, with an average depth of eight feet, was renovated in 1978 and restocked with fish in 1979 (IDNR, no date-b).

Pike State Forest

Pike State Forest, owned and operated by Indiana DNR's Division of Forestry, sits astride the Patoka River adjacent to Patoka River NWR toward its eastern side. The State Forest (SF) consists of 3,889 acres which vary from hilly uplands to the low bottomlands of the river. Due to its diverse habitats, a wide variety of plant and animal life make their homes at Pike SF. Several recreational opportunities are available on the SF, including hunting, horseback riding, picnicking, bird watching

Figure 6: Other Conservation Lands in the Area of Patoka River NWR & MA



and hiking. Visitors can also camp for a fee, with sites available on a first come, first serve basis (IDNR, 2005a).

Acquisition of the land that makes up Pike State Forest began in the 1930s, and continues through the present day. Most of the historic buildings on the property were constructed by the Works Progress Administration (WPA) during the Great Depression, using material cut from local timber stands.

Ferdinand State Forest

Ferdinand State Forest is located about 20 miles southeast of Patoka River NWR. This State Forest consists of 7,700-acres with limited acquisition still occurring. In 1933, the 900 acres that became the SF were purchased by a local conservation club to build a lake and establish an area to hunt and fish. The club offered management of the project to the Indiana Department of Conservation the following year, marking the establishment of Ferdinand State Forest (IDNR, 2005b). In 1934, the Civilian Conservation Corps (CCC) built a camp there, as well as roads, service buildings, and one of the most beautiful forest lakes in the state. Ferdinand SF has excellent deer and squirrel hunting and the surrounding area is rich in German heritage.

The state forest offers primitive camping, fishing, boating, swimming, picnicking, mountain biking, and hunting for whitetail deer, turkey, squirrel, fox and raccoon.

Other Recreation and Conservation Lands

Within an hour or two's drive from Patoka River NWR in southwestern Indiana are a number of other federal and state parks, forests, and fish and wildlife areas offering outdoor recreation and heritage tourism. These include New Harmony State Historic Site, Harmonie State Park (west of Patoka Refuge, along the Wabash River separating Indiana from Illinois), Hovey Lake Fish & Wildlife Area, Lincoln State Park, Jackson Recreation Area, Hoosier National Forest, and Patoka Lake, an 8,800-acre flood control lake 60 miles upstream of the refuge and cooperatively managed by the Army Corps of Engineers and the Indiana Department of Natural Resources.



*Grey wood/beaver flooding, Patoka River NWR & MA.
Photo credit: USFWS*

Socioeconomic Setting

Patoka River National Wildlife Refuge and Management Area is located in Pike and Gibson Counties, Indiana, and is in close proximity to Daviess, Dubois, Knox, Spencer, and Warrick Counties. Compared to the State of Indiana as a whole this seven-county area has a smaller population growth rate and is less racially and ethnically diverse. On average, the area's population has a lower median income, and less high school and college education than the state's population.

Population

The total population of the seven counties was 226,861 in the 2000 Census (USCB, 2006). The population increased 6.9 percent during the 1990s while the state's population increased 9.7 percent. Warrick County grew the most at 16.6 percent, and Knox the least at minus 1.6 percent. The seven-county population was 97.3 percent white in 2000; the State population was 87.5 percent white. In Indiana, 6.4 percent of the people 5 years and older speak a language other than English at home; in the seven-county area the figure is 4.6 percent.

Employment

In 2000 there were a total of 21,744 full- and part-time jobs in Pike and Gibson counties. Farm/forestry/fishing employment accounted for about five percent of the jobs across the area. The manufacturing and education/health/social services industries

were and are the largest economic and employment sectors in these counties (USCB, 2000a; USCB, 2000b).

Income and Education

Average per-capita income in the seven-county area was \$18,619 in 1999; in Indiana it was \$20,397. The median household income in the seven-county area was \$40,057 in 1999; in the state it was \$41,567 (USCB, 2006).

In the seven-county area, 14.8 percent of persons over 25 years of age hold a bachelor's degree or higher. The comparable figure in the state is 19.4 percent. This discrepancy is typical of the difference between largely rural areas like these seven counties and entire state populations which include large numbers of more urban residents who are professionals and have higher educational attainment on average (USCB, 2006).

Potential Refuge Visitors

In order to estimate the potential market for visitors to the Refuge, we looked at 1998 consumer behavior data for an area within an approximate 60 mile radius. The data were organized by zip code areas. We used a 60 mile radius because we thought this was an approximation of a reasonable drive to the Refuge for an outing.

The consumer behavior data that we used in the analysis is derived from Mediamark Research Inc. data. The company collects and analyzes data on consumer demographics, product and brand usage, and exposure to all forms of advertising media. The consumer behavior data were projected by Tetrad Computer Applications Inc. to new populations using Mosaic data. Mosaic is a methodology that classifies neighborhoods into segments based on their demographic and socioeconomic composition. The basic assumption in the analysis is that people in demographically similar neighborhoods will tend to have similar consumption, ownership, and lifestyle preferences. Because of the assumptions made in the analysis, the data should be considered as relative indicators of potential, not actual participation.

We looked at potential participants in birdwatching, photography, freshwater fishing, hunting, and hiking. In order to estimate the general environmental orientation of the population we also looked at the number of people who potentially might hold a membership in an environmental organization.



Winter scenery, Patoka River NWR & MA. Photo credit: USFWS

The consumer behavior data apply to persons greater than 18 years old. For the area that we included in our analysis, out of a total population of 1,233,654 the population of persons greater than 18 years old was 925,980. The estimated maximum participants in the 60 mile radius for each activity are: birdwatching (72,351), photography (99,570), hunting (82,727), freshwater fishing (146,610), and hiking (86,325). The number of persons who might hold a membership in an environmental organization is estimated at about 19,941. The projections represent the core audience for repeated trips to the Refuge. On days with special events or major attractions such as when large numbers of birds are at the Refuge, visitors can be expected to travel longer distances.

Climate

The Refuge lies in the path of moisture-bearing low pressure formations that move from the western Gulf region, northeastward over the Mississippi and Ohio Valleys to the Great Lakes and northern Atlantic Coast. Much of the area's precipitation results from these storm systems, especially in the cooler part of the year. The average annual precipitation totals 44.2 inches. Of this total, about 23 inches, or nearly 52 percent, falls during the growing season of April to September. The highest and lowest annual precipitation totals for the period of record are 64.8 inches in 1945 and 28.0 inches in 1887, respectively. Maximum monthly precipitation is 15.1 inches while the minimum is 0.05 inches. The average seasonal snowfall is about 13.5 inches. On the average, 3 days out of the year have at least 1 inch of snow on the ground (NOAA, 1991).

Convective thunderstorms developing in the maritime tropical air from the Gulf of Mexico and squall line activity seem to be the factors which combine to supply summer rainfall. Severe storms are rather infrequent, but high winds and hail often accompany these storms and can cause isolated property damage. The area is in “tornado alley,” with the potential for tornados highest in early spring and late fall. The tornado frequency is probably less than one every 10 years.

In winter the average temperature is 34 degrees Fahrenheit, with an average daily minimum of 25 degrees. The lowest temperature on record (January 17, 1977) is minus 18 degrees. In summer the average temperature is 76 degrees, and the average daily maximum is 87 degrees. The highest recorded temperature (September 2, 1953) is 104 degrees (NOAA, 1991). Based on the average dates the first and last killing frosts, the area normally has 180 to 190 frost free days per year (SCS, 1989).

Prevailing wind direction is from the south-southwest. Strong and cold north to northwest winds occur from late autumn to early spring as large domes of arctic high pressure move into the Midwest. The strongest winds occur during a deep winter storm passage through the Lower Ohio Valley.

The average relative humidity is mid-afternoon is roughly 60 percent. Humidity is higher at night and the average at dawn is about 85 percent.

Climate Change

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies, under its direction, that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

The increase of carbon dioxide (CO₂) within the earth’s atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact that refuges can affect in a small way. The U.S. Department of Energy’s “*Carbon Sequestration Research and Development*” defines carbon sequestration as “...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere.”

Vegetated land is a tremendous factor in carbon sequestration. Terrestrial biomes of all sorts – grasslands, forests, wetlands, tundra, and desert – are effective both in preventing carbon emission and acting as a biological “scrubber” of atmospheric CO₂. The Department of Energy report’s conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this CCP would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the Refuge. This in turn contributes positively to efforts to mitigate human-induced global climate change.

One Service activity in particular – prescribed burning – releases CO₂ directly to the atmosphere from the biomass consumed during combustion. However, there is actually no net loss of carbon, since new vegetation quickly germinates and sprouts to replace the burned-up biomass and sequesters or assimilates an approximately equal amount of carbon as was lost to the air (Boutton et al. 2006). Overall, there should be little or no net change in the amount of carbon sequestered at Patoka NWR from any of the proposed management alternatives.

Several impacts of climate change have been identified that may need to be considered and addressed in the future:

- Habitat available for cold water fish such as trout and salmon in lakes and streams could be reduced.
- Forests may change, with some species shifting their range northward or dying out, and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat due to stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of sync with the life cycles of their prey species.
- Animal and insect Species historically found farther south may colonize new areas to the north as winter climatic conditions moderate

The managers and resource specialists on the Refuge need to be aware of the possibility of change due to global warming. When feasible, documenting long-term vegetation, species, and hydrologic

changes should become a part of research and monitoring programs on the Refuge. Adjustments in refuge management direction may be necessary over the course of time to adapt to a changing climate.

The following paragraphs are excerpts from the 2000 report, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*, produced by the National Assessment Synthesis Team, an advisory committee chartered under the Federal Advisory Committee Act to help the US Global Change Research Program fulfill its mandate under the Global Change Research Act of 1990. These excerpts are from the section of the report focused upon the eight-state Midwest region.

Observed Climate Trends

Over the 20th century, the northern portion of the Midwest, including the upper Great Lakes, has warmed by almost 4°F (2°C), while the southern portion, along the Ohio River valley, has cooled by about 1°F (0.5°C). Annual precipitation has increased, with many of the changes quite substantial, including as much as 10 to 20% increases over the 20th century. Much of the precipitation has resulted from an increased rise in the number of days with heavy and very heavy precipitation events. There have been moderate to very large increases in the number of days with excessive moisture in the eastern portion of the basin.

Scenarios of Future Climate

During the 21st century, models project that temperatures will increase throughout the Midwest, and at a greater rate than has been observed in the 20th century. Even over the northern portion of the region, where warming has been the largest, an accelerated warming trend is projected for the 21st century, with temperatures increasing by 5 to 10 degrees Fahrenheit (3 degrees to 6 degrees Celsius). The average minimum temperature is likely to increase as much as 1 degree to 2 degrees Fahrenheit (0.5 to 1 degree Celsius) more than the maximum temperature. Precipitation is likely to continue its upward trend, at a slightly accelerated rate; 10 to 30 percent increases are projected across much of the region. Despite the increases in precipitation, increases in temperature and other meteorological factors are likely to lead to a substantial increase in evaporation, causing a soil moisture deficit, reduction in lake and river levels, and more drought-like conditions in much of the region. In addition,

increases in the proportion of precipitation coming from heavy and extreme precipitation are very likely.

Midwest Key Issues

Reduction in Lake and River Levels

Water levels, supply, quality, and water-based transportation and recreation are all climate-sensitive issues affecting the region. Despite the projected increase in precipitation, increased evaporation due to higher summer air temperatures is likely to lead to reduced levels in the Great Lakes. Of 12 models used to assess this question, 11 suggest significant decreases in lake levels while one suggests a small increase. The total range of the 11 models' projections is less than a 1-foot increase to more than a 5-foot decrease. A 5-foot (1.5-meter) reduction would lead to a 20 to 40 percent reduction in outflow to the St. Lawrence Seaway. Lower lake levels cause reduced hydropower generation downstream, with reductions of up to 15 percent by 2050. An increase in demand for water across the region at the same time as net flows decrease is of particular concern. There is a possibility of increased national and international tension related to increased pressure for water diversions from the Lakes as demands for water increase. For smaller lakes and rivers, reduced flows are likely to cause water quality issues to become more acute. In addition, the projected increase in very heavy precipitation events will likely lead to increased flash flooding and worsen agricultural and other non-point source pollution as more frequent heavy rains wash pollutants into rivers and lakes. Lower water levels are likely to make water-based transportation more difficult with increases in the costs of navigation of 5 to 40 percent. Some of this increase will likely be offset as reduced ice cover extends the navigation season. Shoreline damage due to high lake levels is likely to decrease 40 to 80 percent due to reduced water levels.

Adaptations: A reduction in lake and river levels would require adaptations such as re-engineering of ship docks and locks for transportation and recreation. If flows decrease while demand increases, international commissions focusing on Great Lakes water issues are likely to become even more important in the future. Improved forecasts and warnings of extreme precipitation events could help reduce some related impacts.

Agricultural Shifts

Agriculture is of vital importance to this region, the nation, and the world. It has exhibited a capacity to adapt to moderate differences in growing season climate, and it is likely that agriculture would be able to continue to adapt. With an increase in the length of the growing season, double cropping, the practice of planting a second crop after the first is harvested, is likely to become more prevalent. The CO₂ fertilization effect is likely to enhance plant growth and contribute to generally higher yields. The largest increases are projected to occur in the northern areas of the region, where crop yields are currently temperature limited. However, yields are not likely to increase in all parts of the region. For example, in the southern portions of Indiana and Illinois, corn yields are likely to decline, with 10-20 percent decreases projected in some locations. Consumers are likely to pay lower prices due to generally increased yields, while most producers are likely to suffer reduced profits due to declining prices. Increased use of pesticides and herbicides are very likely to be required and to present new challenges.

Adaptations: Plant breeding programs can use skilled climate predictions to aid in breeding new varieties for the new growing conditions. Farmers can then choose varieties that are better attuned to the expected climate. It is likely that plant breeders will need to use all the tools of plant breeding, including genetic engineering, in adapting to climate change. Changing planting and harvest dates and planting densities, and using integrated pest management, conservation tillage, and new farm technologies are additional options. There is also the potential for shifting or expanding the area where certain crops are grown if climate conditions become more favorable. Weather conditions during the growing season are the primary factor in year-to-year differences in corn and soybean yields. Droughts and floods result in large yield reductions; severe droughts, like the drought of 1988, cause yield reductions of over 30 percent. Reliable seasonal forecasts are likely to help farmers adjust their practices from year to year to respond to such events.

Changes in Semi-natural and Natural Ecosystems

The Upper Midwest has a unique combination of soil and climate that allows for abundant coniferous tree growth. Higher temperatures and increased evaporation will likely reduce boreal forest acreage, and make current forestlands more susceptible to



Wood Duck pair, Patoka River NWR & MA. Photo credit: USFWS

pests and diseases. It is likely that the southern transition zone of the boreal forest will be susceptible to expansion of temperate forests, which in turn will have to compete with other land use pressures. However, warmer weather (coupled with beneficial effects of increased CO₂), are likely to lead to an increase in tree growth rates on marginal forestlands that are currently temperature-limited. Most climate models indicate that higher air temperatures will cause greater evaporation and hence reduced soil moisture, a situation conducive to forest fires. As the 21st century progresses, there will be an increased likelihood of greater environmental stress on both deciduous and coniferous trees, making them susceptible to disease and pest infestation, likely resulting in increased tree mortality.

As water temperatures in lakes increase, major changes in freshwater ecosystems will very likely occur, such as a shift from cold water fish species, such as trout, to warmer water species, such as bass and catfish. Warmer water is also likely to create an environment more susceptible to invasions by non-native species. Runoff of excess nutrients (such as nitrogen and phosphorus from fertilizer) into lakes and rivers is likely to increase due to the increase in heavy precipitation events. This, coupled with warmer lake temperatures, is likely to stimulate the growth of algae, depleting the water of oxygen to the detriment of other living things. Declining lake levels are likely to cause large impacts to the current distribution of wetlands. There is some chance that some wetlands could gradually migrate, but in areas where their migration is limited by the topography, they would disappear. Changes in bird popu-

lations and other native wildlife have already been linked to increasing temperatures and more changes are likely in the future. Wildlife populations are particularly susceptible to climate extremes due to the effects of drought on their food sources.

Air Quality

The U. S. Environmental Protection agency has established National Ambient Air Quality Standards (NAAQS) to protect public health and welfare from the detrimental effects of air pollution. Acquired lands of the Refuge and MA are located in areas designated as Nonattainment for Fine Particulate Matter PM-2.5. These areas include Cane Ridge WMA in Montgomery Township, Gibson County and the White River Bottoms WMA in Washington Township, Pike County. Air pollution concentrations for fine particulate matter is above the NAAQS levels for this "criteria pollutant" regulated by the Clean Air Act.

Southwest Indiana is in the Illinois Coal Basin and is blessed with rivers and large quantities of coal. These natural resources have resulted in the concentration of many coal-fired power plants. In fact, southwest Indiana has the highest concentration of coal-fired power plants per given area of anywhere on earth. As such, air pollution associated with these power plants is at a high level which explains why six of the seven counties in southwest Indiana are all or partially in Nonattainment for Fine Particulate Matter (PM- 2.5).

The "criteria pollutants" identified by the EPA as part of the Clean Air Act include carbon monoxide(CO), ozone(O3), nitrogen oxides(NOx), sulfur dioxide(SO2), lead(Pb) and particulate matter(PM). The Clean Air Act's Prevention of Significant Deterioration(PSD) program sets strict standards to limit the amount of additional pollutants(SO2), nitrogen dioxide(NO2) and total suspended particulate concentrations) that can be released into the air within designated Attainment Areas. Under this program, Attainment Areas are divided into three classes, each allowing different levels of additional pollutants. The Refuge and MA as well as most of Indiana, is currently a Class II Attainment Area. A Class II designation allows moderate additional deterioration of air quality unless the area comes under Nonattainment status. Nonattainment status means any new source or proposed modifications to existing sources of air pollutants must provide for offset reductions in existing pollution so that the air quality does not deteriorate even further.

Primary pollutants affecting the area's air quality are fine particulate matter, SO2 and NO2, all of which are associated with coal-burning power plants. Nitrogen oxide is a major component of ozone smog and fine particulate matter. these pollutants are known to cause premature mortality and aggravate respiratory and cardiovascular disease, lung disease and asthma. Most vulnerable to these air pollutants are older adults, people with heart and lung disease, children and pregnant women.

Of the many coal-fired power plants in southwest Indiana, several contribute more concentrated pollutants to the air shed of the Refuge and MA based on their closer proximity and location considering prevailing winds. To the west is Duke Energy's Gibson Generating Station (third largest in world based on 3,250 megawatts), to the north is Indianapolis Power and Light and the Frank E. Ratts Generating Station of Hoosier Energy Division and to the south is the Alcoa Generating Plant in Warrick County and the American Electric Power - Indiana Michigan Power Plant at Rockport.

These and other coal -fired plants are all making major investments in pollution control devices to reduce emissions. However, their emissions are still increasing due to an increase in the amount of coal being burned to produce more power and changes in the blends of coal being burned. Atmospheric concentrations of these EPA "criteria pollutants" can only improve with offset reductions of existing pollution sources.

At the beginning of this 21st century, private industry is being spurred on to construct new ethanol refineries and biofuel power plants with offers of Federal subsidies, relaxation of air pollution standards for ethanol refineries and new regulations requiring energy production from renewable fuel sources. In recognition of the increasing demand for more electric power sources and the Federal mandate to increase the use of fuels made from renewable resources, the Indiana Department of Environmental Management (IDEM) is preparing a new Air Monitoring Station Plan to increase the number of air monitoring stations across the State. The location of these new Air Monitoring Stations will better document existing air pollution Nonattainment locations and serve as a guide for locating new sources of pollution away from existing Nonattainment Areas.

Construction of the new-terrain I-69 Interstate highway crossing through the Refuge and MA will make this a high growth potential area. For the long



Wintering waterfowl, Patoka River NWR & MA. Photo credit: USFWS

term protection and management of the biological resources of the Refuge and MA and enjoyment of these resources by the visiting public, a cooperative effort between the Service and IDEM is being made to establish an Air Monitoring Station on or near the refuge. This is the best way to allow for wise decision making related to permitting new-source industrial developments with inherent pollution outputs.

Geology and Soils

This section of Chapter 3 draws heavily on the Patoka River National Wetlands Project EIS, pages 75-88 (USFWS, 1994).

Geology

The Refuge is located on the eastern shelf of the Illinois River Basin, a prominent regional down-warp (bowl) centered in southeastern Illinois. During the Paleozoic Era this basin underwent repeated cycles of subsidence and uplift with accompanying sedimentation and erosion. The cycles stopped in late Pennsylvanian time when the basin was uplifted and subjected to a final episode of degradation (IDGMR, 1898). The remaining thickness of Pennsylvanian rocks in the area is about 1,200 to 1,900 feet. These rocks are composed of cyclical sequences of shale, siltstone and sandstone intermixed with thin, widespread beds of coal, clay, limestone and black shale. In general, these intermixed layers are dipping 1 to 2 degrees west towards the center of the basin.

Within the Pennsylvanian-age rocks, five distinct formations are exposed within the Refuge & MA boundaries:

- *Staunton Formation:* Composed primarily of sandstone and sandy shale, this 75 to 100 feet thick layer is the oldest (deepest) formation and crops out near the eastern boundary of the Refuge & MA.
- *Linton Formation:* Above the Staunton is the 80-feet thick Linton formation. Composed primarily of sandstone, and shale, this formation is found in the eastern and central areas of the Refuge & MA.
- *Petersburg Formation:* This formation lies above the Linton and crops out in the east and central portions of the Refuge & MA. Approximately 100 feet thick, the formation is a sequence of shale, limestone and sandstone.
- *Dugger Formation:* Above the Petersburg lies a 70 to 100-feet thick sequence of sandstone, siltstone, limestone, shale, coal, and underclay comprising the Dugger formation. This formation occurs in the higher elevations of the western portion of the Refuge & MA.
- *Shelburn Formation:* Composed primarily of sandstone and shale, this formation caps the highest sites in the western part of the Refuge & MA.

In addition to these rock formations, most of the area is covered by a mantle of unconsolidated material. During the Pleistocene period, till, outwash and loess was deposited during successive cycles of continental glaciation, ending about 8,000 years ago with the withdrawal of the Wisconsinian glaciers from Indiana. These deposits range from only several feet to nearly 100 feet thick, with the deepest deposits occurring in the western portion of the Refuge & MA (IDNR, 1990).

Minerals

Oil

Small oil production wells are common within and adjacent to the Refuge & MA with the majority on the western end near Oatsville.

Gas

In the past, any natural gas produced incidental to oil production was vented or burned off at the wellhead. In the past two years, interest has been building in producing natural gas from a deeper geological seam known as the New Albany Shale. This is a complex unconventional reservoir with low volume but low decline production found at about 4,000 feet deep in Gibson County. To date, only a few of these wells have been drilled in southwest Indi-

ana. Coalbed methane gas (CBM) is also being explored as a possible new source of energy especially if coal production continues to decline because of the high sulfur content of most Illinois Basin coals. Methane gas is also being produced from old underground mine voids with one mine gas well in Gibson County.

Coal

The Refuge & MA lies on the eastern edge of the Illinois Coal Basin and is in the heart of Indiana's coal producing region. Most of the coal is of moderate to high sulfur content, which means the coal has to be cleaned and the sulfur scrubbed out of emissions when used in steam electric power plants. Although coal mining has been continuous in and near the Refuge & MA for nearly a century, substantial deposits of coal remain unmined. Recent coal industry statistics indicate that approximately 3,670 million tons of recoverable coal (surface and underground minable) remain in Pike and Gibson counties (ICC, 1992). The Office of Surface Mining (OSM) estimated a total coal reserve base of 105 million tons within the Refuge & MA alone, of which 40.5 million tons are accessible by underground mining and 65.5 million tons accessible by surface mining methods.

Over 20,000 acres of Pike County were surface mined for coal prior to the passage of the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Many of the remaining ungraded spoil ridges and final-cut lakes provide excellent wildlife habitat. Nevertheless, some old overburden spoil ridges and abandoned coal preparation sites contain low grade coal, shale and sandstone laced with natural pyrites. Rainfall leaches out high levels of acid-forming substances such as sulfates and metals such as magnesium, iron, aluminum and manganese. As these metals dissolve in the acid water, the total acid salts reach toxic concentration levels. Toxic runoff from such areas impairs water quality in streams and lakes, devastating aquatic life.

Today, all water from mining sites must pass through sediment ponds to improve water quality; mined areas are graded back to approximate original contours and covered with topsoil; pyritic bearing rock is buried deep in the mine pit out of contact with surface water flows and the site is revegetated according to approved reclamation plans. The array of problems long associated with the area's surface mining activities are not a result of today's mining methods, but rather from strip mining prior to SMCRA. Within the Refuge & MA boundaries there



Impacts of strip mining on adjacent lands, Patoka River NWR & MA. Photo credit: USFWS

are approximately 150 acres of old strip mines. Most of the acid producing abandoned mine lands are located outside the Refuge but within the watershed. Most of these have been or are being reclaimed by Indiana Department of Natural Resources' Abandoned Mine Land Program.

Soils

Lying in the valley's floor and subject to periodic flooding, bottomland soil associations make up the majority of Refuge soils. Upland soil associations are located above the flood-zone on valley side-slopes and ridges.

Bottomland Soil Associations

Found on the floodplains of the Patoka River and its major tributaries, these soils were formed in the sand, silt and clay deposited during flood events. Soils within these associations are nearly level, deep, and poorly drained. Soils can also be classified based on hydric (wetness) characteristics, which in turn influence the type of plants that will grow there. Hydric soils are soils that are wet long enough to periodically produce anaerobic conditions. Hydric soils or soils with hydric inclusions comprise the majority of the soil types found in the bottomland.

Nearly 75 percent (16,970 acres) of the Refuge & MA is composed of three such soil associations:

- *Belknap-Bonnie-Wakeland Association:* While it makes up only 13 percent of Pike County, this association represents 46 percent of the Refuge & MA. With adequate drainage, these soils are used mainly for cultivated crops. Some areas are used for hay and pasture while other areas



South Fork Patoka River, Patoka River NWR & MA.
Photo credit: USFWS

are wooded. Flooding and wetness are the principle problems.

- *Stendal-Bonnie-Birds Association:* This soil association represents about 7 percent of Gibson County and 12 percent of the Refuge. The soils are used mainly as cropland, but flooding, wetness, and ponding are problems. They are well-suited for woodland, and used as such along stream channels and in undrained areas.
- *Petrolia Association:* Approximately 3 percent of Gibson County and 17 percent of the Refuge & MA is comprised of this soil association. Flooding and wetness can hinder crop production, but the soils are well-suited for woodland.

Upland Soil Associations

These associations are found on ridge tops and side slopes adjacent to the above floodplain soils. Having formed in loess, material weathered from sandstone, siltstone, shale, and regolith in surface-mined areas, these soils are generally formed on gently to severely sloping sites and are well-drained.

About 25 percent of the Refuge & MA is composed of five upland soil associations:

- *Zanesville-Hosmer Association:* This soil association represents nearly 17 percent of Pike County and seven percent of the Refuge & MA. These soils are fairly well suited for cultivated crops, woodland and recreational uses. Erosion is a hazard, and Hosmer soil's fragipan restricts rooting depth and permeability. Wetness is a problem associated with perched water tables.
- *Zanesville-Gilpin Association:* Soils in this association make up 14 percent of Pike County and five percent of the Refuge & MA. The hazard of erosion, the slope, a fragipan in the Zanesville soils and the moderate depth to bedrock in the Gilpin soils make the association better suited to woodlands, hay and pasture than to cultivated crops.
- *Hosmer Association:* This soil association comprises 16 percent of Pike and Gibson counties and five percent of the Refuge & MA. These soils are used mainly for cultivated crops, hay, and pasture. Some areas are wooded. Erosion is the primary hazard. Hosmer's fragipan restricts rooting depth and can create localized wetness due to perched water tables.
- *Fairpoint-Bethesda Association:* Soils in this association make up about 16 percent of Pike County and nearly four percent of the Refuge & MA. These soils are found in very steep areas where overburden was cast during surface mining, and in nearly level to strongly sloping areas where overburden was smoothed and shaped. This soil association is mainly suited for woodland, hay and pasture because of the slope, erosion hazard, low available water capacity and scattered rock fragments.
- *Alford-Sylvan Association:* This soil association accounts for approximately 19 percent of Pike and Gibson counties and roughly four percent of the Refuge & MA. These soils are well suited to woodland. The steeper areas of this association are used for hay and pasture while the flatter sites are generally suited to cropland. Slope and the hazard of erosion are the primary problems.

Although there are 73 recognized soil types within the 23,743-acre Refuge & MA, over 70 percent of the Refuge is comprised of soils from just six soil series. These include:

- Belknap series (4,144 acres)
- Bonnie series (3,744 acres)

- Petrolia series (3,230 acres)
- Hosmer series (1,835 acres)
- Zanesville series (1,441 acres)
- Steff series (1386 acres).

The majority of these soil series represent soils that are either hydric or contain hydric inclusions, and are located in the Patoka River floodplain. Fifteen soil types are considered hydric and an additional 15 soil types contain pockets of hydric soil. Combined, these 30 soil types account for over 15,000 acres, or 68 percent of the Refuge. Of the remaining 7,000-plus Refuge acres, approximately 5,300 acres are prone to erosion and are classified highly erodible.

Water and Hydrology

This section was reproduced or modified from the Patoka River National Wetlands Project EIS, pages 88 to 101 (USFWS, 1994).

The drainage area of the Patoka River watershed includes 862 square miles in eight counties. At the upper eastern end of the watershed, the Patoka flows rapidly within a relatively narrow floodplain through deeply incised uplands, dropping at the rate of 12 feet per mile. Much of the uplands in this segment of the watershed are forested, with relatively small farms interspersed throughout. As the river enters the flat land created by Glacial Lake Patoka near Jasper, flow slows dramatically as the river's gradient decreases to 1 foot per mile. The predominant land use in the uplands changes from forestland to farmland.

The Refuge is located within this slow, meandering stretch of river with its wide floodplain, numerous oxbows and low rolling uplands. A total of 30 miles of river channel, 16 miles of natural meanders plus 14 miles on the western end that were channelized in the 1920s, are included in the Refuge & MA boundaries. In addition there are 19 miles of oxbow lakes and three miles of the South Fork, a major tributary entering the Patoka River just north of Oakland City (Figure 7).

Two notable events influence the present water regime of the Patoka River. The first was an attempt to drain nearly 100,000 acres of forested wetlands for farming in the 1920s. Known as Houchin's Ditch and beginning at the town of Winslow, the project replaced 36 miles of natural, meandering river with about 17 miles of dredged, straight ditch. The assumption was that by straightening and deepen-

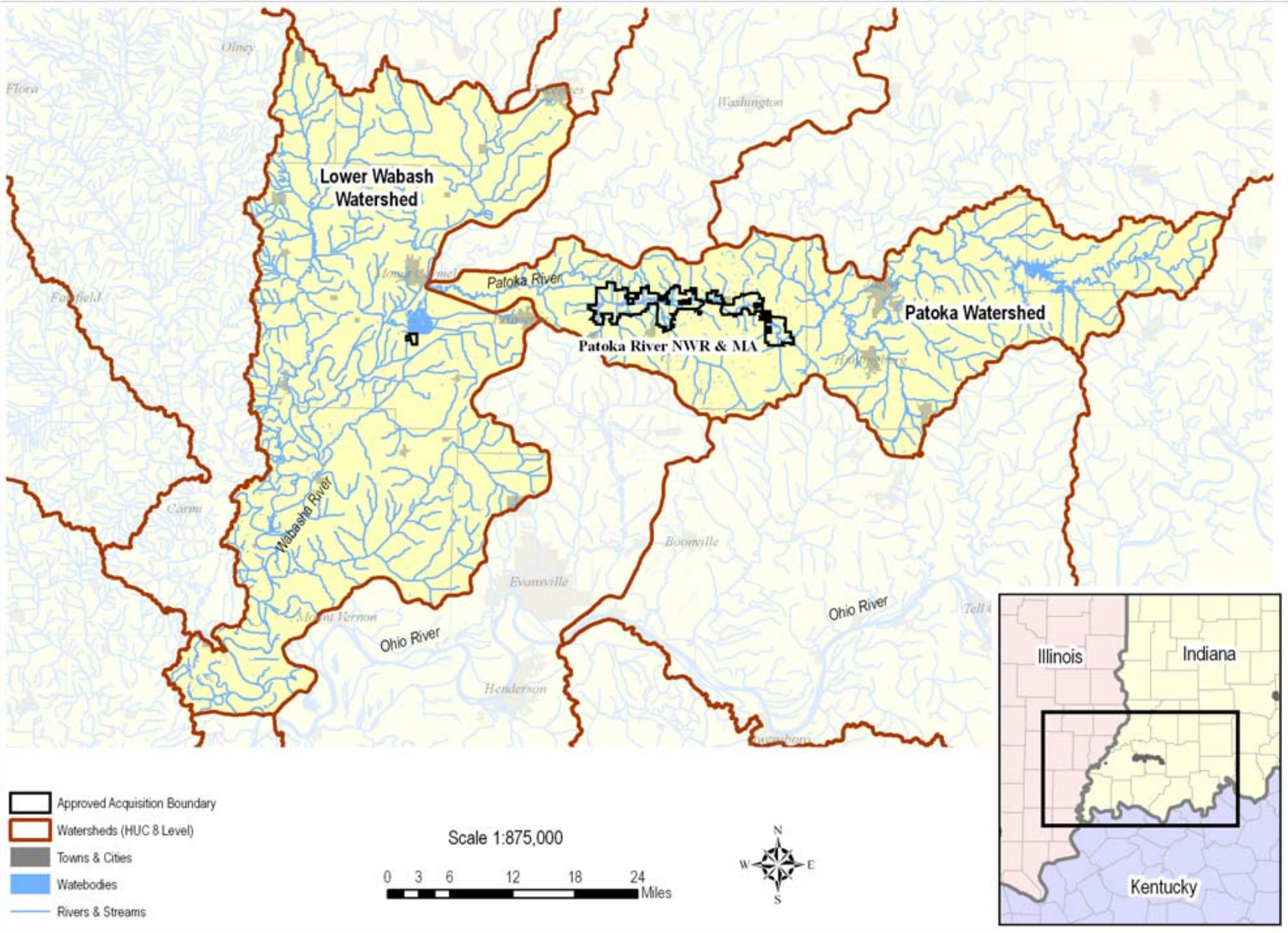
ing the channel, high water would flush through the area more quickly and adjoining lands could be more easily drained. Although some subsequent drainage and clearing of adjacent forested wetlands occurred, overall the project was a failure because of the bowl-shaped topography of this section of the floodplain, the river's low gradient, and the hydrologic relationship between the Patoka and Wabash Rivers.

Nearly 19 miles of natural river meanders were cut off and isolated from the main channel. Water exchange within these man-made oxbows is now limited to periods of high water. Unfortunately, heavy sediment loads are carried during these periods and results in increased deposition in the oxbows. Consequently, these important ecological units are becoming shallower and hold water for a shorter duration. Although this process occurs in all natural riverine systems, new oxbows are continually being created as river meanders are severed from the main channel. In the case of Houchins's Ditch, these oxbows are not being replaced and the associated wetland habitat is being lost.

The second major event affecting the river's flow regime was the Corps of Engineers' construction in the late 1970s of Patoka Lake. Located approximately 63 miles above the Refuge, this 8,000-acre impoundment was designed to provide flood control as well as recreation and water supply. Since the lake was built, flow regulation by it has reduced flood stages in the lower segment of the river usually several times a year.

During the initial start-up of Patoka Lake in 1979, the month of July received an all time high record one month rainfall. The lake behind the dam rose rapidly forcing summer releases of stored water. This resulted in flooding of much of the floodplain crop fields, particularly within the present Refuge and MA boundaries. Farmers blamed the new dam for creating the problem and demanded that something be done. Subsequently, in an effort to lessen the possibilities of summer flooding, a special federal appropriation of \$1.3 million was provided to the Corps to remove all channel obstructions and most leaning trees on both sides of the river from the Patoka Lake Dam to the Wabash River, a length of 121 miles. This was completed in 1981. It reduced localized flooding immediately upstream of drift piles, but largely eliminated in-stream cover and the overhead tree canopy, negatively affecting the river's fish and wildlife resources. The project also

Figure 7: Hydrology at Patoka River NWR & MA



increased the rate and extent of streambank erosion by removing many of the tree roots which had stabilized the river bank.

Agriculture (and associated land clearing, ditching and drain tiles), surface coal mining, and to a lesser extent urban development affect the Patoka River and its watershed. These activities contribute to rapid runoff of precipitation, increased soil erosion, and heavy sediment loads in streams. After any substantial rain event, the Patoka River and its tributaries are characterized by turbid, sediment-laden water.

Ditching, damming, and channelization efforts dating back to the early 1900s are largely responsible for the loss of wetlands throughout the area. Oil well developments, over 20,000 acres of abandoned coal mine lands, intensive agricultural and logging operations as well as runoff or discharges of industrial, community, and farming effluents degrade water quality within the watershed.

Refuge Resources

The sections under this heading draw heavily upon the Patoka River National Wetlands Project EIS (USFWS, 1994).

Plant Communities

Wetlands

Within the Refuge & MA are 12,700 acres of forested wetlands, emergent wetlands, scrub-shrub wetlands, agriculturally modified wetlands, and open water habitat.



American lotus, Snakey Point Marsh, Patoka River NWR & MA. Photo credit: USFWS

Forested Wetland

The majority (55 percent) of wetlands within the Refuge & MA fall in this category. Characterized by woody vegetation that is 20 feet or taller, forested wetlands are found within the floodplain of the Patoka River and its tributaries where the terrain is relatively flat and soils are poorly drained. Soils may remain saturated for most of the growing season on some sites and only a week or two during the growing season on other sites. Most areas of forested wetland experience some degree of annual flooding. Tree species composition often reflects the hydrology of the site. On the wettest areas, the mature forested wetland supports black willow, sweetgum and river birch. Areas frequently or seasonally flooded are dominated by silver maple, cottonwood, sycamore, pin oak, Shumard oak, swamp chestnut oak, overcup oak, swamp white oak, green ash, and red maple. On drier bottomland sites that are infrequently flooded for short durations, the dominant canopy trees include American beech, pecan, black walnut, American elm, and cherrybark and other oaks. For a more complete list of plants common to the Refuge's bottomland forested wetlands see Appendix C.

Forested wetlands transformed by flooding as a result of beaver activity cover hundreds of acres within the Refuge. Depending on when they were created, these areas may contain stumps as well as dead and/or dying trees. They are typically covered by a growth of duckweed, with coontail and bladderwort under the surface. Buttonbush, whitegrass, common arrowhead, and knotweed commonly dominate the borders.

Scrub-shrub Wetland

These freshwater, vegetated wetlands are dominated by woody vegetation less than 20 feet tall. Scrub-shrub wetlands may represent a successional stage leading to forested wetland, or they may be relatively self-maintaining, stable communities. They are more or less permanently inundated. Plant species found in shrub-shrub wetlands include true shrubs such as buttonbush, red-osier dogwood and swamp privet, as well as young trees, or trees and shrubs that are small or stunted because of environmental conditions. Some of these include pumpkin ash, red maple, and willows.

Within the Refuge, scrub-shrub wetlands are found exclusively around the fringes of beaver flooded areas and in many of the numerous river oxbows created either through natural river meandering or as a result of river channelization in the



American Coot, Patoka River NWR & MA. Photo credit: USFWS

1920s. A total of 1,053 acres (4.7 percent) of Refuge lands are scrub-shrub wetlands, which represents eight percent of the Refuge's total wetland acreage.

Emergent Wetland

Emergent wetlands, commonly referred to as marshes and sloughs, are characterized by erect, rooted water plants that are present for most of the growing season in most years. These wetlands normally contain standing water, though at times they will dry up. Common perennial plants found in emergent wetlands include cattail, bulrushes, sedges, dock, and smartweeds. For a more complete list of plants found in this wetland type within the Refuge see Appendix C.

The Refuge contains about a thousand acres of emergent wetlands. This represents about 4.5 percent of the Refuge and 8 percent of the Refuge's total wetland acreage.

Agriculturally Modified Wetland

Lands in this category, although disturbed annually by agricultural activities, still possess the hydrologic characteristics and hydric soils necessary to perform many of the natural functions of undisturbed wetlands. These functions include absorbing rain and flood waters and recharging local groundwater and aquifers. Because of their location in the floodplain, winter flooding makes waste grain as well as natural foods available to migrating and wintering waterfowl. The majority of waterfowl use within the Refuge is currently associated with these agricultural lands. Approximately 22 percent of the Refuge wetlands fall into this category, and nearly all are located at the western end of the Refuge & MA.

Open Water

The 837 acres of Refuge in this category include upland lakes and ponds, oxbows associated with the Patoka River and the waters of the Patoka River and its various tributaries.

Uplands

The principal natural community found in the Refuge is classified upland forest. As with the bottomland forests, upland forest resources have been heavily utilized by the area's timber industry. Mature upland forests are extremely limited in the Refuge; they occur at higher elevations where terrain is steeper and soils are well-drained. On southwest-facing slopes, these forests would typically contain both white and black oaks, hickory, and blackgum. On more mesic (wetter) sites, such as northeast aspects and valleys, the tree species composition would include red oaks, yellow poplar, beech, sugar maple, walnut, hickory, and cherry. Some pines are present in upland forest, but they are not indigenous to this part of Indiana. Although upland forest can be found in most areas of the Refuge, the majority is located in Pike County. This natural community type represents 15 percent of the total Refuge & MA.

Invasive Plant Species

Some exotic (also known as non-native or alien) plants greatly alter the plant communities of natural areas while others more commonly affect already disturbed or agricultural areas. Left unchecked, noxious plant species can seriously degrade the productivity and wildlife value of invaded habitats.

Fortunately, most of the Refuge & MA's wetlands are relatively free of noxious plants. Those in the area possessing the greatest potential for serious impacts include common reed grass, reed canary grass, and moneywort. The first two are a greater threat in open wetland sites, whereas moneywort can carpet large areas of floodplain forests (as well as open areas). Purple loosestrife was found in the Refuge in 2006 and eliminated. Both purple loosestrife and common reed grass have been observed to form monocultures, completely overrunning wetlands to the exclusion of almost all other plant species. Monitoring will be necessary to assure prompt action is taken to control these plants before they become a problem in the future.

On upland sites and agricultural communities, the most troublesome noxious plant is Johnson grass. Owing to its hardiness, growth and reproductive mechanisms, and its close relationship to domestic corn, this introduced species is widespread and difficult to control in both Pike and Gibson counties. As a result of seed dispersal during flood events, bottomland agricultural fields are particularly prone to infestation making it common to see this plant in those areas.

Other plants classified as noxious weeds in the area include Canadian thistle, bur cucumber and shatter cane. Although locally significant, these species do not represent as pervasive a problem as Johnson grass.

Threatened and Endangered Plants

The Indiana Natural Heritage Data Center is a continuously updated data management system which contains locations of all rare plant species in Indiana. Based on this information, which includes both historical collections and recent discoveries, the Indiana Division of Nature Preserves (IDNP) compiled a list of 55 potential rare plants which could occur within the Refuge & MA. IDNP personnel then conducted field investigations to confirm the presence of any of these rare plant species. In 1991, 17 individual areas within the Refuge & MA were inventoried. A total of 20 state-listed plant species were verified during the survey (Homoya, et al., 1992). No federally-listed threatened or endangered plants are known to occur within the Patoka River NWR/NWA.



Drake Wood Duck. Photo credit: USFWS

Two of the 20 state-listed plant species are particularly noteworthy. The discovery of sickle pod (*Cassia obtusifolia*) represents the first documented occurrence of this species in the state. Also, three populations of buttonweed (*Diodia virginiana*) were found in the Project area. These finds represent the second, third and fourth occurrences of this species documented in Indiana. The vast majority of rare plants found during IDNP'S survey are associated with forested and emergent wetlands. Although a few species were found in disturbed habitat, most were growing in relatively stable wetland communities, and were scattered rather evenly throughout the inventoried area of the Patoka River floodplain.

Fish and Wildlife Communities

Birds

The Patoka River and surrounding wetland and upland areas provide an array of habitat types which fulfill the necessary breeding, feeding, migration and wintering requirements for a variety of avian species. Scientific surveys, organized bird counts and casual observations have recorded over 231 species of waterfowl, wading and shore birds, songbirds, game birds and others within the Refuge & MA.

Waterfowl

The Patoka River bottoms, particularly during periods of high water in late fall and early spring, is an important waterfowl migration stop-over in the eastern portion of the Mississippi flyway, and one of the more important sites in the state. Average fall/winter duck populations in the Refuge & MA are conservatively estimated at 5,000-8,000 birds during years with good available water, i.e., sufficient rainfall to provide lowland flooding. Data available for waterfowl use during spring migration shows a minimum of 15,000 ducks, utilizing the area on their journey north. Most of this use occurs in the Oatsville, Wirth and Wheeling Bottoms, historically high-use areas, although birds are also found on the other numerous wetlands throughout the Refuge & MA. Cane Ridge Wildlife Management Area, west of the main body of the Refuge and along the Wabash River, seasonally attracts waterfowl populations estimated at 10,000 ducks and 8,000 Snow Geese annually.

The Patoka River valley contains some of the best Wood Duck nesting and brood rearing habitat in the State. Beaver activity is largely responsible, although other factors such as rising water tables

and erosion-related sedimentation of area ditches also have contributed to the increase in wetlands. Although Wood Duck is the major species breeding on the Refuge & MA, adjacent lands, particularly strip-mined areas reclaimed since 1977, also support nesting by several other waterfowl species, including Mallards, Blue-wing Teal and Northern Shoveler. Local nesting by Giant Canada Geese has been documented since the early 1980s. Most nesting is found on reclaimed strip mine lands.

Shorebirds and Wading Birds

The Patoka River NWR & MA provides an abundant source of food and high quality nesting and roosting sites for resident and migrating shorebirds and wading birds. Although approximately 40 species have been observed in the Refuge & MA, the majority are transitory, utilizing the emergent wetlands, shallow flood waters and temporary mudflats for resting and to obtain protein (in the form of invertebrates) essential for continued migration and successful reproduction.

The Refuge & MA hosts numerous species of plovers, sandpipers, dowitchers, and rails, among others. One notable migrant is the Sandhill Crane. Each fall, thousands of cranes stage at the Jasper-Pulaski Fish and Wildlife area in northern Indiana. Their journey to wintering grounds in Florida takes them over the Patoka River bottomlands. When habitat conditions are suitable, flocks of 50 to 100 birds have been observed resting and feeding before continuing south.

Several species of wading birds, notably the Great Blue Heron, Black-Crowned Night-Heron and Yellow-Crowned Night-Heron, are known to nest within the Refuge & MA. Several other species, including the American and Least Bitterns, Green-Backed Heron, Piping Plover, Killdeer, and Common Snipe have breeding ranges which encompass the Refuge & MA, and it is reasonable to assume that many or most of these species nest here. Wilson's Phalarope and Black-necked Stilt are documented nesters at Cane Ridge Wildlife Management Area, located west of the main body of the Refuge along the Wabash River.

Raptors

The Refuge area supports permanent or seasonal populations of at least 14 species of birds of prey. Open fields and emergent wetlands provide essential habitat for Northern Harriers, American Kestrels, Short-eared Owls, Barn Owls, and Broad-Winged, Rough-Legged, and Red-Tailed Hawks. Forested wetlands and upland forests support Co-

oper's and Sharp-Shinned Hawks, Great Horned Owls, Barred Owls and Eastern Screech Owls. In addition, the state-listed Red-Shouldered Hawk currently nests within the Refuge & MA. The Patoka River area probably has the largest expanse of nesting habitat for this species remaining in the state.

The Osprey, a state-listed endangered species, as well as a species of management concern to the Service, has been observed utilizing Patoka River wetlands during migration. The Mississippi Kite, extremely rare in Indiana, has also been observed on the Refuge.

Upland Game Birds

Resident populations of Bobwhite Quail, Ruffed Grouse and eastern Wild Turkey occur within Patoka River NWR & MA. Resident and migrant populations of Mourning Dove and American Woodcock also occur locally.

In general, quail require a diversity of habitats, including forests, brush, grass and cultivated lands. Successional zones between forest and field (edge or ecotone) is particularly important.

Few quail inhabit the interior of large tracts of bottomland or upland forests. Quail populations in the area are considered fair, with annual recruitment determined generally by winter and spring weather and the availability of suitable nesting/brood habitat.

Ruffed Grouse is a woodland species that generally prefers early stages of forest succession. Hardwood thickets characterized by dense stands of young saplings and vine tangles, old fields reverting to trees and young pine plantations are important habitat components. Historically, Ruffed Grouse populations in Indiana were declining in the early 1960s and their distribution was restricted to a small area in the south-central part of the state. An intense trapping and transplanting effort by the Indiana DNR was undertaken to reverse this trend. As Indiana forests have matured, the amount of young forest preferred by Ruffed Grouse has declined, resulting in lower grouse numbers in recent years.

Generally speaking, the Wild Turkey is a forest dweller, favoring mature mast-producing hardwoods (mainly oaks) with a mixture of understory plants like dogwood, sassafras, and greenbriar. Turkeys also make use of green plants (clover, wheat) and seeds (grasses, wheat, agricultural crops) found in pastures, crop fields, roadsides and disturbed or



Opossum and young, Patoka River NWR & MA. Photo credit: USFWS

abandoned areas. These more open areas provide the insects needed by poult for the protein necessary for rapid growth and development, and the forest/field interface is often preferred by nesting hens. The Refuge & MA contains these essential habitat components, and consequently the area supports a good turkey population.

Although migratory, Mourning Doves are present on the Refuge year round. Winter birds are principally migrants from northern areas utilizing the area after the local breeding population has migrated south. Heaviest concentrations of Mourning Doves occur in late summer as breeding birds and young of the year stage in large flocks prior to moving south. Most local birds are gone by early November. Because of their adaptability and high reproductive capacity, Mourning Doves are the most abundant upland game bird in the area as well as in the state. Strictly ground-feeding seed eaters, doves find abundant foods at Patoka River NWR & MA. Principal foods include waste grain in winter wheat, corn, milo and silage fields, annual weeds (foxtail, spurge, crabgrass, ragweed) in abandoned or disturbed area, and both planted and volunteer vegetation in large areas of newly-reclaimed strip mining lands.

Although limited nesting is known to occur, American Woodcock primarily utilize the area during spring and fall migrations. During these seasons they occur in fairly dense coverts of regenerating woodlands in the early stages of succession. Because the woodcock relies almost exclusively on earthworms as a food source, favored sites are in rich, moist bottomlands or upland riparian areas. Although never abundant on the Refuge, large flights during migration, particularly in the fall, can

result in temporarily high populations in small, isolated areas offering good habitat with plenty of worms.

Passerines (Perching Birds)

Detailed information on the abundance of some non-game bird species is not available, but it is known that well over 100 species of passerines and other species utilize the Refuge & MA at some time each year. Prior to settlement, the larger, unbroken tracts of bottomland forest were undoubtedly important habitat for many neotropical migrants, that is, species that summer and breed in North America and winter in Latin America. Neotropical migrants include most of our forest and grassland songbirds. Subsequent forest fragmentation, both in southern Indiana and nationally for agricultural expansion, roadways, urbanization, utility (pipeline and transmission line) corridors, and timber production has had serious impacts on many of these birds and population declines have been noted for many species. However, counts of singing male Cerulean Warblers noted while canoeing the Patoka River in the eastern third of the Refuge, showed some of the highest count totals recorded in Indiana. The large number of Prothonotary Warbler pairs recorded in the bottoms during a 1997-98 Breeding Bird Research Study by Hurley was significant enough to justify listing the Patoka River NWR as an Important Bird Area by the National Audubon Society.

At the time of the NWR/MA's establishment in the early 1990s, forestland within the area, both upland and bottomland, had been reduced in extent and quality. Yet it still offered the best habitat in the area and has been utilized for nesting and migration by a variety of warblers, thrushes, vireos, woodpeckers, flycatchers and sparrows. The Refuge's reforestation efforts over the past decade have been beneficial to shrub-scrub and forest-dwelling passerines.

Mammals

Indiana is home to 54 species of mammals, of which 41 species occur on the Patoka River NWR & MA. These include an array of game, non-game and furbearing mammals.

Game Mammals

The Refuge provides excellent habitat for Indiana's only big game species, the white-tailed deer. Interspersed bottomland forest, agricultural fields, idle/scrub lands, wetlands and upland forest pro-

vides the habitat diversity necessary for abundant food, protective cover, and reproductive activities. Population density estimates in the 1990s by the Indiana DNR indicate 33 deer per square mile of suitable habitat in Pike County and 22 deer per square mile of deer habitat in Gibson County. In terms of county-wide averages for all types of land and habitat types, Pike County supports 15 deer per square mile while Gibson County is estimated at six per square mile. With the exception of open water and some emergent wetlands, the Refuge & MA is considered to be suitable deer habitat, and supports approximately 25 to 30 deer per square mile. Deer are present in sufficient abundance to cause agricultural depredation in isolated locations. Because of the area's deer abundance, deer hunting is an extremely popular activity for local and visiting sportsmen.

Patoka River woodlands and adjacent uplands provide habitat for both fox and gray squirrels, the most sought after small game mammals in the state. Productive squirrel habitat contains adequate den trees for escape, protection and reproduction, and dependable food sources in all seasons. Squirrel reproduction and survival fluctuates with changing yields of heavy-seeded mast, particularly acorns. Other fruits and berries, floral parts, buds, bark, roots, fungi and animal matter provide foods when heavy mast is unavailable. A variety of hardwood tree species is essential to a balanced habitat, but the stocking of heavy-seeded species – oak, hickory, beech, walnut – determines carrying capacity.

Much of the bottomland forest within the proposed Project area has been continually harvested for the heavy-seeded tree species, i.e., oak and hickory. Subsequently, these woodlands do not contain optimum stands of these important squirrel foods, and populations are considered fair. Upland forests, particularly those managed by the Indiana DNR, are characterized by more tree species diversity; their squirrel populations are generally considered good.

The other major small game mammal within the Refuge & MA is the eastern cottontail rabbit. They require early successional vegetation, and rabbits are found in good numbers in and around abandoned fields, fence rows, pasture borders and reclaimed strip mine lands. As strict herbivores, the cottontail favors new growth grasses, succulent forbs and some agricultural grains. During severe winter weather, the bark of young woody growth can sustain rabbits for short periods.

Furbearers

Furbearers generally include those animals harvested by hunting or trapping primarily for the commercial value of their pelts. Because most of these animals are closely associated with wetland/aquatic sites, Patoka River NWR & MA provides excellent habitat for furbearers such as muskrats, beaver, coyotes, foxes, and others.

Marshes are the preferred habitats of muskrats, but the species also occurs along streams and ditches as well as in lakes and ponds. Areas such as Snakey Point provide excellent muskrat habitat. Although somewhat cyclical, muskrat populations in area marshes, ponds, oxbows, and the Patoka River itself are considered good.

Beaver are thought to have been extirpated in Indiana by 1900. Natural range expansion by way of the extensive river systems and relocating some beavers to wild areas away from human habitations have resulted in a nearly state-wide distribution today. Within the Refuge & MA, nearly all suitable habitat is currently occupied by beaver. Beaver activity is responsible for the shallow water and standing dead timber in several large areas, most notably west of Line Road and north of Snakey Point. Beavers impound areas adjacent to water courses to provide access to food and other essential habitat needs; these areas are later abandoned when food supplies are depleted and the animals move to new territory. Although significant in short-term impacts, these activities are a natural phenomenon in the Patoka's bottomland forests and increase the diversity of wetland types and the wildlife that utilize them. This cycle (bottomland timber beaver impoundment emergent marsh scrub-shrub wetland bottomland timber) has occurred historically in the Patoka bottoms.

Unfortunately, the beaver's habit of impounding waters frequently brings it in direct conflict with man. Beaver activity results in plugged road culverts and flooded roadways, water encroachment on railroad grades, reduced drainage and flooding of agricultural lands, and loss of timber resources. Beaver can be trapped and dams can be removed, but as long as suitable habitat is available these remedies are at best temporary because beaver will quickly re-colonize the site. Refuge management policy is to remove nuisance beavers whenever their works on the refuge are impacting private lands off the refuge.

Coyotes and red and gray foxes are relatively common on the Refuge & MA. Over the last few

decades, the coyote population has gradually increased in areas of suitable habitat, primarily upland brushy, grassy and abandoned fields. Abandoned strip-mined lands as well as newly reclaimed areas provide ideal habitat for coyotes. Red foxes occur in similar habitat and it is believed that the coyote often displaces some red fox from these areas, thus depressing red fox populations. Gray foxes are found more commonly in bushy and wooded habitats both in uplands and bottomlands. Food habits of coyotes and foxes are similar and include primarily small rodents and occasional birds. When present in sufficient numbers coyotes are known to prey heavily on white-tailed deer fawns. Occasionally, coyotes impact livestock producers (sheep and pigs).

Mink, otters, weasels, skunks, opossum, and raccoons are also relatively abundant in the area. Food habits range from the carnivorous behavior of minks, otters, and weasels to the omnivorous habits of raccoons, opossum, and skunks. Mink, otters, weasels and raccoon are closely associated with wetland habitats, streams and ponds; opossum and skunks are more often found in the uplands. Because they are all considered predators, they occasionally cause damage to domestic animals, i.e., prey on poultry and other tended animals. Otters were reintroduced into the Patoka River by the Indiana Department of Natural Resources over a period of several years in the late 1990s. This popular reintroduction effort has resulted in otters dispersing throughout the Patoka River Watershed and beyond.

Nongame mammals

Numerous small nongame mammals find suitable habitat on the Refuge & MA. Included in this group are shrews, moles, bats, chipmunks, mice and voles. Although there are little specific data regarding population sizes, the interspersed of woodlands, wetlands, abandoned fields, agricultural lands, creeks, ponds and river make it reasonable to assume that these species are faring well. Although rarely observed, and frequently underappreciated, nongame mammals are critically important as a food source for the larger, predatory mammals as well as most of the area's hawks and owls.

Amphibians and Reptiles

The Patoka River valley is within the range of at least 60 species of herptiles, that is, snakes, turtles, lizards, skinks, salamanders, newts, sirens, toads and frogs (Conant, 1958). A diverse assortment of reptiles and amphibians occur on the Refuge and fill



Five-lined skink, Patoka River NWR & MA. Photo credit: USFWS

many important niches in the ecosystem's natural food chain. Patoka's herpefauna include the northern copperbelly water snake, a species of concern which has been found to inhabit the buttonbush swamps of the bottoms in large numbers, and spring's tiny harbinger, the spring peeper, a small frog whose persistent, shrill mating call pierces March nights in an ancient rite of spring.

Because the majority of these species require moist woodlands, ponds, streams, marshes, swamps or quiet backwaters, Patoka River NWR & MA provides excellent herptilian habitat. Many species of reptiles and amphibians are nocturnal or secretive in nature which makes it difficult to adequately determine population status. And although there are no current data on population levels, it is assumed that numbers are adequate to maintain existing herptile communities. However, it is reasonable to assume that, as has been noted with other aquatic organisms, populations of reptiles and amphibians have been negatively impacted by the long-term degradation of water quality in the Patoka River watershed. As the acid mine water drainage is eliminated in the watershed and refuge bottomland fields are purchased and restored to hardwood forests, water quality is constantly improving. The South Fork Patoka River is an outstanding example of watershed restoration efforts leading to the reestablishment of a stream fishery which now supports nesting Bald Eagles and public fishing opportunities where none existed for 50 years prior to Refuge establishment.

Fish

Most of the Refuge's fishery resources are associated with the Patoka River and its wetlands. Two fisheries surveys of the Patoka River and many of its tributaries in the late 1980s and early 1990s revealed that fish populations were surprisingly diverse and abundant, especially considering the environmental abuses this river has endured over the past 70 years (Stefanavage, 1993; U.S. Fish and Wildlife Service, 1989). A total of 66 species of fish representing 15 families were found to inhabit these waters. Although not usually considered prime fish habitat, overall species diversity in the Patoka River in 1991 compared favorably with other southwest Indiana streams (Stefanavage, 1993).

Considering the Patoka River's low dissolved oxygen levels, muddy brown/green water, and limited in-stream structure (habitat), it is not surprising that common carp was found to be the most abundant species. Gizzard shad, an important food source for more desirable predatory fish, was the second most abundant. Third in number was small-mouth buffalo, an edible species frequently sought by anglers. It is interesting to note that the small-mouth buffalo population appears large enough to support commercial fishing. Of the more popular game fish, channel and flathead catfish probably provide the best sport fishing opportunities in this section of the river. Largemouth bass, bluegill and crappie, while present, do not have populations large enough, or do not grow at a sufficient rate, to offer substantial fishing opportunities.



Patoka River, Patoka River NWR & MA. Photo credit: USFWS

As a result of the U.S. Army Corps of Engineers channel clearing project in the early 1980s, and ongoing, similar activities by the Upper and Lower Conservancy Districts, fish habitat in terms of in-stream cover ranges from none to very little. Few log jams, brush piles and root-wads are found in the river within the proposed Project area. Consequently, species requiring in-stream cover (largemouth bass, bluegill, crappie) are limited by available habitat. Riffle/pool habitat is also scarce. In general, the stretch of river within the proposed Project is classified glide/run, and is characterized by a mud and silt bottom. Species diversity in the channelized portion of the river (downstream from Winslow) is lower than in the natural, meandering channel. Diversity at sampling sites averaged 14 species in the channelized river while the natural river supported an average of 19 species. Fish of interest to commercial and sport fishermen (buffalo, drum, channel and flathead catfish and spotted bass) were more abundant in the unchannelized section.

In addition to inadequate in-stream habitat, non-point source pollution, particularly acidic waters from abandoned coal mines and illegal releases of salt brine produced from oil wells, has been a limiting factor for the Patoka River fisheries. Decreases in fish numbers and species diversity immediately below Mill Creek and the South Fork Patoka River, both of which have carried high levels of acid mine waters, attest to the deleterious impacts associated with this pollutant. Fish kills associated with acid drainage were not uncommon in the South Fork at the time of the Refuge's establishment. One of these occurred on September 1, 1991, when heavy rain fell after two months of dry weather. Dead bluegill, bowfin, common carp, gar, and largemouth bass were observed. It appears that fish species from the Patoka River would recolonize the lower portion of the South Fork during drought periods. Then, as described above, fish populations in the South Fork would be wiped out when major storm events occurred which flushed acidic water into the stream from abandoned mine areas. This acid water flush-out problem of the South Fork has been largely eliminated in the past 10 years due to the efforts of the Indiana Division of Reclamation's Abandoned Mine Land Reclamation Program and local citizen efforts associated with the Appalachian Clean Stream Initiative of the U.S. Office of Surface Mining. Illegal releases of salt brine from oil wells while documented as being common practice in the 1960s,



Pied-billed Grebe, Patoka River NWR & MA. Photo credit: USFWS

1970's and 1980's has largely been eliminated thanks to enforcement efforts by the Indiana Division of Oil and Gas.

One clear sign that water quality in the main stream Patoka River is improving as a result of improved enforcement actions and millions of dollars of reclamation efforts in the watershed are the increasing reports of paddlefish. (*Polyodon spathula*) since the late 1990s. Known to spawn in the Wabash River, part of the life cycle needs for these gill feeders includes rich feeding grounds found in flooded bottomland hardwoods. As the water quality of the Patoka River has improved, paddlefish have returned to this ancestral feeding area during spring floods to build up their body fats for successful egg production. Fishermen now report seeing paddlefish on a regular basis in the Patoka River and associated tributaries, oxbows and marshes. Recent contaminant surveys by Bloomington Ecological Services in the early 2000s also saw the return of harlequin darters which hadn't been found in the Patoka River since the late 1800s.

Invertebrates

The wetlands associated with the riparian ecosystem along the Patoka River support good invertebrate populations in their nutrient-rich waters. Nesting waterfowl, waterfowl broods and shorebirds are highly dependent on these protein-rich food sources for successful reproduction and healthy growth. Invertebrates associated with wetlands in the area include protozoa, crustaceans, mol-

lusks, snails and insects. Contaminant studies to evaluate the impact of salt brines on freshwater shrimp and crayfish were conducted on the Patoka River between 2000-2002 by Tom Simon of the Bloomington Ecological Services Office. One result of this study was the discovery of a new species of burrower crayfish identified now as the painted-hand mudbug (*Cambarus nov.sp.diogenes*) named because of the red tips on its claws. It turns out that this new crayfish species is the most common species on the Patoka River NWR.

Insects

By far the most obvious (and obnoxious) insects in the area are mosquitoes. Of the 51 species known to occur in Indiana, 30 could be expected to inhabit the southwestern portion of the state (Siverly, 1972). The majority of these species are considered pests whose biting activities often thwart otherwise enjoyable outdoor living and recreational activities, but do not pose any substantial human health risk. The most common nuisance mosquitoes found in local floodplains are *Psorophora ciliata* and *Aedes vexans*, the latter being perhaps the number one pest species in the area. These floodwater species are not significant vectors(carriers) of human diseases in southern Indiana.

Molluscs

Historically, the Patoka River supported a rich diversity of freshwater mussels that were utilized by Native Americans and wildlife alike. One early survey documented 21 species occurring in the river with other historical records showing an additional 12 species. Most of these mussels are relatively common in Indiana's larger creeks. The ring pink and hickory nut are big river species and probably lived near the confluence with the Wabash River. The ring pink is on the federal list of endangered species, but is believed to be extirpated from Indiana. The club-shell, and fat pocketbook, both federally endangered species, are reported in historical records. A more recent survey of the Patoka River found no live specimens of these species, but did turn up a weathered fat pocketbook shell, although not within the portion of the river flowing through the Refuge.

A survey of freshwater mussels conducted in 2000 along the entire length of the Patoka River and portions of its tributaries found 28 mussel species (Ecological Specialists, Inc. 2001). This is fewer than the 33 species reported in historic records. The segment of the Patoka River flowing through the Refuge contained 17 mussel species. No species were

found in the channelized portion of the river probably because the habitat in this stretch has been altered so as to render it unsuitable.

The diversity of freshwater mussels within the Patoka River has declined from historic levels, a trend that is similar for freshwater mussels across North America. Human activities during the past 90 years have greatly reduced the river's capability to support the once large assortment of bottom-dwelling mollusks. River channelization, erosion-related sedimentation, pesticide and fertilizer runoff, pollutants from oil and coal extraction, improperly treated sewage, and toxic industrial discharges have combined to degrade bottom substrates, water quality, and the riverine ecosystem in general. The diversity and numbers of mussels present in a river serves as an excellent barometer of river water quality. The more species and the higher the number of mussels found indicate the higher the water quality and stream bottom health. Future mussel surveys will be used to compare back to the initial surveys conducted when the Patoka River NWR was established to verify improvements resulting from management practices.

Threatened and Endangered Species

Threatened and Endangered Flora

The Indiana Natural Heritage Data Center is a continuously updated data management system which contains locations of all rare plant species in Indiana. Based on this information, which includes both historical collections and recent discoveries, the Indiana Division of Nature Preserves (IDNP) compiled a list of 55 potential rare plants that could occur within the proposed Wetlands Project. IDNP personnel then conducted field investigations to confirm the presence of any of these rare plant species. In 1991, 17 individual areas within the Project area were inventoried. A total of 20 state-listed plant species were verified during the survey (Homoya, et al., 1992). No federally-listed threatened or endangered plants are known to occur within the NWR/MA. The vast majority of rare plants found during IDNP'S survey are associated with forested and emergent wetlands.

Two of the 20 state-listed plant species are particularly noteworthy. The discovery of sickle pod (*Cassia obtusifolia*) was the first documented occurrence of this species in the state. Also, three populations of

buttonweed (*Diodia virginiana*) were found in what is now the Refuge & MA. These finds were the second, third and fourth occurrences of this species documented in Indiana.

More current data on endangered, threatened and rare plants in Gibson and Pike counties are available from the Indiana Department of Nature Preserves (IDNP) within Indiana DNR (IDNP, 2005a; IDNP, 2005b). Table 2 shows those vascular plants listed by IDNP expected to occur in either Gibson or Pike counties, or both, as of 2005. (Table 2)

In addition to these species and subspecies/varieties of wild plants, IDNP lists four "high quality natural communities" found in Gibson and/or Pike counties, including Forest – floodplain wet-mesic, Forest – upland dry-mesic, Forest – upland mesic, and Wetland – swamp shrub. Each of these communities occurs on the Refuge & MA.

Threatened and Endangered Fauna

Whooping Crane (*Grus Americana*)

In 2001, the U.S. Fish and Wildlife Service initiated a reintroduction of a Nonessential Experimental Population of Whooping Cranes in the Eastern United States. The intent was to establish a migratory flock that would summer and breed in Wisconsin and winter in west-central Florida which was historical habitat. Since the migration route is a learned rather than an innate behavior, captive-reared Whooping Cranes released in Wisconsin were led by ultralight aircraft to establish their historical flight path to suitable wintering areas in Florida. Five Whooping Crane yearlings were led over 1,200-miles in 2001, followed by 16 in 2002, 15 in 2003, 17 in 2004, 21 in 2005 and 18 in 2006. The first record of these introduced Whooping Cranes visiting the Patoka River NWR was on November 17, 2003, when a pair (2-02-F and 13-02-M) spent several days in the Patoka River bottoms near the Francisco Mine within the Refuge acquisition area. On March 27, 28 and 29, 2005, No. 2-01-F and No. 8-02-M spent their time in corn field stubble at Patoka River NWR in Pike County near Line Road. Annual stop overs on the Refuge are expected to occur every spring and fall once a viable flock is established.

Bald Eagle (*Haliaeetus leucocephalus*)

An increase in abundance and distribution of the Bald Eagle across the United States led to its reclassification from endangered to threatened in

Table 2: Endangered, Threatened, or Rare Vascular Plants in Gibson and Pike Counties, Indiana, as of 2005

Scientific Name	Common Name	Gibson County	Pike County	FED	STATE	GRANK	SRANK
<i>Acalypha deamii</i>	Mercury	✓			SR	G4?	S2
<i>Armoracia aquatica</i>	Lake Cress	✓			SE	G4?	S1
<i>Azolla caroliniana</i>	Carolina Mosquito-fern	✓			ST	G5	S2
<i>Calyccarpum lyonii</i>	Cup-seed	✓			ST	G5	S2
<i>Carex socialis</i>	Social Sedge	✓			SR	G4	S2
<i>Carex straminea</i>	Straw Sedge	✓			ST	G5	S2
<i>Catalpa speciosa</i>	Northern Catalpa	✓			SR	G4?	S2
<i>Chelone obliqua</i> var. <i>speciosa</i>	Rose Turtlehead	✓	✓		WL	G4T3	S3
<i>Clematis pitcheri</i>	Pitcher Leather-flower	✓			SR	G4G5	S2
<i>Crataegus grandis</i>	Grand Hawthorn	✓			SE	G3G5Q	S1
<i>Crataegus viridis</i>	Green Hawthorn	✓			ST	G5	S2
<i>Cyperus pseudovegetus</i>	Green Flatsedge	✓	✓		SR	G5	S2
<i>Didiplis diandra</i>	Water-purslane	✓	✓		SE	G5	S2
<i>Diodia virginiana</i>	Buttonweed	✓	✓		WL	G5	S2
<i>Gleditsia aquatica</i>	Water-locust	✓			SE	G5	S1
<i>Hibiscus moscheutos</i> ssp. <i>lasiocarpus</i>	Hairy-fruited Hibiscus	✓			SE	G5T4	S1
<i>Hottonia inflata</i>	Featherfoil		✓		ST	G4	S2
<i>Iresine rhizomatosa</i>	Eastern Bloodleaf	✓			SR	G5	S2
<i>Itea virginica</i>	Virginia Willow		✓		SE	G4	S1
<i>Juglans cinerea</i>	Butternut	✓			WL	G3G4	S3
<i>Linum striatum</i>	Ridged Yellow Flax	✓			WL	G5	S3
<i>Ludwigia decurrens</i>	Primrose Willow	✓	✓		WL	G5	S2
<i>Mikania scandens</i>	Climbing Hempweed		✓		SE	G5	S1
<i>Orobanche ludoviciana</i>	Louisiana Broomrape	✓			SE	G5	S2
<i>Phacelia ranunculacea</i>	Blue Scorpion-weed		✓		SE	G4	S1
<i>Platanthera flava</i> var. <i>flava</i>	Southern Rein Orchid	✓			SE	G4T4?Q	S1
<i>Potamogeton pusillus</i>	Slender Pondweed	✓	✓		WL	G5	S2
<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland Meadow Beauty		✓		ST	G5T5	S1
<i>Sagittaria australis</i>	Longbeak Arrowhead		✓		SR	G5	S2
<i>Selaginella apoda</i>	Meadow Spike-moss		✓		WL	G5	S1
<i>Senna obtusifolia</i>	Blunt-leaf Senna		✓		SR	G5	S2
<i>Sparganium angustifolium</i>	Branching Bur-reed	✓			ST	G4G5	S2

Table 2: Endangered, Threatened, or Rare Vascular Plants in Gibson and Pike Counties, Indiana, as of 2005 (Continued)

Scientific Name	Common Name	Gibson County	Pike County	FED	STATE	GRANK	SRANK
<i>Styrax americanus</i>	American Snowbell	✓	✓		WL	G5	S3
<i>Taxodium distichum</i>	Bald Cypress	✓			ST	G5	S2
<i>Trachelospermum difforme</i>	Climbing Dogbane	✓	✓		SR	G4G5	S2
<i>Vitis palmata</i>	Catbird Grape	✓	✓		SR	G4	S2
<i>Wisteria macrostachya</i>	Kentucky Wisteria		✓		SR	G5	S2

Sources: IDNP, 2005a and IDNP, 2005b
FED: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
STATE: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

1995. It also led to a 1999 proposal to remove the Bald Eagle from the endangered species list. The Bald Eagle was removed from the list of threatened and endangered species in July 2007. The species became endangered because of habitat loss and reproductive failure brought on by the accumulation of the pesticide DDT and other organochlorine insecticides. Today, the DDT threat is largely gone. Efforts focus on maintaining sites eagles depend on for nesting, feeding, migration, and wintering. On the Refuge, the Bald Eagle occurs as a winter migrant and a summer breeder. Absent as a nesting species for many years, a chick was produced in spring 2002. A pair of Bald Eagles began nesting near the Snakey Point Marsh adjacent to the South Fork Patoka River in 2001. Unsuccessful that first year, one eaglet was raised in 2002, one in 2003, two out of three in 2004, one killed by falling tree in 2005, two lost from wind storm in 2006, and two fledged in 2007.

Least Tern (*Sterna antillarum*) (Interior Population)

The historic breeding range of the federally listed endangered Least Tern extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included large rivers of the Red, Missouri, Arkansas, Mississippi, Ohio, and Rio Grande River systems. It nests on sand and gravel bars and protected beach areas of large rivers, and winters in coastal Central and South Amer-

ica. The species is endangered because human disturbance and alteration of river systems have rendered much of its nesting habitat unusable.

The 488-acre Cane Ridge Wildlife Management Area lies 24 miles west of the Refuge headquarters includes 193 acres of moist soil wetlands in four management units, 180 acres of reforested bottomland hardwoods, and a 59-acre deep water impoundment with nesting islands that provide habitat for the Least Tern. The terns have used the nesting islands for that purpose fledging 52 young in 2005 and 42 young in 2006.

Fat Pocketbook (*Potamilus capax*)

Designated as federally endangered in 1976, this mussel is found in slow flowing waters of large rivers with mud or sand bottoms. The primary contributors to its decline are activities related to navigation and flood control such as impounded waters or dredging. The fat pocketbook has been found in the Wabash and White Rivers in Indiana. Its specific occurrence and distribution within the Refuge/MA is unknown at this time.

Indiana Bat (*Myotis sodalist*)

The Indiana bat was listed as federally endangered in 1967 under the Endangered Species Conservation Act, a precursor to the Endangered Species Act of 1973. Primarily the bats declined in number because of loss or disturbance of caves or other hibernacula. The bats hibernate communally

in large numbers. Disruption or destruction of a single site can dramatically affect the population. It occurs in several locations across Indiana. A maternity colony containing more than 100 adults in a large dead tree was first documented on the Refuge in 2005.

Copperbelly Water Snake (*Nerodia erythrogaster neglecta*)

The copperbelly water snake was proposed for listing as a threatened species in 1993 because of habitat loss and fragmentation largely associated with coal mining. The listing was never finalized. Instead, the Service entered into conservation agreements with mining regulatory agencies and coal industry representatives in Indiana, Kentucky, and Illinois. The agreements greatly reduced existing threats to the species, especially those posed by mining operations, precluding the need to list the southern population of the snake under the Endangered Species Act. Research conducted on the Patoka River NWR in 1994, 1995 and 1996 showed the Refuge area contained a significant viable population of copperbelly water snakes in suitable habitat which centered around buttonbush swamps associated closely with beaver impoundments. A large area of the Refuge bottomlands were designated Core Conservation Habitat in the Copperbelly Conservation Agreement with coal companies. This designation placed those lands off limits to any future surface coal mining efforts to protect some the highest quality copperbelly habitat remaining in its national range.

In addition to these federally listed species, a number of animal species are listed by the Indiana Department of Nature Preserves on their database of endangered, threatened and rare wildlife in the state (IDNP, 2005a; IDNP, 2005b). Table 3 shows those wild animal species and subspecies listed by IDNP expected to occur in either Gibson or Pike Counties, or both, as of 2005.

Threats to Resources

There are two main kinds of threats to environmental quality and plant and animal communities at Patoka River National Wildlife Refuge and Management Area: invasive species and contaminants. These are now considered in turn.



Current coal mine reclamation, Patoka River NWR & MA. Photo credit: USFWS

Invasive Species

Invasive species are plants or animals that are often (but not always) non-native or exotic to a given habitat. They are capable of spreading, sometimes quickly, to the detriment of native flora and fauna, which may be displaced, reduced in population, or even extirpated. In pursuing its mission to conserve America's native biodiversity, the Service contributes to nationwide efforts to control the unchecked expansion of invasive plant and animal species.

Some exotic (non-native) plants may substantially alter the plant communities of more natural, undisturbed areas while others more commonly affect disturbed or agricultural areas. Left unchecked, these invasive plant species can seriously degrade the productivity and natural value of invaded sites.

Most of the Refuge's wetlands are relatively free of noxious plants. Those in the area possessing the greatest potential for serious impacts include common reed grass (*Phragmites communis*), reed canary grass (*Phalaris arundinacea*) and moneywort (*Lysimachia nummularia*). The first two are a greater threat in open wetland sites, whereas money wart can carpet large areas of floodplain forests (as well as open areas). A plant not yet noted, but certainly expanding its range toward the area, is purple loosestrife (*Lythrum salicaria*). This species and common reed grass have been observed to completely overrun wetlands to the exclusion of almost all other plant species.

In uplands the most troublesome invasive is Johnson grass (*Sorghum halepense*). Due to its hardiness, growth and reproductive mechanisms, and its close relationship to domestic corn, this introduced species is widespread and difficult to control in both Pike and Gibson counties. As a result of seed

Table 3: Endangered, Threatened, or Rare Fauna in Gibson and Pike Counties, Indiana, as of 2005

Scientific Name	Common Name	Gibson County	Pike County	FED	STATE	GRANK	SRANK
Crustacean: Malacostraca							
<i>Orconectes indianensis</i>	Indiana Crayfish	✓			SR	G2G3	S2
Mollusk: Bivalvia (Mussels)							
<i>Cumberlandia monodonta</i>	Spectaclecase	✓		C	SX	G2G3	SX
<i>Cyprogenia stegaria</i>	Eastern Fanshell Pearlymussel	✓	✓	LE	SE	G1	S1
<i>Epioblasma flexuosa</i>	Leafshell	✓			SX	GX	SX
<i>Epioblasma propinqua</i>	Tennessee Riffleshell	✓			SX	GX	SX
<i>Epioblasma torulosa torulosa</i>	Tubercled Blossom	✓	✓	LE	SE	G2TX	SH
<i>Fusconaia subrotunda</i>	Longsolid	✓	✓		SE	G3	S1
<i>Lampsilis ovata</i>	Pocketbook	✓				G5	S2
<i>Lampsilis teres</i>	Yellow Sandshell	✓	✓			G5	S2
<i>Ligumia recta</i>	Black Sandshell	✓				G5	S2
<i>Obovaria retusa</i>	Ring Pink	✓		LE	SX	G1	SX
<i>Obovaria subrotunda</i>	Round Hickorynut	✓	✓		SSC	G4	S2
<i>Plethobasus cooperianus</i>	Orangefoot Pimpleback	✓		LE	SE	G1	S1
<i>Plethobasus cyphus</i>	Sheepnose	✓		C	SE	G3	S1
<i>Pleurobema clava</i>	Clubshell	✓	✓	LE	SE	G2	S1
<i>Pleurobema cordatum</i>	Ohio Pigtoe	✓	✓		SSC	G3	S2
<i>Pleurobema pyramidatum</i>	Pyramid Pigtoe	✓	✓		SE	G2	S1
<i>Potamilus capax</i>	Fat Pocketbook	✓	✓	LE	SE	G1	S1
<i>Ptychobranhus fasciolaris</i>	Kidneyshell		✓		SSC	G4G5	S2
<i>Quadrula cylindrica cylindrica</i>	Rabbitsfoot	✓	✓		SE	G3T3	S1
<i>Simpsonaias ambigua</i>	Salamander Mussel		✓		SSC	G3	S2
Insect: Ephemeroptera (Mayflies)							
<i>Homoeoneuria ammophila</i>	A Sand-filtering Mayfly	✓			SE	G4	S1
<i>Pseudiron centralis</i>	A Mayfly	✓	✓		SE	G5	S1
Insect: Lepidoptera (Butterflies & Moths)							
<i>Euphyes dukesi</i>	Scarce Swamp Skipper	✓			ST	G3	S1S2
Fish							
<i>Ammocrypta clara</i>	Western Sand Darter		✓		SSC	G3	S3
<i>Ammocrypta pellucida</i>	Eastern Sand Darter		✓			G3	S2
<i>Cycleptus elongatus</i>	Blue Sucker	✓	✓		G3	G4	S2
<i>Etheostoma camurum</i>	Bluebreast Darter		✓			G4	S1

Table 3: Endangered, Threatened, or Rare Fauna in Gibson and Pike Counties, Indiana, as of 2005

Scientific Name	Common Name	Gibson County	Pike County	FED	STATE	GRANK	SRANK
<i>Etheostoma histrio</i>	Harlequin Darter	✓	✓			G5	S1
<i>Etheostoma squamiceps</i>	Spottail Darter	✓			G4	G5	S1
<i>Etheostoma tippecanoe</i>	Tippecanoe Darter		✓		SSC	G3G4	S1
Amphibian							
<i>Rana areolata circulose</i>	Northern Crawfish Frog		✓		SE	G4T4	S2
Reptile							
<i>Kinosternon subrubrum</i>	Eastern Mud Turtle	✓			SE	G5	S2
<i>Nerodia erythrogaster neglecta</i>	Copperbelly Water Snake	✓	✓	PS:LT	SE	G5T2T3	S2
<i>Opheodrys aestivus</i>	Rough Green Snake	✓			SSC	G5	S3
<i>Pseudemys concinna hieroglyphica</i>	Hieroglyphic River Cooter	✓			SE	G5T4	S1
Bird							
<i>Ammodramus henslowii</i>	Henslow's Sparrow	✓			SE	G4	S3B
<i>Ardea herodias</i>	Great Blue Heron	✓	✓			G5	S4B
<i>Asio flammeus</i>	Short-eared Owl		✓		SE	G5	S2
<i>Botaurus lentiginosus</i>	American Bittern	✓			SE	G4	S2B
<i>Buteo lineatus</i>	Red-shouldered Hawk	✓	✓		SSC	G5	S3
<i>Buteo platypterus</i>	Broad-winged Hawk		✓	No Status	SSC	G5	S3B
<i>Circus cyaneus</i>	Northern Harrier	✓	✓		SE	G5	S2
<i>Cistothorus platensis</i>	Sedge Wren	✓			SE	G5	S3B
<i>Falco peregrinus</i>	Peregrine Falcon	✓		No Status	SE	G4	S2B
<i>Haliaeetus leucocephalus</i>	Bald Eagle	✓		Delisted 2007	SE	G5	S2
<i>Ixobrychus exilis</i>	Least Bittern	✓			SE	G5	S3B
<i>Lanius ludovicianus</i>	Loggerhead Shrike		✓	No Status	SE	G4	S3B
<i>Nyctanassa violacea</i>	Yellow-crowned Night-heron	✓	✓		SE	G5	S2B
<i>Nycticorax nycticorax</i>	Black-crowned Night-heron		✓		SE G5 S1B	G5	S1B
<i>Phalaropus tricolor</i>	Wilson's Phalarope	✓			SX	G5	SHB
<i>Rallus elegans</i>	King Rail	✓	✓		SE	G4	S1B
<i>Sterna antillarum athalassos</i>	Interior Least Tern		✓	LE	SE	G4T2Q	S1B
<i>Thryomanes bewickii</i>	Bewick's Wren	✓				G5	S1B
<i>Tyto alba</i>	Barn Owl	✓	✓		SE	G5	S2
Mammal							
<i>Lutra canadensis</i>	Northern River Otter	✓	✓			G5	S2
<i>Lynx rufus</i>	Bobcat		✓	No Status		G5	S1
<i>Mustela nivalis</i>	Least Weasel	✓			SSC	G5	S2?

Table 3: Endangered, Threatened, or Rare Fauna in Gibson and Pike Counties, Indiana, as of 2005

Scientific Name	Common Name	Gibson County	Pike County	FED	STATE	GRANK	SRANK
<i>Myotis sodalis</i>	Indiana Bat or Social Myotis	✓	✓	LE	SE	G2	S1
<i>Sylvilagus aquaticus</i>	Swamp Rabbit	✓			SE	G5	S1
<i>Taxidea taxus</i>	American Badger	✓	✓			G5	S2

Sources: IDNP, 2005a and IDNP, 2005b
 FED: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
 STATE: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
 GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
 SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

dispersal during flood events, bottomland agricultural fields are particularly prone to infestation, making it common to see this plant in those areas.

Other plants classified as noxious weeds in the Refuge & MA include Canadian thistle, bur cucumber and shatter cane. Although locally significant, these species do not represent as pervasive a problem as Johnson grass.

Aquatic resources at Patoka River National Wildlife Refuge are also at risk from non-native invasive animals, such as zebra mussels, common carp, grass carp, bighead carp, and silver carp. Although most of these species have not been documented in the Patoka River, all have been documented in the Ohio and Wabash Rivers, many have been documented in other tributaries to the Wabash River in Indiana, and all have the potential to expand their range into the Patoka River. These nuisance aquatic animals may substantially alter habitats and food web dynamics that native aquatic communities are dependant upon for sustainability.

Common carp are established within waters of the Patoka River National Wildlife Refuge and are troublesome in rivers, streams, and wetlands due to their ability to alter aquatic habitats by uprooting vegetation, reducing water transparency, and reducing aquatic plant growth. Grass carp, which are established in the Ohio and Wabash Rivers, consume aquatic vegetation and also have the potential to alter aquatic habitats and their native communities. Bighead and silver carps are established in the Ohio and Wabash Rivers and are rapidly dispersing throughout many interior smaller order streams throughout the Midwest. It is likely that these fish

will disperse into the Patoka River. Bighead and silver carp feed on plankton and have the potential to alter aquatic food webs. Zebra mussels primarily consume phytoplankton, but also filter other suspended materials from the water column and can substantially alter ecosystems that they invade. Zebra mussels have extirpated native unionid mussels after colonizing new waters.

Table 4 lists key invasive species at Patoka River NWR & MA.

Contaminants

The principal contaminants present in the Patoka River area are those associated with surface coal mining and crude oil extraction. Present-day surface mining (post-1977 and SMCRA) is tightly regulated and closely monitored to assure water quality in downstream areas is not substantially impacted by mining refuse or erosion-related sediments. Although occasional accidental discharges of deleterious materials such as slurry from wash plants or equipment-related petroleum products adversely affect aquatic resources in portions of the watershed, for the most part current surface mining contributes little contamination to the Patoka River.

Before SMCRA, however, coal mining, both underground and surface, produced coal refuse piles and slurry ponds containing waste material such as pyrite, shale and clay, which were separated from the usable coal during cleaning operations. In Pike County, at the time of the Refuge's establishment in the early 1990s, there were at least 186 acres of refuse piles, 129 acres of slurry ponds, and 3,113 acres of mined land with less than 75 percent vege-

Table 4: Invasive Plants and Animals at Patoka NWR/MA

Species Name	Summary
Common Carp	Originating in Asia, common carp were introduced to North America in 1877, first in Maryland and subsequently throughout the United States. They spread rapidly and became naturalized in all waters into which they were introduced. They are adapted to relatively low-oxygen, polluted, turbid waters. Due to their habit of grubbing through bottom sediments for food and alteration of their environment, they destroy, uproot and disturb submerged vegetation, causing serious damage to native duck and fish populations.
Phragmites or Common Reed Grass	<i>Phragmites</i> or common reed is a widely distributed, highly aggressive wetland plant whose origin is unclear, although both native and non-native genotypes or lineages have been documented. It can grow up to 6 meters high in dense stands and is long-lived. <i>Phragmites</i> is capable of reproduction by seeds, but primarily does so asexually by means of rhizomes.
Johnson Grass	Originally native to the Mediterranean, this tall, coarse grass with stout rhizomes now occurs in all warm-temperate regions of the world. Johnson grass invades riverbanks and disturbed sites crowding out native species and slowing succession. Rhizome cuttings commonly form new plants, making it very difficult to eradicate. It spreads rapidly and is not affected by many of the agricultural herbicides.
Moneywort or Creeping Jenny	Originally from Europe, this attractive but weedy herb, a member of the Primrose family, has escaped from lawns and gardens and now occurs in many states in the East and West. Moneywort is reported from many counties in Indiana, where it can be found growing in a variety of different habitat types. Preferring moist, rich, shaded soils, it flourishes best and poses the biggest threat in wetter areas such as wet meadows, swamps, floodplain forests, stream banks, bottoms, ditches, roadsides and along the banks of small water bodies.
Japanese Knotweed	Introduced from Asia in the late 1800s as an ornamental and for erosion control, this weed can tolerate a variety of adverse conditions, including deep shade, high temperatures, high salinity and drought. Knotweed is commonly found near water sources, such as streams and rivers, in low-lying areas, waste places and utility rights-of-way and around old home sites. It spreads quickly to form dense thickets that exclude native vegetation and greatly alter natural ecosystems. Japanese knotweed poses a significant threat to riparian areas, where it can survive severe floods and rapidly colonize scoured shores and islands. Once established, populations are extremely persistent.
Reed Canary Grass	This grass is native to lowland areas of the Midwest and has escaped from cultivation in other regions. Various strains of reed canary grass are found throughout the world except Antarctica and Greenland. It is a major threat to marshes and natural wetlands because its hardiness, aggressive nature, and rapid growth allow it to displace native wetland plant species. This species occurs in wetlands, including marshes, wet prairies, wet meadows, fens, stream banks, and swales. It has been planted widely for forage and for erosion control.
Autumn Olive	This deciduous shrub is native to China and Japan and can range from 3 to 20 feet in height. It is easily recognized by the silvery, dotted underside of the leaves. Small, yellowish flowers or red, juicy fruits are abundant and occur on clusters near the stems. Autumn olive invades old fields, woodland edges, and other disturbed areas. It can form a dense shrub layer which displaces native species and closes open areas. Since its introduction in 1830, it has been widely planted for wildlife habitat, mine reclamation, and shelterbelts.

Table 4: Invasive Plants and Animals at Patoka NWR/MA (Continued)

Species Name	Summary
Japanese Honeysuckle	This species is native to eastern Asia and was first introduced into America in 1806 at Long Island, NY. It is an evergreen to semi-evergreen vine that can be found either trailing or climbing to heights of over 80 feet. It has opposite, oval shaped leaves that are 1 to 2.5 inches long and showy, fragrant, tubular flowers that are whitish-pink to yellow in color. Japanese honeysuckle invades a variety of habitats, including forest floors and canopies, roadsides, wetlands, and disturbed areas. It can girdle small saplings by twining around them and can form dense mats in the canopies of trees, shading everything below. Japanese honeysuckle has been planted widely throughout the United States as an ornamental, for erosion control, and for wildlife habitat.
Bush Honeysuckle	The four species of bush honeysuckle that cause most invasive problems (Amur, Morrow's, Tartarian, and Belle) are all referred to as "bush honeysuckle." Native to Asia and western Europe, these shrubs were introduced to North America in the 1700s and 1800s and are frequently used for landscaping and to improve wildlife habitats; they have become naturalized in many areas of the Northeast and Midwest. The bush honeysuckles are tolerant of a variety of edaphic (soil) and environmental conditions. Typical habitats include disturbed successional communities, wetlands, prairie, woodland edges, and partially closed forests.

tation cover (haul roads, railroad grades, etc.) (Allen et al., 1978). Most of these areas were located off the refuge but contributing to runoff in the watershed.

Surface mining also created pyrite-laced cast overburden ridges which act as unconsolidated aquifers easily transporting water through the spoils. Pyrite is the most common sulfide mineral, and its oxidation is one of the most acidic of all weathering actions. In the presence of oxygen and water, sulfuric acid is formed, and results in what is commonly called acid mine drainage (Kolankiewicz, 1982). This runoff water contains high concentrations of acid, calcium, magnesium, iron, aluminum, manganese, sulfate and coal fines, and contributes to the degradation of many of the area's streams and lakes. In some instances, such as Augusta Lake on Sugar Ridge Fish and Wildlife Area 4, acid concentrations are so high that most aquatic organisms, including fish, cannot survive. Although little of this land is within the Refuge, drainage from off-site adversely impacts aquatic resources in several tributaries to the Patoka River as well as the river itself. Mill Creek, Stone Coe Creek, Barren Creek and the South Fork Patoka River have carried heavy loads of acidic water into the Patoka, particularly following heavy rains.

The Abandoned Mine Land Reclamation program, funded by a tax on current coal production, has been active in the watershed starting in the late 1980's remediating barren, acid-producing spoil and refuse sites. Initial efforts of this reclamation pro-

gram focused on revegetating numerous barren sites, de-watering low-pH lakes and eliminating safety hazards including steep highwalls. Efforts to control acid mine drainage seeps and to minimize downstream flowage to mingle with higher quality fresh waters, increased as a result of the Appalachian Clean Stream Initiative began in 1994. This special program made water quality improvement to enhance the general welfare of local communities an equal priority with safety considerations for the Abandoned Mine Land Program. Since then, much headway has been made in reducing the volume of acid mine drainage. Water quality studies completed by the Service in 1992 indicated that acidity levels in affected waterways were as high then as they were in a comprehensive study completed in 1968 (Corbett, 1969). Where there were few if any fish or invertebrates in the South Fork Patoka River in 1992, there are now sufficient quantities to attract nesting Bald Eagles and sport fishermen.

Oil production operations in the area have also affected water quality in the Patoka River and its tributaries. Inadequate storage tank containment, open pits of oil, and irresponsible spills or overflows of crude oil from some of the 82 operating wells/storage tanks within or adjacent to the Refuge have contaminated surface waters and adversely impacted the area's plant and wildlife resources in the past. While not a continuous phenomenon, spills of one sort or another have occurred regularly enough to be of concern. For example, during 1992, at least three spill events were documented to have

directly impacted the South Fork Patoka River. The last spill involving approximately 4,000 gallons of crude oil resulted when a storage tank was struck by lightning. Inadequate earthen berms failed to contain the spill which flowed into the South Fork and had to be contained and removed with soaker booms and pumps. Abandoned orphan oil wells resulting from bankrupt or dead operators remain in place until the Indiana Division of Oil and Gas has funds to clean them up. Cooperative efforts and cost sharing between the refuge and the Division of Oil and Gas have resulted in the removal of at least 10 abandoned oil wells within the refuge area. Presently, there are no abandoned oil wells within the refuge acquisition area.

An additional, and perhaps more insidious, oil production-related pollutant is the salt water often discharged at oil wells. A 1969 study found that at some sites on the Patoka, chlorides from oil well brine waste was a greater threat to water quality than acid mine drainage (Corbett, 1969). Salt water not only impairs water quality, but also sterilizes upland spill areas to the point of eliminating plant life. Stricter regulations, improved enforcement efforts and the increased use of salt water injection wells have reduced the magnitude of this problem in the last decade. Occasional accidents, and, in some cases, deliberate discharges continue to pose the threat of contamination in the watershed.

Being located in a watershed with a substantial amount of agriculture, the Refuge & MA's resources may be exposed to an assortment of agriculture-related contaminants. Erosion of farmland soils as well as direct rainfall runoff can introduce fertilizers and a variety of pesticides, mainly organochlorine or

organophosphate products, into the bottomland ecosystem. These substances may be toxic both through direct exposure as well as through bioaccumulation in the food chain with secondary effects on reproduction and behavior. In a 1989 Indiana Department of Environmental Management (IDEM) monitoring study, tissue analysis of fish from Patoka River confirmed the presence of numerous metals, including mercury, and several pesticides, most notably chlordane, nonachlor and dieldrin. Similar findings have been documented in other bottomland systems in this region of the country (U.S. Fish and Wildlife Service, 1992).

According to files maintained by the IDEM Office of Solid and Hazardous Waste, there are 41 sites in Pike and Gibson counties that are identified under the Comprehensive Environmental Response and Compensation Liability Inventory System (CERCLIS, 1991). Of the total sites, 10 are located within or close to Patoka River NWR & MA. Nine of these were placed on the CERCLIS list because Surface Impoundment Assessments (SIA) had been completed for these sites. These small surface impoundments were created and used to store and dispose of brine and oil well drilling wastes before this practice was banned. The conclusion of "no further remedial action planned" was made regarding these sites. The remaining site on the CERCLIS list is a railroad tie treatment plant located southwest of Winslow. The site was reviewed under authority of the Resource Conservation and Recovery Act (RCRA) by IDEM and EPA for past improper waste disposal in surface impoundments. Subsequent upgrading of the facility corrected those problems.

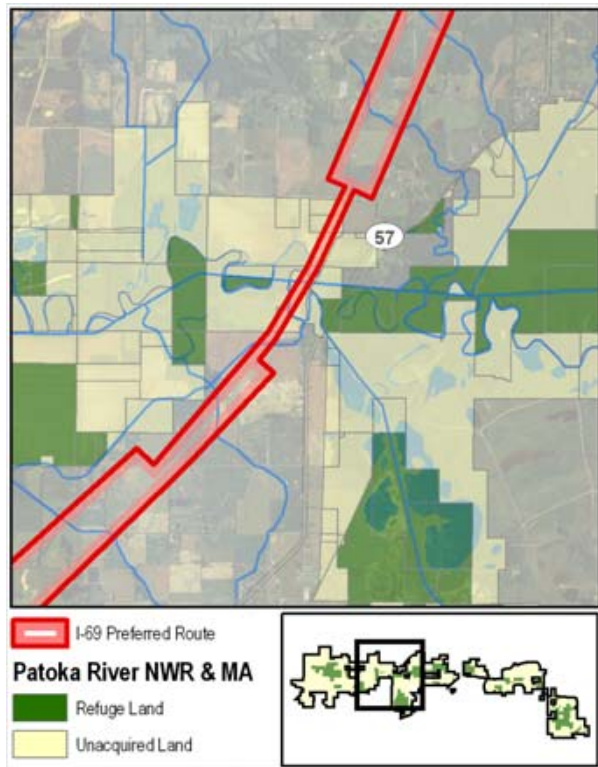
Interstate 69

In 1999 the Indiana Department of Transportation (INDOT) initiated an Environmental Impact Statement (USDOT and INDOT 2003) for the Federal Highway Administration (FHWA) that considered a range of possible highway corridors to link Evansville and Indianapolis, including one that would cross an area within the Refuge acquisition boundary. In March 2004, after extensive public involvement and analysis, the FHWA issued a Record of Decision (USDOT 2004) that selected an alternative that included the Refuge crossing (Figure 8).

After the Record of Decision (ROD) was issued, INDOT began secondary analyses for each of six sections of the highway corridor. These secondary



Refuge entrance sign, Patoka River NWR & MA. Photo credit: USFWS

Figure 8: Projected Route of Interstate 69

analyses, which include additional public involvement, help determine the final alignment of the 350-foot wide highway within the 2,000-foot wide approved corridor. The impacts of the highway crossing on Refuge resources will be considered in the secondary analysis. Each of the six secondary analyses will culminate with a Record of Decision by the FHWA. Once the ROD is issued for a section, final design, land acquisition, and construction can commence. The Refuge Manager continues to work closely with INDOT officials concerning the design and placement of the highway. Although the highway would cross an area within the Refuge acquisition boundary, none of the lands within the highway corridor are presently part of the Refuge and there are no plans to acquire lands within the highway corridor.

As part of a concerted effort to minimize impacts to the fish and wildlife resources of the Refuge, the highway planners agreed to bridge the entire floodplain crossing of the Patoka River NWR & MA. The bridge, approximately one mile long, will be as high as 30 feet above the floodplain floor to allow safe wildlife passage and minimize construction and placement of fill in this wetland environment. This

would greatly reduce the hydrologic impacts in the watershed by minimizing upstream flooding and, thereby, reducing the need for additional mitigation action.

Administrative Facilities

The Refuge utilizes GSA leased space in Oakland City for its headquarters. The office building was newly constructed in 1993. Renovation and expansion occurred in 2003 when the GSA lease was renewed. Currently the office has nine rooms (offices and storage) which encompass approximately 1,900 square feet. The Refuge will continue to pursue opportunities to acquire facilities and move out of leased space.

Through the same GSA lease, the Refuge has access to a 30-foot by 50-foot heated pole barn (1,500 square feet) that is utilized for equipment storage and minor maintenance needs.

Through its land acquisition program, the Refuge owns another pole barn which measures approximately 50 feet by 100 feet (5,000 square feet), and is used to store supplies and equipment.

Archeological and Cultural Values

Responding to the requirement that these plans include “the archaeological and cultural values of the planning unit,” the Service contracted for a cultural resources overview and management direction study. This short section of the CCP derives in part from this source as well as others.

The earliest generally accepted human culture in North America is termed PaleoIndian, commencing approximately 13,000 years ago in Indiana. Evidence of these people is relatively extensive in southern Indiana, and at least 16 PaleoIndian sites are reported in Gibson County. The Refuge, however, is outside the known geological concentrations of PaleoIndian sites.

The next cultural group is termed Archaic, and its origins dated to 10,000 years ago. The Archaic culture is quite evident in southern Indiana. The warm and dry period known as the Hypsithermal (or Altithermal) occurred during the Middle Archaic period when many sources of water disappeared. Archaic period sites occur on the Refuge.

Pottery, constructed burial and other mounds, gardening, and eventually the bow and arrow are among the distinguishing characteristics of the Woodland period that commenced about 2,600 years ago. A variety of sites from the Woodland period are found and more are anticipated within the Refuge.

The Middle Mississippian culture commenced about 950 years ago and continued into the early historic people. Sites from this period are found within the Refuge boundaries and more, especially in buried contexts, can be anticipated in the Refuge area.

The connection between prehistoric cultures and recognized Indian tribes in southwest Indiana has not been established. Treaties at Vincennes included the Shawnee, Potawatomi, Eel River, Kickapoo, Kaskaskia (later Peoria), Delaware, Piankashaw, Wea, and Miami; only the last four plus the Fox having an apparent connection to the Refuge area.

The French moved into southern Indiana, especially Vincennes, in the late 17th century. They were replaced by the British in 1763. In turn, British claims gave way to the United States whose possession was confirmed in 1794. The Refuge area was settled by farmers from the upland South (Appalachia) whose cultural patterns continue into the 21st century; also by Germans and Irish who came to build the Wabash and Erie Canal and stayed as farmers; and by southern and eastern Europeans and African-Americans.

Early transportation routes included the mid-19th century Wabash and Erie Canal.

Following the Civil War, coal mining became the major industry in the area and continues into the 21st century. At least 10 per cent of Pike County has been strip mined.

Current Management

Habitat Management

Forested Wetlands (Bottomland Forest)

Wetland management at Patoka River NWR & MA consists primarily of restoring forested wetlands, that is bottomland forests (Figure 10 and Figure 9). In 2007, the total acreage of forested wetlands on the Refuge & MA was 8,647 acres, of which 3,056 acres were owned by the Service. With the aim of maximizing species diversity within the restored wetland, we are trying to reintroduce the mast component of the forested wetland communities, plant-



Bald Eagle pair, Patoka River NWR & MA. Photo credit: USFWS

ing seedlings at 500 per acre. Trees are planted with a mechanical planter, in rows, and the priority sites are those that will complement our objective to restore a forested border along the river.

We are also engaged in restoration on prior converted wetland, areas that were in agricultural production when they are purchased. Typically we obtain a field that is planted right up to the edge of the River. We then plant seedlings a couple of hundred feet wide parallel to the River. The management of these, once planted, is passive. We just “walk away,” allow competition to encroach, and permit these sites to remain brushy and thick. It does not affect seedling survival, but the thick habitat benefits wildlife. Patoka River wetlands are flooded annually naturally.

Under current management, over the long term (100-200 years), we would like to achieve approximately 12,000 to 13,000 acres of bottomland hardwood stands with a mosaic of age and structural classes distributed across a narrow elevation gradient. Lower elevations would be dominated by black willow, sweetgum, silver maple, and river birch. Pin oak, Shumard oak, swamp chestnut oak, swamp white oak, red maple, green ash, sycamore, and cottonwood would dominate mid-elevations, while upper elevations would be dominated by cherry bark oak, other oaks, hickory, and pecan. Over the coming 10-15 years, the Refuge will maintain existing bottomland forest area of 3,056 acres. We will

Figure 9: Current Landcover (West), Patoka River NWR & MA

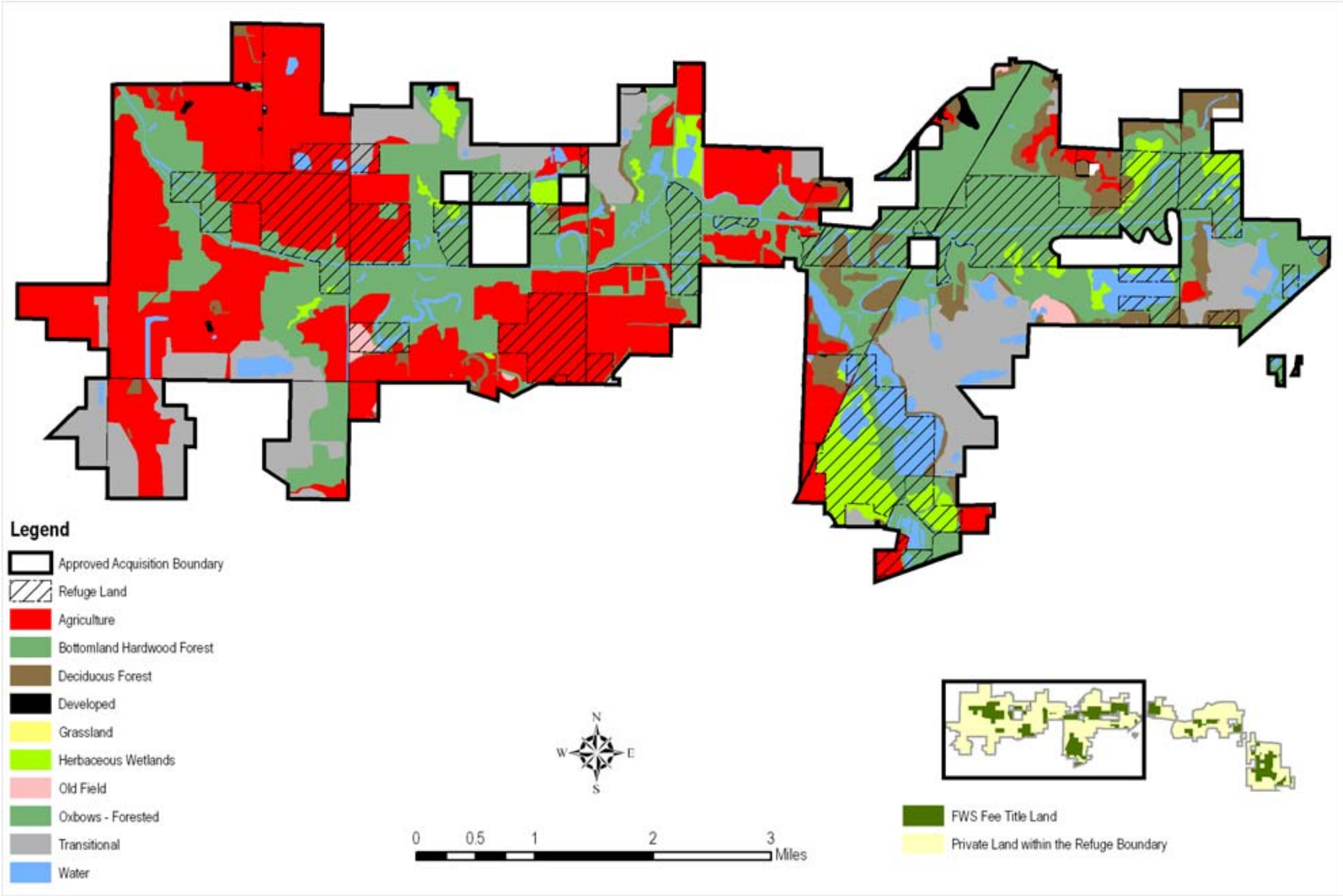
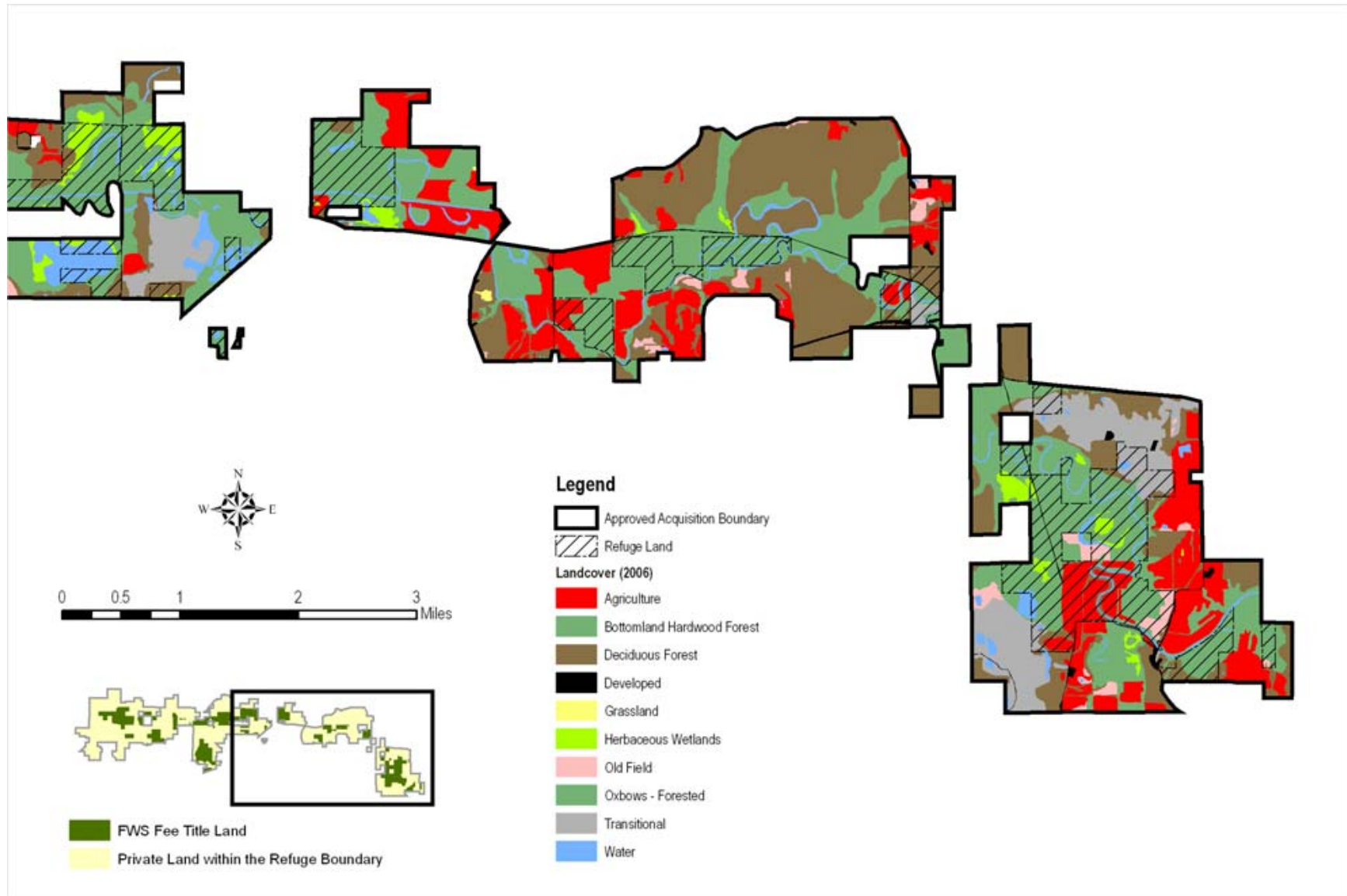


Figure 10: Current Landcover (East), Patoka River NWR & MA



also reforest to bottomland hardwoods future land acquisitions that have suitable soils and that are outside of areas managed as non-forested habitat.

Emergent Wetlands

In 2006, the total acreage of emergent wetlands on the Refuge & MA was 775 acres, of which 465 acres were owned by the Service. Our current objective is to maintain presently owned emergent wetlands (465 acres) in a mixture of vegetation such as cattail, bulrush, sedges, spatterdock, water lily and smartweeds. We will allow the amount and species composition of emergent wetlands across the remainder of the Refuge (both currently owned and future acquisitions) to fluctuate through natural succession.

Lakes and Ponds

In 2006, the total acreage of lakes and ponds on the Refuge & MA was 885 acres, of which 345 acres were owned by the Service. Our objective over the medium term future is to maintain the number and total surface area of lakes and ponds at or above the current amount.

Patoka River, Oxbows, and Patoka Tributaries

In 2006, the total acreage of the Patoka River, its oxbows and tributaries on the Refuge & MA was 534 acres, of which 200 acres were owned by the Service.

Water Quality

The Refuge's current objective is to improve water quality within the Patoka River and its tributaries to move towards compliance with Indiana Department of Environmental Management standards. The long-term goal is removal of the streams from the list of impaired waters.

Moist Soil Units

In 2006, the total area of moist soil units on the Refuge & MA was 265 acres, all owned by the Service.

The Refuge has restored nine small wetlands covering approximately 19 acres that were built between 2000 and 2006. Two were built with low earthen dikes with water control structures, providing the capability to manipulate water levels. These units are managed as moist soil, seasonal wetlands. One depends on flooding for a water source and the other is on a small drainage swale. Water is stored in shallow pools to encourage waterfowl, shorebird and marsh/waterbird use. Seven other wetlands are referred to as macrotopography wetlands which are

shallow scrapes no deeper than two feet in floodplain cropfield locations dependent on annual flooding for water supply. Bottomland hardwood trees have been planted all around these wetlands. They are set up for passive management to resemble old river oxbows.

At Cane Ridge we have four moist soil units that total 193 acres. These are managed to achieve shallow fall flooding, and are slowly drained in the spring. They are intended to benefit waterfowl and shorebirds and are allowed to revegetate and grow in the summer with moist soil plants. The four units can be managed independently with occasional needs of manipulating the vegetation to ensure the control of woody intrusion. The units are fed from the Least Tern unit and they are all gravity flow, so there are no costs associated with this low-intensity type of management. The Refuge maintains 6 miles of dikes at Cane Ridge.

At Dillin Bottoms, Ducks Unlimited designed and supervised construction of two moist soil units covering 62 acres. These units are designed to be flooded by reverse flow flap gates during high water or with a permanent station auger pump operated by a portable diesel engine and PTO shaft.

Over the medium term future, we intend to maintain existing moist soil areas (265 acres) and convert up to a total of 700 acres of bottomland farmland to moist soil management that provides a diversity of native herbaceous plant foods such as wild millet (*Echinochloa* spp.), panic grass (*Panicum* spp.), sedges (*Cyperus* spp. and *Carex* spp.), and beggarticks (*Bidens* spp.).

Grasslands

In cooperation with Quail Unlimited we have planted 25 acres of warm season grasses on the Refuge using commercially available seeds. At the present time, maintenance is limited to mowing or mechanical disturbance. The seed mix is Indian grass, big blue, little blue, side oats, and switch grass.

Upland Forests

In 2006, the total acreage of the upland forest on the Refuge & MA was 2,704 acres, of which 183 acres were owned by the Service. We currently manage 40 acres of upland forest, which was reseeded cropland. The remainder of the upland forest is not actively managed. Over the long term (100-200 years), we hope to achieve a mosaic of hardwood stands of different age and structural classes distributed on upland areas. These forests



Wabash and Erie Canal (left), Patoka River NWR & MA.
Photo credit: USFWS

would be dominated by white oaks, black oaks, hickory, and blackgum on drier sites, and by red oaks, yellow poplar, beech, sugar maple, walnut, hickory, and cherry on wetter sites. In the coming years, we intend to maintain upland forest on presently owned areas (183 acres) and for future acquisitions maintain existing upland forest and restore upland forest on non-forested upland sites with suitable soils.

Cropland

In 2006, the total acreage of bottomland farmland on the Refuge & MA was 4,507 acres, of which 1,059 acres were owned by the Service. For the most part, land acquired as cropland is being maintained as cropland until we have the money and ability to convert them to moist soil units or bottomland forests. The continued farming is being done by the original farmer, or a tenant farmer, through an annual cooperative farming agreement. One-quarter of the crop is left standing in the field as our share. Frequently these fields are not planted at all due to flooding. In those cases, the farmer will plant a mix of wildlife friendly plants (millet, buckwheat, milo) for waterfowl on our fourth of the acreage. Over time, we intend to convert bottomland cropland areas into bottomland forest and moist soil units.

Upland Openings

In 2006, the total acreage of upland openings on the Refuge & MA was 2,139 acres, of which 98 acres were owned by the Service. Over the coming 10-15 years, our objective is to maintain existing owned upland openings and those existing upland openings on future acquisitions of reclaimed minelands.

Invasive Plant Species

Our aim now and over the medium-term future (10-15 years) is to slow the spread of invasive plant species (of present interest are Japanese honeysuckle, reed canary grass, autumn olive, Johnson grass, and Japanese knotweed) through monitoring and control measures.

Interior Least Tern Nesting Habitat

The Refuge provides six acres of nesting habitat for Interior Least Terns at Cane Ridge Wildlife Management Area. This area is kept free of vegetation and is fenced to prevent predation by mammals.

Private Lands and Watershed Management

Patoka River staff work with surrounding private landowners on conservation projects that benefit us jointly. Over the coming 10-15 years, our aim is to increase wildlife habitat and reduce sedimentation on 150 acres of private lands within the Patoka River and surrounding watersheds.

Farm Services Administration Conservation Easements

The Farm Services Agency, formerly known as the Farm Services Administration, is an agency within the U. S. Department of Agriculture. FSA makes loans to farmers and ranchers temporarily unable to obtain credit from commercial lending institutions. FSA sometimes obtains title to real property when a borrower defaults on a loan secured by the property. FSA holds such properties in inventory until sale or other disposal.

The Service is involved in the inventory disposal program because some FSA inventory properties contain or support significant fish and wildlife resources or have healthy restorable wetlands or other unique habitats. Some qualifying properties are transferred to the Service and become part of the National Wildlife Refuge System. Others are sold, with restrictions known as conservation easements that protect wetlands or other habitats. In most cases, the Service is responsible for the management and administration of properties with conservation easements.

Since the late 1980s and early 1990s, the Refuge has managed habitat on six Farm Services Administration Conservation Easements in five different Indiana counties:

- 90 acres with 24.5 acres of riparian habitat in Vermillion County;
- 40 acres of forested wetland in Gibson County;

- 35.8 acres of forested wetland and riparian area in Vermillion County;
- 55 acres of riparian and forested wetlands in Sullivan County;
- 14 acres of riparian habitat in Fountain County;
- 365 acres with eight easements in Martin County.

Land Acquisition

We continue to acquire lands from willing sellers within the acquisition boundary as a means of managing and conserving a diversity of habitats.

Wildlife Management

Threatened and Endangered Species

At present, the only threatened and endangered species on the Refuge that is actively managed is the Interior Least Tern. As noted elsewhere, at the Cane Ridge Wildlife Management Area 24 miles west of the Refuge, the Service is providing a protected nesting area, where a bare sandy substrate on two 3-acre islands is maintained for nesting and fencing provides some protection from disturbance). While other T & E species like the Indiana bat occur at Patoka River NWR & MA, no active measures are underway at this time to conserve their populations. In the near term we intend to implement a monitoring program to track abundance, population trends, and/or habitat associations of listed species.

Migratory and Resident Birds

Currently, there is active management of 62-acres in Dillin Bottoms for migratory and resident birds at Patoka River NWR & MA and 193 acres of moist soil management units at Cane Ridge WMA. Over the next 5 years, we intend to implement a monitoring program to track abundance, population trends, and/or habitat associations of selected migratory and resident bird species or groups of species (e.g. waterfowl, migrating land birds, shorebirds, marsh birds).

Native Resident Wildlife

Currently, there is no active management of native resident wildlife at Patoka River NWR & MA. It is our intent to implement a monitoring program to track abundance, population trends, and/or habitat associations of selected native resident wildlife species in the coming years.

Fish and Other Aquatic Species

At present, Patoka River NWR & MA does not have an active fisheries management program. Management's aim over the next decade and a half is to create or maintain diverse, self-sustaining fisheries in Refuge lakes, ponds, and streams.

Interior Least Terns

We actively manage a nesting population of Interior Least Terns at Cane Ridge Wildlife Management Area. Our objective is to support 100 nesting adult terns producing 75 fledglings annually.

Pest Management

On occasion it is necessary for us to remove beaver dams when their activities impact a neighbor's property or structures.

Fish and Wildlife Monitoring

Except for waterfowl, at present, Patoka River management conducts no standardized monitoring or surveying that results in weekly entries into a database. Instead, we make opportunistic observations. For waterfowl, there are weekly surveys at the Cane Ridge Area. When the Refuge grounds are flooded, we make a circuit to those areas that are accessible to conduct waterfowl counts.

River otter were released on the Refuge in 1996. In the winter when there is snow, the Refuge wildlife biologist walks and drives transects on the Refuge looking for otter sign and thus gauge trends in their activity. Activity that is decreasing, constant, or increasing from one year to the next is a good indication of whether the area's otter population is decreasing, stable, or increasing.



*South Fork birding trail, Patoka River NWR & MA.
Photo credit: USFWS*

Visitor Services

As a relatively new refuge with a small staff and an initial priority on land acquisition, habitat restoration, and environmental remediation (reduction of contaminants), Patoka River has had a smaller visitor services program than other more established national wildlife refuges. Nevertheless, each of the “Big Six” public uses emphasized in the National Wildlife Refuge System Improvement Act of 1997 – hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation – those uses traditionally supported and encouraged on the National Wildlife Refuge System, occurs at Patoka River National Wildlife Refuge and Management Area.

Visitation has grown since the Refuge’s establishment in 1994, increasing to 21,221 visits in 2005. Visitor services have increased commensurately. There are multiple access points to the Refuge and with approximately 75 percent of the land within the Refuge acquisition boundary not yet acquired, Refuge lands are intermingled with private holdings. This intermingling requires clear signing and visitor information. Refuge management plans on placing new entrance signs and kiosks at existing boat ramps, Snakey Point, and along Highway 57 over the next 5 years.

There is not currently a visitor center on the Refuge and there are no plans for one in the foreseeable future. The Refuge headquarters on SR 64 (West Morton) in Oakland City is an administrative site that offers visitor information.

Hunting

There were 8,873 hunting visits (waterfowl 4,093, other migratory birds 466, upland game 1,399, big game 2,915) in 2006. This use is likely to increase over the life of the CCP because of the impending closure of mine company lands and the loss of public hunting opportunities on lands elsewhere in the area. Hunting on the Refuge is in accordance with applicable State regulations.

Migratory birds hunted at Patoka River NWR include ducks, geese, coots, Sora Rails, Common Snipes, Woodcocks, and Mourning Doves. Game birds sought by hunters on the Refuge include Quail and Wild Turkey. Small game at Patoka River NWR & MA includes cottontail rabbits, gray and fox squirrels. Furbearers pursued include red and gray fox, coyote, raccoon, and opossum. The only big game hunting on the Refuge is for white-tailed deer.

Shotgun hunters using scattershot may possess and use only approved non-toxic shot. Use or possession of lead shot is prohibited while hunting all species except Wild Turkey on the Refuge. Firearms, archery equipment and crossbows meeting State requirements are permitted on the Refuge only during the designated hunting season.

All motor vehicles must remain on maintained roads and be parked so as not to interfere with other traffic. Off-road vehicles are not permitted on Refuge lands. Hunters with disabilities must possess the required State permit; State regulations and access conditions apply.

Dogs are allowed for hunting according to State regulations during designated seasons only. Dog training or running in the off-season is prohibited.

For waterfowl hunting, pits or permanent blinds may not be constructed on the Refuge. Only portable blinds or structures constructed of native plant materials are permitted and blinds must be removed or dismantled at the end of each day’s hunt. Decoys must also be removed at the end of each day’s hunt. Likewise, permanent turkey or deer stands may not be erected or used on the Refuge. Portable tree stands may be used for turkey or deer hunting following the same guidelines established for State-owned lands.

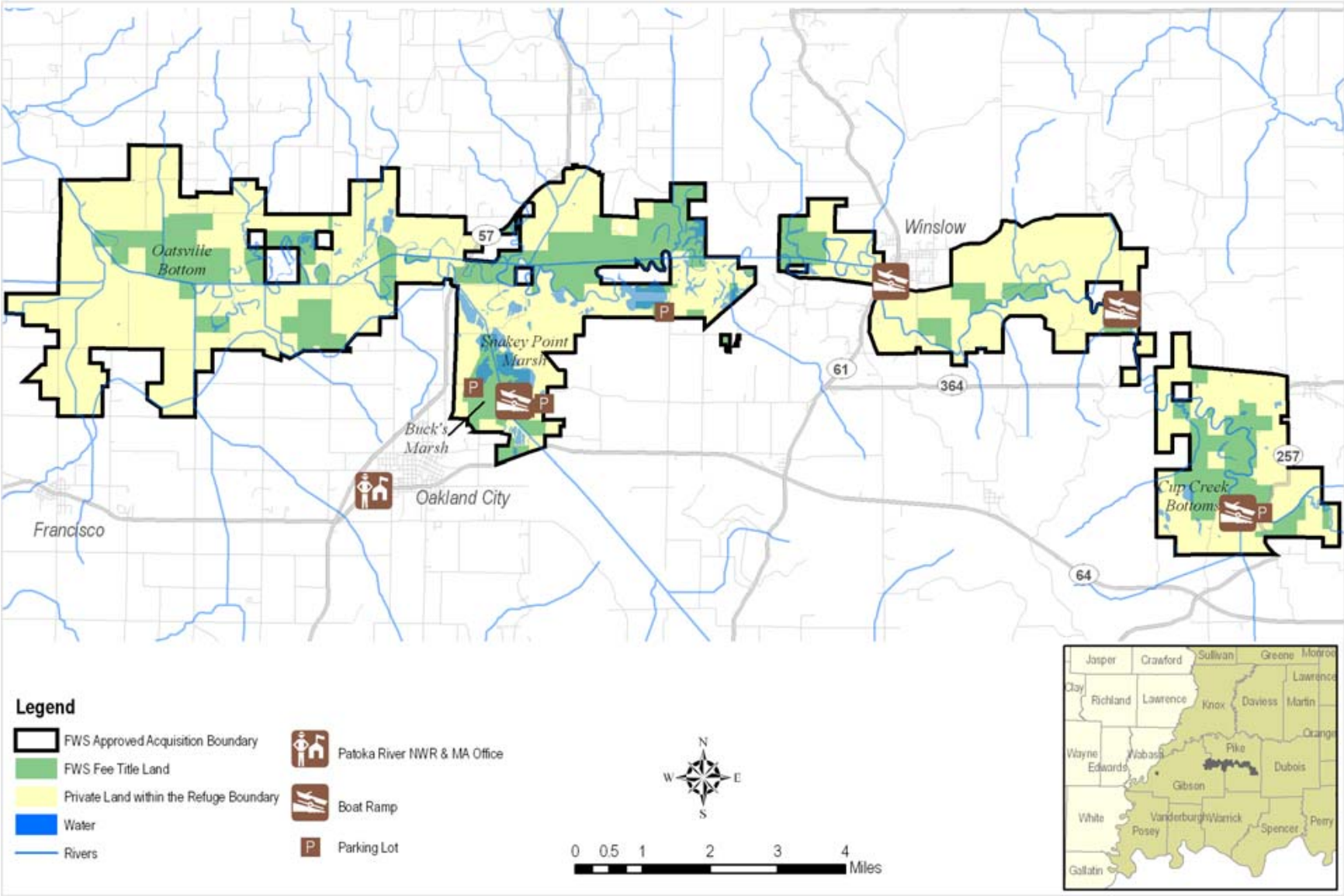
Fishing

There were 7,346 fishing visits to Patoka River NWR in 2006. The Refuge provides both bank and boat fishing opportunities on the Patoka River, its oxbows and tributaries, and at Snakey Point Marsh, in accordance with State seasons and regulations and the Refuge fishing plan. Access to some reaches of the river is limited. Refuge staff works cooperatively with the Indiana Department of Natural Resources on fisheries management.

Of the more popular game fish, channel and flat-head catfish probably provide the best sport fishing opportunities in the section of the river running through the Refuge. Largemouth bass, bluegill and crappie, offer outstanding fishing opportunities at Snakey Point Marsh.

As a result of channel clearing along the Patoka River, fish habitat structure is poor; there is little in-stream cover, that is, few log jams, brush piles and root-wads. Thus, those species requiring in-stream cover (largemouth bass, bluegill, crappie) are limited by available habitat. Riffle/pool habitat is also scarce. Species diversity in the channelized portion of the river (downstream from Winslow) is lower

Figure 11: Current Visitor Facilities, Patoka River NWR & MA



than in the natural, meandering channel. Fish of interest to recreational anglers, including buffalo, drum, channel and flathead catfish and spotted bass, are more abundant in the unchannelized section of the Patoka River.

Wildlife Observation and Photography

There were 6,063 wildlife observation visits and 106 photography visits in 2006. Photography and observation visits are projected to increase to 500 in 2007 because of the new observation platform at Cane Ridge. The Refuge provides opportunities for wildlife observation and photography throughout, but Cane Ridge and Snakey Point in particular have facilities such as trails, docks or observation platforms that facilitate these two activities. The Refuge intends to enhance opportunities for observation and photography by building an observation platform at Cane Ridge and trails at Snakey Point and South Fork.

Interpretation

The Refuge Manager and Assistant Refuge Manager provide guided tours and programs upon request and maintain a monument on the McClure Tract. In the near term, they plan to provide interpretive elements in proposed kiosks and other selected sites as well as increase opportunities for interpreted trails, walks, and programs.

Environmental Education

The Refuge Manager and Assistant Refuge Manager provide environmental education upon request typically less than five times annually. In the near future, their intent is to develop capacity to provide Environmental Education materials and programs to teachers and others upon request.

Friends and Volunteers

Volunteers donated 403 hours of their time to the Refuge in 2006. Staff hopes to help convert this enthusiasm into a more formal Friends group in the coming years.

Outreach

Refuge staff speaks to local civic and sportsmen's groups upon request approximately 12-15 times per year. We also provide information and interviews for local news media and outdoors writers as well as distribute news releases 2-3 times annually. In the coming years, we will be exploring how to establish off-site facilities and opportunities.

Archeological and Cultural Values

Cultural resources are important parts of the nation's heritage. The Service is committed to protecting valuable evidence of human interactions with each other and the landscape. Protection is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

Cultural resources management in the USFWS is the responsibility of the Regional Director and is not delegated for the Section 106 process when historic properties could be affected by Service undertakings, for issuing archeological permits, and for Indian tribal involvement. The Regional Historic Preservation Officer (RHPO) advises the Regional Director about procedures, compliance, and implementation of the several cultural resources laws. The Refuge Manager assists the RHPO by early and timely notification of the RHPO about USFWS undertakings, by protecting archeological sites and historic properties on USFWS managed and administered lands, by monitoring archeological investigations by contractors and permittees, and by reporting violations.

Special Management Areas

There are no designated Special Management Areas on the Refuge.

Wilderness Review

As part of the CCP process, lands within the acquisition boundary of Patoka River National Wildlife Refuge and Management Area were reviewed for wilderness suitability. No lands were considered suitable at this time for Congressional designation as wilderness as defined by the Wilderness Act of 1964. Patoka River NMR/MA does not contain 5,000 contiguous acres of roadless, natural lands. Nor does the Refuge possess any units of sufficient size to make their preservation practicable as wilderness. Refuge lands and waters have been substantially altered by humans, especially by agriculture, river channelization, road-building, and coal mining. As a result of both extensive modification of natural habitats and ongoing manipulation of natural processes, adopting a "hands-off" approach to management at the Refuge would not facilitate the restoration of a pristine or pre-settlement condition, which is the goal of wilderness designation.

Chapter 4: Management Direction

Goals, Objectives and Strategies

The Environmental Assessment in Appendix A describes and analyzes three management alternatives for Patoka River NWR. The Service identifies one as its preferred alternative and it is described in the following chapter as the proposed future management direction that would guide activities on the Refuge for the next 15 years. In some cases the proposed future management direction describes initial steps of a long-term vision that may take 100 years or more to achieve.

Figure 14 and Figure 13 depict the long-term vision (100 years or more in the future) for habitat distribution within the Refuge & MA. It was derived using soils data to determine potential vegetation and by reviewing historical maps and photos. The bottomland forest shown to cover much of the Refuge would be a patchy mosaic with a variety of wetland habitats as well as open areas created by dead and dying trees. Over time, disturbances from wind, water, and wildlife would shift the amount and distribution of these habitats. Lands reclaimed after strip mining may eventually revert to forest or remain as grassy upland openings. A meandering Patoka River is also part of the long-term vision. Channel restoration that includes reconnecting oxbows would add many miles to the straightened portion of the river (Figure 14). The management direction that follows describes steps that move towards the long-term vision, but that are practical and attainable within the 15-year timeframe of this plan.

Goals, objectives, and strategies comprise the proposed future management direction. Goals are descriptive broad statements of desired future con-



Patoka River NWR & MA. Photo credit: USFWS

ditions that convey a purpose. There are three goals for Patoka River NWR. Goals are followed by objectives, specific statements that describe management intent. Objectives provide detail and are supported by rationale statements that describe background, history, assumptions, and technical details to help understand how the objective was formulated. Finally, beneath each objective there is a list of strategies – specific actions, tools, and techniques required to fulfill the objective.

Goal 1: Habitat

Manage a diversity of habitats to benefit threatened and endangered species, waterfowl, other migratory birds, and indigenous species in the Patoka River and associated watersheds.

Objective 1.1: Forested Wetlands (Bottomland Forest)

Total Acres: 8,647; 2007 Owned Acres: 3,056

Over the long-term (100-200 years), achieve approximately 12,000 to 13,000 acres of bottomland hardwood stands with a mosaic of age and structural classes distributed across a narrow elevation gradient with lower elevations domi-

Figure 12: Long-term (100 Years) Landcover, Patoka River NWR & MA (East)

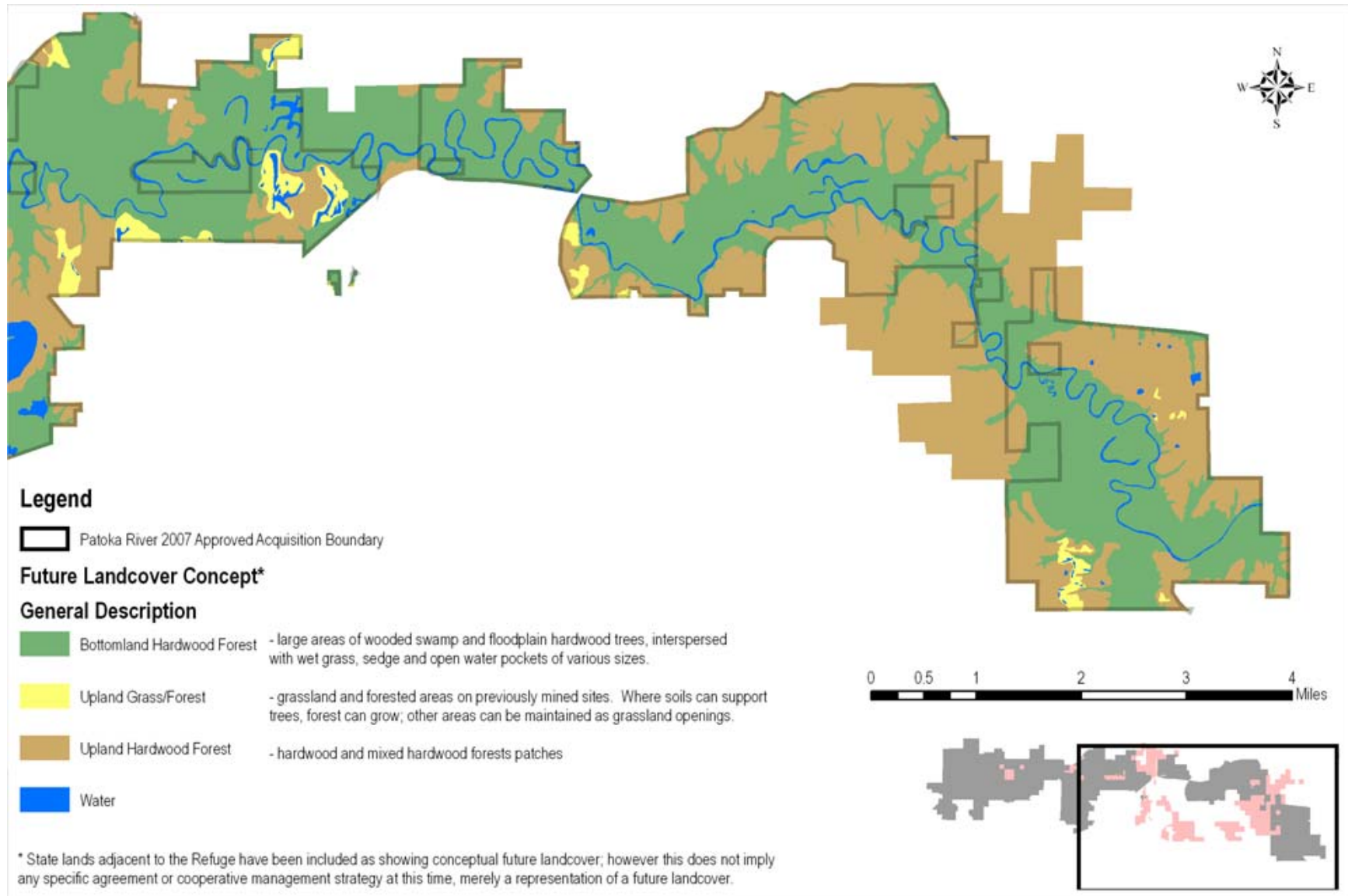


Figure 13: Long-term (100 Years) Landcover, Patoka River NWR & MA (West)

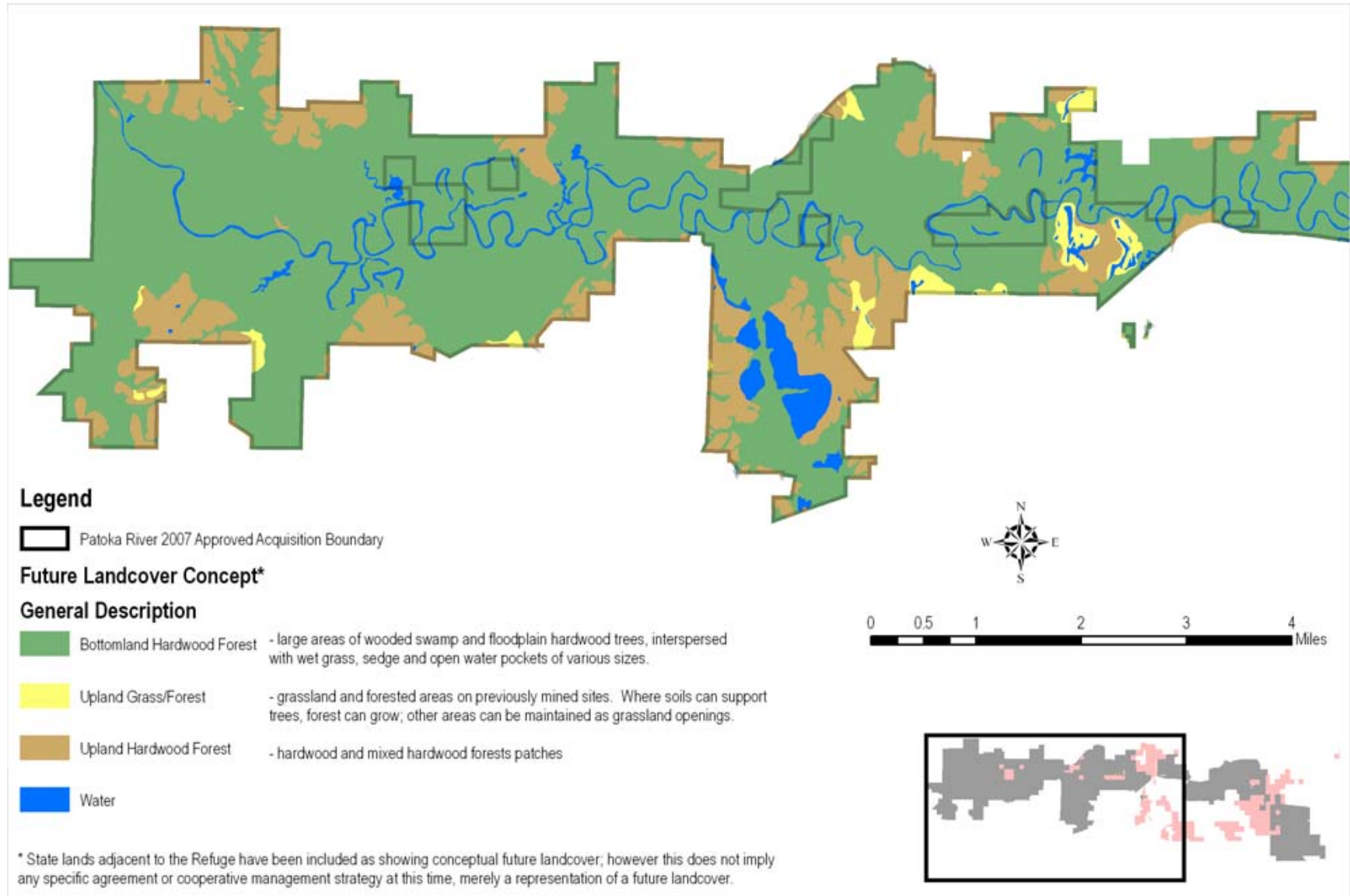
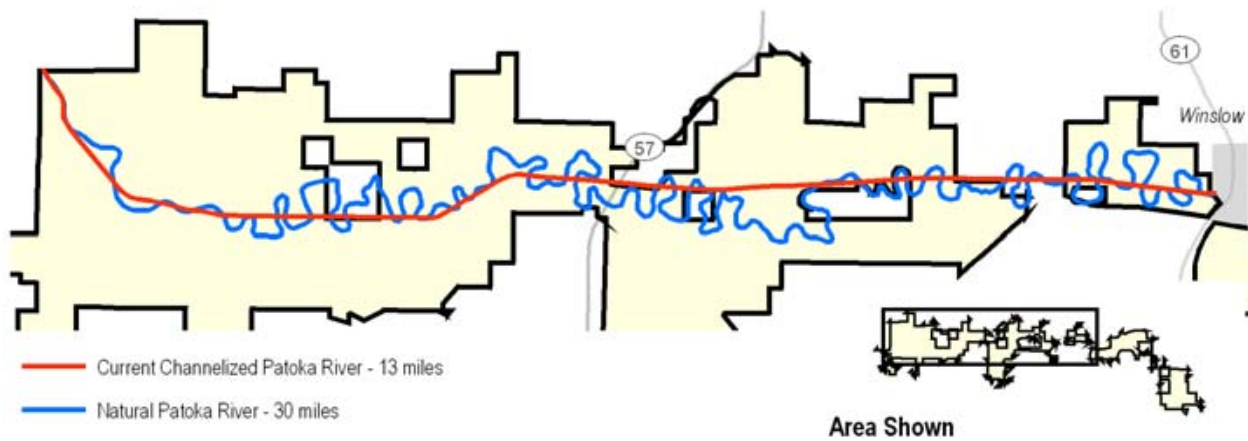


Figure 14: Current and Future Concept of Patoka River Channel

nated by black willow, sweetgum, silver maple, and river birch, mid elevations dominated by pin oak, shumard oak, swamp chestnut oak, swamp white oak, red maple, green ash, sycamore, and cottonwood, and upper elevations dominated by cherry bark oak, other oaks, hickory, and pecan. Over the life of the plan, maintain existing bottomland forest (presently 3,056 acres) and reforest to bottomland hardwoods future land acquisitions that have suitable soils and that are outside of areas managed as non-forested habitat (see Objective 1.6 Bottomland Farmland and Objective 1.7 Moist Soil Units).

Rationale: Bottomland forests are diverse wetlands with many hydrologic features including sheet or overland flow, meander scrolls or relic channels, vernal pools, habitat mounds, depressions, and ridge and swale topography (Wharton et al. 1982, Dunn and Roach 2001). Incorporating these features in wetland restoration creates a diverse wetland habitat providing areas with permanent water, semi-permanent water and seasonally flooded wetlands (Smith 2001). Bottomland forests are also characterized by a multi-tiered canopy and a shifting mosaic of age classes. Canopy gaps created by one or more fallen trees resulting from flooding, windstorms, beaver activity, or other disturbance make up 3-5 percent of bottomland forests (Heitmeyer et al. 2005). These openings in the forest canopy quickly succeed to scrub-shrub habitats and most eventually succeed to bottomland forest.

We identified 15,633 acres of bottomland soils – those on the Indiana list of hydric soils as well as

other frequently flooded soils – within the Refuge boundary. Presently, 9,032 acres of these soils are covered by bottomland forest. The Natural Resources Conservation Service's Official Soil Series Descriptions (Soil Survey Staff NRCS – USDA undated) show hardwood forest as the natural vegetation suited for all but 166 acres of the remaining 6,601 acres of bottomland soils (Figure 12 and Figure 13). These potential bottomland forest sites are presently in various cover types with the majority in farmland (5,367 acres). Restoring the extent and species diversity of forested wetlands within the planning area is consistent with Refuge purposes, existing soils information, known presettlement vegetative cover (Parker and Ruffner 2004), and Service policy (U.S. Fish and Wildlife Service 2001). We derived the long-term goal of 12,000 to 13,000 acres by subtracting acreages devoted to moist soil units, and other land uses from the total acres of bottomland soils suited for bottomland forest.

Strategies

1. Plant mast producing bottomland hardwood species on sites with suitable soils.
2. Conduct forest surveys or inventories every 5 years to monitor changes in health, composition, and structure of bottomland forest.
3. Complete a Habitat Management Plan with specific management recommendations to maintain bottomland forest species and age class diversity.
4. Restore micro and macro topographic features on selected bottomland farmland and



Habitat restoration, Patoka River NWR & MA. Photo credit: USFWS

reforest 60-80 percent of these sites with the balance (20-40 percent) remaining as scrub-shrub wetlands. See Stratman (2000) and Dunn and Roach (2001) for additional information.

5. On suitable sites enhance or restore native canebreaks.
6. Add one full-time (1.0 FTE) forester/wildlife biologist.
7. Target reforestation to minimize fragmentation, create large contiguous blocks of forest, and increase connectivity to other forested areas.

Objective 1.2: Emergent Wetlands

Total Acres: 775; 2007 Owned Acres: 465

Over the next 15 years, maintain presently owned emergent wetlands at Snakey Point and Buck's Marsh in a mixture of vegetation such as cattail, bulrush, sedges, spatterdock, water lily and smartweeds. Allow the amount and species composition of emergent wetlands across the remainder of the refuge (both currently owned and future acquisitions) to fluctuate through natural succession.

Rationale: Snakey Point and the adjoining Buck's Marsh contain much of the 775 acres of emergent wetlands within the Refuge acquisition boundary. These sites are likely wetter than before the South Fork Patoka River was channelized in the 1920s. Sediments dredged from the stream bottom and piled along either side of the channel form levees that impede drainage creating a mixture of open water and emergent vegetation. Siltation and beaver activity also played a role in creating the present

condition of these wetlands. Emergent wetlands attract a variety of wildlife. In addition to providing food and resting sites for resident and migrating waterfowl, numerous wading birds, song birds, fur-bearing mammals, reptiles and amphibians, and fish and other aquatic organisms use the marshes during various seasons of the year.

Strategies

1. As part of a Habitat Management Plan, develop a management regime for emergent wetlands that maintains desired plant species and vegetation/open water interspersions.
2. Conduct a study to learn more about the hydrology and geomorphology of the Snakey Point/Buck's Marsh complex in order to determine the feasibility of future water level manipulations that may be necessary to enhance/maintain habitat conditions.

Objective 1.3: Lakes and Ponds

Total Acres: 885; 2007 Owned Acres: 345

Over the next 15 years, maintain the number of lakes and ponds at or above the amount present in 2006 and increase their aquatic habitat diversity.

Rationale: Natural and man-made lakes within the Refuge acquisition boundary provide habitat diversity, support aquatic species, and provide wildlife dependent recreation opportunities.

Strategies

1. Place structure (tree tops, boulders, etc.) in lakes and ponds to increase aquatic habitat diversity.

Objective 1.4: Patoka River, Oxbows, and Patoka Tributaries

Total Acres: 534; 2007 Owned Acres: 200

Within 5 years of plan approval, collect information necessary to evaluate stream channel restoration options for the Patoka River and its tributaries that includes restoring channelized stream to meandering stream.

Rationale:

In the 1920s there was an attempt to drain nearly 100,000 acres of forested wetlands along the Patoka River to make it suitable for farming. Known as Houchin's Ditch and beginning at the town of Winslow, the project replaced 36 miles of natural, meandering river with about 17 miles of dredged, straight ditch. Nearly 19 miles of natural river meanders



*Snakey Point fishing pier, Patoka River NWR & MA.
Photo credit: USFWS*

were cut off and isolated from the main channel. Water exchange within these man-made oxbows is now limited to periods of high water, but heavy sediment loads carried during these periods results in increased deposition in the oxbows. Consequently, these important ecological units are becoming shallower and hold water for a shorter duration. Although this process occurs in all natural riverine systems, normally new oxbows are continually being created as river meanders are severed from the main channel. In the case of Houchins's Ditch, these oxbows are not being replaced and the associated wetland habitat is being lost. We require more information about the morphology and hydrology of the Patoka River and its tributaries before undertaking channel restoration.

Strategies

1. Develop partnership with Corps of Engineers to complete evaluation of stream restoration.

Objective 1.5: Water Quality

Within 15 years of plan approval, improve water quality within the Patoka River and its tributaries to move towards compliance with Indiana Department of Environmental Management standards with the long-term goal of removal of the streams from the list of impaired waters.

Rationale: Presently, the Patoka River and its tributaries are listed as impaired waters by the Indiana Department of Environmental Management (IDEM 2006b). Waters are considered impaired when they fail to meet one or more standards necessary to support one or more of the following uses: aquatic life support, fish consumption, drinking water supply, and recreational use. Improving water quality will help restore the biolog-

ical integrity and environmental health of the Patoka River system and is consistent with current Service policy (U.S. Fish and Wildlife Service 2001).

Strategies

1. Continue working on abandoned mine land reclamation in conjunction with the IDNR Division of Mining and Reclamation and Department of Interior Office of Surface Mining and Reclamation.
2. Work with local groups to monitor and identify opportunities to improve water quality within the Patoka River watershed.
3. Attend and support watershed planning activities to enhance water quality.
4. Cooperate with Upper and Lower Patoka River Conservancy Districts to maximize wildlife benefits associated with their activities.
5. Maintain relationships with Indiana DNR Division of Oil and Gas, Indiana Department of Environmental Management to ensure proper operation of oil and gas wells in the watershed.

Objective 1.6: Bottomland Farmland

Total acres: 4,507; 2007 Owned acres: 1,059

Over the life of the plan, maintain up to 1,000 acres of bottomland farmland in two to three contiguous blocks as stopover habitat for migratory waterbirds. Convert all other bottomland farmland, both currently owned and future acquisitions, to bottomland forest (including ridge/swale macrotopography wetlands) or moist soil management units.

Rationale: Service policy calls for maintaining or restoring refuge habitats to historic conditions if doing so is feasible and does not conflict with refuge purposes (U. S. Fish and Wildlife Service 2001). Retaining up to 1,000 acres of bottomland farmland departs substantially from the bottomland forest indicated by historic conditions (Parker and Ruffner 2004) and soils (Soil Survey Staff NRCS—USDA undated) of these sites, but it helps fulfill Refuge purposes by providing stopover habitat for migrant waterbirds that favor wetlands with short vegetation (Helmert 1992). This type of stopover habitat historically occurred as sandbars, mudflats, and oxbows along the floodplains and tributaries of the Mississippi and Ohio Rivers before they were extensively altered (de Szalay et al. 2000). Migrants shifted to flooded farmland in the absence of this habitat. Presently, spring flooding inundates bot-

tomland farmland along the Patoka River, providing stopover habitat for migrant shorebirds and some types of waterfowl. Such frequently flooded farmland is a focus of the Indiana Wetland Reserve Program (WRP). Nearly 49,000 acres are enrolled in the Indiana WRP with more than 25,000 acres occurring along the lower reaches of the Wabash and White Rivers, areas close to Patoka River NWR (USDA—NRCS website, G. Roach personal communication June 6, 2006). The majority of sites along the lower reaches of the Wabash and White River are being reforested, making them unsuitable for some migrant waterbirds. This trend is expected to continue. Given the loss of native habitat and the restoration of frequently flooded farmland to forest, it is consistent with Refuge purposes to retain one or more large open blocks of bottomland to provide habitat for open wetland dependent migratory species. Retarding succession on these sites through moist soil management, prescribed burning, or other mechanical or chemical means is not possible because of insufficient land ownership and/or it would exceed current and projected future funding and staffing levels. For the 15-year planning horizon of this CCP, farming is the most cost-effective means to prevent these sites from succeeding to forest and to maintain them as stopover foraging habitat.

Each spring thousands of waterfowl, shorebirds, and wading birds use flooded bottomland farmland within the Refuge as stopover habitat. Many of these migrant waterbirds prefer non-forested wetlands with short vegetation (Helmers 1992) and would not use these areas if they were forested. The birds prefer flooded bottomland farmland within the Refuge for several reasons. Surrounding privately owned farmland is not buffered by bottomland forest and agricultural practices on these sites do not leave residual vegetation as is done on Refuge owned farmland.

Strategies

1. Maintain cooperative agreements, which require cooperating farmers to annually leave a portion of crops as food for wildlife.
2. Where feasible, restore micro and macro topographic features on portions of bottomland farmland fields to increase the duration they provide wetland conditions. See Stratman (2000) and Dunn and Roach (2001) for additional information.

Objective 1.7: Moist Soil Units

500-700 acres

Within 15 years of plan approval, maintain existing moist soil areas (265 acres) and convert up to a total of 700 acres of bottomland farmland to moist soil management that provides a diversity of native herbaceous plant foods such as wild millet (*Echinochloa* spp.); panic grass (*Panicum* spp.); sedges (*Cyperus* spp. and *Carex* spp.); and beggarticks (*Bidens* spp.).

Rationale: Moist soil management is a widespread practice for producing a diverse mixture of native herbaceous plant foods and invertebrates (Frederickson and Taylor 1982). It mimics seasonal flooding that has long occurred in the lowlands of the Patoka River corridor, but moist soil units – areas impounded by levees, dikes, and structures that permit precise control of water levels – allow managers to consistently produce conditions favorable to growth of native plants. Seeds produced by these plants provide balanced nutrition for migrating waterfowl, and also provide food and habitat for other migratory birds and wildlife. The diverse mixture of native plants also creates conditions that produce abundant invertebrates, a high protein wildlife food source.

Strategies

1. Disturb (through mowing, disking, fire, etc...) an average of one third of Moist Soil Unit acreage annually to set back succession.



*Bottomland forest hydrology, Patoka River NWR & MA.
Photo credit: USFWS*

2. Moist soil units will be maintained in early successional native plant communities for the production of annual seed crops.
3. Flood Moist Soil Units in stages beginning in October or November, initially flooding one-third and progressively flooding more of each unit as waterfowl deplete the food supply until units are entirely inundated.
4. Begin draining in March to expose mudflats by April to benefit migrating shorebirds which can feed on invertebrates.
5. Maintain pumps, dikes and water control structures in good working order.
6. Maintain units to demonstrate comparison practices for educational purposes.

Objective 1.8: Upland Forest

Total Acres: 2,704; 2007 Owned Acres: 183

Over the long-term (100-200 years), achieve a mosaic of hardwood stands of different age and structural classes distributed on upland areas and dominated by white oaks, black oaks, hickory, and blackgum on drier sites, and by red oaks, yellow poplar, beech, sugar maple, walnut, hickory, and cherry on wetter sites. Over the life of the plan, maintain upland forest on presently owned acres (183) and for future acquisitions maintain existing upland forest and restore upland forest on non-forested upland sites with suitable soils.

Rationale: We identified 6,720 acres of upland soils within the Refuge boundary. Presently, 2,704 acres of these soils are covered by upland forest. The Natural Resources Conservation Service's Official Soil Series Descriptions (Soil Survey Staff NRCS – USDA undated) shows hardwood forest as the potential natural vegetation suited for the remaining 4,016 acres of upland soils. These potential upland forest sites are presently in various cover types with the majority in farmland (3,213 acres). Restoring the extent and species diversity of upland forest within the planning area is consistent with Refuge purposes, existing soils information, known presettlement vegetative cover (Parker and Ruffner 2004), and Service policy (U.S. Fish and Wildlife Service 2001).

There is additional support for maintaining or restoring upland sites within the Refuge to oak-hickory forest. McNab and Avers (1994) identify oak-hickory forest as the potential natural vegetation for the uplands within the Central Till Plains Oak-Hickory Ecological Section where the Refuge

is located. Parker and Ruffner (2004) and Fralish (1997) assert that human caused disturbance played a major role in the dominance of oak-hickory forest in this region for at least the past 400 years and likely much longer (Fralish 2004). Fire suppression within this landscape over the past century has shifted the forest composition away from oaks towards maple and beech (Ruffner and Groninger 2004). Fralish (2004) argues that oak and hickory play a keystone role in the Central Hardwood Forest and are of major importance in maintaining biodiversity. Thompson and Dessecker (1997) also note the importance of oak and early successional communities within the Central Hardwood Forest.

Strategies

1. Conduct forest surveys or inventories every 5 years to monitor changes in health, composition, and structure of forestlands.
2. Develop and implement 5-year forest management plan to promote regeneration of white and red oaks.
3. As indicated, conduct timber stand improvement, including selective harvest if necessary, to provide habitat diversity and stimulate regeneration and plant growth on the forest floor.
4. Plant tree species appropriate to upland sites with emphasis on mast producing species particularly oaks.

Objective 1.9: Upland Openings

Total Acres: 2,139; 2007 Owned Acres: 98

Over the life of the plan, maintain reclaimed minelands as early successional habitat (grasslands) and convert other upland openings to upland forest.

Rationale: Surface mining has and continues to occur on upland sites within the Refuge acquisition boundary. Since 1977 federal law requires coal operators to restore mined land to beneficial uses. Some reclamation sites were planted to grass and remain in this condition. Populations of many grassland bird species are declining in part because of loss of grassland habitat. These "mine grasslands" serve as surrogate habitat for some grassland birds including Grasshopper Sparrows, Henslow's Sparrows, Eastern Meadowlarks, and Dickcissels, which are identified as conservation priorities for the Midwest Region of the Service (Bajema et al. 2001, DeVault et al. 2002).

Service policy calls for maintaining or restoring refuge habitats to historic conditions if doing so is feasible and does not conflict with refuge purposes (U. S. Fish and Wildlife Service 2001). Available information on historic vegetation indicates hardwood forests occurred on upland sites within and surrounding the Refuge (Parker and Ruffner 2004). Hardwood forest is also listed as the potential natural vegetation for upland soils (those not classified as hydric or frequently flooded) within the Refuge (Soil Survey Staff NRCS – USDA undated). Surface mined lands may eventually revert to forest, but mining activity severely altered soil structure and properties allowing grasses to predominate. Although grasslands probably did not historically occur on surface mined areas within the Refuge the habitat is not out of place. Homoya (personal communication March 8, 2007) notes that historically grassland habitat did occur near the Refuge. This is further supported by the description of the Central Till Plains Oak-Hickory Ecological Section where the Refuge is located. It notes fire and other disturbance agents generally discouraged woody vegetation and encouraged grasslands on the flatter upland divides between forested drainages and opened the canopy in the ravines and on slopes (McNab and Avers 1994).

Strategies

1. Use prescribed burning, mechanical, or chemical methods to maintain upland openings.
2. Where feasible, place openings along perimeter of Refuge to minimize fragmentation and promote habitat diversity.

Objective 1.10: Invasive Plant Species

Within 5 years of plan approval assess the location and extent of invasive plant infestations and develop measurable annual targets to help eradicate or slow the spread of invasive plant species (of present interest are Japanese honeysuckle, reed canary grass, autumn olive, Johnson grass, and Japanese knotweed).

Rationale: Exotic or non-native plants are those that have been deliberately or inadvertently transported and transplanted by humans outside their native range, often found on another continent. Certain exotic plants become “invasive” if they survive and begin to spread on their own, in the absence of the population controls (e.g. diseases, parasites, environmental constraints, organisms that fed on them) that held their propagation in check in their native ranges. Invasive exotics are



Habitat restoration – tree planting, Patoka River NWR & MA. Photo credit: USFWS

troublesome because they displace native vegetation on which native animal species depend.

Strategies

1. Complete a comprehensive inventory to assess the location and extent of invasive plant infestations.
2. Use mechanical, chemical and biological controls to check the spread of invasive plant species.
3. Communicate with other state and federal resource agencies, as well as non-governmental organizations, to stay current on emerging threats and effective management and control techniques related to invasive species.

Objective 1.11: Private Lands and Watershed Management

Over the life of the plan, increase wildlife habitat and reduce sedimentation on 150 acres of private lands within the Patoka River and surrounding watersheds.

Rationale: The Patoka River watershed extends beyond the boundaries of the Refuge. Land use and activities within the watershed affect the quality of Refuge habitats. Working with neighboring land owners to improve wildlife habitat and water quality complements conservation actions on the Refuge. The Service’s Partners for Fish and Wildlife Program is devoted to providing technical and financial assistance to private landowners and Tribes who are willing to work with the Service and other partners on a voluntary basis to help meet the habitat needs of Federal Trust Species.

Strategies

1. Distribute information concerning habitat development opportunities on private lands during Refuge presentations and via local media and other agency (USDA, Indiana DNR) publications and web sites.
2. Coordinate with interested landowners on a timely basis to assess habitat development or improvement opportunities and secure voluntary agreements for appropriate projects.
3. Provide technical resource assistance to other agencies, particularly NRCS, to maximize wildlife benefits associated with programmatic conservation programs such as the Conservation Reserve Program, Wetlands Reserve Program and others.
4. Conduct annual review of Farm Services Agency easements for compliance. Reviews may be completed through a variety of methods including contact with land owners, aerial photography reconnaissance, or on-site inspection.

Objective 1.12: Interior Least Tern Nesting Habitat

Over the life of the plan, continue to provide 6 acres of nesting habitat for Interior Least Terns at Cane Ridge Wildlife Management Area capable of accommodating up to 100 nesting adult terns and producing 75 fledglings annually.

Rationale: The Interior Least Tern is federally listed as endangered. Cane Ridge Wildlife Management Area, a 488-acre satellite of Patoka River NWR, contains two islands created and maintained as nesting habitat for Least Terns. The site was created as part of a Habitat Conservation Agreement with Duke Energy to lure nesting terns away from sites at a neighboring power plant. The site now harbors the largest nesting colony of Interior Least Terns east of the Mississippi River.

Strategies

1. Annually inspect and repair, as necessary, predator fencing which encloses the two nesting islands.
2. Ensure adequate water depth surrounding the nesting islands to provide foraging habitat for the terns and to discourage mammalian predators.
3. Through mechanical and chemical means, ensure that the nesting substrate remains relatively free of vegetation and attractive to nesting terns.



Oxbows adjacent to the channelized river, Patoka River NWR & MA. Photo credit: USFWS

4. Ensure the Refuge has all necessary permits to allow staff to utilize whatever methods necessary to minimize avian predation on the nesting tern colony.

Objective 1.13: Land Acquisition

Within 5, 10 and 15 years of Plan approval, the Refuge will include 50 percent (11,000 acres), 70 percent (15,400 acres) and 80 percent (17,600 acres) respectively, of the lands within the acquisition boundary.

Rationale: Land acquisition is a critical component of fish and wildlife conservation since it permanently protects their basic need of habitat. On a narrow, linear refuge, land acquisition is a critical component of restoring the habitat connectivity needed for the health of many species. Land acquisition can also be cost-effective in the long-term due to inflation of land costs and the costs of acquiring undeveloped land versus developed land that also needs restoration. This objective represents an aggressive land acquisition program and averages 1,080-acres per year from 2007-2011, 880-acres per

year from 2012-2016 and 450-acres per year from 2017-2021 to achieve goals set in the 1994 Land Protection Plan and other approved acquisition documents.

Strategies

1. Secure land by any legal means from cooperative landowners including donations, bequeaths, purchases and land trades.
2. Secure funding from any available source including donations, bequeaths, appropriations, grants and through collaborative efforts with partners to include cost-sharing programs such as the Wetland Reserve Program, carbon sequestration trade-offs and similar programs that may become available.
3. Provide accurate and up-to-date information on land acquisition opportunities to Citizen Committees, Friends Groups, other conservation-oriented non-government organizations, Joint Venture partners and elected officials to assist in their efforts to secure adequate land acquisition funding.
4. Maintain communication with land owners within and around the Refuge of the status of the Service's land acquisition program.
5. Prioritize tracts for acquisition based on most critical wildlife needs and highest threat of loss due to other land development proposals.
6. Continue to be open to review of proposals by partners to protect other lands that may become available in the vicinity of the Refuge that provide critical habitat for threatened, endangered and other species of concern and consider all avenues of protecting that habitat including fee title purchase, conservation



Migrating Mallards, Patoka River NWR & MA. Photo credit: USFWS

easements and cooperative agreements by the Service or other conservation entities.

Objective 1.14: Air Quality

Over the life of the plan, work to improve air quality within the Refuge to levels that meet or exceed Environmental Protection Agency standards.

Rationale: Maintaining air quality to protect Refuge resources is consistent with the Service policy on Biological Integrity, Diversity, and Environmental Health. In recent years, the air quality within portions of Pike and Gibson counties as well as neighboring counties Warrick, Dubois, and Vanderburgh has failed to attain the national standard for particulate matter, one of six principal pollutants that have National Ambient Air Quality Standards set by the Environmental Protection Agency. Much of Gibson and Pike counties, where the Refuge is located, are outside this “nonattainment area” most likely because no air quality data are available. In addition to primary standards intended to protect public health, the Clean Air Act sets secondary standards to protect public welfare. These secondary standards include protection for animals and vegetation, two resources that play an important role in fulfilling Refuge purposes. In 2007 there was a proposal to site an industrial facility near the Refuge that would discharge additional effluent into the atmosphere. This generated concern among Refuge staff and the local public. In 2008 the Refuge working in conjunction with the Indiana Department of Environmental Management placed an air quality monitoring station near the Refuge.

Strategies

1. Continue to work with Indian Department of Environmental Management and local citizens groups (currently Pike/Gibson Citizens for a Quality Environment).
2. Support establishment of a permanent air monitoring station in the vicinity of the Refuge.

Goal 2: Wildlife

Perpetuate listed species, waterfowl, other migratory birds, and native fish and wildlife, within the Patoka River and associated watersheds while restoring and preserving the biological integrity, diversity, and environmental health of the Refuge.

Objective 2.1: Threatened and Endangered Species

Within 5 years of plan approval, implement a monitoring program to track abundance, population trends, and/or habitat associations of listed species.

Rationale: To evaluate whether management actions are having the predicted consequences, we need to monitor actual outcomes, most often using a representative sample of sites to ensure that, on average, the effects of a particular type of treatment match expectations. Information gained through monitoring helps us learn and adapt, increasing our effectiveness in meeting conservation objectives. Established in 2005, the Service's Biological Monitoring Team is developing a series of monitoring protocols to ensure uniform data collection and analysis. Refuge monitoring activities will be compliant with the goals of the Biological Monitoring Team shown below (U. S. Fish and Wildlife Service 2005).

- Refuges will evaluate achievement of their wildlife and habitat goals, and track the management and conservation of their natural resources over time and space through systematic collection, storage, and reporting of biological data that address specific management information needs.
- Refuges will initiate management-focused research (Adaptive Management) and develop new tools and techniques to fill information gaps. Adaptive management research will be used to clarify the outcomes of specific management actions and guide future management programs.
- Refuges will contribute to regional, national, and continental conservation of trust resources as partners with other FWS Programs (Migratory Birds, Fisheries, Endangered Species, others) and the States, by collaborating with other agencies performing similar monitoring efforts to ensure that data can be easily exchanged for analyses at multiple landscape scales.

Strategies

1. Monitor Bald Eagle nest(s) to track nest success/productivity
2. Every 5 years cooperate/contract with university/Coop unit/ES endangered species specialist to determine status of Indiana bats on the Refuge.
3. Continue cooperative efforts with Indiana DNR, Duke Energy to monitor Interior Least Tern nesting colony (nesting success, production, predation)
4. Candidate species (Indiana crayfish, northern copperbelly watersnake) – survey, inventory, habitat evaluation.
5. Complete Inventory and Monitoring step-down plan.

Objective 2.2: Migratory and Resident Birds

Within 5 years of plan approval, implement a monitoring program to track abundance, population trends, and/or habitat associations of selected migratory and resident bird species or groups of species (e.g. waterfowl, migrating land birds, shorebirds, marsh birds).

Rationale: See rationale for Objective 2-1 Threatened and Endangered Species.

Strategies:

1. In cooperation with Indiana DNR, conduct weekly waterfowl surveys at Patoka River NWR, Cane Ridge WMA, and Gibson Generating Station.
2. Develop partnership with local birding organizations and other competent birders to conduct Christmas Bird Count, Breeding Bird Survey, colonial nesters survey, and shorebird surveys in conformance with appropriate protocols
3. Develop, as appropriate, surveys designed to measure the impacts of habitat management efforts on migratory bird populations and use (reforestation, water manipulation, early successional habitat management).

Objective 2.3: Native Resident Wildlife

Over the life of the plan, track abundance, population trends, and/or habitat associations of selected native resident wildlife species.

Rationale: The Indiana Comprehensive Wildlife Strategy identifies species of greatest conservation need within the state including many that are not

Federal Trust Species. The Refuge, which includes intermingled state lands (Pike State Forest and Sugar Ridge Fish and Wildlife Area) contains habitat for many of these species. Monitoring their status in cooperation with the Indiana Department of Natural Resources supports implementation of the Indiana Comprehensive Wildlife Strategy.

Strategies

1. Cooperate with IDNR to collect monitoring information on selected native resident wildlife.

Objective 2.4: Fish and Other Aquatic Species

Over the next 15 years, create or maintain diverse, self-sustaining fisheries in Refuge lakes, ponds, and streams. Within the Patoka River and its tributaries, improve the Index of Biotic Integrity for fish and other aquatic species communities with the long term goal of meeting or exceeding the Indiana Department of Environmental Management threshold for “fully supporting”.

Rationale: Presently, the Patoka River and its tributaries are listed as impaired waters by the Indiana Department of Environmental Management (IDEM 2006b). Waters are considered impaired when they fail to meet one or more standards necessary to support one or more of the following uses: aquatic life support, fish consumption, drinking water supply, and recreational use. Improving water quality will help restore the biological integrity and environmental health (U.S. Fish and Wildlife Service 2001) of the Patoka River system as measured through an increase in the Index of Biotic Integrity as monitored and reported by the Indiana Department of Environmental Management (IDEM 2006a). The Index of Biotic Integrity is a composite indicator that incorporates multiple dimensions of living systems to quantify biological conditions in aquatic environments. Such indicators have been recommended for monitoring ecological conditions on Refuges (Meretsky et al. 2006).

Strategies

1. Periodically inventory and monitor fish and aquatic species in Refuge waters.
2. See strategies under Objective 1-5 Water Quality.

Goal 3: People

Visitors, nearby residents and other stakeholders have the opportunity to enjoy wildlife-dependent recreation, understand and appreciate the natural resources, ecological processes and cultural resources of the Refuge, thereby supporting the Service’s mission.

Objective 3.1: Welcoming and Orienting Visitors

Within 5 years of plan approval, improve directional signing, determine the feasibility of off-site welcoming and orientation facilities, and place new entrance signs and kiosks at existing boat ramps, Snakey Point, and along Highway 57.

Rationale: Welcoming and orienting Refuge visitors contributes to several of the criteria defining a quality wildlife dependent recreation program (U.S. Fish and Wildlife Service 2006a). The number of visitors and amount of visitor services has increased to 21,221 visits since the Refuge was established in 1994. There are multiple access points to the Refuge and with approximately 75 percent of the land within the Refuge boundary not yet acquired, Refuge lands are intermingled with other holdings requiring clear signing and visitor information.

Strategies

1. Provide online Refuge information and map of boundaries.
2. Post boundaries on lands that abut the acquisition boundary of the Refuge and along selected sites that abut county roads.
3. Develop Visitor Facility enhancement projects to provide new entrance signs and kiosks at major access points.



Trumpeter Swans, Patoka River NWR & MA. Photo credit: USFWS

4. Develop and maintain a general brochure and fact sheet.

Objective 3.2: Hunting

Over the life of the plan, provide hunting in line with State seasons and regulations except within designated sanctuary areas and according to the Refuge hunting and fishing plan.

Rationale: Hunting programs help promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System. Hunting is a priority general public uses of the National Wildlife Refuge System, and Service policy directs us to provide hunting opportunities when compatible (U. S. Fish and Wildlife Service 2006b).

Strategies

1. Enlist assistance from the Indiana DNR and volunteers to run any additional hunts.
2. Manage hunts to minimize conflicts with other uses and resources.
3. Assist as appropriate with hunter education, youth hunts, hunts for the disabled, and a women's skill program.
4. As more land is acquired more sanctuary areas will be identified and posted closed to all hunting to provide a feeding and resting area for migratory birds. Maintaining waterfowl sanctuary areas free of all hunting serves waterfowl and hunters by keeping birds in the area thereby providing prolonged hunting opportunities in adjoining areas.
5. Maintain Cane Ridge as a sanctuary free of all hunting.

Objective 3.3: Fishing

Over the life of the plan, continue to provide fishing in line with State seasons and regulations according to the Refuge hunting and fishing plan. Continue to work cooperatively with the Indiana Department of Natural Resources on fisheries management. Within 5 years of plan approval, provide enhanced fishing access (more docks, ramps, etc...).

Rationale: Fishing programs help promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System. Fishing is a priority general public uses of the National Wildlife Refuge System, and Service policy directs us to provide



*Plant identification workshop, Patoka River NWR & MA.
Photo credit: USFWS*

fishing opportunities when compatible (U. S. Fish and Wildlife Service 2006c).

Strategies

1. If successful in acquiring suitable lands, install a boat ramp near Oatsville in cooperation with the IDNR.
2. Provide additional accessible facilities such as trails, boat ramps, and fishing piers along fishable waters as lands are acquired within the Refuge.
3. Provide accessible bank fishing opportunities.

Objective 3.4: Wildlife Observation and Photography

Over the life of the plan, continue to provide opportunities for wildlife observation and photography at Cane Ridge and Snakey Point. Within 5 years of plan approval, enhance observation and photography Refuge-wide as opportunities present themselves.

Rationale: Wildlife observation and photography programs can help promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System. Wildlife observation and photography are priority general public uses of the National Wildlife Refuge System, and Service policy directs us to provide wildlife observation and photography opportunities when compatible (U. S. Fish and Wildlife Service 2006d and 2006e).

Strategies

1. Provide additional accessible wildlife observation and photography facilities such as blinds,

observation platforms, trails, etc. at selected sites as lands are acquired within the Refuge.

2. Install spotting scope at Cane Ridge Wildlife Management Area observation platform.
3. Determine the feasibility of a canoe route along the Patoka River.

Objective 3.5: Interpretation

Over the life of the plan, continue to provide guided tours and programs upon request and maintain monument on McClure Tract. Within 5 years of plan approval, provide interpretive elements in proposed kiosks and other selected sites and increase opportunities for interpreted trails, walks, and programs.

Rationale: Well-designed interpretive programs can be effective resource management tools that provide us an opportunity to influence visitor attitudes about natural resources, refuges, the Refuge System, and the Service and to influence visitor behavior when visiting units of the Refuge System. Interpretation is a priority general public use of the National Wildlife Refuge System, and Service policy directs us to provide interpretation programs when compatible (U. S. Fish and Wildlife Service 2006g).

Strategies

1. Evaluate interest and feasibility of developing an interpretive canoe/boating route along the Patoka River.
2. Place orientation kiosks at one or more of the following locations: Pikeville boat ramp, Survant boat ramp and Snakey Point.
3. Place kiosk and interpretive signs at Cane Ridge Wildlife Management Area.
4. Place interpretive signs at all observation sites.
5. Consider providing a visitor contact area within or adjoining the Refuge office to offer interpretive materials.

Objective 3.6: Environmental/Conservation Education

Over the life of the plan, continue to provide environmental education upon request at the current level of less than 5 times per year. Within 3 years of plan approval, develop capacity to provide Environmental Education materials and programs to teachers and others upon request.

Rationale: Providing and promoting environmental education helps develop a citizenry that has the

awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of our Nation's environmental resources. Environmental education is a priority general public use of the National Wildlife Refuge System, and Service policy directs us to provide environmental education programs when compatible (U. S. Fish and Wildlife Service 2006f).

Strategies

1. Offer teacher workshops to introduce educators to the Refuge, Refuge System and Service provided environmental education materials.
2. Provide opportunities for scouts and 4H students to complete conservation projects on the Refuge.
3. Maintain a supply or access to a source of environmental education materials for local teachers.

Objective 3.7: Friends and Volunteers

Within 5 years of plan approval, establish a Friends group.

Rationale: A Refuge Friends Group is a grass-roots organization formed by citizens who have a shared vision of supporting their local National Wildlife Refuge. They join with Service personnel in a partnership that seeks to accomplish mutually defined goals. Establishing a Friends group helps build a constituency of support for the Refuge, provides people with opportunities to assist us in the accomplishment of our mission, enhances our performance through the creativity and innovations, labor, and expertise contributed by Friends members.

Strategies

1. Continue to work with Southwest Four Rivers Project Committee of the Upper Mississippi River Joint Venture.
2. Continue to maintain a working relationship with Evansville Audubon Society and the Izaak Walton League, Ducks Unlimited, Waterfowl USA, Quail Unlimited, and other organizations.
3. Continue to solicit support from the local community for special projects.

Objective 3.8: Outreach

Over the life of the plan, continue to speak to local civic and sportsmen's groups upon request approximately 12-15 times per year. Also con-



*Canoeing the Patoka River, Patoka River NWR & MA.
Photo credit: USFWS*

tinue to provide information and interviews for local news media and outdoors writers as well as distribute news releases 2-3 times annually. Within 5 years of CCP approval, explore opportunities to establish off-site facilities and opportunities.

Rationale: The Service's National Outreach Strategy (U.S. Fish and Wildlife Service, 1997) defines outreach as two-way communication between the U.S. Fish and Wildlife Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with the goal of improving joint stewardship of our natural resources. Providing a clear consistent message about the role of the Refuge helps build support and understanding.

Strategies

1. Work with county tourism associations to help promote the Refuge.
2. Continue with active participation and communication throughout the watershed through media articles, meeting with elected officials, representatives or other organizations such as soil and water conservation districts to promote Refuge programs.

Chapter 5: Plan Implementation

New and Existing Projects

This CCP outlines an ambitious course of action for the future management of Patoka River NWR & MA. The ability to enhance wildlife habitats on the Refuge and to maintain existing and develop additional quality public use facilities will require a significant commitment of staff and funding from the Service. The Refuge will continually need appropriate operational and maintenance funding to implement the objectives in this plan.

The following provides a brief description of the highest priority Refuge projects, as chosen by the Refuge staff and listed in the Service Asset and Maintenance Management System (SAMMS). Completion of these projects is dependent on acquiring suitable lands. A full listing of unfunded Refuge projects and operational needs can be found in Appendix J.

Construct Visitor Parking Lots

As new lands are acquired, appropriate sites will be identified to construct small gravel parking lots to provide safe parking for wildlife dependent recreation activities.

Completion of Observation Deck

Completion of this project will include an accessible boardwalk from the parking lot to the existing observation deck, an interpretive kiosk and signs, and two ADA approved spotting scopes.

Reconnect Oxbows on Patoka River

In cooperation with the Army Corps of Engineers we will select a small site along the channelized portion of the Patoka River cutoff oxbow will be



Anas platyrhynchos ova, Patoka River NWR & MA. Photo credit: USFWS

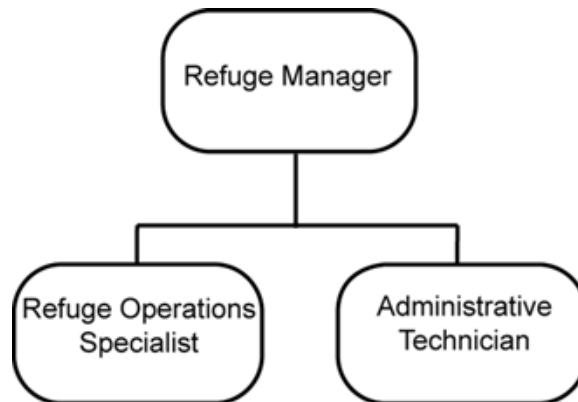
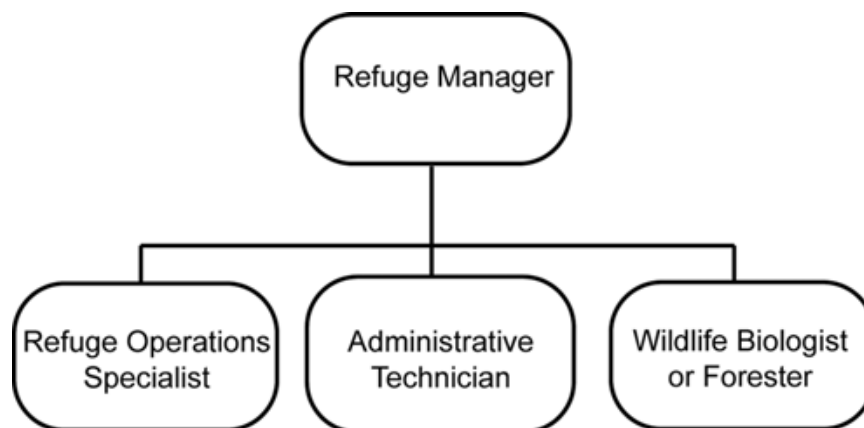
reconnected to the main channel of the Patoka River as a demonstration project and to evaluate its effectiveness in restoring bottomland hydrology.

Maintenance and Construction of Storage Facilities

When an appropriate tract of land is purchased a permanent maintenance and storage facility will be constructed to support Refuge operations.

Macrotopography Wetlands

On bottomland farmland construct a series of ridge and swale wetland complexes with depressional basins within the floodplain ranging in size from one-tenth to 5 acres with depths from 0 to 24 inches. These wetlands will be formed in a variety of shapes to provide landscape diversity. The ridges and mounds will be planted with bottomland hardwood trees.

Figure 15: Current Staffing Chart, Patoka River NWR**Figure 16: Staffing Required to Fully Implement Plan**

Future Staffing Requirements

Implementing the visions set forth in this CCP will require additions to the organizational structure of Patoka River National Wildlife Refuge. Existing staff will direct their time and energy in somewhat new directions and one new staff member would be added to assist in these efforts. The first organizational chart shows the existing Refuge staff as of Fiscal Year 2007. A permanent full-time wildlife biologist or forester is needed to fully implement this plan. See Figure 16.

Partnership Opportunities

Partnerships have become an essential element for the successful accomplishment of Patoka River NWR goals, objectives, and strategies. The objectives outlined in this CCP need the support and the partnerships of federal, state and local agencies, non-governmental organizations and individual citizens. This broad-based approach to managing fish and wildlife resources extends beyond social and political boundaries and requires a foundation of support from many. Patoka River NWR will continue to seek creative partnership opportunities to achieve its vision for the future.

Particularly notable partners of the Refuge include:

Table 5: Step-down Management Plan Schedule

Step-down Management Plan	Completed or Updated	Anticipated Completion or Revision
Safety	--	2008
Air Quality Management	--	2008
Hunting and Fishing	1996	2010
Wildlife Observation and Photography	--	2012
Interpretation	--	2013
Habitat Management	--	2010
Inventory and Monitoring	--	2009
Fire Management	2002	-

- Ducks Unlimited
- Duke Energy
- Waterfowl USA
- National Fish and Wildlife Foundation
- Natural Resources Conservation Service
- Audubon Society
- Izaak Walton League
- Quail Unlimited
- McCormick Farms
- Conservation Fund
- Four Rivers RC&D
- Indiana Department of Natural Resources
- Division of Fish and Wildlife
- Division of Forestry
- Division of Oil and Gas
- Division of Mining and Reclamation
- Army Corps of Engineers

Step-down Management Plans

Step-down management plans help meet the goals and objectives of the CCP. Some step-down plans are required by Service policy and others are used to specify strategies and implementation schedules beyond the detail of the CCP. The following list and Table 5 show the step-down management plans we intend to prepare or revise to realize the intent of the CCP.

- Safety
- Air Quality Management

- Hunting and Fishing
- Wildlife Observation and Photography
- Interpretation
- Habitat Management
- Inventory and Monitoring
- Fire Management

Archeological and Cultural Values

As part of its larger conservation mandate and ethic, the Service through the Refuge Manager applies the several historic preservation laws and regulations to ensure historic properties are identified and are protected to the extent possible within its established purposes and Refuge System mission.

The Refuge Manager early in project planning for all undertakings, informs the RHPO (Regional Historic Preservation Officer) to initiate the Section 106 process. Concurrent with public notification and involvement for environmental compliance and compatibility determinations if applicable, or cultural resources only if no other issues are involved, the Refuge Manager informs and requests comments from the public and local officials through presentations, meetings, and media notices; results are provided to the RHPO.

Archeological investigations and collecting are performed only in the public interest by qualified archeologists or by persons recommended by the Governor working under an Archaeological



Young white-tailed buck, Patoka River NWR & MA. Photo credit: USFWS

Resources Protection Act permit issued by the Regional Director. Refuge personnel take steps to prevent unauthorized collecting by the public, contractors, and Refuge personnel.

The Refuge Manager will, with the assistance of the RHPO, develop a step-down plan for surveying lands to identify archeological resources and for developing a preservation program to meet the requirements of Section 14 of the Archaeological Resources Protection Act and Section 110(a)(2) of the National Historic Preservation Act.

The Refuge Manager should have and implement a plan for inspecting the condition of known cultural resources on the Refuge and report to the RHPO changes in the conditions.

The Refuge Manager will initiate budget requests or otherwise obtain funding from the 1 percent O&M program base provided for the Section 106 process compliance:

1. Inventory, evaluate, and protect all significant cultural resources located on lands controlled by the FWS, including historic properties of religious and cultural significance to Indian tribes.
2. Identify and nominate to the National Register of Historic Places all historic properties including those of religious and cultural significance to Indian tribes.

3. Cooperate with Federal, state, and local agencies, Native American tribes, and the public in managing cultural resources on the Refuge.
4. Integrate historic preservation with planning and management of other resources and activities. Historic buildings are rehabilitated and adapted to reuse when feasible.
5. Recognize the rights of Native American to have access to certain religious sites and objects on Refuge lands within the limitations of the FWS mission.

Monitoring and Evaluation

The direction set forth in this CCP and specifically identified strategies and projects will be monitored throughout the life of this plan. On a periodic basis, the Regional Office will assemble a station review team whose purpose will be to visit Patoka River NWR and evaluate current Refuge activities in light of this plan. The team will review all aspects of Refuge management, including direction, accomplishments and funding. The goals and objectives presented in this CCP will provide the baseline from which this field station will be evaluated.

Plan Review and Revision

The CCP for the Refuge is meant to provide guidance to the refuge manager and staff over the next 15 years. However, the CCP is also a dynamic and flexible document and several of the strategies contained in this plan are subject to natural uncontrollable events such as windstorms and floods. Likewise, many of the strategies are dependent upon Service funding for staff and projects. Because of all these factors, the recommendations in the CCP will be reviewed periodically and, if necessary, revised to meet new circumstances. If any revisions are major, the review and revision will include the public.

Appendix A: Finding of No Significant Impact

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and here.

Appendix B: Glossary

Appendix B: Glossary

Aquatic Species

Includes all freshwater, anadromous and estuarine fishes, freshwater mollusks, freshwater crustaceans and freshwater amphibians.

Archaeological and Cultural Values

Any material remains of past human life or activity greater than 100 years old which are of archaeological interest as defined by Section 4(a) of the Archaeological Resources Protection Act and 43 CFR Part 7.3.

Biodiversity

The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

Candidate Species

Those species for which the Service has on file sufficient information on biological vulnerability and threats to propose them for listing.

Compatible Use

A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director or designee, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge (PL 105-57).

Comprehensive Conservation Plan

Plan: A document, completed with public involvement, that describes the desired future condition and provides long-term (15 year planning horizon) guidance to accomplish the purposes of the refuge system and the individual refuge units.

Conservation

The management of natural resources to prevent loss or waste. Management actions may include preservation, restoration and enhancement.

Conservation (Species)

The use of all methods and procedures which are necessary to bring any species to the point at which the measures provided are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation. Conservation is the act of managing a resource to ensure its survival and availability.

Cultural Resources

Cultural Resources: “those parts of the physical environment – natural and built – that have cultural value to some kind of sociocultural group... [and] those non-material human social institutions....” (King, p.9). Cultural resources include historic sites, archeological sites and associated artifacts, sacred sites, traditional cultural properties, cultural items (human remains, funerary objects, sacred objects, and objects of cultural patrimony) (McManamon, Francis P. DCA-NPS; letter 12-23-97 to Walla Walla District, COE), and buildings and structures.

Ecosystem

Dynamic and interrelating complex of plant and animal (including humans) communities and their associated non-living environment.

Ecosystem Approach

1) Protecting or restoring the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated. 2) Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and that basic ecosystem processes are perpetuated indefinitely (Clark and Zaunbrecher 1987).

Endangered Species

A listed species in danger of extinction throughout all or a significant portion of its range.

Enhance (habitats)

Improves habitat through alteration, treatment, or other land management of existing habitat to increase habitat value for one or more species without bringing the habitat to a fully restored or naturally occurring condition.

Forest Fragmentation

Fragmentation may occur when a forested landscape is subdivided into patches. Fragmentation may also occur when numerous openings for such things as fields, roads, and powerlines interrupt a continuous forest canopy. The resulting landscape pattern alters habitat connectivity and edge characteristics, influencing a variety of species.

Interjurisdictional Fish

Populations of fish that are managed by two or more states or national or tribal governments because of the scope of their geographic distributions or migrations.

Invasive Species

An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Migratory Nongame Birds of Management Concern

Those species of nongame birds that (a) are believed to have undergone significant population declines; (b) have small or restricted populations; or (c) are dependent upon restricted or vulnerable habitats.

Migratory Species

Species that move substantial distances to satisfy one or more biological needs, most often to reproduce or escape intolerable cyclic environmental conditions.

National Wildlife Refuge System

All lands and waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction.

Protect (habitat)

Maintain current quality or prevent degradation to habitat. The act of ensuring that habitat quantity and quality do not change, most often as a

result of human activities but sometimes in response to unwelcome natural processes or phenomena.

Recovery Plans (species)

Documents developed by the Service that outline tasks necessary to stabilize and recover listed species. Recovery plans include goals for measuring species progress towards recovery, estimated costs and time frames for the recovery process, and an identification of public and private partners that can contribute to implementation of the recovery plan.

Restore (habitat)

Returns the quantity and quality of habitat to some previous naturally occurring condition, most often some baseline considered suitable and sufficient to support self-sustaining populations of fish and wildlife.

Riparian Habitats

Those lands adjacent to streams or rivers that form a transition zone between aquatic and upland systems and are typically dominated by woody vegetation that is of a noticeably different growth form than adjacent vegetation. Riparian areas may or may not meet the definition of wetlands used by Cowardin *et al.* (1979).

Rotation

The period during which a single generation is allowed to grow.

Species of Concern

A species not on the federal list of threatened or endangered species, but a species for which the Service or one of its partners has concerns.

Stakeholders

State, tribal, and local government agencies, academic institutions, the scientific community, non-governmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.

Threatened Species

A listed species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Undertaking

A project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval..." (36 CFR 800.16(y); 12-12-2000), i.e., all Federal actions.

Uplands

All lands not meeting the definition of wetlands, deepwater, or riverine.

Watershed

The area drained by a river or stream and its tributaries.

Wetlands

Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (Cowardin *et al.*, 1979. In layman's terms, this habitat category includes marshes, swamps and bogs.

Wildlife-dependent Recreational Use

A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.

Appendix C: Species Lists

List of Bird Species / page 99

List of Mammal Species / page 106

List of Herptofauna Species / page 107

List of Fish Species / page 109

List of Fresh Water Mussel Species / page 112

List of Plant Species / page 113

Appendix C: Species Lists

Bird Species List, Patoka River NWR & MA

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Common loon	<i>Gavia immer</i>	✓		
Pied-billed grebe	<i>Podilymbus podiceps</i>	✓	✓	
Horned grebe	<i>Podiceps auritus</i>	✓		
American white pelican	<i>Pelecanus erythrorhynchos</i>	✓		
Double-crested cormorant	<i>Phalacrocorax auritus</i>	✓	✓	
American bittern	<i>Botaurus lentiginosus</i>	✓	✓	✓
Least bittern	<i>Ixobrychus exilis</i>	✓	✓	✓
Great blue heron	<i>Ardea herodias</i>	✓	✓	
Snowy egret	<i>Egretta thula</i>	✓	✓	
Great egret	<i>Casmerodius albus</i>	✓	✓	✓
Little blue heron	<i>Egretta caerulea</i>	✓	✓	
Cattle egret	<i>Bubulcus ibis</i>	✓	✓	
Green heron	<i>Butorides striatus</i>	✓	✓	
Black-crowned night-heron	<i>Nycticorax nycticorax</i>	✓	✓	✓
Yellow-crowned night-heron	<i>Nycticorax violaceus</i>	✓		✓
White-faced ibis	<i>Plegadis chihi</i>		✓	
Wood stork	<i>Mycteria americana</i>		✓	
Greater white-fronted goose	<i>Anser albifrons</i>	✓	✓	
Snow goose	<i>Chen caerulescens</i>	✓	✓	
Canada goose	<i>Branta canadensis</i>	✓	✓	
Tundra swan	<i>Cygnus columbianus</i>	✓	✓	
Trumpeter swan	<i>Cygnus buccinator</i>	✓		✓
Mute swan	<i>Cygnus olor</i>	✓		
Wood duck	<i>Aix sponsa</i>	✓	✓	
Gadwall	<i>Anas strepera</i>	✓	✓	
American wigeon	<i>Anas americana</i>	✓	✓	
American black duck	<i>Anas rubripes</i>	✓	✓	
Mallard	<i>Anas platyrhynchos</i>	✓	✓	
Blue-winged teal	<i>Anas discors</i>	✓	✓	
Green-winged teal	<i>Anas crecca</i>	✓	✓	
Northern shoveler	<i>Anas clypeata</i>	✓	✓	
Northern pintail	<i>Anas acuta</i>	✓	✓	
Canvasback	<i>Aythya valisineria</i>	✓	✓	
Redhead	<i>Aythya americana</i>	✓	✓	
Ring-necked duck	<i>Aythya collaris</i>	✓	✓	
Lesser scaup	<i>Aythya affinis</i>	✓	✓	
Bufflehead	<i>Bucephala albeola</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Common goldeneye	<i>Bucephala clangula</i>	✓	✓	
Hooded merganser	<i>Lophodytes cucullatus</i>	✓	✓	
Common merganser	<i>Mergus merganser</i>	✓		
Ruddy duck	<i>Oxyura jamaicensis</i>	✓	✓	
Turkey vulture	<i>Cathartes aura</i>	✓	✓	
Osprey	<i>Pandion haliaetus</i>	✓	✓	✓
Mississippi kite	<i>Ictinia mississippiensis</i>	✓		✓
Golden eagle	<i>Aquila chrysaetos</i>		✓	
Bald eagle	<i>Haliaeetus leucocephalus</i>	✓	✓	✓
Northern harrier	<i>Circus cyaneus</i>	✓	✓	✓
Sharp-shinned hawk	<i>Accipiter striatus</i>	✓	✓	✓
Cooper's hawk	<i>Accipiter cooperii</i>	✓	✓	
Red-shouldered hawk	<i>Buteo lineatus</i>	✓	✓	✓
Broad-winged hawk	<i>Buteo platypterus</i>	✓		✓
Red-tailed hawk	<i>Buteo jamaicensis</i>	✓	✓	
Rough-legged hawk	<i>Buteo lagopus</i>	✓	✓	
American kestrel	<i>Falco sparverius</i>	✓	✓	
Merlin	<i>Falco columbarius</i>	✓	✓	
Peregrine falcon	<i>Falco peregrinus</i>	✓	✓	
Wild turkey	<i>Meleagris gallopavo</i>	✓	✓	
Northern bobwhite	<i>Colinus virginianus</i>	✓	✓	
King rail	<i>Rallus elegans</i>	✓	✓	✓
Yellow rail	<i>Coturnicops noveboracensis</i>	✓		
Virginia rail	<i>Rallus limicola</i>	✓	✓	✓
Sora	<i>Porzana carolina</i>	✓	✓	
Purple gallinule	<i>Porphyryla martinica</i>	✓		
Common moorhen	<i>Gallinula chloropus</i>	✓	✓	✓
American coot	<i>Fulica americana</i>	✓	✓	
Sandhill crane	<i>Grus canadensis</i>	✓	✓	✓
Whooping crane	<i>Grus americana</i>	✓		✓
Black-bellied plover	<i>Pluvialis squatarola</i>	✓	✓	
American golden plover	<i>Pluvialis dominica</i>	✓	✓	
Semipalmated plover	<i>Charadrius semipalmatus</i>	✓	✓	
Killdeer	<i>Charadrius vociferus</i>	✓	✓	
Black-necked stilt	<i>Himantopus mexicanus</i>	✓	✓	
American avocet	<i>Recurvirostra americana</i>	✓	✓	
Greater yellowlegs	<i>Tringa melanoleuca</i>	✓	✓	
Lesser yellowlegs	<i>Tringa flavipes</i>	✓	✓	
Solitary sandpiper	<i>Tringa solitaria</i>	✓	✓	
Spotted sandpiper	<i>Actitis macularia</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Willet	<i>Catoptrophorus semipalmatus</i>		✓	
Ruddy turnstone	<i>Arenaria interpres</i>	✓	✓	
Semipalmated sandpiper	<i>Calidris pusilla</i>	✓	✓	
Least sandpiper	<i>Calidris minutilla</i>	✓	✓	
Pectoral sandpiper	<i>Calidris melanotos</i>	✓	✓	
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>		✓	
Short-billed dowitcher	<i>Limnodromus griseus</i>	✓	✓	
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	✓	✓	
Stilt sandpiper	<i>Calidris himantopus</i>		✓	
Common snipe	<i>Gallinago gallinago</i>	✓	✓	
American woodcock	<i>Scolopax minor</i>	✓		
Wilson's phalarope	<i>Phalaropus tricolor</i>	✓	✓	
Bonaparte's gull	<i>Larus philadelphia</i>	✓	✓	
Ring-billed gull	<i>Larus delawarensis</i>	✓	✓	
Herring gull	<i>Larus argentatus</i>		✓	
Caspian tern	<i>Sterna caspia</i>		✓	
Common tern	<i>Sterna hirundo</i>	✓	✓	
Forster's tern	<i>Sterna forsteri</i>	✓	✓	
Least tern	<i>Sterna antillarum</i>		✓	✓
Black tern	<i>Chlidonias niger</i>	✓	✓	✓
Rock dove	<i>Columba livia</i>	✓	✓	
Mourning dove	<i>Zenaida macroura</i>	✓	✓	
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	✓	✓	
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	✓	✓	
Barn owl	<i>Tyto alba</i>	✓		✓
Eastern screech-owl	<i>Otus asio</i>	✓	✓	
Great-horned owl	<i>Bubo virginianus</i>	✓	✓	
Barred owl	<i>Strix varia</i>	✓	✓	
Short-eared owl	<i>Asio flammeus</i>	✓	✓	✓
Common nighthawk	<i>Cordeiles minor</i>	✓	✓	✓
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>		✓	
Whip-poor-will	<i>Caprimulgus vociferus</i>	✓	✓	✓
Chimney swift	<i>Chaetura pelagica</i>	✓	✓	
Ruby-throated hummingbird	<i>Archilochus colubris</i>	✓	✓	
Belted kingfisher	<i>Ceryle alcyon</i>	✓	✓	
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	✓	✓	
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	✓	✓	
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	✓	✓	
Downy woodpecker	<i>Picoides pubescens</i>	✓	✓	
Hairy woodpecker	<i>Picoides villosus</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Northern flicker	<i>Colaptes auratus</i>	✓	✓	
Pileated woodpecker	<i>Dryocopus pileatus</i>	✓	✓	
Easter wood-pewee	<i>Contopus virens</i>	✓	✓	
Yellow-bellied flycatcher	<i>Empidonax flaviventris</i>	✓		
Acadian flycatcher	<i>Empidonax virscens</i>	✓	✓	
Alder flycatcher	<i>Empidonax alnorum</i>	✓		
Willow flycatcher	<i>Empidonax trailii</i>	✓	✓	
Least flycatcher	<i>Empidonax minimus</i>	✓		
Easter phoebe	<i>Sayornis phoebe</i>	✓	✓	
Great crested flycatcher	<i>Myiarchus crinitus</i>	✓	✓	
Eastern kingbird	<i>Tyrannus tyrannus</i>	✓	✓	
Loggerhead shrike	<i>Lanius ludovicianus</i>	✓	✓	✓
White-eyed vireo	<i>Vireo griseus</i>	✓	✓	
Bell's vireo	<i>Vireo bellii</i>	✓	✓	
Yellow-throated vireo	<i>Vireo flavifrons</i>	✓	✓	
Blue-headed vireo	<i>Vireo solitarius</i>	✓		
Warbling vireo	<i>Vireo gilvus</i>	✓	✓	
Philadelphia vireo	<i>Vireo philadelphicus</i>	✓		
Red-eyed vireo	<i>Vireo olivaceus</i>	✓	✓	
Blue jay	<i>Cyanocitta cristata</i>	✓	✓	
American crow	<i>Corvus brachyrhynchos</i>	✓	✓	
Horned lark	<i>Eremophila alpestris</i>	✓	✓	
Purple martin	<i>Progne subis</i>	✓	✓	
Tree swallow	<i>Tachycineta bicolor</i>	✓	✓	
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	✓	✓	
Bank swallow	<i>Riparia riparia</i>	✓	✓	
Cliff swallow	<i>Hirundo pyrrhonota</i>	✓	✓	
Barn swallow	<i>Hirundo rustica</i>	✓	✓	
Carolina chickadee	<i>Parus carolinensis</i>	✓	✓	
Tufted titmouse	<i>Parus bicolor</i>	✓	✓	
Red-breasted nuthatch	<i>Sitta canadensis</i>	✓		
White-breasted nuthatch	<i>Sitta carolinensis</i>	✓	✓	
Brown creeper	<i>Certhia americana</i>	✓	✓	
Marsh wren	<i>Cistothorus palustris</i>		✓	✓
Sedge wren	<i>Cistothorus platensis</i>		✓	✓
Carolina wren	<i>Thryothorus ludovicianus</i>	✓	✓	
House wren	<i>Troglodytes aedon</i>	✓	✓	
Winter wren	<i>Troglodytes troglodytes</i>	✓	✓	
Golden-crowned kinglet	<i>Regulus satrapa</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Ruby-crowned kinglet	<i>Regulus calendula</i>	✓	✓	
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	✓	✓	
Northern wheatear	<i>Oenanthe oenanthe</i>	✓		
Eastern bluebird	<i>Sialia sialis</i>	✓	✓	
Veery	<i>Catharus fuscescens</i>	✓	✓	
Gray-cheeked thrush	<i>Catharus minimus</i>	✓	✓	
Swainson's thrush	<i>Catharus ustulatus</i>	✓	✓	
Hermit thrush	<i>Catharus guttatus</i>	✓	✓	
Wood thrush	<i>Hylocichla mustelina</i>	✓	✓	
American robin	<i>Turdus migratorius</i>	✓	✓	
Gray catbird	<i>Dumetella carolinensis</i>	✓	✓	
Northern mockingbird	<i>Mimus polyglottos</i>	✓	✓	
Brown thrasher	<i>Toxostoma rufum</i>	✓	✓	
European starling	<i>Sturnus vulgaris</i>	✓	✓	
American pipit	<i>Anthus rubescens</i>	✓	✓	
Cedar waxwing	<i>Bombycilla cedrorum</i>	✓	✓	
Blue-winged warbler	<i>Vermivora pinus</i>	✓		
Golden-winged warbler	<i>Vermivora chrysoptera</i>	✓		✓
Tennessee warbler	<i>Vermivora peregrina</i>	✓	✓	
Nashville warbler	<i>Vermivora ruficapilla</i>	✓		
Northern parula	<i>Parula americana</i>	✓		
Yellow warbler	<i>Dendroica petechia</i>	✓	✓	
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>	✓		
Magnolia warbler	<i>Dendroica magnolia</i>	✓	✓	
Cape May warbler	<i>Dendroica tigrina</i>	✓		
Black-throated blue warbler	<i>Dendroica caerulescens</i>	✓		
Yellow-rumped warbler	<i>Dendroica coronata</i>	✓	✓	
Black-throated green warbler	<i>Dendroica virens</i>	✓	✓	
Blackburnian warbler	<i>Dendroica fusca</i>	✓		
Yellow-throated warbler	<i>Dendroica dominica</i>	✓	✓	
Pine warbler	<i>Dendroica pinus</i>	✓		
Prairie warbler	<i>Dendroica discolor</i>	✓		
Palm warbler	<i>Dendroica palmarum</i>	✓	✓	
Bay-breasted warbler	<i>Dendroica castanea</i>	✓		
Blackpoll warbler	<i>Dendroica striata</i>	✓		
Cerulean warbler	<i>Dendroica cerulea</i>	✓		✓
Black-and-white warbler	<i>Mniotilta varia</i>	✓	✓	✓
American redstart	<i>Setophaga ruticilla</i>	✓	✓	
Prothonotary warbler	<i>Protonotaria citrea</i>	✓	✓	
Ovenbird	<i>Seiurus aurocapillus</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Northern waterthrush	<i>Seiurus noveboracensis</i>	✓		
Louisiana waterthrush	<i>Seiurus motacilla</i>	✓		
Kentucky warbler	<i>Oporornis formosus</i>	✓		
Connecticut warbler	<i>Oporornis agilis</i>	✓		
Mourning warbler	<i>Oporornis philadelphia</i>	✓	✓	
Common yellowthroat	<i>Geothlypis trichas</i>	✓	✓	
Hooded warbler	<i>Wilsonia citrina</i>	✓		✓
Wilson's warbler	<i>Wilsonia pusilla</i>	✓	✓	
Canada warbler	<i>Wilsonia canadensis</i>	✓		
Yellow-breasted chat	<i>Icteria virens</i>	✓	✓	
Summer tanager	<i>Piranga rubra</i>	✓	✓	
Scarlet tanager	<i>Piranga olivacea</i>	✓	✓	
Eastern towhee	<i>Pipilo erythrophthalmus</i>	✓	✓	
American tree sparrow	<i>Spizella arborea</i>	✓	✓	
Chipping sparrow	<i>Spizella passerina</i>	✓	✓	
Field sparrow	<i>Spizella pusilla</i>	✓	✓	
Vesper sparrow	<i>Pooecetes gramineus</i>	✓		
Savannah sparrow	<i>Passerculus sandwichensis</i>	✓	✓	
Grasshopper sparrow	<i>Ammodramus savannarum</i>	✓	✓	
Henslow's sparrow	<i>Ammodramus henslowii</i>	✓		✓
Fox sparrow	<i>Passerella iliaca</i>	✓		
Song sparrow	<i>Melospiza melodia</i>	✓	✓	
Lincoln's sparrow	<i>Melospiza lincolni</i>	✓	✓	
Swamp sparrow	<i>Melospiza georgiana</i>	✓	✓	
White-throated sparrow	<i>Zonotrichia albicollis</i>	✓	✓	
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	✓	✓	
Dark-eyed junco	<i>Junco hyemalis</i>	✓	✓	
Northern cardinal	<i>Cardinalis cardinalis</i>	✓	✓	
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	✓	✓	
Blue grosbeak	<i>Guiraca caerulea</i>	✓	✓	
Indigo bunting	<i>Passerina cyanea</i>	✓	✓	
Dickcissel	<i>Spiza americana</i>	✓	✓	
Bobolink	<i>Dolichonyx oryzivorus</i>	✓	✓	
Red-winged blackbird	<i>Agelaius phoeniceus</i>	✓	✓	
Eastern meadowlark	<i>Sturnella magna</i>	✓	✓	
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	✓	✓	
Rusty blackbird	<i>Euphagus carolinus</i>	✓	✓	
Common grackle	<i>Quiscalus quiscula</i>	✓	✓	
Brown-headed cowbird	<i>Molothrus ater</i>	✓	✓	
Orchard oriole	<i>Icterus spurius</i>	✓	✓	

Bird Species List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Patoka River	Cane Ridge WMA	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Baltimore oriole	<i>Icterus galbula</i>	✓	✓	
Yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>		✓	✓
Purple finch	<i>Carpodacus purpureus</i>	✓	✓	
House finch	<i>Carpodacus mexicanus</i>	✓	✓	
Pine siskin	<i>Carduelis pinus</i>	✓		
American goldfinch	<i>Carduelis tristis</i>	✓	✓	
House sparrow	<i>Passer domesticus</i>	✓	✓	

Mammals Known or Expected to Occur in the Patoka River Area

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
<i>Modified from July 1994 Patoka River National Wetlands FEIS, Appendix I</i>		
Virginia opossum	<i>Didelphis virginiana</i>	
Southeastern shrew	<i>Sorex longirostris</i>	
Short-tailed shrew	<i>Blarina brevicauda</i>	
Least shrew	<i>Cryptotis parva</i>	
Eastern mole	<i>Scalopus aquaticus</i>	
Star-nose mole	<i>Condylura cristata</i>	✓
Little brown bat	<i>Myotis lucifugus</i>	✓
Indiana bat	<i>Myotis sodalis</i>	✓
Eastern pipistrelle	<i>Pipistrellus subflavus</i>	✓
Big brown bat	<i>Eptesicus fuscus</i>	
Red bat	<i>Lasiurus borealis</i>	✓
Hoary bat	<i>Lasiurus cinereus</i>	✓
Eastern cottontail rabbit	<i>Sylvilagus floridanus</i>	
Swamp rabbit	<i>Sylvilagus aquaticus</i>	✓
Eastern chipmunk	<i>Tamias striatus</i>	
Woodchuck	<i>Marmota monax</i>	
Gray squirrel	<i>Sciurus carolinensis</i>	
Fox squirrel	<i>Sciurus niger</i>	
Southern flying squirrel	<i>Glaucomys volans</i>	
Beaver	<i>Castor canadensis</i>	
Deer mouse	<i>Peromyscus maniculatus</i>	
White-footed mouse	<i>peromyscus leucopus</i>	
Meadow vole	<i>Microtus pennsylvanicus</i>	
Prairie vole	<i>Microtus ochrogaster</i>	
Woodland vole	<i>Microtus pinetorum</i>	
Muskrat	<i>Ondatra zibethicus</i>	
Southern bog lemming	<i>Synaptomys cooperi</i>	
Norway rat	<i>Rattus norvegicus</i>	
House mouse	<i>Mus musculus</i>	
Meadow jumping mouse	<i>Zapus hudsonius</i>	
Coyote	<i>Canis latrans</i>	
Red fox	<i>Vulpes vulpes</i>	
Gray fox	<i>Urocyon cinereoargenteus</i>	
Raccoon	<i>Procyon lotor</i>	
Long-tailed weasel	<i>Mustela frenata</i>	
Mink	<i>Mustela vison</i>	
River Otter	<i>Lutra canadensis</i>	✓
Badger	<i>Taxidea taxus</i>	✓
Striped skunk	<i>Mephitis mephitis</i>	
Bobcat	<i>Felix rufus</i>	✓
White-tailed deer	<i>Odocoileus virginianus</i>	

Herptofauna List, Patoka River NWR & MA

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Snakes		
Midland water snake	<i>Nerodia sipedon pleuralis</i>	
Copperbelly water snake	<i>Nerodia erythrogaster neglecta</i>	✓
Diamond-backed water snake	<i>Nerodia rhombifera</i>	
Midland brown snake	<i>Storeria dekayi wrightorum</i>	
Red-bellied snake	<i>Storeria occipitomaculata occipitomaculata</i>	
Eastern garter snake	<i>Thamnophis sirtalis sirtalis</i>	
Eastern ribbon snake	<i>Thamnophis sauritis sauritis</i>	
Western smooth earth snake	<i>Virginia valeriae elegans</i>	
Eastern hognose snake	<i>Heterodon platirhinos</i>	
Northern ringneck snake	<i>Diadophis punctatus edwardsi</i>	
Midwest worm snake	<i>Carphophis amoenus helenae</i>	
Southern black racer	<i>Coluber constrictor priapus</i>	
Rough green snake	<i>Opheodrys aestivus</i>	✓
Black rat snake	<i>Elaphe obsoleta obsoleta</i>	
Black king snake	<i>Lampropeltis getula niger</i>	
Prairie king snake	<i>Lampropeltis calligaster calligaster</i>	
Red milk snake	<i>Lampropeltis triangulum sypila</i>	
Northern copperhead	<i>Agkistrodon contortrix mokasen</i>	
Western cottonmouth	<i>Agkistrodon piscivorus leucostoma</i>	✓
Mud snake	<i>Farancia abaevara reinwardtii</i>	✓
Turtles		
Common snapping turtle	<i>Chelydra serpentina serpentina</i>	
Stinkpot	<i>Sternotherus odoratus</i>	
Eastern mud turtle	<i>Kinosternon subrubrum subrubrum</i>	✓
Map turtle	<i>Graptemys geographica</i>	
Midland painted turtle	<i>Chrysemys picta marginata</i>	
Red-eared turtle	<i>Pseudemys scripta elegans</i>	
Eastern box turtle	<i>Terrapene carolina carolina</i>	
Smooth softshell turtle	<i>Apalone mutica mutica</i>	
Eastern spiny softshell turtle	<i>Apalone spinifera spinifera</i>	
Lizards and Skinks		
Northern fence lizard	<i>Sceloporus undulatus hyacinthinus</i>	
Ground skink	<i>Scincella lateralis</i>	
Five-lined skink	<i>Eumeces fasciatus</i>	

Herptofauna List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Broad-headed skink	<i>Eumeces laticeps</i>	
Salamanders, Newts, and Sirens		
Mudpuppy	<i>Necturus maculosus</i>	✓
Western lesser siren	<i>Siren intermedia nettingi</i>	
Central newt	<i>Notophthalmus viridescens louisianensis</i>	
Spotted salamander	<i>Ambystoma maculatum</i>	
Small-mouthed salamander	<i>Ambystoma texanum</i>	
Marbled salamander	<i>Ambystoma opacum</i>	
Eastern tiger salamander	<i>Ambystoma tigrinum tigrinum</i>	
Red-backed salamander	<i>Plethodon cinereus cinereus</i>	
Zig-zag salamander	<i>Plethodon dorsalis dorsalis</i>	
Slimy salamander	<i>Plethodon glutinosus glutinosus</i>	
Southern two-lined salamander	<i>Eurycea bislineata bislineata</i>	
Eastern newt	<i>Notophthalmus viridescens viridescens</i>	
Longtail salamander	<i>Eurycea longicauda longicauda</i>	
Toads and Frogs		
Eastern spadefoot	<i>Scaphiopus holbrookii holbrookii</i>	✓
Fowler's toad	<i>Bufo fowleri</i>	
Northern spring peeper	<i>Hyla crucifer crucifer</i>	
Eastern gray tree frog	<i>Hyla versicolor</i>	
Blanchard's cricket frog	<i>Acris crepitans blanchardi</i>	
Western chorus frog	<i>Pseudacris triseriata triseriata</i>	
Southern leopard frog	<i>Rana sphenoccephala utricularia</i>	
Northern crayfish frog	<i>Rana areolata circulosa</i>	
Green frog	<i>Rana clamitans melanota</i>	
Wood frog	<i>Rana sylvatica</i>	
Bullfrog	<i>Rana catesbeiana</i>	
Cope's gray treefrog	<i>Hyla chrysoscelis</i>	

Fish Species Occurring in the Patoka River and Its Tributaries

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Spotted gar	<i>Lepisosteus oculatus</i>	
Shortnose gar	<i>Lepisosteus platostomas</i>	
Longnose gar	<i>Lepisosteus ossus</i>	
Bowfin	<i>Amia calva</i>	
Paddlefish	<i>Polyodon spathula</i>	
Gizzard shad	<i>Dorsoma cepedianum</i>	
Threadfin shad	<i>Dorsoma petenense</i>	
Goldeye	<i>Hiodon alosoides</i>	
Weed shiner	<i>Notropis texanus</i>	
Spotfin shiner	<i>Cyprinella spiloptera</i>	
Steelcolor shiner	<i>Cyprinella whipplei</i>	
Ribbon shiner	<i>Lythrurus fumeus</i>	
River shiner	<i>Notropis blennioides</i>	
Suckermouth minnow	<i>Phenacobius mirabilis</i>	
Bluntnose minnow	<i>Pimephales notatus</i>	
Redfin shiner	<i>Lythrurus umbratilis</i>	
Shoal chub	<i>Macrhybopsis hyostomus</i>	
Golden shiner	<i>Notemigonus crysoleucas</i>	
Central stoneroller	<i>Campestris anomalum</i>	
Creek chub	<i>Semotilus atromaculatus</i>	
Common carp	<i>Cyprinus carpio</i>	
Emerald shiner	<i>Notropis atherinoides</i>	
Pallid shiner	<i>Hybopsis amnis</i>	✓
Sand shiner	<i>Notropis stramineus</i>	
Channel shiner	<i>Notropis wickliffi</i>	
Pugnose minnow	<i>Opsopoeodus emiliae</i>	
Bullhead minnow	<i>Pimephales vigilax</i>	
Silverjaw minnow	<i>Ericymba buccatta</i>	
Striped shiner	<i>Luxilus chrysocephalus</i>	
Blacknose dace	<i>Rhinichthys obtusus</i>	
Fathead minnow	<i>Pimephales promelas</i>	
Cypress minnow	<i>Hybognathus hayi</i>	
Mississippi silvery minnow	<i>Hybognathus nuchalis</i>	
Mimic shiner	<i>Notropis volucellus</i>	
Southern redbelly dace	<i>Phoxinus erythrogaster</i>	
Spotted sucker	<i>Minytrema melanops</i>	
Golden redbreast	<i>Moxostoma erythrum</i>	
Silver redbreast	<i>Moxostoma anisurum</i>	
Shorthead redbreast	<i>Moxostoma macrolepidotum</i>	
River carpsucker	<i>Carpodacus carpio</i>	
Quillback	<i>Carpodacus cyprinus</i>	

Fish Species Occurring in the Patoka River and Its Tributaries

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Highfin carpsucker	<i>Carpionodes velifer</i>	
Smallmouth buffalo	<i>Ictiobus bubalus</i>	
Largemouth buffalo	<i>Ictiobus cyprinella</i>	
Black buffalo	<i>Ictiobus niger</i>	
White sucker	<i>Catostomus commersonii</i>	
Creek chubsucker	<i>Erimyzon oblongus</i>	
Lake chubsucker	<i>Erimyzon sucetta</i>	
Flathead catfish	<i>Pylodiotis olivaris</i>	
Channel catfish	<i>Ictalurus punctatus</i>	
Stonecat	<i>Noturus flavus</i>	
Tadpole madtom	<i>Noturus gyrinus</i>	
Brindled madtom	<i>Noturus miurus</i>	
Yellow bullhead	<i>Ameiurus natalis</i>	
Brown bullhead	<i>Ameiurus nebulosus</i>	
Black bullhead	<i>Ameiurus melas</i>	
Grass pickerel	<i>Esox americanus</i>	
Northern pike	<i>Esox lucius</i>	
Central mudminnow	<i>Umbra limi</i>	
Pirate perch	<i>Aphredoderus sayanus</i>	
Blackstripe topminnow	<i>Fundulus notatus</i>	
Starhead topminnow	<i>Fundulus dispar</i>	
Western mosquitofish	<i>Gambusia affinis</i>	
Brook silverside	<i>Labidesthes sicculus</i>	
Rock bass	<i>Ambloplites rupestris</i>	
Flier	<i>Centrarchus macropterus</i>	
Green sunfish	<i>Lepomis cyanellus</i>	
Longear sunfish	<i>Lepomis megalotis</i>	
Orangespotted sunfish	<i>Lepomis humilis</i>	
Bluegill	<i>Lepomis macrochirus</i>	
Redear sunfish	<i>Lepomis microlophus</i>	
Warmouth	<i>Lepomis gulosus</i>	
Redspotted sunfish	<i>Lepomis miniatus</i>	
Smallmouth bass	<i>Micropterus dolomieu</i>	
Spotted bass	<i>Micropterus punctulatus</i>	
Largemouth bass	<i>Micropterus salmoides</i>	
White crappie	<i>Pomoxis annularis</i>	
Black crappie	<i>Pomoxis nigromaculatus</i>	
White bass	<i>Morone chrysops</i>	
Yellow bass	<i>Morone mississippiensis</i>	
Mud darter	<i>Etheostoma asprigene</i>	
Rainbow darter	<i>Etheostoma caeruleum</i>	

Fish Species Occurring in the Patoka River and Its Tributaries

Common Name	Scientific Name	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Bluntnose darter	<i>Etheostoma chlorosoma</i>	
Harlequin darter	<i>Etheostoma histrio</i>	
Slough darter	<i>Etheostoma gracile</i>	
Johnny darter	<i>Etheostoma nigrum</i>	
Orangethroat darter	<i>Etheostoma spectabile</i>	
Logperch	<i>Percina caprodes</i>	
Blackside darter	<i>percina maculata</i>	
Slenderhead darter	<i>Percina phoxocephala</i>	
Dusky darter	<i>Percina sciera</i>	
River darter	<i>Percina shumardi</i>	
Saddleback darter	<i>Percina vigil</i>	
Sauger	<i>Sander canadense</i>	
Freshwater drum	<i>Aplodinotus grunniens</i>	
Banded sculpin	<i>Cottus carolinae</i>	
Silver carp	<i>Hypophthalmichthys molitrix</i>	
Grass carp	<i>Ctenopharyngodon idella</i>	
Bighead carp	<i>Hypophthalmichthys nobilis</i>	
Blue catfish	<i>Ictalurus furcatus</i>	
Crustacean Species		
Calico crayfish	<i>Orconectes immunis</i>	
Indiana crayfish	<i>Orconectes indianensis</i>	
Northern clearwater crayfish	<i>Orconectes propinquus</i>	
Northern cave crayfish	<i>Orconectes inermis inermis</i>	
White River crayfish	<i>Procambarus acutus</i>	
Painted-hand mudbug	<i>Cambarus polychromatus</i>	
Great Plains mudbug	<i>Cambarus (Lacunicambarus) species A</i>	
Karst ersyfish	<i>Cambarus laevis</i>	
Mississippi grass shrimp	<i>Palaemonetes kadiakensis</i>	
Cavespring crayfish	<i>Cambarus tenebrosus</i>	
Digger crayfish	<i>Fallicambarus fodiens</i>	
Reproduced from July 1994 Patoka River National Wetlands FEIS, Appendix I Modified by Tom Simon (USFWS) & Dan Carnahan (Indiana DNR), April, 2007		

Fresh Water Mussels Found on Patoka River MWR/MA

Common Name	Scientific Name
Threeridge	<i>Amblema p. plicata</i>
Flat Floater	<i>Anodonta suborbiculata</i>
Rock Pocketbook	<i>Arcidens confragosus</i>
Wabash Pigtoe	<i>Fusconaia flava</i>
Fatmucket	<i>Lampsilis siliquioidea</i>
Yellow Sandshell	<i>Lampsilis teres</i>
White Heelsplitter	<i>Lasmigona c. complanata</i>
Fragile Papershell	<i>Leptodea fragilis</i>
Washboard	<i>Megalonaias nervosa</i>
Pink Heelsplitter	<i>Potamilus alatus</i>
Pink Papershell	<i>Potamilus ohioensis</i>
Giant Floater	<i>Pyganodon grandis</i>
Pimpleback	<i>Quadrula p. pustulosa</i>
Mapleleaf	<i>Quadrula quadrula</i>
Pistolgrip	<i>Tritogonia verrucosa</i>
Deertoe	<i>Truncilla truncata</i>
Pondhorn	<i>Unio merus tetralasmus</i>

Plant List, Patoka River NWR & MA

Common Name	Scientific Name
American elm	<i>Ulmus americana</i>
Black gum	<i>Nyssa sylvatica</i>
Black haw	<i>Viburnum prunifolium</i>
Black willow	<i>Salix nigra</i>
Boneset	<i>Eupatorium serotinum</i>
Box elder	<i>Acer negundo</i>
Broadleaf uniola	<i>Chasmanthemum latifolium</i>
Bugleweed	<i>Lycopus rubellus</i>
Calico aster	<i>Aster lateriflorus</i>
Cardinal flower	<i>Lobelia cardinalis</i>
Catbird grape	<i>Vitis cinerea</i>
Catchfly grass	<i>Leersia lenticularis</i>
Cherrybark oak	<i>Quercus falcata</i> var. <i>pagodaefolia</i>
Clearweed	<i>Pilea pumila</i>
Common persimmon	<i>Diospyros virginiana</i>
Ditch stonecrop	<i>Penthorum sedoides</i>
Dogbane	<i>Trachelospermum difforme</i>
Eastern cottonwood	<i>Populus deltoides</i>
False nettle	<i>Boehmeria cylindrica</i>
Fleabane	<i>Pluchea camphorate</i>
Frog fruit	<i>Phyla lanceolata</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Greenbrier	<i>Smilax hispida</i>
Groundnut	<i>Apios americana</i>
Hackberry	<i>Celtis occidentalis</i>
Kingnut hickory	<i>Carya laciniosa</i>
Lizard's tail	<i>Saururus cernuus</i>
Louisiana sedge	<i>Carex louisianica</i>
Mad-dog skullcap	<i>Scutellaria lateriflora</i>
Milkweed	<i>Asclepias perennis</i>
Moneywort	<i>Lysimachia nummularia</i>
Moonseed	<i>Menispermum canadensis</i>
Nettle	<i>Laportea canadensis</i>
Pecan	<i>Carya illinoensis</i>
Pin oak	<i>Quercus palustris</i>
Poison ivy	<i>Rhus radicans</i>
Purple fringeless orchid	<i>Platanthera peramoena</i>
Ragwort	<i>Senecio glabellus</i>

Plant List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name
Red maple	<i>Acer rubrum</i>
River birch	<i>Betula nigra</i>
Sedge	<i>Carex muskingumensis</i>
Sedge	<i>Carex squarrosa</i>
Sedge	<i>Carex intumescens</i>
Sedge	<i>Carex tribuloides</i>
Sedge	<i>Carex grayi</i>
Sedge	<i>Carex lupulina</i>
Sensitive fern	<i>Onoclea sensibilis</i>
Shumard oak	<i>Quercus shumardii</i>
Silver maple	<i>Acer saccharinum</i>
Small white aster	<i>Aster vimineus</i>
Smooth buttonweed	<i>Spermacoce glabra</i>
Swamp chestnut oak	<i>Quercus michauxii</i>
Swamp white oak	<i>Quercus bicolor</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Sycamore	<i>Platanus occidentalis</i>
Trumpet creeper	<i>Campsis radicans</i>
Virginia dayflower	<i>Commelina virginica</i>
Water parsnip	<i>Sium suave</i>
Winged monkey flower	<i>Mimulus alatus</i>
Woodreed	<i>Cinna arundinacea</i>
Emergent Wetland Communities--selected plant species	
American snowbell	<i>Styrax americana</i>
Barnyard grass	<i>Echinochloa crus-galli</i>
Beggarticks	<i>Bidens discoidea</i>
Beggarticks	<i>Bidens frondosa</i>
Beggarticks	<i>Bidens tripartita</i>
Blunt spikerush	<i>Eleocharis obtusa</i>
Buttonbush	<i>Cephalanthus occidentalis</i>
Cattail	<i>Typha latifolia</i>
Catchfly grass	<i>Leersia lenticularis</i>
Clammy hedge hysop	<i>Gratiola neglecta</i>
Clearweed	<i>Pilea pumila</i>
Common bladderwort	<i>Utricularia vulgaris</i>
Common arrowhead	<i>Sagittaria latifolia</i>
Creeping eragrostis	<i>Eragrostis hypnoides</i>

Plant List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name
Cyperus	<i>Cyperus ferruginescens</i>
Cyperus	<i>Cyperus erythrorhizos</i>
Dayflower	<i>Commelina diffusa</i>
Ditch stonecrop	<i>Penthorum sedoides</i>
Duckweed	<i>Lemna</i> spp.
Fall panicum	<i>Panicum dichotomiflorum</i>
False pimpernel	<i>Lindernia dubia</i>
False nettle	<i>Boehmeria cylindrica</i>
Featherfoil	<i>Hottonia inflata</i>
Fleabane	<i>Pluchea camphorata</i>
Frog fruit	<i>Phyla lanceolata</i>
Grass-leaved arrowhead	<i>Sagittaria graminea</i>
Greater duckweed	<i>Spirodela polyrhiza</i>
Hornwort	<i>Ceratophyllum demersum</i>
Humped bladderwort	<i>Utricularia gibba</i>
India heliotrope	<i>Heliotropium indicum</i>
Lizard's tail	<i>Saururus cernuus</i>
Long beak arrowhead	<i>Sagittaria australis</i>
Loosestrife	<i>Rotata ramosior</i>
Mad-dog skullcap	<i>Scutellaria lateriflora</i>
Mermaid weed	<i>Proserpinaca palustris</i>
Mild water pepper	<i>Polygonum hydropiperoides</i>
Nodding bur marigold	<i>Bidens cernua</i>
Nodding smartweed	<i>Polygonum lapathifolium</i>
Panicum	<i>Panicum agrosticoides</i>
Paspalum	<i>Paspalum fluitans</i>
Pink knotweed	<i>Polygonum pennsylvanicum</i>
Pumpkin ash	<i>Fraxinus tomentosa</i>
Rice cutgrass	<i>Leersia oryzoides</i>
Scarlet ammannia	<i>Ammannia coccinea</i>
Short beak arrowhead	<i>Sagittaria brevirostra</i>
Small water plantain	<i>Alisma subcordatum</i>
Smooth buttonweed	<i>Spermacoce glabra</i>
Southern pond lily	<i>Nuphar advena</i>
St. John's-wort	<i>Hypericum mutabile</i>
Swamp cottonwood	<i>Populus heterophylla</i>
Swamp loosestrife	<i>Decodon verticillatus</i>
Swamp privet	<i>Forestiera acuminata</i>

Plant List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name
Swamp dock	<i>Rumex verticillatus</i>
Virginia dayflower	<i>Commelina virginiana</i>
Water starwort	<i>Callitriche heterophylla</i>
Water-plantain	<i>Lophotocarpus calycinus</i>
Water-purslane	<i>Didiplis diandra</i>
Water-purslane	<i>Ludwigia palustris</i>
Whitegrass	<i>Leersia virginica</i>
Wolffia	<i>Wolffia</i> spp.
Yellow water buttercup	<i>Ranunculus flabellaris</i>
Yerba de tajo	<i>Eclipta alba</i>
Upland Forest Community--selected plant species	
American beech	<i>Fagus grandifolia</i>
American elm	<i>Ulmus americana</i>
Basswood	<i>Tilia americana</i>
Bitternut hickory	<i>Carya cordiformis</i>
Black cherry	<i>Prunus serotina</i>
Black oak	<i>Quercus velutina</i>
Black locust	<i>Robinia pseudoacacia</i>
Black gum	<i>Nyssa sylvatica</i>
Black walnut	<i>Juglans nigra</i>
Black ash	<i>Fraxinus nigra</i>
Bladdernut	<i>Staphylea trifolia</i>
Blue beech	<i>Carpinus caroliniana</i>
Butternut	<i>Juglans cinerea</i>
Catalpa	<i>Catalpa speciosa</i>
Chestnut oak	<i>Quercus montana</i>
Chinkapin oak	<i>Quercus muehlenbergii</i>
Downy serviceberry	<i>Amelanchier arborea</i>
Eastern red cedar	<i>Juniperus virginiana</i>
Flowering dogwood	<i>Cornus florida</i>
Hackberry	<i>Celtis occidentalis</i>
Hawthorne	<i>Crataegus</i> spp.
Honey locust	<i>Gleditsia triacanthos</i>
Ironwood	<i>Ostrya virginiana</i>
Jack pine	<i>Pinus banksiana</i>
Kentucky coffeetree	<i>Gymnocladus dioica</i>
Mockernut hickory	<i>Carya glabra</i>

Plant List, Patoka River NWR & MA (Continued)

Common Name	Scientific Name
Northern red oak	<i>Quercus rubra</i>
Ohio buckeye	<i>Aesculus glabra</i>
Osage-orange	<i>Maclura pomifera</i>
Pawpaw	<i>Asimina triloba</i>
Persimmon	<i>Diospyros virginiana</i>
Pignut hickory	<i>Carya glabra</i>
Post oak	<i>Quercus stellata</i>
Red mulberry	<i>Morus rubra</i>
Red maple	<i>Acer rubrum</i>
Red pine	<i>Pinus resinosa</i>
Redbud	<i>Cercis canadensis</i>
Sassafras	<i>Sassafras albidum</i>
Scarlet oak	<i>Quercus coccinea</i>
Scotch pine	<i>Pinus sylvestris</i>
Shagbark hickory	<i>Carya ovata</i>
Shellbark hickory	<i>Carya laciniosa</i>
Shingle oak	<i>Quercus imbricaria</i>
Southern red oak	<i>Quercus falcata</i>
Spicebush	<i>Lindera benzoin</i>
Staghorn sumac	<i>Rhus typhina</i>
Sugar maple	<i>Acer saccharum</i>
Sycamore	<i>Platanus occidentalis</i>
White pine	<i>Pinus strobus</i>
White oak	<i>Quercus alba</i>
White ash	<i>Fraxinus americana</i>
Witch-hazel	<i>Hamamelis virginiana</i>
Yellow poplar	<i>Liriodendron tulipifera</i>

Appendix D: Resource Conservation Priorities, Ohio River Valley Ecosystem

Resource Conservation Priorities, Ohio River Valley Ecosystem¹

Common Name	Scientific Name	Documented on Refuge	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Amphibians			
Hellbender	<i>Cryptobranchus allenganiensis</i>		
Arachnids			
Pseudoscorpion (no common name)	<i>Apochthonous hobbsi</i>		
Birds			
Acadian flycatcher	<i>Empidonax virescens</i>	✓	
American woodcock	<i>Scolopax minor</i>	✓	
Bachman's sparrow	<i>Aimophila aestivalis</i>		
Bald eagle	<i>Haliaeetus leucocephalus</i>	✓	✓
Barn owl	<i>Tyto alba</i>	✓	✓
Bell's vireo	<i>Vireo bellii</i>	✓	
Bewick's wren	<i>Thryomanes bewickii</i>		
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	✓	
Blue-winged warbler	<i>Vermivora pinus</i>	✓	
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>	✓	
Canada goose - Giant population	<i>Branta canadensis</i>	✓	
Canada goose - Southern James Bay population	<i>Branta canadensis</i>	✓	
Canada goose - resident giants	<i>Branta canadensis</i>	✓	
Cerulean warbler	<i>Dendroica cerulea</i>	✓	✓
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>	✓	
Common moorhen	<i>Gallinula chloropus</i>	✓	✓
Dickcissel	<i>Spiza americana</i>	✓	
Field sparrow	<i>Spizella pusilla</i>	✓	
Golden-winged warbler	<i>Vermivora chrysoptera</i>	✓	✓
Grasshopper sparrow	<i>Ammodramus savannarum</i>	✓	
Greater yellowlegs	<i>Tringa melanoleuca</i>	✓	
Henslow's sparrow	<i>Ammodramus henslowii</i>	✓	✓
Kentucky warbler	<i>Oporornis formosus</i>	✓	
King rail	<i>Rallus elegans</i>	✓	✓
Loggerhead shrike	<i>Lanius ludovicianus</i>	✓	
Long-eared owl	<i>Asio otus</i>	✓	
Louisiana waterthrush	<i>Seiurus motacilla</i>	✓	
Mallard	<i>Anas platyrhynchos</i>	✓	

Resource Conservation Priorities, Ohio River Valley Ecosystem¹

Common Name	Scientific Name	Documented on Refuge	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Northern flicker	<i>Colaptes auratus</i>	✓	
Northern harrier	<i>Circus cyaneus</i>	✓	✓
Orchard oriole	<i>Icterus spurius</i>	✓	
Peregrine Falcon	<i>Falco peregrinis anatum</i>	✓	✓
Prairie warbler	<i>Dendroica discolor</i>	✓	
Prothonotary warbler	<i>Protonotaria citrea</i>	✓	
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	✓	
Red-shouldered hawk	<i>Buteo lineatus</i>	✓	✓
Rusty blackbird	<i>Euphagus carolinus</i>	✓	
Short-billed dowitcher	<i>Limnodromus griseus</i>	✓	
Short-eared owl	<i>Asio flammeus</i>	✓	✓
Stilt sandpiper	<i>Calidris himantopus</i>	✓	
Swainson's warbler	<i>Limnothlypis swainsonii</i>		
Upland sandpiper	<i>Bartramia longicauda</i>		✓
Whip-poor-will	<i>Caprimulgus vociferus</i>	✓	✓
Whooping crane - Eastern population	<i>Grus americana</i>	✓	
Wood duck	<i>Aix sponsa</i>	✓	
Wood thrush	<i>Hylocichla mustelina</i>	✓	
Worm-eating warbler	<i>Helmitheros vermivorus</i>		✓
Crustaceans			
Crayfish (O. illinoisensis)	<i>Orconectes illinoisensis</i>		
Crayfish (O. inermis testii)	<i>Orconectes inermis testii</i>		✓
Crayfish (O. kentuckiensis)	<i>Orconectes kentuckiensis</i>		
Crayfish (O. sloanii)	<i>Orconectes sloanii</i>		
Crayfish (O. stannardi)	<i>Orconectes stannardi</i>		
Indiana crayfish	<i>Orconectes indianensis</i>	✓	✓
Rusty crayfish	<i>Orconectes rusticus</i>		
Fish			
Bighead carp	<i>Hypophthalmichthys nobilis</i>	✓	
Blue sucker	<i>Cycleptus elongatus</i>		
Eastern sand darter	<i>Ammocrypta pellucida</i>		
Grass carp	<i>Ctenopharyngodon idella</i>	✓	
Lake sturgeon - Inland population	<i>Acipenser fulvescens</i>		✓
Logperch (P. evermanni)	<i>Percina evermanni</i>		
Logperch (P. manitou)	<i>Percina manitou</i>		

Resource Conservation Priorities, Ohio River Valley Ecosystem¹

Common Name	Scientific Name	Documented on Refuge	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Longhead darter	<i>Percina macrocephala</i>		
Northern cavefish	<i>Amblyopsis spelaea</i>		✓
Paddlefish	<i>Polyodon spathula</i>	✓	
Scioto madtom	<i>Noturus trautmani</i>		
Shovelnose sturgeon	<i>Scaphirhynchus platyrhynchus</i>		
Spotted darter	<i>Etheostoma maculatum</i>		✓
Insects			
Kramer's cave beetle	<i>Pseudanophthalmus krameri</i>		
Ohio cave beetle	<i>Pseudanophthalmus ohioensis</i>		
Wabash belted skimmer	<i>Macaromia wabashensis</i>		
Mammals			
Gray bat	<i>Myotis grisescens</i>		✓
Indiana Bat	<i>Myotis sodalis</i>	✓	✓
Mussels			
Asiatic clam	<i>Corbicula fluminea</i>		
Black sandshell	<i>Ligumia recta</i>		
Clubshell	<i>Pleurobema clava</i>		✓
Elktoe	<i>Alasmidonta marginata</i>		
Fanshell	<i>Cyprogenia stegaria</i>		✓
Mapleleaf	<i>Quadrula quadrula</i>	✓	
Monkeyface	<i>Quadrula metanevra</i>		
Northern riffleshell	<i>Epioblasma rangiana</i>		✓
Orange-foot pimpleback	<i>Plethobasus cooperianus</i>		✓
Pimpleback	<i>Quadrula pustulosa</i>	✓	
Pink mucket pearlymussel	<i>Lampsilis abrupta</i>		✓
Pistolgrip	<i>Tritogonia verrucosa</i>	✓	
Purple cat's paw pearlymussel	<i>Epioblasma obliquata obliquata</i>		
Rabbit's foot	<i>Quadrula cylindrica cylindrica</i>		✓
Ring pink mussel (=golf stick)	<i>Obovaria retusa</i>		
Rock pocketbook	<i>Arcidens confragosus</i>	✓	
Rough pigtoe	<i>Pleurobema plenum</i>		✓
Round pigtoe	<i>Pleurobema coccineum</i>		
Salamander mussel	<i>Simpsonaias ambigua</i>		✓
Scaleshell mussel	<i>Leptodea leptodon</i>		

Resource Conservation Priorities, Ohio River Valley Ecosystem¹

Common Name	Scientific Name	Documented on Refuge	Noted in Indiana Comprehensive Wildlife Strategy as Species of Greatest Conservation Need
Sheepnose	<i>Plethobasus cyphus</i>		✓
Slippershell	<i>Alasmidonta viridis</i>		
Snuffbox	<i>Epioblasma triquetra</i>		✓
Spectaclecase	<i>Cumberlandi mondonga</i>		
Threeridge	<i>Amblema plicata</i>	✓	
Tubercled-blossom pearlymussel	<i>Epioblasma torulosa torulosa</i>		✓
Washboard	<i>Megalonaias nervosa</i>	✓	
White cat's paw pearlymussel	<i>Epioblasma obliquata</i>		✓
White wartyback mussel	<i>Plethobasus cicatricosus</i>		✓
Zebra mussel	<i>Dreissena polymorpha</i>		
Plants			
Earleaf foxglove	<i>Agalinus auriculata</i>		
Eastern prairie fringed orchid	<i>Platanthera leucophaea</i>		
Glade (Darlington's) spurge	<i>Euphorbia purpurea</i>		
Hall's bulrush	<i>Schoenoplectus hallii</i>		
Northern wild monkshood	<i>Aconitum noveboracense</i>		
Running buffalo clover	<i>Trifolium stoloniferum</i>		
Short's bladderpod	<i>Lesquerella globosa</i>		
Small whorled pagonia	<i>Isotria medeoloides</i>		
Virnigia spirea	<i>Spiraea virginiana</i>		
Reptiles			
Copperbelly watersnake - S pop.	<i>Nerodia erythrogaster neglecta</i>	✓	✓
Eastern massasauga	<i>Sistrurus catenatus catenatus</i>		
Timber rattlesnake	<i>Crotalus horridus</i>		✓

1. Source: U.S. Fish & Wildlife Service. Fish & Wildlife Conservation Priorities, Region 3, January 2002.

Appendix E: Compliance Requirements

Appendix E / Compliance Requirements

Rivers and Harbor Act (1899) (33 U.S.C. 403)

Section 10 of this Act requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States.

Antiquities Act (1906)

Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Migratory Bird Treaty Act (1918)

Designates the protection of migratory birds as a Federal responsibility. This Act enables the setting of seasons, and other regulations including the closing of areas, Federal or non Federal, to the hunting of migratory birds.

Migratory Bird Conservation Act (1929)

Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.

Fish and Wildlife Coordination Act (1934), as amended

Requires that the Fish and Wildlife Service and State fish and wildlife agencies be consulted whenever water is to be impounded, diverted or modified under a Federal permit or license. The Service and State agency recommend measures to prevent the loss of biological resources, or to mitigate or compensate for the damage. The project proponent must take biological resource values into account and adopt justifiable protection measures to obtain maximum overall project benefits. A 1958 amendment added provisions to recognize the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs. It also authorized the Secretary of Interior to provide public fishing areas and accept donations of lands and funds.

Migratory Bird Hunting and Conservation Stamp Act (1934)

Requires every waterfowl hunter 16 years of age or older to carry a stamp and earmarks proceeds of the Duck Stamps to buy or lease waterfowl habitat. A 1958 amendment authorizes the acquisition of small wetland and pothole areas to be designated as 'Waterfowl Production Areas,' which may be acquired without the limitations and requirements of the Migratory Bird Conservation Act.

Historic Sites, Buildings and Antiquities Act (1935), as amended

Declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. Provides procedures for designation, acquisition, administration, and protection of such sites.

Refuge Revenue Sharing Act (1935), as amended:

Requires revenue sharing provisions to all fee-title ownerships that are administered solely or primarily by the Secretary through the Service.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act (1948)

Provides that upon a determination by the Administrator of the General Services Administration, real property no longer needed by a Federal agency can be transferred without reimbursement to the Secretary of Interior if the land has particular value for migratory birds, or to a State agency for other wildlife conservation purposes.

Federal Records Act (1950)

Directs the preservation of evidence of the government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Fish and Wildlife Act (1956)

Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Refuge Recreation Act (1962)

Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

Wilderness Act (1964), as amended

Directed the Secretary of Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuge and National Park Systems and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Secretary of Agriculture was directed to study and recommend suitable areas in the National Forest System.

Land and Water Conservation Fund Act (1965):

Uses the receipts from the sale of surplus Federal land, outer continental shelf oil and gas sales, and other sources for land acquisition under several authorities.

National Wildlife Refuge System Administration Act (1966), as amended by the National Wildlife Refuge System Improvement Act (1997) 16 U.S.C. 668dd-668ee. (Refuge Administration Act)

Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

National Historic Preservation Act (1966), as amended:

Establishes as policy that the Federal Government is to provide leadership in the preservation of the nation's prehistoric and historic resources.

Architectural Barriers Act (1968)

Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

National Environmental Policy Act (1969)

Requires the disclosure of the environmental impacts of any major Federal action significantly affecting the quality of the human environment.

Uniform Relocation and Assistance and Real Property Acquisition Policies Act (1970), as amended:

Provides for uniform and equitable treatment of persons who sell their homes, businesses, or farms to the Service. The Act requires that any purchase offer be no less than the fair market value of the property.

Endangered Species Act (1973)

Requires all Federal agencies to carry out programs for the conservation of endangered and threatened species.

Rehabilitation Act (1973)

Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal government to ensure that anybody can participate in any program.

Archaeological and Historic Preservation Act (1974)

Directs the preservation of historic and archaeological data in Federal construction projects.

Clean Water Act (1977)

Requires consultation with the Corps of Engineers (404 permits) for major wetland modifications.

Surface Mining Control and Reclamation Act (1977) as amended (Public Law 95-87) (SMCRA)

Regulates surface mining activities and reclamation of coal-mined lands. Further regulates the coal industry by designating certain areas as unsuitable for coal mining operations.

Executive Order 11988 (1977)

Each Federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order 11990

Executive Order 11990 directs Federal agencies to (1) minimize destruction, loss, or degradation of wetlands and (2) preserve and enhance the natural and beneficial values of wetlands when a practical alternative exists.

Executive Order 12372 (Intergovernmental Review of Federal Programs)

Directs the Service to send copies of the Environmental Assessment to State Planning Agencies for review.

American Indian Religious Freedom Act (1978)

Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Fish and Wildlife Improvement Act (1978)

Improves the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. It authorizes the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. It also authorizes the use of volunteers on Service projects and appropriations to carry out a volunteer program.

Archaeological Resources Protection Act (1979), as amended

Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Federal Farmland Protection Policy Act (1981), as amended

Minimizes the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Emergency Wetlands Resources Act (1986)

Promotes the conservation of migratory waterfowl and offsets or prevents the serious loss of wetlands by the acquisition of wetlands and other essential habitats.

Federal Noxious Weed Act (1990)

Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Native American Graves Protection and Repatriation Act (1990)

Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

Americans With Disabilities Act (1992)

Prohibits discrimination in public accommodations and services.

Executive Order 12898 (1994)

Establishes environmental justice as a Federal government priority and directs all Federal agencies to make environmental justice part of their mission. Environmental justice calls for fair distribution of environmental hazards.

Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996)

Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

Executive Order 13007 Indian Sacred Sites (1996)

Directs Federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

National Wildlife Refuge System Improvement Act (1997)

Considered the "Organic Act of the National Wildlife Refuge System. Defines the mission of the System, designates priority wildlife-dependent public uses, and calls for comprehensive refuge planning.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act (1998)

Amends the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes.

National Trails System Act

Assigns responsibility to the Secretary of Interior and thus the Service to protect the historic and recreational values of congressionally designated National Historic Trail sites.

Treasury and General Government Appropriations Act of 2001 (Public Law 106-554)

In December 2002, Congress required federal agencies to publish their own guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information that they disseminate to the public (44 U.S.C. 3502). The amended language is included in Section 515(a). The Office of Budget and Management (OMB) directed agencies to develop their own guidelines to address the requirements of the law. The Department of the Interior instructed bureaus to prepare separate guidelines on how they would apply the Act. The U.S. Fish and Wildlife Service has developed "Information Quality Guidelines" to address the law.

Cultural Resources and Historic Preservation

The National Wildlife Refuge System Improvement Act of 1997, Section 6, requires the Service to make a determination of compatibility of existing, new and changing uses of Refuge land; and Section 7 requires the Service to identify and describe the archaeological and cultural values of the refuge.

The National Historic Preservation Act (NHPA), Section 106, requires Federal agencies to consider impacts their undertakings could have on historic properties; Section 110 requires Federal agencies to manage historic properties, e.g., to document historic properties prior to destruction or damage; Section 101 requires Federal agencies consider Indian tribal values in historic preservation programs, and requires each Federal agency to establish a program leading to inventory of all historic properties on its land.

The Archaeological Resources Protection Act of 1979 (ARPA) prohibits unauthorized disturbance of archeological resources on Federal and Indian land; and other matters. Section 10 requires establishing "a program to increase public awareness" of archeological resources. Section 14 requires plans to survey lands and a schedule for surveying lands with "the most scientifically valuable archaeological resources." This Act requires protection of all archeological sites more than 100 years old (not just sites meeting the criteria for the National Register) on

Federal land, and requires archeological investigations on Federal land be performed in the public interest by qualified persons.

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) imposes serious delays on a project when human remains or other cultural items are encountered in the absence of a plan.

The American Indian Religious Freedom Act (AIRFA) iterates the right of Native Americans to free exercise of traditional religions and use of sacred places.

EO 13007, Indian Sacred Sites (1996), directs Federal agencies to accommodate access to and ceremonial use, to avoid adverse effects and avoid blocking access, and to enter into early consultation.

Appendix F: Mailing List

Appendix G: Mailing List

United States Senate

- U.S. Senator Evan Bayh
- Senator Richard Lugar

United States House of Representatives

- U.S. Representative Baron P. Hill, Indiana Ninth Congressional District
- U.S. Representative Brad Ellsworth, Indiana Eighth Congressional

State Elected Officials

- Governor Mitch Daniels
- State Senator Lindel O. Hume
- State Representative Kreg Battles
- State Representative Dave Crooks

Federal Government

- Hoosier National Forest
- U.S. Army Corps of Engineers - Louisville District
- U.S. Fish and Wildlife Service, Ecological Services - Indiana
- USDA/Natural Resource Conservation Service
- U.S. Fish and Wildlife Service,Portland,OR
- U.S. Fish and Wildlife Service,Albuquerque,NM
- U.S. Fish and Wildlife Service,Atlanta,GA
- U.S. Fish and Wildlife Service,Hadley,MA
- U.S. Fish and Wildlife Service,Lakewood,CO
- U.S. Fish and Wildlife Service Chief, Conservation Planning",Anchorage,AK
- U.S. Fish and Wildlife Service,Shepherdstown,WV
- U.S. Fish and Wildlife Service, Division of Conservation Planning & Policy,Arlington,VA

State Government

- Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology

- Indiana Secretary of Commerce, Indiana Economic Development Corporation
- Director, Indiana Department of Natural Resources
- Commissioner, Indiana Department of Transportation
- State Historic Preservation Officer
- Indiana Department of Natural Resources, Forestry
- The Advisory Council on Historic Preservation
- Indiana Department of Natural Resources, Nature Preserves
- Indiana Department of Natural Resources, Division of Fish and Wildlife
- Indiana Department of Natural Resources, Division of Reclamation
- Indiana Department of Environmental Management, Southwest Regional Office
- Ferdinand State Forest
- Indiana 15 Regional Planning Commission
- Indiana Coal Council, Inc.
- Indiana State University
- Indiana University School of Law - Bloomington
- Sugar Ridge Fish and Wildlife
- The Advisory Council on Historic Preservation

Tribes

- Delaware Tribe of Indians
- Miami Tribe
- Sac & Fox Nation of Missouri
- Sac & Fox Nation of the Mississippi in Iowa
- Sac & Fox Nation of Oklahoma
- Peoria Indian Tribe of Oklahoma
- Delaware Nation of Oklahoma

Local Government

- Executive Director, Dubois County Tourism Commission, Dubois County

- Executive Director, Pike County Chamber of Commerce
- Executive Director, Princeton Area Chamber of Commerce, Gibson County
- Executive Director, Warrick County Chamber of Commerce, Warrick County
- Executive Director, Evansville Convention & Tourism Bureau, Vanderburgh County
- Executive Director, Gibson County Visitors & Tourism Bureau, Gibson County
- Executive Director, Vincennes/Knox County Convention and Visitors, Knox County
- Jasper Chamber of Commerce
- Gibson County Commissioners
- Gibson County Council
- Oakland City Mayor
- Pike County Commissioners
- Pike County Council
- Columbia Township Fire Department
- Francisco Volunteer Fire Department
- Gibson County Courthouse
- Gibson County Visitors & Tourism Bureau
- Hoosier Environmental Council
- Huntingburg Chamber of Commerce, Dubois County
- Jefferson Township Fire Department
- Lockhart Township Fire Department
- Petersburg Volunteer Fire Department
- Pike County Commissioners
- Union Community Volunteer Fire Department

Libraries

- Petersburg, Indiana
- Huntingburg, Indiana
- Princeton, Indiana
- Oakland City, Indiana

Business

- Alliance Coal, LLC
- Americal Real Estate Inc
- American Acres Inc.
- Bernardin-Lochmueller And Associates
- Brookston Resources Inc
- Broshears Realty

- C/O Locust Street Company Inc - Attn: William Muller
- Charity Farm
- Dan's Fence Company
- Duke Energy, Environmental Services
- Four Rivers Rc&D
- Gibson County Coal, LLC
- Gilbert J Rode & Sons Inc
- Heritage Realty LLC
- Hopper Resources Inc
- Jasper Engines & Transmissions
- JDH Contracting Inc
- Jerry Aigner Construction Inc
- Landmark Archaeological & Environmental Services Inc
- Lechner's Inc
- McCormick Farms Inc
- Mesker Park Zoo & Botanic Garden
- Morgan Backhoe Service
- Multi Resource Management, Inc.
- Mulzer Crushed Stone Inc.
- Nature Preserves
- Old National Bank
- Owensville Montgomery TFP District
- Peabody Energy
- Quality Climate Control
- R&T Garage
- Ryan Kerns Excavating LLC
- Solar Sources, Inc
- Southern RR Company
- Tri State Equipment
- Triad Mining
- Triad Mining, Inc
- Velpen C&D Fill Site Inc
- Velpen Trucking & Disposal Company Inc
- Vincennes Sun-Commercial
- Wyatt Seed Company Inc.

Non-Government Organizations

- Audubon Society
- Audubon Society of the District of Columbia
- Evansville Audubon Society
- Defenders of Wildlife
- Ducks Unlimited

- Humane Society of the United States, Washington, DC
- Indiana Division Of The Izaak Walton League Of America, Inc.
- Indiana Sportsman's Roundtable, Inc.
- National Trappers Association, Inc.
- Indiana Wildlife Federation
- National Wildlife Refuge Association
- National Wildlife Federation
- PEER Refuge Keeper, Aurora, NY
- Quail Unlimited
- Sierra Club - Midwest Office
- Sycamore Land Trust
- SW Indiana 4 Rivers Project Committee – NAWMP
- The Conservation Fund
- The Nature Conservancy
- Triple H Gun Club
- Waterfowl USA
- Wesselman Woods Nature Preserve
- White Oak Whitetails, Inc.
- Wildlife Land & Resource Management
- Institute for Policy Research
- Wilderness Watch
- The Wilderness Society
- WTVW Fox 7
- Washington Times-Herald

Media

- 14 WFIE TV
- Evansville Courier And Press
- Huntingburg Press
- Linton Daily Citizen
- Petersburg Press Dispatch
- Princeton Clarion
- South Gibson Star Times
- The Herald
- The Herald-Times
- The Indianapolis Star
- The Times
- WBDC Radio Station
- WEHT News 25 Tv
- WIKY Evansville Radio Station
- WITZ Radio Station
- WJPS - 93.5 Fm
- WRAY Radio Station

Appendix G: Compatibility Determinations

In accordance with the Refuge Improvement Act of 1997, no uses for which the Service has authority to regulate may be allowed on a unit of Refuge System unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge. Managers must complete a written compatibility determination for each use, or collection of like-uses, that is signed by the manager and the Regional Chief of Refuges in the respective Service region.

Draft compatibility determinations applicable to uses described in the CCP were included in the Draft CCP and available for a 30-day review period.

The signed compatibility determinations are available for review at Refuge Headquarters. Compatibility determinations were prepared and approved for:

- Environmental Education
- Farming
- Fishing
- Hunting
- Interpretation
- Research by Third Parties
- Wildlife Observation and Photography

Appendix H: List of Preparers

Appendix H: List of Preparers

Name	Title/Contribution	Degrees/Other Related Experience	Years with FWS
Patoka River NWR & MA			
Bill McCoy	Refuge Manager. Writer, Direct Planning Effort, Public Meetings	B.S., Pennsylvania State University, Graduate work botany and zoology, Southern Illinois University and St. Cloud State University.	37
Bob Dodd	Refuge Wildlife Specialist. Writer, Direct Planning Effort, Public Meetings	B.S., Fisheries and Wildlife Biology, Iowa State University	37
Rosalie Mosley	Administrative Technician. General Administrative Support	--	11
Regional Office			
Jon Kauffeld	Refuge Supervisor. Direct Planning Effort, CCP Review	MS Wildlife management, Univ of Nevada, Reno, 1977 BS Natural Resource Management, Univ of Wisconsin, Madison, 1974	30
Conservation Planning			
Thomas Larson	Chief of Conservation Planning. CCP Review	M.S., Wildlife Ecology, University of Wisconsin, Madison. Other: National Park Service; Peace Corps	30
Dean Granholm	Refuge Planning Specialist. Lead Planner	B.S., Wildlife, University of Minnesota. Other: U.S. Forest Service 15 years	4
Gabriel DeAlessio	GIS Specialist/Biologist. Cartography Spatial Analysis	B.S., Natural Resource Engineering & Mgmt, Univ. of Connecticut, Storrs. Other: Contractor DoD 2.5 years	7
Jane Hodgins	Technical Writer/Editor. Newsletter, Document editing	B.A., Journalism, College of St. Thomas, St. Paul. Other: Senior Editor, Editor and Reporter, 14 years.	8
Jane Lardy-Nelson	Editorial Assistant. Mailings, Administrative Support	--	20
Migratory Birds			
Robert Russell	Wetland Bird Biologist. Direct Planning Effort CCP Review	M.A., Biogeography, University of Arizona. Other: National Park Service 1.5 years.	8
Visitor Services & Communications			
Donna Stanek	Chief of Visitor Services and Outreach. Direct Planning Effort, CCP Review	B.S., Parks and Recreation Administration M.S., Recreation and Resource Management	25
H. John Dobrovolny	Regional Historic Preservation Officer. Historian	B.A., History, Sacramento State College, Sacramento. Other: National Park Service 14 years.	27

Name	Title/Contribution	Degrees/Other Related Experience	Years with FWS
Indiana Department of Natural Resources			
Jeff Thompson	District Wildlife Biologist	Not Available	N/A
Mangi Environmental Group			
Leon Kolankiewicz	Biologist/Environmental Planner Direct Planning Effort, Writing	B.S., Wildlife Management, Virginia Tech, Blacksburg. M.S., Natural Resources Management & Environmental Planning, University of British Columbia, Vancouver. Other: 25 years as an a conservation professional including experience with U.S. Fish and Wildlife Service, Alaska Department of Environmental Conservation, Alaska Department of Fish and Game, University of Washington, National Marine Fisheries Service, Peace Corps, Orange County (CA) Environmental Management Agency, Carrying Capacity Network.	N/A

Appendix I: Literature Cited

Appendix I: Literature Cited

- Allen, J.H., T.C. Thomas, and R.R. Kelly. 1978. A Survey to Determine the Extent and Environmental Effects of Derelict Lands Resulting from the Surface Extraction of Coal, PL. 62, Acts of 1976. Indiana Department of Natural Resources.
- Bajema, R. A., T. L. DeVault, P. E. Scott, and S. L. Lima. 2001. Reclaimed coal mine grasslands and their significance for Henslow's Sparrows in the American Midwest. *Auk*. 118:422–431.
- Conant, R. 1958. A Field Guide to Reptiles and Amphibians of the United States and Canada East of the 100th Meridian. Houghton Mifflin Co.
- Corbett, D.M. 1969. Acid Mine Drainage Problems of the Patoka River Watershed, Southwestern Indiana: Indiana University Water Resources Research Center Report of Investigations No. 4.
- de Szalay, F.A., D. Helmers, D. Humberg, S.J. Lewis, B. Pardo, M. Shieldcastle. 2000. Upper Mississippi Valley / Great Lakes Regional Shorebird Conservation Plan. Technical report prepared for the U.S. Shorebird Conservation Plan, Manomet, Massachusetts. Available URL: <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/UMVGL5.doc>
- DeVault, T. L., P. E. Scott, R. A. Bajema, and S. L. Lima. 2002. Breeding bird communities of reclaimed coal mine grasslands in the American Midwest. *J. Field Ornithol.* 73:268–275.
- Dunn, R.; Roach, G. 2001. Wetland Restoration Techniques in Indiana Utilizing Macrotopography Measures. ASABE Paper No. 012060. American Society of Agricultural and Biological Engineers, St. Joseph, Mich. Available URL (abstract only): <http://asae.frymulti.com/abstract.asp?aid=7378&t=2>
- Egan-Bruhy, Kathryn C. Comprehensive Conservation Plan Archaeological and Historic Resources, Patoka River National Wildlife Refuge and Management Area in Pike and Gibson Counties, Indiana. 2003: CCRG, Jackson, Michigan.
- Ecological Specialists, Inc. 2001. Unionid mussel survey of the Patoka River, Indiana. Prepared for U.S. Fish and Wildlife Service, Patoka River National Wildlife Refuge, Oakland City, IN. 22pp. and appendices.
- Fralish J. S. 1997. Community succession, diversity, and disturbance in the Central Hardwood Forest, Chapter 11. *In*: M. W. Schwartz (ed.). Conservation in highly fragmented landscapes. Chapman and Hall, New York, New York. 436 p.
- Fralish, James S. 2004. The Keystone Role of Oak and Hickory in the Central Hardwood Forest Gen. Tech. Rep. SRS-73. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. pp. 78–87.
- Fredrickson, L.H., and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service, Resource Publication 148, 29 pp.
- Graziano, Angela V. and Diana H. Cross. 1993. 13.2.2. The North American Waterfowl Management Plan: A New Approach to Conservation. Waterfowl Management Handbook – Fish and Wildlife Leaflet 13.2.2. (revised).
- Heitmeyer M. E., Cooper R. J., Dickson J. G., Leopold B. D. 2005. Ecological relationships of warmblooded vertebrates in bottomland hardwood ecosystems. Pages 281–306 *in* L. H. Fredrickson, S. L. King, R. M. Kaminski, editors Ecology and management of bottomland hardwood ecosystems: the state of our understanding.

- University of Missouri-Columbia, Gaylord Memorial Laboratory, Special Publication No. 10, Puxico, Missouri, USA.
- Helmert D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network, Manomet, Mass. 58 p.
- Homoya, M.A., D.B. Abrell, J.R. Aldrich and T.W. Post. 1995. Natural Regions of Indiana. Indiana Academy of Science. Vol. 94:245-268.
- Indiana Department of Environmental Management (IDEM). 2006a. Indiana Integrated Water Monitoring and Assessment Report 2006. Office of Water Quality Watershed Branch.
- Indiana Department of Environmental Management (IDEM) website. 2006b.
<http://www.in.gov/idem/programs/water/303d/index.html> [Accessed November 14, 2006]
- Indiana Department of Geology and Natural Resources. 1898. Twenty-third Annual Report.
- Indiana Department of Natural Resources. No date-a. Sugar Ridge Fish & Wildlife Area. Accessed at: <http://www.in.gov/dnr/fish-wild/publications/sugar.htm> on the World Wide Web on 2-20-06.
- Indiana Department of Natural Resources. No date-b. Glendale Fish & Wildlife Area. Accessed at: <http://www.in.gov/dnr/fish-wild/publications/glendale.htm> on the World Wide Web on 2-20-06.
- Indiana Department of Natural Resources. 1988. Wetlands – Indiana's Endangered Natural Resource. Appendix to Indiana Outdoor Recreation 1989: An Assessment and Policy Plan. Indianapolis, Indiana.
- Indiana Department of Natural Resources. 1990. Hydrogeology of Gibson County, Indiana.
- Indiana Department of Natural Resources. 2005a. Division of Forestry. Pike State Forest. Accessed on the World Wide Web on 2-20-06 at: <http://www.in.gov/dnr/forestry/index.html?http://www.in.gov/dnr/forestry/stateforests/pike.htm&2>
- Indiana Department of Natural Resources. 2005b. Division of Forestry. Ferdinand State Forest. Accessed on the World Wide Web on 2-20-06 at: <http://www.in.gov/dnr/forestry/index.html?http://www.in.gov/dnr/forestry/stateforests/ferdind.htm&2>
- Indiana Division of Nature Preserves. 2005a. Indiana Department of Natural Resources. List of Endangered, Threatened, and Rare Species by County: Gibson County. 11-22-05. Accessed 12-13-06 on the World Wide Web at: <http://www.in.gov/dnr/naturepr/species/gibson.pdf>.
- Indiana Division of Nature Preserves. 2005b. Indiana Department of Natural Resources. List of Endangered, Threatened, and Rare Species by County: Pike County. 11-22-05. Accessed 12-13-06 on the World Wide Web at: <http://www.in.gov/dnr/naturepr/species/pike.pdf>.
- Indiana WETlands. 2004. Data and Information. Accessed online on 14 February 2006 at: <http://www.in.gov/wetlands/data/index.html>.
- King, Thomas F. Cultural Resource Laws & Practice. 1998: AltaMira Press, Walnut Creek, California.
- Kolankiewicz, Leon. 1982. *Alaskan Coal Development: An Assessment of Potential Water Quality Impacts*. Alaska Department of Environmental Conservation, Water Quality Management Planning Program.
- McNab, W. H. and P. E. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. Administrative Publication WO-WSA-5. Washington, DC: U.S. Department of Agriculture, Forest Service. 267 pp.
- Meretsky, V.J., R.L. Fischman, J.R. Karr, D.M. Ashe, J.M. Scott, R.F. Noss, and R.L. Schroeder. 2006. New Directions in Conservation for the National Wildlife Refuge System. *BioScience*: Vol. 56, No. 2 pp. 135–143.
- Munson, C.A (editor). 1980. Archeological Salvage Excavations at Patoka Lake, Indiana. Glenn A. Black Laboratory of Archeology, Indiana University.

- North American Waterfowl Management Plan. 1998. North American Waterfowl Management Plan: Expanding the Vision – 1998 Update. Accessed online 2-18-06 at: <http://www.fws.gov/birdhabitat/NAWMP/images/NAWMP1998.pdf>.
- North American Waterfowl Management Plan. 2004. North American Waterfowl Management Plan: 2004 Strategic Guidance. Accessed 2-18-06 on the World Wide Web at: <http://www.fws.gov/birdhabitat/NAWMP/images/NAWMP2004.pdf>.
- National Oceanic and Atmospheric Administration. 1991. Local Climatological Data, Annual Summary with Comparative Data. Evansville, Indiana.
- Ohio River Valley Ecosystem Team, U.S. Fish and Wildlife Service. No date. Accessed online on 14 February 2006 at: <http://www.fws.gov/orve/>.
- Parker, George R.; Ruffner, Charles M. 2004. Current and historical forest conditions and disturbance regimes in the Hoosier-Shawnee ecological assessment area Gen. Tech. Rep. NC-244. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 267 p. Available URL: http://ncrs.fs.fed.us/pubs/gtr/gtr_nc244/gtr_nc244_ch3.pdf
- Partners in Flight. No date. Interior Low Plateaus. Accessed online 2-19-06 at: http://www.blm.gov/wildlife/pl_14sum.htm.
- Rolley, R.E. 1991. Indiana's Wetland Inventory, *Wildlife Management and Research Note No. 532*. Indiana Department of Natural Resources.
- Ruffner C. M., J. W. Groninger. 2004. Oak ecosystem restoration and maintenance in southern Illinois, p. 177–181. *In*: M. A. Spetich (ed.). Upland Oak Ecology Symposium, History, Current Conditions and Sustainability. U.S.D.A. Forest Service General Technical Report SRS-73, Asheville, North Carolina. 311 p.
- Sieber, E. and C.A. Munson. 1992. Looking at History: Indiana's Hoosier National Forest Region, 1600 to 1950. U.S. Department of Agriculture, Forest Service.
- Silverly, R.E. 1972. Mosquitoes of Indiana. Public Health Entomology Laboratory. Ball State University, Muncie, Indiana.
- Smith, R.M. 2001. Wetland Hydrology Restoration Techniques Utilized in the Northeast Arkansas Delta. ASABE Paper No. 012063. American Society of Agricultural and Biological Engineers, St. Joseph, Mich. Available URL (abstract only): <http://asae.frymulti.com/abstract.asp?aid=6265&t=2>
- Soil Conservation Service, U.S. Department of Agriculture. 1989. *Soil Survey of Gibson County, Indiana*.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions [Online WWW]. Available URL: "<http://soils.usda.gov/technical/classification/osd/index.html>". [Accessed August 16, 2005]
- Stefanavage, Thomas. 1993. Fisheries Survey of the Patoka River in Gibson and Pike Counties. 1991 Fish Management Report. Indiana Department of Natural Resources, Indianapolis.
- Stratman, D. 2000. Using micro and macrotopography in wetland restoration. Indiana Biology Technical Note 1. U.S. Department of Agriculture, Natural Resources Conservation Service, Indianapolis, Indiana.
- Thompson, Frank R. III; Dessecker, Daniel R. 1997. Management of early-successional communities in central hardwood forests: with special emphasis on the ecology and management of oaks, ruffed grouse, and forest songbirds. General Technical Report NC-195. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station.
- U. S. Census Bureau. 2000. Census 2000: Summary File 3. Profile of Selected Economic Characteristics, Pike County, Indiana. Accessed 2-21-06 online at: http://factfinder.census.gov/servlet/QTTable?_bm=y&-qr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-_lang=en&-_sse=on&-geo_id=05000US18125.

- U. S. Census Bureau. 2006. State and County Quick-Facts: Indiana. Accessed on 2-21-06 at: <http://quickfacts.census.gov/qfd/states/18000.html>.
- USDA—Natural Resources Conservation Service website <http://www.nrcs.usda.gov/programs/wrp/states/in.html> [accessed May 22, 2006].
- U. S. Department of the Interior, National Park Service. 2006. National Register of Historic Places – Index by State and County: Indiana and Gibson and Pike counties. Accessed 12/19/06 on the World Wide Web at: http://www.nr.nps.gov/iwisapi/explorer.dll?IWS_SCHEMA=NRIS1&IWS_LOGIN=1&IWS_REPORT=100000066.
- U.S. Department of Transportation Federal Highway Administration. 2004. Tier 1 Record of Decision Evansville to Indianapolis, Indiana FEIS.
- U.S. Department of Transportation Federal Highway Administration and Indiana Department of Transportation. 2003. Tier 1 Final Environmental Impact Statement and Section 4(f) Evaluation. Evansville to Indianapolis, Indiana FEIS.
- U. S. Fish and Wildlife Service. No date. Overview of the U.S. Shorebird Conservation Plan and Council. Accessed online 2-19-06 at <http://shorebirdplan.fws.gov/USShorebird/overview.htm>.
- U. S. Fish and Wildlife Service. 1989. Preacquisition Contaminant Survey for the Patoka River National Wildlife Refuge. Unpublished agency report. Ecological Services, Bloomington, Indiana.
- U. S. Fish and Wildlife Service. 1990. Regional Wetlands Concept Plan. Emergency Wetlands Resources Act.
- U. S. Fish and Wildlife Service. 1994. Patoka River National Wetlands Project: Final Environmental Impact Statement. July.
- U. S. Fish and Wildlife Service. 1997. National Outreach Strategy: a Master Plan for Communicating in the U. S. Fish and Wildlife Service. Washington D.C., USA. Available URL: http://library.fws.gov/Pubs/outreach_strategy.pdf
- U. S. Fish and Wildlife Service. 1999. Strategic Plan for Conservation of Fish and Wildlife Service Trust Resources in the Ohio River Valley Ecosystem. U.S. Fish and Wildlife Service Regions 5, 4, and 3. December 1999 (Second Revision). Accessed online on 14 Feb. 2006 at: <http://www.fws.gov/orve/stratplan.html>.
- U. S. Fish and Wildlife Service. 2001. Biological integrity, diversity, and environmental health. 601 FW 3. National Wildlife Refuge System, Department of Interior. Available URL: <http://policy.fws.gov/601fw3.html>
- U. S. Fish and Wildlife Service. 2005. National Wildlife Refuge System Strategic Plan for Biological Monitoring and Adaptive Management: Fiscal Years 2006-2010. Biological Monitoring Team Regions 3 and 5.
- U. S. Fish and Wildlife Service. 2006a. General Guidelines for Wildlife-Dependent Recreation. 605 FW 1. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw1.html>
- U. S. Fish and Wildlife Service. 2006b. Wildlife-Dependent Recreation: Hunting. 605 FW 2. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw2.html>
- U. S. Fish and Wildlife Service. 2006c. Wildlife-Dependent Recreation: Fishing. 605 FW 3. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw3.html>
- U. S. Fish and Wildlife Service. 2006d. Wildlife-Dependent Recreation: Wildlife Observation. 605 FW 4. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw4.html>
- U. S. Fish and Wildlife Service. 2006e. Wildlife-Dependent Recreation: Wildlife Photography. 605 FW 5. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw5.html>

- U. S. Fish and Wildlife Service. 2006f. Wildlife-Dependent Recreation: Environmental Education. 605 FW 6. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw6.html>
- U. S. Fish and Wildlife Service. 2006g. Wildlife-Dependent Recreation: Interpretation. 605 FW 7. National Wildlife Refuge System, Department of Interior. Available URL: <http://www.fws.gov/policy/605fw7.html>
- Waterbird Conservation for the Americas. 2005a. Home Page. Accessed 2-19-06 on the World Wide Web at: <http://www.waterbirdconservation.org/>.
- Waterbird Conservation for the Americas. 2005b. Upper Mississippi Valley/Great Lakes. Accessed 2-19-06 on the World Wide Web at: <http://www.fws.gov/birds/waterbirds/UMVGL/>.
- Wharton, C. H., W.M. Kitchens, E.C. Pendleton, and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the Southeast: a community profile. U.S. Fish and Wildlife Service, Biological Services Program, Washington, D.C. FWS/OBS-81/37. 133 pp. Available URL: http://training.fws.gov/library/FWS-OBS/81_37.pdf

Appendix J: Priority Refuge Operational and Maintenance Needs

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Project Description	Estimated Cost
Patoka River Completion of Observation Deck	40,000
Patoka River Construct Maintenance & Storage Facilities	783,000
Patoka River Construct Wood Duck banding Station.	43,000
Patoka River Construct Snakey Point Public Use Facility.	208,000
Patoka River Construct Public use facilities.	204,000
Patoka River Construct Refuge Office, Visitor Contact Stations	1,566,000
Construct Macrotopography wetlands - Oatsville Bottoms	To Be Determined
Reconnect Oxbows on Patoka River	720,000
Patoka River Construct Public Use Canoe and Boat Facilities.	105,000
Patoka Parking and Access Road General Rehab	8,879
Patoka Road Service Access Fromme Tract 213a General Rehab	To Be Determined
Patoka Parking Public FHWA Rte___ Buck General Rehab	3,474
Patoka Parking Public FHWA Rte 901 McClure General Rehab	5,478
Patoka Trail Native Bird Trail General Rehab	6,931
Patoka Boat Launch Survant Landing General Rehab	1,595
Patoka Building Storage Equipment Repair	35,000
Patoka Parking Public Snakey Point General Rehab	2,212
Patoka NWR West Graulich Road Bridge removal	12,000
Patoka Parking Public FHWA Rte 902 Survant General Rehab	31,640
Patoka Levee Graulich Impoundment General Rehab	86,936
Patoka Ditch Graulich West General Rehab	To Be Determined
Patoka Ditch Graulich East General Rehab	To Be Determined

Appendix K: Response to Comments on the Draft CCP

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Wildlife

Comment: If the primary benefit of the Refuge is for migrating waterfowl, is 1,000 acres of crops enough to attract them?

Response: The Refuge was established under the authority of the Emergency Wetlands Resources Act and derives its purpose from that law and others. The Refuge purposes are stated on page 4 of the Draft Comprehensive Conservation Plan and include conservation of wetlands, and providing for migratory birds and other fish and wildlife. This broader purpose requires a greater diversity of habitats to meet that purpose. Migrating waterfowl and other water birds are attracted to crop fields, but moist soil habitat and a mosaic of forested and non-forested wetlands (as described on page 70 of the Draft CCP) are also valuable habitats, providing food, water and resting areas.

Condemnation Concerns

Comment: An individual voiced opposition to the use of condemnation, also called eminent domain, to acquire land for the Refuge.

Response: The U.S. Fish & Wildlife Service has no plans to acquire land through condemnation. All land acquisition that has occurred for Patoka River NWR & MA has been from willing sellers and all that is proposed in the future would be from willing sellers.

If it seems like land acquisition is a major focus of the Patoka River NWR & MA, it's because the Refuge is still young. Approximately one-quarter of the total area approved for acquisition is currently part of the Refuge, and because the Service buys from willing sellers, the land it has acquired includes numerous, unconnected tracts. To fulfill the purposes the Refuge was established for, which include wetland conservation and providing habitat for waterfowl, other migratory birds, endangered species and resident wildlife, a refuge needs a contiguous land base. As the Refuge gradually acquires land, the emphasis will shift from acquisition to various management and restoration projects.

Opposed to Land Acquisition

Comment: The Refuge should not acquire additional lands because there is already sufficient acreage and public ownership adversely affects neighboring private land owners.

Response: The size and location of the refuge in southwestern Indiana was determined after long and thoughtful consideration by many people in the natural resource management field. After eight years of planning and public debate, the refuge boundary was finally established and approved in 1994. It has always been acknowledged that the refuge acquisition program would take decades based on buying land from willing sellers. As the population grows, more and more land will be developed for housing, industry, agriculture and transportation. Once completed, the refuge will come to be recognized as a wildlife oasis providing assurance of at least a representative sample of our natural heritage for future generations to enjoy and learn from.

The Refuge purposes are stated on page 4 of the Draft Comprehensive Conservation Plan and include conservation of wetlands, providing for migratory birds and other fish and wildlife. All other uses that occur on the Refuge must be evaluated for compatibility—that is the use must either help fulfill the Refuge purposes or, at a minimum, not detract from the purposes.

As far as maintenance and upkeep, the refuge has been actively involved with many partners in providing new facilities and habitat restoration. The refuge has planted 422,000 hardwood trees on 843 acres of acquired lands and has constructed 347 acres of manageable wetlands on the refuge through 2007. Three new boat ramps are available to the public near Pikeville, Survant and Snakey Point Marsh. A public fishing pier and walking trail is available at Snakey Point. Numerous parking areas have been provided for visitor use. We recognize that the public may get frustrated at the checkerboard ownership patterns of the refuge but that is to be expected with a willing seller only acquisition program.

The Refuge has the same obligations as any other landowner and the same rights as any other landowner. Being adjacent to or surrounded by Refuge land does not impede a landowners' rights, access, or use of property.

Land Acquisition Support

Comment: *Some individuals expressed support for continued emphasis on land acquisition, calling it the "critical piece of the puzzle" in the CCP. Others noted that there are a number of willing sellers within the approved acquisition area and that the Refuge suffers from a lack of funding to pursue those properties.*

Response: Building a refuge takes time and we truly appreciate all support for Patoka River NWR & MA. We are especially grateful to the individuals who have partnered with the refuge to help secure funding grants and to those who are making the Refuge possible by selling their land to the Service.

Annual appropriations for land acquisition on National Wildlife Refuges are made by the U.S. Congress from the Land and Water Conservation Fund (LWCF). This fund receives revenue when the U.S. Government leases offshore oil development rights and collects annual royalty payments from oil production. There is stiff competition for these funds as there are many other refuges across the United States that are also growing in size and faced with severe threats of development on those lands approved for inclusion in those refuges. Friends and supporters of refuges expressing their concerns for growth of their local refuge really do make a difference.

While some may feel that Patoka River NWR (5,946 acres) has grown too slowly especially when compared to similar refuges established in the same time period such as Canaan Valley NWR (15,901 acres) in West Virginia or Cypress Creek NWR (15,395 acres) in southern Illinois, there are some bright spots. The lack of funding support has resulted in formation of partnerships with many individuals, non-profit organizations, industry and state agencies. For example, with the help of partners, the refuge has competed for and received four North American Waterfowl Management Plan grants since 1995. These grants have provided \$1,144,500 for land acquisition plus \$294,000 for habitat restoration.

There has always been a long list of many willing sellers. The list is growing shorter as private interests and corporations continue to take advantage of the lack of regular funding from the LWCF and buy land for personal use and development from frustrated willing sellers. Too be sure, the vision for which Patoka River NWR was established is facing a long and tedious journey which only increased public support can hope to remedy.

Support of the Refuge

Comment: Many people wrote to express support for the work of Refuge staff and management of the land to benefit wildlife and wildlife habitat. Others wrote to support Alternative 3, the preferred alternative.

Response: Refuge staff and Regional Office planners appreciate your support. Many people contributed to the Comprehensive Conservation Plan by asking good questions at public meetings, reviewing the draft CCP and offering comments on the plan. We appreciate the time you have been willing to dedicate to the planning process and we appreciate your thoughts on the plan. The Patoka River NWR and MA is a unique place and we are looking forward to implementing the plan over the next 15 years.

Timber Management

Comment: *Timber Harvest should be used as a management tool to maintain age class diversity within forested portions of the Refuge.*

Response: Strategy 3 under Objective 1.1 Forested Wetlands of the selected alternative calls for completion of a Habitat Management Plan with specific management recommendations to maintain bottomland forest species and age class diversity. The Habitat Management Plan is more site specific than the CCP and will consider various management options including timber harvesting.

Anyone familiar with the history of land use practices in the Patoka River bottoms recognizes that the timber resource has been high-graded for over a century with more valuable timber species being continuously cut and removed from the forest stand. With the past emphasis on clearing and draining to make more land available for agriculture, little effort was ever expended to manage the composition of the forest. Whatever grew back, grew back on its own. This meant that mast producing trees includ-

ing many species of oaks, hickories and pecans were repeatedly cut out until the seed source for natural regeneration became limited. Lighter seeded species such as silver maple, cottonwood and green ash came to dominate the forest composition.

As the refuge acquires more of the bottomland acreage, a Habitat Management Plan will be prepared to address future timber management with a goal of increasing species diversity. This would likely be done by interplanting numerous species of oaks and other mast producing species in the understory and then conducting timber sales for selective cutting of soft hardwoods mentioned above. This would provide daylight to jumpstart the previously planted oak seedlings and better enable them to compete for a place in the new forest stand.

Present refuge reforestation efforts have focused on restoring a diversity of timber species on bottomland cropland areas with a history of flooding and crop loss. One of the goals identified in the Concept Refuge Management Plan that was part of the approved Environmental Impact Statement in 1994, was to reestablish a continuous forested corridor along all 30 miles of the Patoka River channel within the refuge boundary. Most of the 843 acres planted to date have been in the river bottoms.

Sanctuary: Move It Around

Comment: *Some people believe that sanctuary areas like the Cane Ridge Wildlife Management Area exclude public hunting and benefit adjoining private land owners. They say that sanctuary areas should be located in close proximity to areas where public hunting is allowed and be rotated to different locations periodically.*

Response: Sanctuary areas – locations where wildlife, especially migratory waterfowl, are not hunted – are known to benefit both wildlife and hunters. The strategy under *Objective 3.2 Hunting* of the selected alternative calls for establishing sanctuary areas as more land is acquired. It is likely that these areas would be rotated to different locations periodically. The 488-acre Cane Ridge Wildlife Management Unit is closed to hunting. The original intent of the Cane Ridge property was to provide an area where waterfowl could feed and rest without disturbance from hunting. There are no other sanctuaries on public lands in the vicinity and although adjoining landowners do benefit from its proximity the ducks found at Cane Ridge are known to spend time at other hunted areas including Oatsville Bot-

toms of the Patoka River NWR. Also, the Indiana Department of Natural Resources recently purchased 840 acres adjacent to Cane Ridge WMA. This property known as Tern Bar Slough Wildlife Diversity Area is scheduled to have managed waterfowl hunting beginning in 2010.

Sanctuary: The Refuge Should Protect Wildlife From Hunting and Fishing

Comment: *Some people said that refuges are “useless” if wildlife is “harassed” by anglers and hunters, and asked that Patoka River NWR establish “plenty of sanctuary” for wildlife.*

Response: The National Wildlife Refuge Improvement Act of 1997 established six priority wildlife-dependent public uses on refuges. These six uses are: hunting, fishing, wildlife observation, wildlife photography, environmental interpretation and environmental education. Refuges are required to evaluate the potential for these six public uses and, if they are not appropriate on the refuge, give good reason why they are not appropriate. For example, on Agassiz National Wildlife Refuge in northern Minnesota, moose hunting has been deemed not compatible in response to a declining moose population. Some permits will be issued if moose rebound sufficiently, but otherwise moose hunting will not be allowed.

If providing habitat achieves what the Service wants to achieve, namely healthy and abundant populations of diverse wildlife species, hunting and fishing will not have harmful effects on the population as a whole. In fact, hunting and fishing contribute to improving the overall health of a species and habitat by maintaining sustainable populations of wildlife. For example, when there are too many deer for habitat to support, deer will overbrowse the understory vegetation and eliminate most of the tree seedlings and broadleaf plants. This affects forest regeneration and has long-term negative consequences on habitat and other species of wildlife. Wildlife also becomes more susceptible to disease when the number of animals exceeds the natural food supply. A healthy population of animals is dependent on a healthy habitat which means the food supply is adequate for all.

Disturbance of wildlife is a topic we consider before permitting activities on the Refuge. Compatibility determinations that include anticipated impacts of each public use were included in Appen-

dix F of the Draft CCP and Environmental Assessment. Also, the selected alternative includes a strategy under *Objective 3.2 Hunting* that calls for additional sanctuary areas as more land is acquired.

Economic Concerns

Comment: One individual wondered whether it was cost effective to plant trees in areas prone to beaver caused flooding.

Response: Prolonged flooding whether caused by beavers or other sources is one of the challenges to restoring bottomland forest. In some cases planted trees are lost to flooding, despite this, planting is the most effective means of restoring tree species reduced or eliminated from bottomland forests by previous land use practices. Restoring native habitat is part of the National Wildlife Refuge System mission and is supported by other Service policies. Beavers are native to forested wetlands like those along the Patoka River and beaver-caused disturbance is part of the bottomland forest system. Nearly every location along the Patoka River is potentially subject to beaver activity as well as prolonged flooding caused by other factors within the Patoka River watershed. Restoring such sites sometimes results in additional costs if replanting is deemed necessary rather than relying on natural succession of vegetative communities following beaver or other flooding disturbances

Support for Alternative 3

Comment: The Refuge received several comments supporting Alternative 3 of the Draft Environmental Assessment.

Response: We appreciate support for the preferred alternative, and we appreciate all of the time and thought that people devoted to the CCP.

Hunting Support

Comment: Hunting is a safe activity that should always be emphasized and expressed at every opportunity when the subject of hunting comes up in the future.

Response: Hunting is one of the six priority wildlife-dependent public uses identified in the National Wildlife Refuge Improvement Act of 1997. Refuges evaluate whether wildlife populations are sufficient to support hunting and whether there is enough space for hunters to have a positive and safe experi-

ence. Presently, all but 606 acres of the more than 6,000 acres of Refuge lands are open to hunting consistent with Indiana DNR regulations.

Public Use

Comment: We heard from individuals who are interested in more public access to the Refuge and the Patoka River, individuals who are concerned that the sound of traffic and conflicts with other Refuge uses are diminishing visits for birders and hikers, and an individual who would like to see a step-down plan for ATV use on the Refuge.

Response: Public access at Patoka River NWR & MA is limited by how much land the Refuge has acquired and the location of that land. In some cases, public access isn't feasible because the land owned by the Refuge is surrounded by private land. In other cases, a tract might be too small to accommodate visitors pursuing different interests. We want visitors to have as much access to the Refuge as possible without compromising wildlife needs, and we want those visits to be satisfying. We expect public access and the overall visitor experience to improve as the Refuge grows.

The Service is developing regulations to govern Off-Road Vehicle (ORV) use on national wildlife refuges. No new ORV use is authorized until the regulations are complete and Service policy is revised. Off-Road Vehicles including All-Terrain Vehicles are prohibited on the Refuge and there are no plans to change this. Any use permitted on a National Wildlife Refuge must pass two separate tests. The first test is to determine if the use is appropriate and the second is to determine if the use is compatible with the purposes for which the refuge was established. The terms "appropriate" and "compatible" and the associated processes are defined in Service policies.

Public Use Regulations

Comment: One individual suggested decreasing the intensity of hunting to provide wildlife relief from hunting pressure and that any such change should be done with public involvement.

Response: Strategy 4 under Objective 3.2 Hunting of the selected alternative calls for identifying sanctuary areas – places where hunting is prohibited – once more land is acquired. This would be done as part of developing a Hunting and Fishing Plan for the Refuge and would include public review.

Comment: One individual suggested implementing a no hunting safety zone where Refuge and private lands border.

Response: Hunting is permitted on specified Refuge lands in accordance with State laws and regulations. Any current or future State regulations governing hunting and firearms are enforced by Indiana Department of Natural Resources Conservation Officers.

Comment: One individual opposed the use of Off Road Vehicles on Refuge lands.

Response: Off-Road Vehicles including All-Terrain Vehicles are prohibited on the Refuge and there are no plans to change this.

Suggested Edits

Comment: One individual suggested modifying the section on Potential Refuge Visitors to highlight air quality as an important factor affecting Refuge visitation.

Response: We made no change to the section on Potential Refuge Visitors. We feel the section entitled Air Quality adequately covers the subject.

Comment: One individual suggested that not all partners were listed in the section entitled Existing Partnerships.

Response: We reviewed the list and feel it reflects the range of existing partners. We expect our list of partners to grow over the 15 year period covered by the CCP.

Comment: One individual commented that Ruffed Grouse populations are at low levels because of a lack of young forest habitat.

Response: We added a sentence to the section entitled *Fish and Wildlife Communities* to note this change.

Comment: One individual commented that local place names used in the text do not appear on the maps.

Response: We agree and have added a number of place names to Figure 11 Current Visitor Facilities.

Comment: One individual commented that Appendix B should be modified to show Snowy Egret as occurring at Patoka River NWR as well as Cane Ridge WMA.

Response: We made the change to Appendix B.

Comment: One individual felt the amount of waterfowl noted in the section entitled *Fish and Wildlife Communities* (5,000 to 8,000) is too low and should be increased to 15,000 to 20,000.

Response: We reviewed the section and believe it is accurate as stated. The numbers in question are referencing average fall/winter waterfowl numbers not peak numbers.

Comment: One individual noted that the scientific name of broadleaf uniola had changed.

Response: We made the correction to Appendix C.

Comment: One individual noted that the AB Brown power plant was not listed in the section on Air Quality.

Response: The paragraph in question lists several power plants as examples (one in each direction from the Refuge), but it is not intended to be a comprehensive list.

Comment: One individual commented that under the section entitled *Socioeconomic Setting* that Gibson county should be described as one of the fastest growing counties in Indiana.

Response: We reviewed the section, and although some of the Census figures may be dated, it is generally accurate. The local area has grown in population and economic activity, but much of that growth occurred in adjoining counties.

Contaminants/Air and Water Quality/ Refuge Threats

Comment: One commenter suggested the Refuge should monitor local air quality and work to maintain air quality standards.

Response: We added an objective statement and strategies regarding Air Quality to the CCP and revised the Environmental Assessment to account for this change. Air quality was not identified as a planning issue during the initial scoping phase of the process and was not included in the Draft CCP/EA. It became an issue in the later stages of the planning process largely because of a proposal to site an industrial facility on lands near the Refuge. Service policy directs Refuge Managers to maintain and where feasible restore the environmental health of the Refuge, this includes air quality. As documented in the CCP and EA the Refuge continues to work

with the Indiana Department of Environmental Management to develop air quality monitoring near the Refuge.

Comment: *One commenter suggested the Refuge should monitor proposals for nearby industrial, commercial and residential facilities and communicate concerns regarding any actions that may disturb any of the sites identified under the Comprehensive Environmental Response and Compensation Liability Inventory System (CERCLIS) or other contaminant sites. The commenter also suggested that the Refuge identify evacuation distances for local industrial sitings to better understand the potential hazards posed by these sites, and communicate any concerns to the Indiana Department of Environmental Management.*

Response: We have and continue to monitor off site development proposals as we become aware of them. We work in conjunction with the Service's Environmental Contaminants Program which is dedicated to identifying sources of environmental contamination, assessing impacts of contaminants to fish and wildlife resources, and helping to restore contaminated habitats. If there is potential for any proposed development to affect Refuge resources we communicate our concerns to the appropriate authority or regulating body.

There are a number of methods the Service employs to identify and deal with contaminants. First, contaminant surveys are mandatory prior to the acquisition of any Refuge lands. A preacquisition survey was conducted in 1989 for the Refuge. Second, the Environmental Contaminants Program also conducts the Contaminants Assessment Process (CAP). This is a standardized and comprehensive approach used to assess potential threats posed by environmental contaminants to National Wildlife Refuges as well as other Service lands. The CAP process involves reviewing information available on the ecological and physical characteristics of the Service land and surrounding area relative to possible contaminant issues.

This review requires the primary investigator to compile and interpret information acquired from various sources. To facilitate the investigation, the Service's Division of Environmental Contaminants and the U.S. Geological Survey, Biological Resource Division's Biomonitoring of Environmental Status and Trends (BEST) Program jointly developed a data management system. The system retrieves and organizes information from contaminants-related, on-line databases maintained by the Environmental

Protection Agency (EPA). In addition, the CAP requires that the Primary Investigator acquire data from other sources including interviews with refuge managers, biologists and various experts as well as scientific literature. Potential point and nonpoint contaminant sources and types are inventoried and pathways that these contaminants may follow to reach the area of concern are identified. Then, areas of potential contamination are identified and the contaminant issues described. The information summarized through the CAP can provide the basis by which land managers select options to reduce contaminant impacts on the species and lands under their stewardship. The CAP also identifies Service-managed areas located downstream or down-gradient from highways, railways, or navigation channels that may be vulnerable to hazardous substance spills. Such areas may then be targeted for baseline data collection which could support future on-Refuge investigations, natural resource damage assessments, or field work.

Finally, if a contaminant problem is suspected, the Environmental Contaminants Program can conduct further studies to help identify the cause as well as potential solutions. A number of such studies conducted on and around the Refuge have helped guide past contaminant remediation efforts related to abandoned oil wells and acid mine drainage.

Comment: *One commenter noted that pollution problems associated with farming, mining, and sewage have improved through the efforts of Refuge staff.*

Response: Thank you for the comment. We believe our efforts in conjunction with our partners have reduced pollutants within the Patoka River watershed.

Comment: *One individual supported banning Off Road Vehicles, mining, power plant development and the construction of Interstate 69 within 10 miles of the Refuge to protect sensitive habitat.*

Response: The Refuge has no authority to ban activities, including Off Road Vehicles (ORVs), mining, power plant development, and construction of Interstate 69 on lands not under Refuge ownership. Presently, Off Road Vehicles are prohibited on Patoka River NWR lands and there are no plans to change this. In March 2004, after extensive public involvement and analysis, the Federal Highway Administration issued a Record of Decision that selected an alternative that will cross within the

Refuge acquisition boundary, but not on lands owned by the Refuge. The Refuge participated in the process and obtained a number of mitigating measures to protect Refuge resources. These items are noted in Chapter 3 of the Comprehensive Conservation Plan under the heading *Interstate 69*.

Comment: *One commenter recommended the Refuge request the Environmental Protection Agency exercise its oversight authority and give considerable attention to environmental and economic effects with respect to permits that come before the Indiana Department of Environmental Management.*

Response: We continue to work with the Indiana Department of Environmental Management and the Environmental Protection Agency to identify and mitigate potential threats to Refuge resources. This includes providing relevant data to be used in the permitting process.

Comment: *One commenter recommended the Refuge study the hydrology of the surrounding watershed to determine ground and surface water relationships and use the results to determine if existing State water quality standards are sufficient to achieve Refuge objectives.*

Response: Most of the water quality issues within the Patoka River watershed are a result of crude oil extraction and surface coal mining that occurred prior to the 1977 Surface Mining Control and Reclamation Act. Past clean up efforts have succeeded in part because they were preceded by studies to gather sufficient information. Existing water quality regulations have helped in clean up efforts to date and we have no reason to believe they would not be adequate to achieve the desired on-Refuge conditions included in the selected alternative.

Environmental Education

Comment: *Two readers voiced support for more environmental education on the Refuge. One reader specified environmental education for local children who are currently going to Evansville to experience bottomland hardwood forests, and another reader suggested that environmental education programs would result in people having more commitment to land stewardship and not littering when they visit.*

Response: We believe that environmental education is essential to teaching children about this country's magnificent natural resources and making people more aware of good land stewardship. We

are pleased to see support for the Refuge playing a role in local environmental education. As a young Refuge with a small staff, our ability to offer environmental education programs is limited right now. As the Refuge acquires land, staff, and basic outdoor learning facilities, we will be in a better position to support environmental education efforts by local educators.

Refuge Funding/Staffing

Comment: *Some people said that the CCP is too optimistic about future funding for land acquisition and staffing.*

Response: The CCP is a 15-year plan, and we believe that our objectives and strategies are achievable in that timeframe. In terms of positions, the Refuge would gain one full-time position (a wildlife biologist or a forester) over the next 15 years. To date we have acquired one-fourth of the approved acquisition area; our objective is to acquire 50 percent within 5 years, 70 percent within 10 years, and 80 percent within 15 years. Achieving that objective depends on the availability of funding and willing sellers, and we recognize that both are hard to predict.

Patoka River Oxbow Restoration

Comment: *Restoring the Patoka River would have adverse effects on flood control, local economies, and private property.*

Response: *Objective 1.4 Patoka River, Oxbows, and Patoka Tributaries* of the selected alternative calls for collecting information necessary to evaluate stream channel restoration options for the Patoka River. Based on the results of this evaluation, it may result in an additional proposal for river channel restoration. Public involvement and review along with an analysis of potential impacts would accompany any such proposal.

Support for Alternative 1: Current Management Direction (No Action)

Comment: *Some individuals commented that they support Alternative 1 as the preferred alternative in the Draft Environmental Assessment.*

Response: We appreciate support for the Refuge's work to improve bottomland hardwood forest and other habitats. We identified Alternative 3: Inten-

sive Habitat Management and Active Visitor Services, as the preferred alternative because we think it is a better route for continuing to improve habitat and contribute to healthy populations of resident and migratory wildlife.

Visitor Center

Comment: *The plan should include provisions to construct a Visitor Center for the Refuge or at least an expansion of the existing space to provide interpretive and outreach materials.*

Response: We added a strategy to Objective 3.5 Interpretation to provide for development of a visitor contact area as necessary and feasible. We did discuss the possibility of a Visitor Center for the Refuge during the planning process, but did not develop a proposal. This should have been noted in the Environmental Assessment but was not. We added this information to the section of the Environmental Assessment entitled *Alternatives Considered But Not Developed*. Visitor Centers represent substantial capital investments and require subsequent monies for maintenance and upkeep. The Service considers a number of factors before proceeding with any new facilities. Presently, the patchwork ownership pattern and visitation levels do not support the addition of a Visitor Center at Patoka River NWR. The primary focus of the CCP over the next 15 years is on acquiring additional lands which is likely to attract additional visitors.

Trespassing

Comment: *An individual commented that he or she has signed the boundaries of his or her property and since then has not experienced problems with Refuge visitors trespassing.*

Response: Refuge staff are always very pleased when visitors are not causing conflicts with neighbors, and we applaud the writer for taking the initiative to post the boundaries. We also know that the Refuge has a responsibility to do what it can to help visitors navigate the Refuge without trespassing on private property, and the CCP calls for greater emphasis on posting the boundaries.

Public Notification

Comment: *One commenter indicated that although they were affected by the plan, they were not directly contacted for comment.*

Response: We apologize for this oversight. Our intent was to notify all those interested or affected by the CCP planning effort, but unfortunately we did not make direct contact with everyone. The draft CCP/EA, a summary, and/or a compact disc was sent to 416 members of the public; organizations; local, State, and Federal agencies; elected officials; and public libraries. The draft CCP/EA was also available online at the Region 3 Conservation Planning website. The comment period began on October 17, 2007 and lasted 45 days. During the comment period we held an open house meeting that was publicized through the local media.

Paper Waste

Comment: *One writer protested the "paper wasted" and the printing costs associated with providing people with a copy of the Draft CCP.*

Response: Although the Refuge and the entire U.S. Fish & Wildlife Service would very much like to reduce both paper use and printing costs, we have an obligation to make Refuge planning as open as possible. That means providing updates on the planning process and, ultimately, a draft CCP for people to review. We distribute draft CCPs in three ways: we print copies and mail them to individuals who have indicated an interest in receiving one as well as to local libraries; we mail the CCP in electronic format on a compact disk; and we post the CCP on the Division of Comprehensive Conservation Planning website.

Planning staff regularly discuss ways we might reduce printing costs and our use of paper, and we expect that in the future we will rely less on printed copies and more on making documents available electronically and on the Web. In the time being, we believe that computer use is not convenient enough or widespread enough among all demographic groups for us to quit printing paper copies of CCPs.